

# **LIFT STATION SPECIFICATIONS**



## **SECTION 011000 - SUMMARY**

### **PART 1 - GENERAL**

#### **1.1 LOCATION OF PROJECT**

- A. The pump station and associated structures and equipment at the north end of Jefferson Street at approximate Sta. 102+75, 145' Rt.

#### **1.2 PROJECT DESCRIPTION**

- A. These Specifications apply to those portion of the stormwater pump station, screening chamber, discharge structure and associated equipment not covered elsewhere.

#### **1.3 SPECIFICATIONS**

- A. In general, these Specifications describe the work to be performed by the various trades, other than work specifically excluded. It shall be the responsibility of the Contractor and Subcontractors to perform all work incidental to their trade, whether or not specific mention is made of each item, unless such incidentals are included under another Item.
- B. It is advised that the Contractors and all subcontractors familiarize themselves with the contents of the complete Specifications, particularly for the trades preceding, following, related or adjacent to their work.

#### **1.4 DRAWING SCHEDULE**

- A. The work to be done under this Contract is shown on the following Drawings:

<u>Title</u>	<u>Sheet No.</u>
OTT-Jefferson St. Reconst. Plans	1-73

**END OF SECTION 011000**

## **SECTION 012100 - ALLOWANCES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements governing allowances.
  - 1. Selected materials and equipment are specified in the Contract Documents by allowances. In some cases, these allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
  - 1. Lump-sum allowances.
  - 2. Unit-cost allowances.
  - 3. Contingency allowances.
  - 4. Inspection and testing allowances.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 1 Section "Modification Procedures" specifies procedures for submitting and handling Change Orders.
  - 2. Division 1 Section "Quality Control Services" specifies procedures governing the use of allowances for inspection and testing.

#### **1.3 SELECTION AND PURCHASE**

- A. At the earliest practical date after award of the Contract, advise the Engineer of the date when the final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At the Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by the Architect from the designated supplier.

**1.4 SUBMITTALS**

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show the actual quantities of materials delivered to the site for use in fulfillment of each allowance.

**1.5 CONTINGENCY ALLOWANCES**

- A. Use the contingency allowance only as directed for the Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. The Contractor's related costs for products and equipment ordered by the Owner under the contingency allowance are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to the Owner by Change Order.

**1.6 INSPECTION AND TESTING ALLOWANCES**

- A. Inspection and testing allowances include the cost of engaging the inspection or testing agencies, the actual inspections and tests, and reporting the results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting upon failure of previous tests and inspections.
- C. Costs of services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the inspection and testing allowance to Owner by Change Order.

**1.7 UNUSED MATERIALS**

- A. Return unused materials to the manufacturer or supplier for credit to the Owner, after installation has been completed and accepted.
  - 1. When requested by the Architect, prepare unused material for storage by Owner where it is not economically practical to return the material for credit. When directed by the Architect, deliver unused material to the Owner's storage space. Otherwise, disposal of unused material is the Contractor's responsibility.

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine products covered by an allowance promptly upon delivery for damage or defects.

**3.2 PREPARATION**

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

**3.3 SCHEDULE OF ALLOWANCES**

- A. Allowance No. 1: Pump Station Telemetry - \$4,500
- B. Allowance No. 2:
- C. Allowance No. 3:
- D. Allowance No. 4:
- E. Allowance No. 5:

**END OF SECTION 012100**

## **SECTION 012513 – PRODUCT SUBSTITUTION PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 MATERIALS AND EQUIPMENT**

- A. In the specifications and on the Engineer's drawings, are specified and shown certain pieces of equipment and materials deemed most suitable for the service anticipated. This is not done to eliminate other equipment and materials equally as good and efficient. The Contractor shall prepare his bid on the particular materials and equipment specified. Following the award of the contract, should the Contractor desire to use other equipment and materials, he shall submit to the Owner a written request for such change and state the advantage to the Owner and the savings or additional cost involved by the proposed substitution. The determination as to whether or not such change will be permitted rests with the Owner and the Engineer.
- B. Each major item of equipment shall be inspected by a manufacturer's representative during installation and upon completion of the work. The Contractor shall supply the Engineer with a certificate of such inspection.

**END OF SECTION 012513**

**SECTION 013323 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES****PART 1 - GENERAL****1.1 GENERAL**

- A. The Contractor shall submit detailed drawings, acceptable catalog data, specifications and material certifications for all equipment and materials specified or required for the property completion of the work.
- B. The intent of these items is to demonstrate compliance with the design concept of the work and to provide the detailed information necessary for the fabrication, assembly and installation of the work specified. It is not intended that every detail of all parts of manufactured equipment be submitted; however sufficient detail will be required to ascertain compliance with the specifications and establish the quality of the equipment proposed.

Shop Drawing shall be sufficiently clear and complete to enable the Engineer and Owner to determine that items proposed to be furnished conform to the specifications and that items delivered to the site are actually those that have been reviewed.

- C. It is emphasized that the Engineer's review of Contractor's submitted data is for general conformance to the contract drawings and specifications but subject to the detailed requirements of drawings and specifications. Although the Engineer may review submitted data in details, such review is an effort to discover errors and omissions in Contractor's drawings. The Engineer's review shall in no way relieve the Contractor of his obligation to properly coordinate the work and to engineer the details of the work in such a manner that the purposes and intent of the contract will be achieved. Such review by the Engineer shall not be construed as placing on him, or on the Owner, any responsibility for the accuracy and for proper fit, functioning or performance of any phase of the work included in the contract.
- D. Shop Drawings shall be submitted in proper sequence and with due regard to the time required for checking, transmittal and review so as to cause no delay in the work. The Contractor's failure to transmit appropriate submittals to the Engineer sufficiently in advance of the work shall not be grounds for time extension.
- E. The Contractor shall submit Shop Drawings for all fabricated work and for all manufactured items required to be furnished in the Contract in accordance with the General Provisions and as specified herein. Shop Drawings shall be submitted sufficient time to allow at least twenty-one (21) calendar days after receipt of the Shop Drawings from the Contractor for checking and processing by the Engineer.
- F. It is the responsibility of each Prime Contractor to furnish to all other Prime Contractors and especially the General Construction Contractor reviewed Shop Drawings for



guidance in interfacing the various traders, i.e., sleeves, inserts, anchor bolts, terminations, and space requirements.

- G. No work shall be performed requiring Shop Drawings until same have been reviewed by Engineer.
- H. Accepted and reviewed Shop Drawings shall not be construed as approval of changes from Contract plan and specification requirements.
- I. The Engineer will review the first and second Shop Drawing item submittals are no cost to the Contractor. Review of the third submittal and any subsequent submittal will be at the Contractor's expense. Payment will be deducted from the Contractor amount at a rate of 2.8 times direct labor cost plus expenses.

## **1.2 SUBMITTAL PROCEDURE**

- A. All required submission shall be made to the Engineer by the Prime Contractor(s) only. Any data prepared by subcontractors and suppliers and all correspondence originating with subcontractors, suppliers, etc., shall be submitted through the Contractor.
- B. Contractor shall review and approve all Shop Drawings prior to submission. Contractor's approval shall constitute a representation to Owner and Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each Shop Drawing or sample with the requirements of the work and the Contract Documents.
- C. Submittal Preparation: Mark each submittal with a permanent label or page for identification. Provide the following information on the label for proper processing and recording of action taken:
  - 1. Location
  - 2. Project Name
  - 3. Contract
  - 4. Name and Address of Engineer
  - 5. Name and Address of Contractor
  - 6. Name and Address of Supplier
  - 7. Name of Manufacturer
  - 8. Number and Title of appropriate Specification Section
  - 9. Drawing Number and Detail References, as appropriate
  - 10. Submittal Sequence or Log Reference Number
    - a. Provide a space on the label for the Contractor's review and approval markings and a space for the Engineer's "Action Stamp".

- D. Each Shop Drawing, sample and product data submitted by the contractor shall have affixed to it the following Certifications Statement including the Contractor's company name and signed by the Contractor:

Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved Shop Drawings and all Contract requirements.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Company

- E. Shop Drawings shall be submitted in not less than six (6) copies to the Engineer at the address specified at the preconstruction conference. Single mylar or sepia reproducible copies of simple Shop Drawings may be submitted with prior approval of the engineer.
- F. At the time of each submission, Contractor shall in writing identify any deviations that the Shop Drawings or samples may have from the requirements of the Contract Documents.
- G. Drawings shall be clean, legible, and shall show necessary working dimensions, arrangement, material finish, erection data, and like information needed to define what is to be furnished and to establish its suitability for the intended use. Specifications may be required for equipment or materials to establish any characteristics of performance where such are pertinent. Suitable catalog data sheets showing all options and marked with complete model numbers may, in certain instances, be sufficient to define the articles which it is proposed to furnish.
- H. For product which require submittal of samples, furnish samples so as not to delay fabrication, allowing the Engineer reasonable time for the consideration of the samples submitted. Properly label samples, indicating the material or product represented, its place of origin, the names of the vendor and Contractor and the name of the project for which it is intended. Ship samples prepaid. Accompany samples with pertinent data required to judge the quality and acceptability of the sample, such as certified tests records and, where required for proper evaluation, certified chemical analyses.

### **1.3 REVIEW PROCEDURE**

- A. Engineer will review with reasonable promptness all properly submitted Shop Drawings. Such review shall be only for conformance with the design concept of the project and for compliance with the information given in the plans and specifications and shall not extend to means, methods, sequences, techniques, or procedures of construction or to safety precautions or programs incident thereto.

- B. The review of a separate item as such will not constitute the review of the assembly in which the item functions. The contractor shall submit entire systems as a package.
- C. All Shop Drawings submitted for review shall be stamped with the Engineer's action and associated comments.
- D. Except for submittals for record, information or similar purposes, where action and return is required or requested, the engineer will review each submittal, mark to indicate action taken, and return accordingly. Compliance with specified characteristics is the Contractor's responsibility.

Action Step: The engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

- 1. If Shop Drawings are found to be in general compliance, such review will be indicated by marking the first statement.
  - 2. If only minor notes in reasonable number are needed, the Engineer will make same on all copies and mark the second statement. Shop Drawings so marked need not be resubmitted.
  - 3. If the submitted Shop Drawings are incomplete or inadequate, the Engineer will mark the third statement, request such additional information as required, and explain the reasons for revision. The Contractor shall be responsible for revisions and/or providing needed information, without undue delay, until such Shop Drawings are acceptable. Shop Drawings marked with No.3 shall be completed and resubmitted.
  - 4. If submitted Shop Drawings are not in compliance with the Contract Documents, the Engineer will mark the fourth statement. The Contractor will be responsible to submit a new offering conforming to specific products specified herein and/or as directed per review citations.
- E. No submittal requiring a Change Order for either value or substitution or both, will be returned until the Change Order is approved or otherwise directed by the Owner.

**APPLICATION FOR USE OF SUBSTITUTE ITEM**

TO: \_\_\_\_\_

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

SPECIFIED ITEM:

Page	Paragraph	Description
A.		The undersigned requests consideration of the following as a substitute item in accordance with Article 6.05 of the General Conditions.
B.		Change in Contract Price (indicate + or -)    \$ _____
C.		Attached data includes product description, specifications, drawings, photographs, references, past problems and remedies, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified. For consideration of the attached data as SHOP DRAWINGS, submittal shall be in accordance with requirements of Section 013323.
D.		Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its property installation.

The undersigned certifies that the following paragraphs, unless modified by attachments are correct:

1. The proposed substitute does not affect dimensions shown on Drawings.
2. The undersigned will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the requested substitution.
3. The proposed substitution will have adverse effect on other contractors, the construction scheduled or specified warranty requirements. (If proposed substitution affects construction schedule, indicate below using + or -)

\_\_\_\_\_ CONSECUTIVE CALENDAR DAYS

4. Maintenance and service parts will be locally available for the proposed substitution.

The undersigned further states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item, and agrees to reimburse the Owner for the charges of the Engineer for evaluating this proposed substitute item.

E. Signature:

\_\_\_\_\_

Firm:

\_\_\_\_\_

Address:

\_\_\_\_\_

\_\_\_\_\_

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

Attachments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

For Use by Engineer:

\_\_\_\_\_ Accepted as evidenced by affixed SHOP DRAWING REVIEW stamp

\_\_\_\_\_ Accepted as evidenced by included CHANGE ORDER

\_\_\_\_\_ Not accepted as submitted. See Remarks

\_\_\_\_\_ Acceptance requires completion of submittal as required for SHOP DRAWINGS

\_\_\_\_\_ Not accepted. Do not resubmit

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

Remarks: \_\_\_\_\_

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**APPLICATION FOR USE OF “OR-EQUAL” ITEM**

TO: \_\_\_\_\_

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

SPECIFIED ITEM:

Page	Paragraph	Description
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- A. The undersigned requests consideration of the following as a substitute item in accordance with Article 6.05 of the General Conditions.

- B. Change in Contract Price (indicate + or -) \$ \_\_\_\_\_

- C. Attached data includes product description, specifications, drawings, photographs, references, past problems and remedies, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified. For consideration of the attached data as SHOP DRAWINGS, submittal shall be in accordance with requirements of Section 013323.

- D. Signature:

Firm:

Address:

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

Attachments: \_\_\_\_\_

For Use by Engineer:

\_\_\_\_\_Accepted as evidenced by affixed SHOP DRAWING REVIEW stamp

\_\_\_\_\_Accepted as evidenced by included CHANGE ORDER

\_\_\_\_\_Not accepted as submitted. See Remarks

\_\_\_\_\_Acceptance requires completion of submittal as required for SHOP DRAWINGS

\_\_\_\_\_Not accepted. Do not resubmit

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

Remarks: \_\_\_\_\_

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**END OF SECTION 013323**

## **SECTION 013326 – PRODUCT TESTING AND CERTIFYING**

### **PART 1 - GENERAL**

#### **1.1 QUALITY OF PROJECT**

- A. Where the specifications call for mill or shop tests, the Contractor shall furnish duplicate copies of attested manufacturer's certificates showing details of quality or performance sufficient to demonstrate conformity to contract requirements. Mill, shop or witness tests shall be subject to view by the Engineer's representative, but the Engineer's representation shall not relieve the Contractor from the necessity of furnishing certificates specified. The Engineer shall be notified by the Contractor in writing, sufficiently in advance of the time of making tests, so that proper arrangements may be made. Waiving of witness of tests by the Engineer may be in writing only by the Engineer. All costs for travel, lodging, food and transportation that are necessary for the engineer's representative and the Owner's representative to attend witness tests shall be included in the Contractor's bid for those items(s) specifically designated as being subject to witness testing.
- B. Unless otherwise specified, all materials equipment and articles shall be erected, installed, applied, or connected, used, clean and conditioned in accordance with the printed instructions and directions of the manufacturer.
- C. The installation shall be so made that its several component parts will function together as a workable system. It shall be complete with all accessories necessary for its operation and shall be left with all equipment properly adjusted and in working order.
- D. The work shall be executed in conformity with the best practice and so as to contribute to efficient of operation, minimum maintenance, accessibility and sightlines. It shall also be executed so that the installation will conform and accommodate itself to the building structure, its equipment and usage.
- E. Whenever in the Contract Documents a particular brand, make of material, device or equipment is shown or specified, such brand, make of material, device or equipment is to be regarded merely as standard and such trade name shall be followed by "or equal".

#### **1.2 QUALITY ASSURANCE**

- A. The equipment and materials to be furnished under this Contract shall be the products of well-established and reliable firms which had had ample experience for at least five (5) years in the manufacture of equipment or materials similar in design and of equal quality to that specified. If required, the manufacturer shall submit a list of installations of similar equipment which have been in successful operation for at least five (5) years.



**1.3 EXPERIENCE CLAUSE REQUIREMENT AND PERFORMANCE BONDS FOR MANUFACTURER**

- A. For every piece of equipment furnished under this Contract, the manufacturer will be required to have a minimum of five (5) years of experience in providing this specific type of equipment. In lieu of this experience requirement, the manufacturer will be required to provide performance bond(s) for the faithful performance of the equipment and guarantee payment in a sum of not less than 150% of the total equipment price for the completed work for that item. In the absence of verifiable experience, the manufacturer will be required to provide the performance bond(s) for the same number of years that the manufacturer was found lacking in experience from the specified five (5) year period. The performance bond(s) shall be from an approved surety company, to the satisfaction of the Owner's Law Director.
- B. Agents of bonding companies which write bonds for the performance and payment of the contract shall furnish power of attorney bearing the seal of the company, evidencing such agent's authority to execute the particular type of bond to be furnished, and evidencing also the right of the surety company to do business in the State of Ohio. Copy of this proof shall be attached to each copy of the contract.
- C. The bond shall be purchased through a surety company with a local agent upon whom service of process can be made.
- D. In the event of failure of surety or co-surety, the manufacturer shall immediately furnish a new bond, as required herein. The manufacturer's bond will not be released until all provisions of the contract have been fulfilled.
- E. The surety used for the bid bond and performance bond shall be listed in the latest U.S. Treasury Circular 570 and the Penal Sumas shall be within the maximum specified for such company in said Circular 570.

**PART 2 - PRODUCTS (Not Used)****PART 3 - EXECUTION (Not Used)****END OF SECTION 013326**

## **SECTION 014126 – GENERAL REGULATIONS AND PERMITS**

### **PART 1 - GENERAL**

#### **1.1 REGISTRATION**

- A. All Contractors and subcontractors shall be registered with the City Building Department having jurisdiction. Contact the Building Department for additional registration information.

#### **1.2 PERMITS**

- A. The Contractor shall apply for and pay for all permits from the Owner and/or other authorities having jurisdiction.

#### **1.3 ARCHAEOLOGICAL DISCOVERIES**

- A. Contractors and subcontractors are required under O.R.C. Section 149.53 to notify the Ohio Historical Society and the Ohio Historic Site Preservation Board of Archaeological Discoveries located in the project area, and to cooperate with those entities in archaeological and historic surveys and salvage efforts if such discoveries are uncovered within the project area.

Contact: Department Head  
Resource Protection and Review  
Ohio Historic Preservation Office  
800 East 17<sup>th</sup> Avenue  
Columbus, Ohio 43211-2497  
614.298.2000

- B. Should archaeological discoveries or other activities delay progress of the work, an adjustment in contract time will be made.

**END OF SECTION 014126**

## **SECTION 014223 – INDUSTRY STANDARDS**

### **PART 1 - GENERAL**

#### **1.1 ABBREVIATIONS**

- A. Abbreviations, as used, designate the following:

AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
AIEE	-	American Institute of Electrical Engineers
ANSI	-	American National Standards Institute
ASTM	-	American Society of Testing and Materials
AWWA	-	American Water Works Association
CMS	-	Construction and Material Specifications
NEMA	-	National Electrical Manufacturers Association
ODOT	-	Ohio Department of Transportation
ORC	-	Ohio Revised Code
UL	-	Underwriters Laboratories, Inc.

#### **1.2 REFERENCE TO OTHER SPECIFICATIONS**

- A. Where reference is made to specifications such as ASTM, AWWA, AASHTO, or ODOT, the latest edition shall be used unless otherwise noted on the plans or in the specifications.

#### **1.3 CODES AND STANDARDS**

- A. All work provided for by these specifications must be installed according to the provisions of the State and local building codes, subject to inspection and acceptance by the State and local inspectors.

**END OF SECTION 014223**

## **SECTION 015100 – TEMPORARY POWER SERVICE**

### **PART 1 - GENERAL**

#### **1.1 ELECTRICAL POWER**

- A. The Contractor shall furnish, at his own expense, all electrical power which may be required for the project. All temporary lines shall be furnished and installed by the Contractor at his own expense in a manner which meets the approval of the Engineer, and shall be removed by the Contractor at the completion of the construction.

**END OF SECTION 015100**

## **SECTION 016600 – PRODUCT HANDLING AND PROTECTION**

### **PART 1 - GENERAL**

#### **1.1 DELIVERY AND STORAGE OF MATERIALS**

- A. The Contractor shall be responsible for delivery and storage of all materials.
- B. The Contractor shall coordinate with the Engineer on the arrangement for storing construction materials and equipment. Deliveries of all construction materials and equipment should be made at suitable times.
- C. The Contractor shall store all materials required for the performance of this contract at sites designated by the Engineer.
- D. All stockpiles shall be neat, compact, completely safe, and barricaded with warning lights if necessary.
- E. Precautions shall be taken so that no shade trees, shrubs, flowers, sidewalks, driveways or other facilities will be damaged by the storage of materials. The Contractor shall be responsible for the restoration of all stockpile sites to their original condition.
- F. Materials, tools and machinery shall not be piled or placed against shade trees, unless they shall be amply protected against injury therefrom. All materials, tools, machinery, etc. stored upon public thoroughfares must be provided with red lights at night time so as to warn traffic of such obstruction.
- G. Materials shall be stored as to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, shall again be inspected prior to their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. Approved portions of the construction site may be used for storage purposes and for the placing of the Contractor's plant and equipment, but any additional space required therefore must be provided by the Contractor at his expense. Private property shall not be used for storage purposes without written permission of the property owner or lessee, and copies of such written permission shall be furnished to the Engineer. All storage sites shall be restored to their original condition by the Contractor at his expense.

**END OF SECTION 016600**

## **SECTION 017823 - MAINTENANCE MANUALS**

### **PART 1 - GENERAL**

#### **1.1 OPERATION AND MAINTENANCE MANUALS**

- A. Operation and maintenance information shall be submitted for all manufactured items, i.e. equipment, hardware, pumps, valves, motors, etc.
- B. This manual will either contain or make reference to all information that has been issued during the construction and start-up periods, as well as information necessary for the proper operation and maintenance of equipment.
- C. It shall be the responsibility of the Contractor who supplies such equipment to obtain from his vendors, the required information and submit this information to the Engineer. This information will be accepted only if properly identified and only after it has been revised, where necessary, to conform to previous transmittals of the same material that have been “approved as noted” by the Engineer. All submittals shall be on 8-1/2"x11" size paper or folded to that size.
- D. In general, and where applicable, the information shall consist of, but not be limited to, six (6) sets of the following:
  - 1. Descriptive literature, bulletins or other data covering equipment or system.
  - 2. Complete list of equipment and appurtenances included with system, complete with manufacturer and model number.
  - 3. Utility requirements.
  - 4. General arrangement drawing.
  - 5. Sectional assembly.
  - 6. Dimension print.
  - 7. Materials of construction.
  - 8. Certified performance curve.
  - 9. Performance guarantee.
  - 10. Parts list.
  - 11. Recommended spare parts list with part and catalog number.
  - 12. Lubrication recommendations and instructions.
  - 13. Schematic wiring diagrams.
  - 14. Schematic piping diagrams.
  - 15. Instrumentation data.
  - 16. Drive dimensions and data.
  - 17. Control data.
  - 18. Operating instructions, including troubleshooting guidelines and preventative maintenance instructions with task schedule.
  - 19. Maintenance instruction in
  - 20. Required tools and equipment for operation and maintenance.

21. Safety considerations for O & M procedures.

**END OF SECTION 017823**

## **SECTION 018000 - SYSTEM PERFORMANCES**

### **PART 1 - GENERAL**

#### **1.1 GENERAL**

- A. It is the intent of this Contract that the final installation shall be complete in all respects.
- B. The Contractor shall be responsible for all minor details, whether or not shown on the Drawings or specifically included in these Specifications

#### **1.2 BUILDINGS**

- A. The building and components shall function properly and in accordance with the plans, specifications and industry standards.
- B. The following components includes, but is not necessarily limited to, the following:
  - 1. Roofing
  - 2. Doors
  - 3. Windows
  - 4. Painting Systems
  - 5. Floor Coverings
  - 6. Equipment
    - a. Architectural
    - b. Mechanical
    - c. Electrical

#### **1.3 FACILITIES**

- A. The facilities and equipment shall function properly and in accordance with the plans, specifications and industry standards.
- B. The following equipment includes, but is not necessarily limited to, the following:
  - 1. Valves
  - 2. Pumping Equipment
  - 3. Rotating Equipment
  - 4. Aeration Equipment
  - 5. Flotation Equipment
  - 6. Blowers
  - 7. Telemetry
  - 8. HVAC
  - 9. Electrical



#### **1.4 CERTIFICATION**

- A. The Contractor shall provide written certification from the manufacturer and/or installers that the various major components are in working order or have been installed in accordance with the manufacturer's instructions.

**END OF SECTION 018000**

## **SECTION 034000.08- PRECAST CONCRETE VAULTS, WETWELL AND STRUCTURES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 specification sections, apply to work of this section.

#### **1.2 SUMMARY**

- A. Furnish and install precast concrete vaults, wetwells, and structures at the locations shown on the plans.

#### **1.3 QUALITY ASSURANCE**

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

#### **1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer's dimension drawings, technical data and application instructions.

### **PART 2 - PRODUCTS**

#### **2.1 SIZE, DIMENSIONS**

- A. Vault dimensions shall conform nominally to those shown on the plans.
- B. Final wetwell size and any changes in wetwell size shall be coordinated with the pump supplier.

#### **2.2 MATERIALS**

- A. The materials used in the manufacture of the vaults shall conform to the following requirements:
  - 1. Cement: Portland Cement, Type II, conforming to ASTM C150 or ASTM C175.
  - 2. Concrete Aggregate: ASTM C33. The maximum size of aggregate shall not be more than one inch (1").
  - 3. Reinforcing Steel: ASTM A615, Grade 60.
  - 4. Gaskets: All joints shall be sealed against water leakage in or out by an acid-resistant and base-resistant flexible joint sealer material.

5. Wall pipes: Cast iron, AWWA C110.

## 2.3 QUALITY CONTROL

- A. Precast concrete containing hairline cracks which are visible but not measurable by ordinary means may be accepted. Cracks of width measurable by ordinary means (0.01 inch wide and over) shall cause rejection. The Engineer shall make the final decision on whether the cracks are acceptable or not, and if the cracks are detrimental to the member structurally.
- B. Surfaces shall be devoid of any honeycomb, evidence of spalling, holes, or voids. Such imperfections may be patched, except those reaching into reinforcing.
- C. Precast concrete units which do not conform to the specified requirements, including strength, dimensional tolerances, and finishes, shall be replaced with precast concrete units that meet the requirements of this section. The Contractor shall also be responsible for the expense of corrections to any other work affected by or resulting from corrections to the precast concrete work. All corrections shall be made promptly and at no additional expense to the Owner.

## 2.4 CONSTRUCTION

- A. The vault shall be constructed of properly reinforced 5,000 psi, 28-day compression strength precast concrete. All reinforced concrete shall be of such thickness and properly reinforced to support the full earth loads, hydrostatic forces, and pumping-induced static and dynamic forces that will be imposed on it. Minimum wall and bottom slab thickness shall be eight inches (8"). The vault shall be prefabricated in as few sections as possible for ease in shipment and handling. Design and construction of precast units shall conform to ASTM C913.
- B. Individual vault sections shall be joined one to another with a horizontal tongue and groove joint. Each joint shall be sealed with a 4" x 1/2" neoprene gasket. All joints shall be watertight. Non-compression joints with grout sealing compounds will not be acceptable. The neoprene gasket shall be installed and compressed to fit the contour of the receiving "groove" of each casting within the system before the adjoining "tongue" section is set into position.
- C. Wall pipes, sleeves, manhole covers, etc. of the indicated sizes and locations shall be cast into the structure at the time of manufacture.
- D. The vault/wetwell top slab shall be designed and manufactured to support 300 PSP uniform live load plus the concentrated load of the pump. All structural steel supporting members shall be galvanized.
- E. Precast vault manufacturer to provide enlarged base, or other measures, required to counteract buoyance under all construction and permanent installed conditions. Design high water elevation – 576.5.

## **2.5 SUGGESTED MANUFACTURER**

- F. The precast concrete vaults shall be a product of Mack Vault, Valley City, Ohio; Norweco, Norwalk, Ohio; or approval equal.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install units on six-inch (6") minimum thickness gravel bedding.
- B. Backfill with approved granular material compacted in six-inch (6") lifts.
- C. Fill unit with clean water prior to backfilling.

### **END OF SECTION 034000.08**

## **SECTION 083113 - ALUMINUM ACCESS DOORS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division - 1 Specification sections, apply to work of this section.

#### **1.2 DESCRIPTION OF WORK**

- A. This section includes the furnishing and installation of all aluminum access doors and frames as shown on the Drawings necessary to complete the work of this Contract. Access doors shall include frames, hinges, handles, coatings, hardware and all appurtenances necessary for a complete installation.

#### **1.3 QUALITY ASSURANCE**

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

#### **1.4 WARRANTY**

- A. Manufacturer shall guarantee against defects in material or workmanship for a period of five years under normal use, operation and service.

#### **1.5 SUBMITTALS**

- A. Manufacturer's catalog data showing:
  - 1. Dimensions, spacing, and construction of doors and frames.
  - 2. Materials of construction.
- B. Detail shop drawings showing:
  - 1. Dimensions of each access door and frame.
  - 2. Location and identification mark.

### **PART 2 - PRODUCTS**

#### **2.1 FLOOR DOORS**

- A. Interior/exterior doors shall be Type "J" or Type "JD" as manufactured by the Bilco Company; AHS Series by East Jordan Iron Works or approved equal.

- B. The access frame shall be 1/4 in. aluminum with an anchor flange around the perimeter.
- C. The access door shall be 1/4 in. aluminum diamond pattern plate to withstand a live load of 300 pounds per square foot or H-20 vehicle loading, if specified. The door shall be equipped with heavy forged brass hinges, stainless steel pins, spring operators for easy operation, and an automatic hold-open arm with release handle. A snap lock with removable handle shall be provided. A 1-1/2 in. drainage coupling shall be located in the front right corner of the access frame.
- D. Hardware shall be cadmium plated and factory finish shall be a mil finish with bituminous coating applied to the exterior of the frame.
- E. Access door and frame for interior/exterior doors shall be of the types and sizes specified.
- F. All doors shall be equipped with a lockable hasp within a flush, recessed, opening with hinged cover.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with manufacturer's instructions.

**END OF SECTION 083113**

## **SECTION 099770 - SPECIAL COATINGS**

### **PART 1 – GENERAL**

#### **1.1 SUMMARY**

- A. Work covered by this Section includes the furnishing and application of paints, stains, primers, varnishes and other finish, decorative and protective coatings.
- B. Shop priming and factory prefinishing are required on some, but not necessarily all, of the items described in other sections.
- C. Extent of work:
  - 1. All new process equipment and process piping.
  - 2. All building and room surfaces as indicated on the plans or as scheduled.
  - 3. All conduits, ducts, drains, etc of other trades unless such product is deemed having an acceptable factory pre-finish, under the following conditions:
    - a. When specifically called out as requiring special coating protection.

#### **1.2 DEFINITIONS**

- A. Special coating systems are defined as those types of materials and methods of application requiring more than normal skills and techniques for mixing, handling and application, as specified in the "Painting" section.
  - 1. The term "special coating systems" as used in this section includes applied materials used in prime, intermediate and finish coats.
  - 2. The word "paint", as applied in this and or other Sections shall apply to all special coatings required herein for the protection of materials from corrosive environment, weathering processes, or for aesthetic or other reasons.
  - 3. The term "exposed surfaces" is defined to include areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place in areas to be coated. Extend special coatings in these areas as required to maintain the coating system integrity and provide desired protection.

#### **1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical information including basic materials analysis application instructions for each coating material specified.
  - 1. List each material and cross-reference to the specific coating and finish system and application. Identify each material by the manufacturer's catalog number and general classification.
  - 2. In the event that the submittal requests a substitution then the following ASTM

test results from an independent testing laboratory for the referenced products shall be included:

ASTM B 117 Salt Fog  
ASTM D 3359 (Method A and B) Adhesion Test  
ASTM G8, Method A Cathodic Disbondment  
ASTM D 4541 (Elcometer)  
ASTM D 4060 Taber Abrasion  
ASTM D 522 (Conical Mandrel)  
ASTM D 3363 Pencil Hardness  
ASTM D 2794 Impact  
ASTM G 53 QUV Exposure  
ASTM D 2240 Durometer, Shore D  
ASTM D 870 Immersion (Potable Water)  
ASTM E 96 Moisture Vapor Transmission  
ASTM D 2370 Tensile Strength and Elongation  
ASTM D 638 Tear Strength

- B. Manufacturer's representative color and texture sample cards shall be submitted to the Engineer at least 30 days prior to paint application. Contractor shall coordinate work so as to allow sufficient time for paint to be delivered to the job site.

#### **1.4 QUALITY ASSURANCE**

- A. Single Source Responsibility: Provide primers and other undercoat material produced by the same manufacturer as the finish coats. Use only thinners recommended by the manufacturer, and only within recommended limits.
- B. Coordination of Work: Review other sections of these specifications in which other coatings are to be provided to ensure compatibility of the total coatings systems for various substrates.
1. Upon request, furnish information on the characteristics of pre-primed materials, to ensure that provisions for specified finish coats can be appropriately applied.
  2. Notify the Engineer of any anticipated problems involved in using the coatings systems as specified.

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

- A. Deliver materials to the job site in the manufacturer's original, new, unopened packages and containers bearing manufacturer's name and label and the following information:
1. Name or title of material.
  2. Federal Specification number, if applicable.
  3. Manufacturer's stock number and date of manufacture.
  4. Manufacturer's name.
  5. Contents by volume, for major pigment and vehicle constituents.
  6. Thinning instructions.
  7. Application instructions.



8. Color name and number.
  9. Handling instructions and precautions.
- B. Store materials not in actual use in tightly covered containers at a minimum ambient temperature of 45 deg. F (7 deg. C) in a well ventilated area. Maintain containers used in storage of coatings in a clean condition, free of foreign materials and residue.
1. Protect from freezing where necessary. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all necessary precautionary measures to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of stains.
- C. No material shall be applied unless the containers are opened in the presence of the Owner's Representative.

## **1.6 PROJECT CONDITIONS**

- A. Apply coatings only when the temperature of surfaces to be coated and surrounding air temperatures are above 45 deg. F (7 deg. C), unless otherwise permitted by manufacturer's printed instructions.
- B. Do not apply coatings in snow, rain, fog or mist, or when the relative humidity exceeds 85%, or to damp or wet surfaces unless otherwise permitted by manufacturer's printed instructions. Allow wet surfaces to dry thoroughly and attain the temperature and conditions specified before proceeding with or continuing with the coating operation.
1. Work may continue during inclement weather only if areas and surfaces to be coated are enclosed and the temperature within the area can be maintained within limits specified by the manufacturer during application and drying periods.
- C. Report to responsible person such as safety personnel, General Trades Superintendent, etc., any condition which may pose a threat to the health and welfare of employees.
- D. Keep working area clean and safe.
- E. Obey all job site rules and regulations.
- F. Surfaces not to be painted; unless specifically stated otherwise:
1. Face brick
  2. Pre-finished wall panels, partitions and ceiling tile
  3. Items with acceptable factory-applied final finish
  4. Concealed ducts, pipes and conduit.
  5. Glass, Aluminum, Copper, Bronze, Stainless Steel

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
  - 1. Tnemec Company, Inc., North Kansas City, Missouri
  - 2. Carboline Company, At. Louis, Missouri
  - 3. Sherwin Williams Company, Cleveland, Ohio
- B. Material Quality: Provide the best quality grade of the various types of coatings as regularly manufactured by acceptable coating manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.
- C. Proprietary names to designate colors or materials are not intended to imply that products of named manufacturers are required to the exclusion of equivalent products of other manufacturers.
- D. Request for substitution shall include manufacturer's literature for each product giving the name, product number, generic type, descriptive information, solids by volume, recommended dry film thickness and certified test reports showing results to equal the performance criteria of the products listed herein.

### 2.2 COATING SYSTEMS

- A. Ferrous Metal:
  - 1. Submerged, Non-Potable
    - Surface Preparation: SSPC-SP10 Near White Blast
    - First Coat:
      - Tnemec Series N69 Hi-Build Epoxoline II @ 3.0-5.0 mils dry
      - Carboline Carboguard 890 @ 3.0 - 5.0 DFT
      - Sherwin Williams Dura-Plate 235 at 3.0-5.0 mils DFT
    - Second Coat:
      - Tnemec Series N69 Hi-Build Epoxoline II @ 6.0-8.0 mils dry
      - Carboline Carboguard 890 @ 4.0 - 6.0 DFT
      - Sherwin Williams Dura-Plate 235 at 5.0-8.0 mils DFT

NOTE: If shop primed, field surface preparation for weld seams and abraded areas is SSPC-SP-10 and spot prime with Series 161 @ 3-5 mils dry or Carboline Carboguard 890 @ 3.0 - 5.0 DFT or Sherwin Williams Dura-Plate 235 @3.0-5.0 mils DFT.

- 2. Non-Submerged, Interior Exposure
  - Surface Preparation: SSPC-SP6 Commercial Blast
  - First Coat:
    - Tnemec Series N69 Hi-Build Epoxoline II @ 3.0-5.0 mils dry

Carboline Carboguard 60 @ 3.0 - 5.0 DFT  
Sherwin Williams Macropoxy 646 at 3.0-5.0 mils DFT

Second Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 4.0-6.0 mils dry  
Carboline Carboguard 60 @ 4.0 - 6.0 DFT  
Sherwin Williams Macropoxy 646 at 4.0-6.0 mils DFT

NOTE: If shop primed, field surface preparation for weld seams and abraded areas is SSPC-SP-10 and spot prime with Series N69 @ 3-5 mils dry or Carboline Carboguard 60 @ 3.0 - 5.0 DFT or Sherwin Williams Macropoxy 646 at 3.0-5.0 mils DFT.

3. Non-Submerged, Exterior Exposure

Surface Preparation: SSPC-SP6 Commercial Blast

First Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 3.0-5.0 mils dry  
Carboline Carboguard 60 @ 3.0 - 5.0 DFT  
Sherwin Williams Macropoxy 646 at 3.0-5.0 mils DFT

Second Coat: Tnemec Series 1075 Endura-Shield II @ 2.0-4.0 mils dry  
Carboline Carbothane 133 LH @ 3.0 - 5.0 DFT  
Sherwin Williams Acrolon 218 HS or Hi-Solids Polyurethane at 3.0-5.0 mils DFT

NOTE: If shop primed, field surface preparation for weld seams and abraded areas is SSPC-SP-6 and spot prime with Series N69 @ 3-5 mils dry or Carboline Carboguard 60 @ 3.0 - 5.0 DFT or Sherwin Williams Macropoxy 646 at 3.0-5.0 mils DFT.

4. Galvanized Steel (including Bar Joist and Galvanized Steel)

Surface Preparation: SSPC-SPI Solvent Clean on galvanized surfaces.  
SSPC-SP7 Brush-Off blast to lightly profile surface.

First Coat: N69 Hi-Build Epoxoline II @ 2.0-4.0 mils dry  
Carboline Carboguard 888 @ 3.0 - 4.0 DFT  
Sherwin Williams Macropoxy 646 at 3.0-4.0 mils DFT

B. Non-Ferrous Metals:

1. Interior Exposure

Surface Preparation: SSPC-SP1 Solvent Clean and Scarify per SSPC-SP 3

First Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 2.0-3.0 mils dry  
Carboline Carboguard 60 @ 3.0 - 5.0 DFT  
Sherwin Williams Macropoxy 646 at 3.0-5.0 mils DFT

Second Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 3.0-5.0 mils dry  
Carboline Carboguard 60 @ 3.0 - 5.0 DFT  
Sherwin Williams Macropoxy 646 at 3.0-5.0 mils DFT

## 2. Exterior Exposure

Surface Preparation: SSPC-SP1 Solvent Clean and Scarify per SSPC-SP 3

First Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 2.0-3.0 mils  
dry Carboline Carboguard 60 @ 3.0 - 5.0 DFT  
Sherwin Williams Macropoxy 646 at 3.0-5.0 mils DFT

Second Coat: Tnemec Series 1075 Endura-Shield @ 2.0-4.0 mils dry  
Carboline Carbothane 133 LH @ 3.0 - 5.0 DFT  
Sherwin Williams Acrolon 218 HS or Hi-Solids  
Polyurethane at 3.0-5.0 mils DFT

## C. Wood

Surface Preparation: Clean and dry

First Coat: Tnemec Series 36-603 Undercoater @ 300 sq.ft. per gal.  
Carboline Carbocrylic 120 @ 1.0 - 2.0 DFT  
Sherwin Williams Multi-Purpose Primer at 1.0-2.0 mils  
DFT

Second Coat: Tnemec Series 23 Enduratone @ 400 sq.ft. per gal.  
Carboline Carbocoat 8215 @ 400 sq. ft. per gal.  
Sherwin Williams Pro Mar 200 Alkyd at 400 sq. ft. per gal

Third Coat Tnemec Series 23 Enduratone @ 400 sq.ft. per gal.  
Carboline Carbocoat 8215 @ 400 sq. ft. per gal.  
Sherwin Williams Pro Mar 200 Alkyd at 400 sq. ft. per gal

## D. PVC Pipe

Surface Preparation: Lightly sand

First Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 200 sq.ft. per  
gal.  
Carboline Carboguard 60 @ 200 sq. ft. per gal.  
Sherwin Williams Macropoxy 646 at 200 sq. ft. per gal

## 2.3 COLOR CODING AND PROCESS SYSTEM IDENTIFICATION

A. The following color coding is suggested for **wastewater** transport and treatment systems. Color coding for processing piping, equipment and appurtenances is a suggested system unless otherwise specified or requested by Owner. Final coding to be determined in the field:

1. Equipment - light gray with O.S.H.A. orange coupling guards and O.S.H.A. yellow belt guards.
2. Pipe Supports - hangers to be same color as piping applied, floor post to be same as adjacent wall color, and fabricated racks to be manufacturer's standard protective finish or paint same as adjacent wall color if not having a suitable protective finish.
3. Process piping-exposed interior or exterior:

- a. Submerged Pipe or Supports - Black
- b. Intermittently Submerged Metals - Black (unless piping as defined otherwise)
- c. Raw wastewater - Medium Grey\*

\*These colors are recommended as standard by WEF.

- C. Miscellaneous, non-process related items such as electrical conduit, duct work, roof drains, etc. are to be properly prepped and finished to match adjacent wall or ceiling color.

1. In situations where two colors do not have sufficient contrast to easily differentiate between them, a six (6) inch band of contrasting color shall be on one of the pipes at approximately thirty (30) inch intervals.

### 3.2 SURFACE PREPARATION

A. General:

1. Dislodge dirt, rust, plaster nibs, mortar spatter and other dry material by scraping or brushing. Remove dust and loose material by brushing, sweeping, vacuuming or blowing with high-pressure air.
2. Remove oil, wax and grease by scraping off heavy deposits and cleaning with mineral spirits or a hot trisodium phosphate solution followed by a water rinse.
3. Verify that surfaces to be coated are dry, clean and free of dust, dirt, oil, wax grease or other contaminants.

B. Non-Ferrous Metal:

1. SSPC-SPI solvent cleaning to remove all contaminants.

C. Ferrous Metal:

1. Enclosed: Remove loose rust, mill scale and other foreign matter by hand (SSPC-SP2) or power tool (SSPC-SP3) cleaning and apply specified coating before rusting occurs.
2. Non-Submerged, Architecturally Exposed: Society of Protective Coatings, SSPC-SP6 Commercial Blast.
3. Submerged Steel: Society of Protective Coatings, SSPC-SP10 Near White Blast.

D. Galvanized Metal:

1. Remove contaminants and protective mill coating by SSPC-SP1 Solvent Cleaning or steam cleaning. All surfaces shall be prepared by light brush blasting to achieve a minimum 1.0 mil abrasive blast profile

E. Wood:

1. Remove surface deposits of sap and pitch by scraping and cleaning with mineral spirits.

2. Seal knots and pitch pockets with a product manufactured for this specific purpose.
3. Sand rough spots of smooth siding and finish woodwork.
4. After prime coat is dry, fill cracks, holes and scratches with suitable wood filler or spackling compound and when dry, sand flush with surface.
5. Sand lightly between coats.

## **PART 3 - EXECUTION**

### **3.1 PRE-WORK INSPECTION**

- A. Examine surfaces to be coated and report conditions that would adversely affect appearance or performance of coating systems and which cannot be put into an acceptable condition by preparatory work specified in Paragraph 3.2.
- B. Do not proceed with surface preparation and application until surface is acceptable or authorization to proceed is given by the Owner's representative.

### **3.2 SURFACE PREPARATION**

- A. General:
  1. Dislodge dirt, rust, plaster nibs, mortar spatter and other dry material by scraping or brushing. Remove dust and loose material by brushing, sweeping, vacuuming or blowing with high-pressure air.
  2. Remove oil, wax and grease by scraping off heavy deposits and cleaning with mineral spirits or a hot trisodium phosphate solution followed by a water rinse.
  3. Verify that surfaces to be coated are dry, clean and free of dust, dirt, oil, wax grease or other contaminants.
- B. Non-Ferrous Metal:
  1. SSPC-SPI solvent cleaning to remove all contaminants.
- C. Ferrous Metal:
  1. Enclosed: Remove loose rust, mill scale and other foreign matter by hand (SSPC-SP2) or power tool (SSPC-SP3) cleaning and apply specified coating before rusting occurs.
  2. Non-Submerged, Architecturally Exposed: Society of Protective Coatings, SSPC-SP6 Commercial Blast.
  3. Submerged Steel: Society of Protective Coatings, SSPC-SP10 Near White Blast.
- D. Galvanized Metal:
  1. Remove contaminants and protective mill coating by SSPC-SP1 Solvent Cleaning or steam cleaning. All surfaces shall be prepared by light brush blasting to achieve a minimum 1.0 mil abrasive blast profile

E. Wood:

1. Remove surface deposits of sap and pitch by scraping and cleaning with mineral spirits.
2. Seal knots and pitch pockets with a product manufactured for this specific purpose.
3. Sand rough spots of smooth siding and finish woodwork.
4. After prime coat is dry, fill cracks, holes and scratches with suitable wood filler or spackling compound and when dry, sand flush with surface.
5. Sand lightly between coats.

### 3.3 APPLICATION

- A. General: Apply special coatings by brush, roller, spray, squeegee, or other applicators in accordance with the manufacturer's directions. Brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
1. Coating colors, surfaces treatments and finishes are indicated in the "Schedules" of the contract documents.
  2. Provide finish coats that are compatible with the primers used.
  3. The number of coats and coating film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the coating manufacturer. Sand between coating applications where sanding is required to produce an even smooth surface in accordance with the coating manufacturer's directions.
  4. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces.
  5. Coat the back sides of access panels, removable or hinged covers, and similar hinged items, to match exposed surfaces.
- B. Minimum Coating Thickness: Apply each material at not thinner than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire coating system as recommended by the manufacturer.
- C. Prime Coats: Before the application of finish coats, apply a prime coat, as recommended by the coating manufacturer, to material that is required to be painted or finished, and which has not been prime coated by others.
1. Recoat primed and sealed substrates where there is evidence of suction spots or unsealed areas in the first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.
- D. Brush Application: Brush-out and work brush coats into surfaces in an even film. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.
1. Apply primers and first coats by brush unless the manufacturer's instructions permit use of mechanical applicators.

- E. Mechanical Applications: Use mechanical methods for coating application when permitted by the coating manufacturer's recommendations, governing ordinances, and trade union regulations.
  - 1. Wherever spray application is used, apply each coat to provide the equivalent hiding of brush-applied coats. Do not double-back with spray equipment building-up film thickness of 2 coats in one pass, unless recommended by the coating manufacturer.
- F. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or recoat work not in compliance with specified requirements.
- G. Spray application will not be permitted for the Primary Clarifier Painting bid item.

### **3.4 INSPECTION**

- A. Request acceptance of each coat before applying succeeding coats.
- B. The Contractor shall furnish the Engineer a suitable thickness detector of a type recommended by the paint manufacturer.
- C. Any field painting found to be defective shall be removed and the surfaces repainted as the Engineer may direct at no additional cost to the Owner.
- D. Before final approval of the work, all damaged surfaces of paint (field or factory applied) shall be cleaned and repainted or touched up as directed.

### **3.5 FIELD QUALITY CONTROL**

- A. The Owner reserves the right to invoke the following material testing procedure at any time, and at any number of times during the period when coating operations are being conducted.
  - 1. The Owner will engage the services of an independent testing laboratory to sample the coating being used. Samples of material delivered to project site will be taken, identified and sealed, and certified in the presence of the Contractor.
  - 2. The testing laboratory will perform appropriate tests for any or all of the following characteristics as required by the Owner:
    - a. Quantitative materials analysis.
    - b. Absorption.
    - c. Accelerated weathering.

### **3.6 CLEANING**

- A. Clean-Up: At the end of each work day during progress of work, remove rubbish, empty cans, rags and other discarded materials from the site.
  - 1. Upon completion of the work, clean window glass and other spattered surfaces. Remove spattered coatings by washing, scraping or other proper methods,



using care not to scratch or otherwise damage adjacent finished surfaces.

### **3.7 PROTECTION**

- A. Protect work of other trades, whether to be coated or not, against damage from coating operations. Correct damage by cleaning, repairing or replacing, and recoating as acceptable to the Engineer. Leave the work in an undamaged condition.
- B. Provide "Wet Paint" signs as required to protect newly-coated finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of coating operations.
  - 1. At completion of the work of other trades, touch-up and restore damaged or defaced coated surfaces.

**END OF SECTION 099770**

**SECTION 131200 - 8' X 9' X 9' PRECAST CONCRETE BUILDING PREASSEMBLED****PART 1 – GENERAL****1.1 SUMMARY**

- A. Contractor shall furnish a precast concrete transportable building. Building to be delivered and placed on owner's prepared stone foundation in accordance with manufacturer's recommendations. Precast building to be EASI-SET® brand Model 0809 as manufactured by *Norwalk Concrete Industries (NCI) Norwalk, OH, or approved Equal*. Building to be provided by manufacturer with all necessary openings as specified by contractor in conformance with manufacturer's structural requirements.

**1.2 QUALITY ASSURANCE**

- A. IBC 2006 International Building Code
- B. ASTM C33 Concrete Aggregates
- C. ASTM C39 Method of Test for Compressive Strength of Cylindrical Concrete Specimens
- D. ASTM C143 Method of Test for slump of concrete
- E. ASTM C150 Standard Specification for Portland Cement
- F. ASTM C192 Method of Making and Curing Test Specimens in the Laboratory.
- G. ACI 1211.1 Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete
- H. NPCA Plant Certifications Program
- I. AWS D1.1 Structural Welding Code.

**1.3 DESIGN REQUIREMENTS**

- A. Dimensions:
  - Exterior: 8' x 9' in plan (minimum, sized to fit all equipment)
  - Interior: 7'-6"x 8'-6" x 9'-0" high
- B. Design Loads:
  - 1. Seismic load performance category 'D'. Site Class D

2. Standard Live Roof Load – 60 PSF
  3. Standard Floor Load – 250 PSF
  4. Standard Wind Loading – 130 MPH
- C. Roof: Roof panel shall slope shall have a 3:12 gable roof. The roof shall extend a minimum of 2-1/2" beyond the wall panel on each side and have a Drip Edge on Underside of Roof Panel to prevent water migration into the building along top of wall panels.
- D. Roof, floor, and wall panels must each be produced as single component monolithic panels. No roof, floor, or vertical wall joints will be allowed, except at corners. Wall panels shall be set on top of floor panel.
- E. Floor panel must have 1/2" step-down around the entire perimeter to prevent water migration into the building along the bottom of wall panels.

## **1.4 SUBMITTALS**

- A. Engineering calculations that are designed and sealed by a professional engineer, licensed to practice in the state where the project is located, shall be submitted for approval.

## **PART 2 – PRODUCTS**

### **2.1 MATERIALS**

- A. Concrete: Steel-reinforced, 5000 PSI minimum 28-day compressive strength, air-entrained (ASTM C260).
- B. Reinforcing Steel: ASTM A615, Grade 60 unless otherwise specified.
- C. The concrete mix design is designed to ACI 211.1 to produce concrete of good workability.
- D. Mix – 1 cubic yard; Avg. 28-day strength 5,000 psi
1. Cement will be low alkali Type I-II or Type III conforming to ASTM C-150
  2. Coarse aggregates used in the concrete mix design will be conform to ASTM C33 with the designated size of coarse aggregate #67
  3. Minimum water/cement ratio will not exceed 0.40. Slump will not exceed 5".
  4. Air-entrained admixtures will conform to ASTM C620. Water reducing admixtures will conform to ASTM C494, Type. A. Plasticizing admixtures will conform to ASTM C 1017. Other admixtures will not be used without customer approval.

## **2.2 POST-TENSIONING**

- A. Post-tensioning Strand: 41K Polystrand CP50, .50, 270 KSI, 7-wire strand, enclosed within a greased plastic sheath, (ASTM A416). Roof and floor are to be each post-tensioned by a single, continuous tendon. Said tendon shall form a substantially rectangular configuration having gently curving corners wherein the positioning of the cable member results in a pattern of one or more loops and a bisecting of the loop(s). The cable member starts from one corner of the concrete building panel, forms a gentle perimeter loop(s) returning to a point where the cable member entered the concrete building panel. The tendon then turns 90° and follows the cable member(s) to a point midway along the “Y” axis of the concrete building panel and then turns 90° along the “X” axis of the concrete building panel. This bisects the concrete building panel and crosses the opposite parallel portion of the cable member and exits from an adjacent side of the concrete building panel.

## **2.3 COLD WEATHER CONCRETE**

- A. Cold weather concrete placement will be in accordance with ACI 306.
- B. Concrete will not be placed if ambient temperature is expected to be below 35° F during the curing period unless heat is readily available to maintain the surface temperature of the concrete at 45° F.
- C. Materials containing frost or lumps of frozen materials will not be used.

## **2.4 HOT WEATHER CONCRETE**

- A. The temperature of the concrete will not exceed 80° F, at the time of placement, and when the ambient temperature reaches 90° F the concrete will be protected with moist covering.

## **2.5 CAULKING**

- A. All joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking shall be “Dymonic FC” or equal.

## **2.6 STRUCTURAL JOINTS**

- A. All welding will be by Certified Welders only (in accordance with AWS D1.1).
- B. Wall components will be joined together with 2 welded plate pairs at each joint. Weld plates will be anchored into the concrete panels and welded together with a continuous weld.
- C. Walls and roof will be joined with weld plates, at each building corner.

- D. The joint between the floor slab and walls will be joined with a grout mixture on the inside, a matching colored caulk on the outside and two weld plates per wall.

## **2.7 STEEL DOORS**

- A. Doors will be flush panel type 1-3/4" thick, minimum 18-gauge prime coated steel panels with minimum 16-gauge internal bracing channels with polyurethane core. Doors to be galvanized steel. Door shall be 3'-6" x 7'-0" minimum dimensions and sized to allow the installation, and replacement, of the proposed electrical equipment.
- B. Door frames will be knocked down or welded type, single rabbet, minimum 16-gauge prime coated steel width to suit wall thickness as manufactured by Ceko Door Products.

## **2.8 DOOR HINGES**

- A. Door hinges will be 32D Stainless steel 4-1/2" x 4-1/2", manufactured by McKinney or approved equal.

## **2.9 LOCKSET**

- A. Lockset will meet ANSI 156.13, Grade 1 Mortise Type lockset for exterior doors. Yale 8800 series or equal
- B. Lever handle both inside and out.
- C. Either handle operates latch unless outside handle is locked by inside thumb turn.
- D. Mortise lock will automatically release when inside lever handle is turned.
- E. Inside lever always active.
- F. U.S. 26D finish.

## **2.10 POWER AND LIGHTING**

- A. Structure shall come equipped with interior LED light fixtures sized to adequately illuminate the interior space with 15 foot-candles at a work plane of 2.5 feet above the finished floor.
- B. One fully weatherproof exterior LED light fixture mounted adjacent to, or above, the entry door equipped with photoelectric and manual override switches. The fixture will provide at least 1.0 foot-candle at ground level at the doorway.
- C. Interior shall be provided with at least two (2) – GFCI 120VAC 20A duplex outlets.

## **2.11 INSULATION**

- A. Walls and ceiling of structure shall be insulated to a minimum R – Value of 15.

## **2.12 HVAC**

- A. Structure shall be equipped with a heating and cooling system sized to maintain the internal temperature between 65° (heating) and 75° F (cooling). It is estimated that the variable frequency drives and other internal equipment will produce approximately 5,100 watts of rejected heat (17,5000 btuh sensible load) when all three are operating at peak flow. Contractor shall coordinate with the pump controller supplier to accommodate heat output from variable frequency drives and other control equipment.

## **2.13 ELECTRICAL AND TELEMETRY EQUIPMENT**

- A. Contractor and supplier of control building shall coordinate placement of all required Stormwater lift station power, control and telemetry equipment within, or attached to, the precast concrete control building. Provisions shall be made for all required wall and roof penetrations to accommodate the required conduit including, but no limited to, power to building and pump controls, power and control conduit to / from wetwell, emergency generator receptacle, telemetry conduit, attachment of telemetry antennae, HVAC equipment and conduit, and any and all other required equipment and conduit necessary for a complete operating system. Telemetry system equipment will be furnished and installed by Data Command, Akron Ohio ph#330-294-4477 Attn: Michael Zronek. An allowance of \$4,500 has been included in the bid form for Data Command to furnish and install the telemetry system.

## **2.14 FINISHING CONCRETE**

- A. Interior floor and wall slabs (not required with wall mounted insulation) will have smooth finish painted white with non-slip coating final color approved by the owner.
- B. All exterior building walls and exterior screen walls will have an ashlar stone appearance with the final appearance approved by the owner. The color of the exterior walls, will be grey, but final color shall be chosen by the owner based on samples supplied by the building precaster.
- C. All exterior surfaces of the roof panels will be either simulated metal roof or troweled finish unless otherwise specified. The underside of the overhang will have a smooth finish. The color of the exterior roof shall be chosen by the owner based on samples supplied by the building precaster.

## **2.15 CRACKS AND PATCHING**

- A. Small holes, depressions and rock pockets will be patched with a suitable material. The patch will match the color, finish and texture of the surrounding surface.
- B. Patching will not be allowed on defective areas if the structural integrity of building is affected.
- C. Structural cracks will be determined by the design engineer and an appropriate repair prescribed or the material rejected.

## **2.16 CURING AND HARDENING CONCRETE**

- A. Concrete surfaces will not be allowed to dry out from exposure to hot, dry weather during the initial curing period.
- B. Curing compounds will not be used on interior walls as they will prevent paint adhesion.

## **PART 3 – EXECUTION**

### **3.1 SITE PREPARATION REQUIREMENTS (MANUFACTURER'S RECOMMENDATION)**

- A. EASI-SET® building shall bear fully on a crushed stone base that is at least two feet larger than the length and width of building.
- B. Stone shall be a minimum of 12" thick or down to firm subgrade. The vertical soil capacity under stone shall be compacted to have minimum bearing of 1,500 pounds per square foot. Stone shall be 3/8" or smaller and must be screeded level within 1/4" in both directions. Stone shall be placed within a perimeter form with flat and level top edge for screeding. Forming material shall remain around stone until after the building is set.
- C. The crushed stone base shall be kept within the confines of the soil or perimeter form. Do not allow the base to become unconfined so that it may wash, erode, or otherwise be undermined.
- D. Provide positive drainage for the fill, pad or slab as required.

### **3.2 ACCESS**

- A. Contractor must provide a level, unobstructed area large enough for a crane and a tractor-trailer to park adjacent to the pad. Crane must be able to place outriggers within 5'-0" of edge of pad and truck and crane must be able to get side by side under their own power. No overhead lines may be within 75' radius of center of pad.

**END OF SECTION 131200**



## **SECTION 220529 - HANGERS AND SUPPORTS**

### **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 hangers and supports for mechanical system piping and equipment.
- B. Related sections include the following:
  - 1. Division 5 Section "Metal Fabrications" for materials for attaching hangers for pipe and supports to building structure.

#### **1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

#### **1.5 SUBMITTALS**

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal hanger shield insert indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

- C. Welding Certificates: Copies of certificates for welding procedures and operators.

## **1.6 QUALITY ASSURANCE**

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Code: Section IX, “Welding and Brazing Qualifications.”
- B. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Pipe Hangers:
    - a. AAA Technology and Specialties Co., Inc.
    - b. B-Line Systems, Inc.
    - c. Carpenter & Patterson, Inc.
    - d. Empire Tool & Manufacturing Co., Inc.
    - e. Globe Pipe Hanger Products, Inc.
    - f. Grinnell Corp.
    - g. GS Metals Corp.
    - h. Michigan Hanger Co., Inc.
    - i. National Pipe Hanger Corp.
    - j. PHD Manufacturing, Inc.
    - k. PHS Industries, Inc.
    - l. Piping Technology & Products, Inc.
  - 2. Channel Support System:
    - a. B-Line Systems, Inc.
    - b. Grinnell Corp.; Power-Strut Unit
    - c. GS Metals Corp.
    - d. Michigan Hanger Co., Inc.: O-Strut Div.
    - e. National Pipe Hanger Corp.
    - f. Thomas Betts Corp.
    - g. Unistrut Corp.
    - h. Wesanco, Inc.
  - 3. Powder-Actuated Fastener System:

- a. Gumbo Fastening Corp.
- b. Hilti, Inc.
- c. ITW Ramset/Red Head
- d. Masterset Fastening Systems, Inc.

## **2.2 MANUFACTURED UNITS**

- A. Pipe Hangers, Supports, and components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" article in Part 3 for where to use specific hanger and support types.
  - 1. Galvanized Metallic Coatings: For piping equipment that will not have field-applied finish.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
  - 1. Coatings: Galvanized

## **2.3 MISCELLANEOUS MATERIALS**

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical Anchor Fasteners: Insert type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- D. Grout: ASTM C 1107, Grade B, Factory-mixed and –packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
  - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  - 2. Properties: Non-staining, non-corrosive and non-gaseous.
  - 3. Design Mix: 5000 psi, 28-day compressive strength

## **PART 3 - EXECUTION**

### **3.1 HANGER AND SUPPORT APPLICATION**

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.

- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specifications sections.
- C. Horizontal Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification sections, install the following types:
1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 13.
  2. Yoke Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1.2 to NPS 24, if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8.
  7. Adjustable Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
  9. Adjustable Swivel- Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
  10. Split Pipe-Ring with or without Turnbuckle Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron flange.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron flange and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 382): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 6): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- D. Vertical Piping Clamps: Unless otherwise indicated and except as specified in piping system specification sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system specification sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6" for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 50 450 deg F piping installations.
- F. Building Attachments: Unless otherwise indicated and except as specified in piping system specification sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top Beam C Clamps (MSS Type 19): For use under roof installations with bar joist construction to attach to top flange of structural shape.
  3. Side Beam or Channel Clamps (MSS Type 20): For attaching to bottom of flange of beams, channels, or angles.
  4. Center Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top Beam Clamps (MSS 25): For top beams if hanger rod is required tangent to flange edge.
  8. Side Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked Steel Clamps with Eye Nuts (MS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extension.
  11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.:
  12. Welded Steel Brackets: For support of pipes from below or for suspending from above using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lbs.
    - b. Medium (MSS Type 32): 1,500 lbs.
    - c. Heavy (MSS 33): 3000 lbs.
  13. Side Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where head room is limited.
- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system specification sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high density, 100 psi minimum compressive strength, water –repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360- sheet metal shield.
- H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system specification sections, install the following types:
1. Restraint- Control Devices (MSS Type 46): Where indicated to control piping movement,
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Swing Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
  - a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

### **3.2 HANGER AND SUPPORT INSTALLATION**

- A. Pipe and Hanger Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field channel systems.
  1. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
  1. Pipes of Various Sizes: Support together and space trapezes for smallest size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  2. Field fabricate from ASTM A 36/a 36M, steel shapes selected for loads being supported. Weld steel according to AWS D 1.1.
- D. Install building attachments with concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- E. Install power-actuated drive-pin fasteners in concrete after concrete is placed completely cured. Use operators that are licensed by power actuated tool manufacturer. Install fasteners according to power-actuated tool manufacturer's operating manual.

- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.



- b. NPS 4: 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
  - c. NPS 5 and NPS 6: 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
  - d. NPS 8 to NPS 14: 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
  - e. NPS 16 to NPS 24: 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
- 5. Pipes NPS 8 (DN 200) and Larger: Include wood inserts.
  - 6. Insert Material: Length at least as long as protective shield.
  - 7. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

### **3.3 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make smooth bearing surface.

### **3.4 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedure for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### **3.5 ADJUSTING**

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

### **3.6 PAINTING**

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Division 9 Section "Painting".
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION 220529**

## **SECTION 260500 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES:**

- A. General
- B. Intent of Drawings
- C. Interpretation of Drawings
- D. Quality Control
- E. Submittals
- F. Location Environmental Considerations
- G. Products
- H. Coordination
- I. Demolition
- J. Electrical Installation
- K. Relocate or Make Modifications to Any Existing Electrical, Instrumentation or Control Systems Wiring
- L. Quality Assurance
- M. Examination
- N. Preparation and Storage
- O. Installation
- P. Field Quality Control
- Q. Painting
- R. Cleaning
- S. Operation - Maintenance and Spare Parts Data

#### **1.2 GENERAL**

- A. The Electrical Contractor shall be responsible to check with the equipment manufactures of the physical size of the equipment that it will fit and that it can be

moved into the indicated locations.

- B. Intent of Drawings – The Drawings are not intended to be used for construction purposes for the electrical work, but to supplement the Specifications as to the principal features of the electrical design. The intent of this section is that all equipment and electrical devices furnished and installed under this and other sections of the Specifications be properly interconnected to permit successful system operation regardless of whether all interconnections are specifically referenced in the Specifications and associated Drawings.
- C. Interpretation of Drawings
  - 1. The locations of equipment to which electrical connections are to be made are approximate as shown on the Drawings. It shall be the Electrical Contractor's responsibility to determine the exact conduit locations by reviewing shop drawings. The sizes of disconnect switches, motor starters, overload heaters, fuses or circuit breakers are approximate, and it shall be the Electrical Contractors responsibility to obtain the correct sizes based on the actual installed equipment or items. The conduit and wire sizes shown on the Drawings are the minimum sizes required and shall not be reduced.
- D. Quality Control
  - 1. The Electrical Contractor shall maintain a level of quality of materials and installation means as to assure the completed electrical, instrumentation and control system will be completed in compliance with the Specifications.
- E. Submittals
  - 1. Shop Drawings - Submit shop drawings under provision of Section 01061 for all electrical equipment and devices.
  - 2. Shop drawings shall include manufacturer's literature, specifications, schematic diagrams, field wiring interconnection diagrams and any other data necessary to indicate compliance with the Specifications
  - 3. Final "Record" Contract Drawings - Drawings and information required shall include but not be limited to the following:
    - a. Conduit runs shall be shown and identified at each end of run, include where conduit originates and the termination. Each conduit shall have a pull string attached and fastened at each end.
    - b. Power Distribution Schematics - Show actual installed switching details, cable size and type, conduit size, locations and runs, fuse size and type, circuit breaker frame size, trip setting and type.
    - c. Details and Diagrams:
      - 1.) Elementary Wiring Diagrams – Show actual motor control wiring with wire numbers, telephone system cable routing and station identification with cable numbers.
      - 2.) One Line Diagrams - Show equipment names, fuse sizes and types, heater sizes, conduit and wire sizes, motor FLA and horsepower. Include wire and cable numbers or identification.
      - 3.) Instrumentation and control Diagrams - Show actual installed,

wired instrumentation loop diagrams, include actual installed device Tag Nos, Model Nos, Scaling,

d. Lighting and Device Schedule

- 1.) Show actual manufacturers and model numbers.
- 2.) Lighting panel layouts
- 3.) Actual circuit No. circuit description, breaker size and type.

4. Payment for the Division 16 work and materials shall not exceed 90% of the total bid price until all Operations and Maintenance data and record as built drawings have been completed and received by the Owner.

F. Location Environmental Considerations

1. Provide satisfactory operation and maintenance under the following conditions
2. Temperature:
  - a. Outside: - 20° to 110° F
  - b. Inside: +40° to 120° F
3. Relative Humidity: 100 percent
4. Process Temperature:
  - a. Liquid: 32° to 105° F
  - b. Air: - 32° to 200° F
5. Atmosphere:
  - a. As indicated on the drawings
  - b. Corrosive atmosphere Hydrogen Sulfide
  - c. Wet Locations
    - 1.) As defined in NEC ART. 100.
    - 2.) Outside exposed areas, areas indoors near pumps, frequent washdown areas.
  - d. The interiors of conduits and raceways located in wet areas shall also classified as wet areas.
  - e. Damp Locations
    - 1.) As defined in NEC ART 100
    - 2.) Areas under covered enclosures
  - f. Wet and Corrosive areas
    - 1.) Enclosures located in areas that are wet and corrosive shall be rated for NEMA 4X Stainless Steel or as noted on the drawings.
  - g. Hazardous Areas (Classified)

- 1.) Areas that are a hazardous area are indicated on the drawings. All new equipment and installation methods shall conform to the requirements in the NEC.

#### H. Products

1. Electrical materials and equipment shall be new and shall be labeled by the Underwriters Laboratories, Inc when ever standards have been established and the label service applies.
2. Wire and Terminal Labeling - Tag all wire, cable and conduit at each end or termination with suitable permanent tags, printed, stamped, or engraved with the wire, cable or conduit number. The figures on the tags shall be clear and legible.
3. Safety Signs - High voltage warning signs shall be provided and placed at all guarded locations as required by the N.E.C. The signs shall be permanent and conspicuous, and shall be plainly visible even when doors are open or panels removed from compartments.
4. Engraved Nameplates - Identify all electrical enclosures with engraved phenolic nameplates. Engrave and mount nameplates for all switchgear, disconnect switches, and individual motor starter enclosures indicating equipment served. Nameplates shall be **white with black letters**. Minimum letter size shall be one-quarter inch.

#### I. Demolition

1. Electrical Contractor shall disconnect power from existing equipment to be removed. General Contractor to remove and dispose of actual equipment.
2. Electrical contractor shall perform the demolition of electrical equipment where indicated on the electrical contract drawings.

#### J. Electrical Installation

1. Electrical Contractor shall furnish and install, adjust, connect, and put into satisfactory operation all electrical equipment, control components and instrumentation items as indicated on the Drawings and specified herein.

#### K. Coordination

1. Electrical Contractor shall review all Specifications and Drawings for the electrical work included under these sections and coordinate this work. Investigate existing conditions in the field before submitting proposal. Become acquainted with the conditions under which the work of this section of the Specifications will be performed and accept all conditions as found.
2. Schedule and coordinate all relocations of, or modifications to electrical, instrumentation or control systems wiring, conduit equipment, or appurtenances to whatever extent is necessary and required in order to conform to structural and architectural conditions, duct work and piping interference's, etc., shall be included under this section of the Specifications.
3. Coordinate with other trades on the project so that all trades install their work to avoid interference with each other. Arrangements made among the trades which result in deviations from Drawings and Specifications are subject to the approval of the Owner.

4. The control panels and/or equipment are to be provided by the equipment supplier, General Contractor, and System Integrator. These items will require power and/or interconnections from the disconnect switch to the control panel and/or field mounted devices or junction boxes for power and control. Specific details to be determined by the shop drawings.

### 1.3 REFERENCES

- A. American National Standards Institute (ANSI).
- B. Factory Mutual Engineering Division (FM).
- C. Illumination Engineering Society (IES).
- D. Institute of Electrical & Electronics Engineers (IEEE).
- E. Insulated Cable Engineers Association (ICEA).
- F. Instrumentation, Systems and Automation Society (ISA)
- G. Joint Industrial Council (JIC).
- H. National Electrical Code (NEC).
- I. National Electrical Manufacturers Association (NEMA).
- J. International Electrical Testing Association (NETA).
- K. National Fire Protection Association (NFPA)
- L. Occupational Safety and Health Administration (OSHA)
- M. Ohio Building Code (OBC).
- N. Underwriters' Laboratories Incorporated (UL).
- O. ANSI/NEMA 1-2000 Standard Practices for Good Workmanship in Electrical Contracting.
- P. Quality Assurance
  1. Regulatory requirements
    - a. The Contractor shall obtain and pay for all fees for permits and inspections as required.
  2. Installation Standards
    - a. NEC – installation of electrical items shall be in accordance with the NEC.
    - b. Instrumentation and control – Installation of the instrumentation, control system shall be in accordance with standards of the ISA.

## **PART 2 – PRODUCTS (Not Applicable)**

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Inspect all devices at delivery for damage.
- B. Confirm all devices at delivery are as required according to design and shop drawings.
- C. Examine the site and structures for any obstructions which may interfere with the electrical installation as planned.

### **3.2 PREPARATION AND STORAGE**

- A. Provide a dry heated storage area for all electrical and electronic equipment and devices.
- B. Electrical and electronic equipment devices shall be stored and shall be heated to prevent condensation from forming. Electrical and electronic equipment found with condensation in the enclosure or condensation caused damage will not be accepted.

### **3.3 INSTALLATION**

- A. The locations of equipment to which electrical connections are to be made are approximate as indicated on the Drawings.
- B. It shall be the Contractor's responsibility to check shop drawings relating to equipment requiring electrical connections and to determine the exact conduit locations.
- C. Electrical and electronic equipment installed but not energized shall continue to have a heat source to maintain the enclosure free of condensation. Electrical and electronic equipment found with condensation in the enclosure or condensation caused damage will not be accepted.
- D. Contractor shall perform all chasing, channeling, drilling and patching necessary. Repair any damage to the building or any equipment. Replace damaged equipment if, in the Engineer's judgment, the repair would not be satisfactory.
- E. No work shall be covered or hidden from view until it has been inspected and approved by the Owner.
- F. Any workmanship or materials not meeting the requirements of the Specifications or Drawings shall be immediately replaced by the Contractor without cost to the Owner and to the satisfaction of the Owner.
- G. All wiring shall have permanent labels at all terminations and junctions of the wires and on all field wiring terminal strips.



- H. Safety signs shall be furnished and installed on or around all electrical equipment.
- I. Permanent marking labels shall be installed on exposed sides of each piece of electrical equipment, pull boxes, junction boxes and terminal boxes stating the maximum voltage level involved with the associated equipment.
- J. Concrete equipment pads for electrical equipment shall be furnished and placed by the Electrical Contractor.

### **3.4 PAINTING**

- A. All wood panel mounting boards shall be painted.
- B. All electrical enclosures shall undergo a phosphatizing prepainting treatment. Final paint coats shall be a polyester powder coating with ANSI 61 light gray color for enclosures mounted inside and with ANSI 24 medium gray color for enclosures mounted outside.
- C. Remove any rust and touch up any scratches on all new electrical devices or enclosures with matching touch-up paint as supplied by the manufacturer.

### **3.5 FIELD QUALITY CONTROL**

- A. Major components of the Electrical System shall be tested per NETA standards. NETA's Standard Specification for Testing, Parts 1 to 5, shall govern all testing.
- B. The following tests are per NETA Acceptance Testing Specifications, Part 7, Inspection and Test Procedures. Visual and Mechanical Inspections shall be performed for all equipment.
  - 1. Cables - Low Voltage shall have the following tests: Insulation resistance, continuity.
  - 2. Circuit Breakers - Low Voltage (Molded Case) that are rated at over 100 amps shall have the following tests: Contact resistance, time-current characteristic, instantaneous pickup current, insulation resistance.
  - 3. Grounding Systems shall have the following test: Fall of potential.
  - 4. Surge Arresters shall have the following tests: 60 hz sparkover, insulation power factor, ground continuity.
- C. After all testing has been completed to the satisfaction of the Owner, the entire Electrical (Power) System shall operate for a minimum test period of 30 days. Cumulative down time of all components furnished under Division 16 shall not exceed 1/2 hour as recorded by the Engineer during the test period. System documentation shall be delivered on the last day of test period. Test period shall not end until system documentation has been delivered. If the cumulative downtime limit is exceeded, the Engineer shall have the following options.
  - 1. Extend the test period as required until the cumulative downtime during the

- proceeding 30 days does not exceed 1/2 hour as recorded by the Engineer.
2. Sub-systems which have no components contributing to the cumulative downtime will be approved as a partial acceptance.
- D. Sub-systems which have components that contributed to the cumulative downtime shall have their test period begin after all repairs and adjustments have been made.

### **3.6 OPERATION - MAINTENANCE AND SPARE PARTS DATA**

- A. Submit specific data and information required under individual Division 16 Sections.
1. Submit operation data as required.
  2. Submit maintenance data as required.
  3. Spare Parts Data - Submit as required. Include manufacturer's list of recommended spare parts.
  4. Parts and supplies judged to be necessary to keep equipment and control system operating successfully for first year of operation shall be furnished.
  5. Review individual sections for required lists of spare parts to be furnished.

### **3.7 CLEANING**

- A. All areas are to be cleaned of construction debris and wire. Electrical equipment is to be cleaned of all construction dirt, dust, etc.
- B. All electrical and electronic equipment shall be kept clean and free of all dust, dirt, and debris at all times.
- C. All electrical and electronic boxes and enclosures shall have the covers of these boxes and enclosures closed and sealed except when actually working in these boxes and enclosures.

**END OF SECTION 260500**

## **SECTION 260519 – CONDUCTORS AND CABLES**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Building wire and cable.
- B. Wiring connectors and connections.

#### **1.2 RELATED SECTIONS**

- A. Section 260553 - Electrical Identification.

#### **1.3 REFERENCES**

- A. Quality Control: Follow requirements for references and standards.
- B. NECA Standard of Installation (National Electrical Contractors Association).
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- D. NFPA 70 - National Electrical Code.

#### **1.4 SUBMITTALS FOR REVIEW**

- A. Submittals: Follow procedures for submittals.
- B. Product Data: Provide for each cable assembly type.

#### **1.5 SUBMITTALS AT PROJECT CLOSEOUT**

- A. Contract Closeout Submittals – Follow as required.
- B. Project Record Documents: Record actual locations of components and circuits.

#### **1.6 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

#### **1.7 REGULATORY REQUIREMENTS**

- A. Conform to NFPA 70.

- B. Furnish products listed and classified by Underwriters Laboratories Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose

## **1.8 PROJECT CONDITIONS**

- A. Verify that field measurements are as indicated.
- B. Conductor sizes are based on copper only.
- C. Wire and cable routing indicated is approximate unless dimensioned.

## **1.9 COORDINATION**

- A. Coordinate Work under provisions of Section 260500.
- B. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

## **PART 2 - PRODUCTS**

### **2.1 BUILDING WIRE**

- A. Manufacturers:
  - 1. Okonite Company.
  - 2. Alpha Wire Company.
  - 3. Southwire
  - 4. Substitutions: Follow as required for Material and Equipment.
- B. Description: Multi-stranded insulated copper wire, #12 AWG minimum for feeders and branch circuits and #14 AWG minimum for control circuits.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: NFPA 70; Type XHHW or THWN insulation for service, feeders and branch circuits and control circuits.

### **2.2 WIRING CONNECTORS**

- A. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
- B. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller. Buchanan crimp (Split cap and insulator) or Ideal crimp connector with wrap cap insulator.
- C. Use Adhesive-lined heat shrink tubing for watertight connections; T & B, 3M, or Raychem.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that mechanical work likely to damage wire and cable has been completed.

### **3.2 PREPARATION**

- A. Completely and thoroughly swab raceway before installing wire.

### **3.3 INSTALLATION**

- A. Quality Control: Follow as required by manufacturer's instructions.
- B. Route wire and cable as required to meet Project Conditions.
- C. Install cable in accordance with the NECA "Standard of Installation."
- D. Use stranded conductors for control circuits.
- E. Use conductor not smaller than 12 AWG for power and lighting circuits.
- F. Use conductor not smaller than 14 AWG for control circuits.
- G. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (25 m).
- H. Pull all conductors into raceway at same time.
- I. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- J. Protect exposed cable from damage.
- K. Use suitable cable fittings and connectors.
- L. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- M. Clean conductor surfaces before installing lugs and connectors.
- N. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- O. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape un-insulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- P. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- Q. Use insulated spring wire connectors with plastic caps for copper conductor splices

and taps, 10 AWG and smaller.

- R. Identify and color code wire and cable under provisions of Section 16075. Identify each conductor with its circuit number or other designation indicated.
- S. Replace conductors damaged during installation.
- T. No splices are allowed in conduits or raceways.

### **3.4 FIELD QUALITY CONTROL**

- A. Starting of Systems: Follow requirements for field inspection, testing, and adjusting.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

**END OF SECTION 260519**

## **SECTION 260526 - GROUNDING AND BONDING**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.

#### **1.2 RELATED SECTIONS**

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

#### **1.3 REFERENCES**

- A. ANSI/NFPA 70 - National Electrical Code.

#### **1.4 GROUNDING SYSTEM DESCRIPTION**

- A. The system shall consist of a series of driven ground rod electrodes interconnected with bare stranded ground conductor.
- B. All building footer and slab rebar greater than 1/2" shall be bonded to the ground conductor. Bond at 20 ft intervals and at each corner. IAW NEC. Connections to rebar may be made with suitable sized ground clamps.
- C. All connections shall be by exothermic welds (Cadweld or equal) installed according to the manufacturer's instructions.
- D. Tests shall be performed to determine the grounding grid resistance to ground. The test method shall be as described in NETA Standard ATS-1987, "Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems." A three-point fall-of-potential test shall be used using two auxiliary electrodes for the measurement. Test reports shall be provided describing the testing procedure and results. The grid-to-ground resistance shall be no greater than 5 ohms. If necessary, additional rods shall be added to achieve the 5-ohm ground. When the Contractor has obtained satisfactory results, he shall submit test reports to the Engineer for approval. After approval, the contractor shall bond the service entrance ground grid to the service entrance enclosure ground bus. The Owner or Owner's representative shall have the opportunity to inspect all exothermic welds.
- E. All ground cables shall have a minimum of 24" of ground cover.

## **1.5 PERFORMANCE REQUIREMENTS**

- A. Grounding System Resistance: 5 ohms maximum.

## **1.6 SUBMITTALS**

- A. Product Data: Provide for grounding electrodes and connections.
- B. Test Reports: Indicate overall resistance to ground (and resistance of each electrode).
- C. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

## **1.7 PROJECT RECORD DOCUMENTS**

- A. Submit under provisions of Section 260500.
- B. Accurately record actual locations of grounding electrodes.

## **1.8 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc.

## **PART 2 - PRODUCTS**

### **2.1 ROD ELECTRODE**

- A. Manufacturers:
  - 1. ITT Blackburn Co.
  - 2. Copperweld, Bimetallic.
  - 3. American Electric - Blackburn.
- B. Material: Copper-clad steel.
- C. Diameter: 3/4 inch.
- D. Length: 10 feet.

### **2.2 MECHANICAL CONNECTORS**

- A. Manufacturers:
  - 1. Burndy Corp.



2. O-Z/Gedney.

- B. Material: Bronze.

### **2.3 EXOTHERMIC CONNECTIONS**

- A. Manufacturers:

1. Cadweld.

### **2.4 WIRE**

- A. Material: Stranded copper.
- B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.

### **3.2 INSTALLATION**

- A. Install Products in accordance with manufacturer's instructions.
- B. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground spaced at minimum 10 FT.
- C. Provide bonding to meet Regulatory Requirements.
- D. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

### **3.3 FIELD QUALITY CONTROL**

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

## **END OF SECTION 260526**

## **SECTION 260529 - SUPPORTING DEVICES**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Conduit and equipment supports.
- B. Anchors and fasteners.
- C. Concrete equipment supports

#### **1.2 REFERENCES**

- A. NECA - National Electrical Contractors Association.
- B. ANSI/NFPA 70 - National Electrical Code.

#### **1.3 SUBMITTALS**

- A. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

#### **1.4 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

### **PART 2 - PRODUCTS**

#### **2.1 PRODUCT REQUIREMENTS**

- A. Materials and Finishes: Provide adequate corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Anchors and Fasteners:
  - 1. Concrete block walls: Use expansion anchors.

2. Steel Structural Elements: Use welded fasteners.
3. Concrete Surfaces: Use expansion anchors.

## **2.2 CHANNEL SYSTEMS**

### **A. Manufacturer:**

1. Unistrut, B-Line, Allied Power -Strut.
2. or Equal

### **B. Description:**

1. Galvanized steel. - General locations
2. Aluminum- Wet, damp areas
3. Stainless steel - Wet, damp corrosive areas where compatible with chemicals
4. Fiberglass - Wet, damp, corrosive areas where compatible with chemicals

### **C. Size: 1-5/8" x 1-5/8"**

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- C. Do not fasten supports to pipes and conduit except as shown on Drawings.
- D. Obtain permission from Engineer before drilling or cutting structural members.
- E. Fabricate supports from structural steel, galvanized steel, aluminum or stainless steel channel. Rigidly weld members or use stainless steel hex head bolts and hardware to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- F. Install surface-mounted cabinets and panel boards with minimum of four anchors.
- H. In wet and damp locations use stainless steel or aluminum channel supports with stainless steel fasteners.
- I. In wet and damp locations use stainless steel or aluminum spacers to stand cabinets and panel boards one inch off wall.
- J. Spray coat cut end of galvanized steel channel or rigid steel conduit with spray cold galvanizing.

- K. Galvanized pipe used as equipment supports are to have the open ends capped with galvanized end caps.
- L. Provide concrete equipment pad, housekeeping pads, for all equipment that will be floor mounted. Pads to be formed, chamfer edges, and have a troweled finish. Concrete shall be smoothed around conduits. Equipment panels shall be anchored using concrete anchors. Equipment pads for outdoor mounted panels shall extend from the front of the equipment panel 3'-6" min. to allow for opening and standing.

**END OF SECTION 260529**

## **SECTION 260530 – ELECTRICAL DUCT BANK**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. PVC conduit.
- B. Pull Boxes/Handhole Enclosures

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Duct bank:
  - 1. Basis of Payment: Includes purchase, delivery, and installation of duct, fittings, supports, accessories, trenching, aggregate bedding or concrete encasement (where required), and backfill.
- B. Pull Boxes/Handhole Enclosures
  - 1. Basis of Payment: Includes purchase, delivery, and installation of pull box.

#### **1.4 REFERENCES**

- A. Quality Control: Follow requirements for references and standards.
- B. ASTM C857 - Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
- C. ASTM C858 - Underground Precast Concrete Utility Structures.
- D. STM C891 - Installation of Underground Precast Utility Structures.
- E. ASTM C1037 - Inspection of Underground Precast Utility Structures.
- F. IEEE C2 - National Electrical Safety Code.
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- H. NEMA TC 2 and TC3 - Schedule 40 PVC Conduit and PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- I. NFPA 70 - National Electrical Code.
- J. UL 651A - Type EB and A PVC Conduit and HDPE Conduit.

- K. ANSI/SCTE 77-2007 Specifications for Underground Enclosure Integrity.

## **1.5 SUBMITTALS FOR REVIEW**

- A. Submittals: Follow procedures for submittals.
- B. Product Data: Provide for manhole accessories.
- C. Shop Drawings: Indicate dimensions, reinforcement, size and locations of openings, and accessory locations for precast manholes.

## **1.6 SUBMITTALS FOR INFORMATION**

- A. Follow requirements for submittals in general project requirements.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

## **1.7 SUBMITTALS FOR CLOSEOUT**

- A. Project Record Documents: Record actual routing and elevations of underground conduit and duct, and locations and sizes of manholes.

## **1.8 REGULATORY REQUIREMENTS**

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

## **1.9 FIELD SAMPLES**

- A. Provide as required.

## **1.10 FIELD MEASUREMENTS**

- A. Verify that field measurements are as indicated.
- B. Verify routing and termination locations of duct bank prior to excavation for rough-in.
- C. Duct bank routing is shown in approximate locations unless dimensions are indicated. Route as required to complete duct system.
- D. Pull box locations and quantity are shown in approximate locations. Locate as required to complete duct bank system.

## **PART 2 - PRODUCTS**

### **2.1 PLASTIC CONDUIT**

- A. Rigid Plastic Conduit: NEMA TC 2, Schedule 40 PVC, with fittings and conduit bodies to NEMA TC 3.
- B. Rigid Plastic Underground Conduit: UL 651A, Type A PVC.

### **2.2 DUCT BANK PULL BOXES**

- A. Description: Pull boxes shall be as manufactured by Quazite.
- B. Load capacity of box to be as indicated on drawings or as indicated in ANSI SCTE-77-2007.
- C. Provide all necessary items for a complete installation.
- D. Pull boxes shown are approximate sizes. Size pull boxes as required for proper installation.
- E. Enclosure with Walls 48" or Shorter
  - 1. Enclosures, boxes and cover are required to conform to all test provisions of ANSI/SCTE 77 "Specifications for Underground Enclosure Integrity" for Tier as shown on Drawings. When multiple Tiers are specified, the boxes must physically accommodate and structurally support compatible covers while possessing the highest Tier rating. In no assembly can the cover design load exceed the design load of the box. All components in an assembly (box & cover) are manufactured using matched surface tooling. All covers are required to have a minimum coefficient of friction of 0.05 in accordance with ASTM C1028 and the corresponding Tier level embossed on the top surface. Independent third party verification or test reports stamped by a registered Professional Engineer certifying that all test provisions of this specification have been met are required with each submittal.

### **2.3 ACCESSORIES**

- A. Underground Warning Tape: 4-inch wide plastic tape, metal-backed, colored red or yellow with suitable warning legend describing buried electrical lines.
- B. Underground conduit PVC support chairs

## **PART 3 - EXECUTION**

### **3.1 DUCT BANK INSTALLATION**

- A. Quality Control: Follow requirements in manufacturer's instructions.
- B. Install duct to locate top of duct bank at depths as indicated on drawings.
- C. Install duct with minimum slope of 4 inches per 100 feet. Slope duct away from building entrances.
- D. Cut duct square using saw or pipe cutter; de-burr cut ends.
- E. Insert duct to shoulder of fittings; fasten securely.
- F. Join nonmetallic duct using adhesive as recommended by manufacturer.
- G. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- H. Install no more than equivalent of three 90-degree bends between pull points.
- I. Use suitable separators and chairs installed not greater than 4 feet on centers.
- J. Conduit spacing shall be 12" minimum from 480/277 volt conduits to mA/communication signal conduits and 6" minimum from 120/240 volt conduits and mA/communication signal conduits.
- K. Provide suitable pull string in each empty duct.
- L. Swab duct with wire brush and mandrel. Use suitable caps to protect installed duct against entrance of dirt and moisture.
- M. Backfill as required in Backfill Section. Aggregate bedding shall be placed and tamped in layers. Bedding shall be placed in trench bottom prior to installation of the bottom ducts.
- N. Concrete encasement required where indicated. Ensure that concrete totally encases conduits in duct bank to eliminate any voids.
- P. Interface installation of underground warning tape with backfilling as required in Backfill Section. Install tape 6 inches below finished surface.
- Q. Install a vertical two-foot length of #8 rebar to extend to 6" below finish grade at each duct bank intersection, bend and at 100 ft intervals of straight duct bank run for locating the duct bank



### **3.3 PULL BOXES/HANDHOLE ENCLOSURES**

- A. Quality Control: Follow requirements in manufacturer's instructions.
- B. Excavate for manhole installation under the provisions of Excavation Section.
- C. Excavate hole approximately 8" deeper than the depth of the pull box at finished grade and approximately 8" larger than the box. Provide minimum of 6 – 8 inches of gravel in the excavation bottom. Compact gravel to minimize settling.
- D. Set box on compacted gravel and backfill to finished grade.
- E. Install in accordance with NEC 314.30.

**END OF SECTION 260530**

## **SECTION 260533 - CONDUIT**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Metal conduit.
  - 1. Rigid Galvanized Steel
  - 2. Aluminum
- B. PVC coated rigid galvanized steel.
- C. Nonmetallic conduit.
- D. Flexible metal conduit.
- E. Liquid-tight flexible metal conduit.
- F. Fittings and conduit bodies.

#### **1.2 RELATED SECTIONS**

- A. Section 260529 - Supporting Devices.
- B. Section 260553 - Electrical Identification.
- C. Sections 260534- Boxes.

#### **1.3 REFERENCES**

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ANSI C80.5 - Rigid Aluminum Conduit
- C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- D. ANSI/NFPA 70 - National Electrical Code.
- E. NECA "Standard of Installation."
- F. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- G. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

#### **1.4 DESIGN REQUIREMENTS**

- A. Conduit Size: ANSI/NFPA 70.

#### **1.5 SUBMITTALS**

- A. Submit under provisions of Section 012333.
- B. Product Data: Provide for metallic conduit, flexible metal conduit, liquid-tight flexible metal conduit, nonmetallic conduit, flexible nonmetallic conduit, fittings, conduit bodies of each type planned to be used.

## **1.6 PROJECT RECORD DOCUMENTS**

- A. Submit under provisions of project general requirements.
- B. Accurately record actual routing of all conduits exposed and concealed on record drawings.

## **1.7 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect, and handle Products to site under provisions of Section 016600.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

## **1.9 PROJECT CONDITIONS**

- A. Verify routing and termination locations of conduit prior to rough-in.
- B. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

## **PART 2 - PRODUCTS**

### **2.1 CONDUIT REQUIREMENTS**

- A. Minimum Size: 3/4 inch unless otherwise specified.
- B. Underground Installations:
  - 1. More than two feet from Foundation Wall: Use schedule 40 PVC conduit.
  - 2. Within two feet from Foundation Wall: Use plastic coated galv. rigid conduit.
  - 3. In or Under Slab on Grade: Use schedule 40 PVC conduit.
  - 4. When changing from underground to above ground, use PVC coated galv.

- rigid conduit to approximately two feet above finished grade.
5. Conduits passing through poured concrete sidewalks, floating type slabs on grade shall be sleeved.
- C. Outdoor Locations, Above Grade: Use rigid galvanized steel conduit.
- D. In Slab Above Grade:
1. Use schedule 40 PVC.
  2. Maximum Size Conduit in Slab: 3/4" for conduits crossing each other.
- E. Continuously Wet and Damp Locations: Use aluminum or PVC coated rigid steel conduit.
- F. Corrosive Location: Use PVC coated rigid steel or schedule 40 PVC.
- G. Dry Locations:
1. Concealed in framed wall or above suspended ceilings: Use steel electrical metallic tubing or schedule 40 PVC conduit.
  2. Exposed: Use rigid galvanized steel or aluminum conduit or as noted on drawings.
  3. Flexible metal conduit can be used for equipment connections. Max length of 3 feet.
- H. Classified hazardous Class 1, Division 1 areas & Screen Rooms: PVC coated rigid steel conduit and explosion-proof flexible equipment connections.
- I. Equipment Connections:
1. Use liquid-tight flexible metal conduit.
  2. In corrosive or chemical rooms, use non-metallic flexible conduit and fittings.
- J. Flexible Conduits shall be limited to three feet or less.

## **2.2 METAL CONDUIT**

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1 all steel fittings.

## **2.3 PVC COATED METAL CONDUIT**

- A. Manufacturers:
1. Robroy Industries "Plasti-Bond."
  2. Thomas –Betts – "OCAL Blue".

- B. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mils thick.
- C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel fittings with external PVC coating to match conduit.

## **2.4 FLEXIBLE METAL CONDUIT**

- A. Description: Interlocked aluminum construction.
- B. Fittings: ANSI/NEMA FB 1.

## **2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT**

- A. Manufacturers:
  - 1. Sealtight VA Anaconda Metal Hose Div.
  - 2. Liquidtight type L.A. Electric Flex Co.
- B. Description: Interlocked aluminum construction with PVC jacket.
- C. Fittings: ANSI/NEMA FB 1.

## **2.6 NONMETALLIC CONDUIT**

- A. Manufacturers:
  - 1. Carlon Electrical Products Div.
  - 2. LCP.
  - 3. Quil.
- B. Description: NEMA TC 2; Schedule 40 PVC.
- C. Fittings and Conduit Bodies: NEMA TC 3.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Install conduit in accordance with NECA "Standard of Installation."
- B. Install nonmetallic conduit in accordance with manufacturer's instructions.
- C. Arrange supports to prevent misalignment during wiring installation.
- D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers,

clevis hangers, and split hangers.

- E. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- F. Fasten conduit supports to building structure and surfaces under provisions of Section 260529.
- G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports
- H. Do not attach conduit to ceiling support wires.
- I. Arrange conduit to maintain headroom and present neat appearance.
- J. Route exposed conduit parallel and perpendicular to walls.
- K. Route conduit in and under slab from point-to-point.
- L. Do not cross conduits in slab unless  $\frac{3}{4}$ " conduits.
- M. Maintain adequate clearance between conduit and piping.
- N. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
- O. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- P. Bring conduit to shoulder of fittings; fasten securely.
- Q. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- R. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- S. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2-inch size.
- T. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- U. Provide suitable fittings to accommodate expansion and deflection where conduit crosses, control and expansion joints.
- V. Conduits shall be sloped in such a manner that water may drain to the closest pull

box if possible.

- W. Provide suitable pull string in each empty conduit except sleeves and nipples.
- X. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- Y. Ground and bond conduit under provisions of Section 260526.
- Z. Identify conduit under provisions of Section 260553.
- ZA. Flexible conduit, non-metallic, liquid-tight and metallic, shall not be used in length longer than 6 feet unless specifically approved. Flexible conduit is not to be used in place of neatly run rigid conduit.
- ZB. Where called out on plans provide cable terminators / sealing bushings, CRC by O-Z/Gedney or approved equal. Verify specific cable outside diameters and follow manufacturer's installation requirements.

**END OF SECTION 260533**

## **SECTION 260534 - PULL, JUNCTION BOXES AND ENCLOSURES**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Pull Boxes
- B. Junction Boxes
- C. Accessories

#### **1.2 RELATED SECTIONS**

- A. Section 260529 - Supporting Devices.

#### **1.3 REFERENCES**

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
- C. ANSI/NFPA 70 - National Electrical Code.

#### **1.4 SUBMITTALS**

- A. Submit under provisions of general project requirements and Section 260500.
- B. Product Data: Provide manufacturer's standard data for boxes and enclosures.
- C. Junction box locations and details
  - 1. Terminal block layout
  - 2. Grounding

#### **1.5 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.



## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Hoffman.
- B. Rittal.
- C. Or Equal

### **2.2 PULL BOXES**

- A. Construction:
  - 1. Outdoors, Wet Damp areas, Corrosive areas. NEMA Type 4/4X, sunlight resistant fiberglass, polycarbonate or SS as specified on Drawings, enclosure with continuous hinge covers.
    - a. Covers: Continuous SS hinge, held closed by SS screws
  - 2. Indoors exposed NEMA 12, 13 or as specified on Drawings.
  - 3. Indoors flush wall mounted NEMA 1 w/ flush covers
  - 4. Indoors concealed NEMA 1 w/ screw cover
  - 5. Indoor wet and damp NEMA 4XSS
  - 6. Indoor corrosive areas NEMA 4XSS or compatible with chemical
  - 7. Hazardous locations NEMA 7

### **2.3 TERMINAL HINGED COVER ENCLOSURES**

- A. Construction:
  - 1. Outdoor, Wet Damp areas, Corrosive areas. NEMA 4/4X, sunlight resistant fiberglass or polycarbonate or SS as specified on Drawings, Type 4/4X enclosure with continuous hinge cover.
    - a. Covers: Continuous SS hinge, held closed by flush latch operable by screwdriver.
  - 2. Indoors exposed NEMA 12, 13
  - 3. Indoors flush wall mounted NEMA 1 w/ flush covers
  - 4. Indoors concealed NEMA 1 w/ screw cover
  - 5. Indoor wet and damp NEMA 4XSS
  - 6. Indoor corrosive areas NEMA 4XSS or compatible with chemical
  - 7. Hazardous locations NEMA 7
- B. Provide white enamel interior metal panel for mounting terminal blocks and electrical components.

## **2.4 CABINETS**

- A. Provide metal barriers to form separate compartments containing control wiring at less than 50 volts from power wiring.
- B. Provide accessory feet for free-standing equipment.

## **2.5 TERMINAL BLOCKS**

- A. Manufacturers:
  - 1. Weidmuller SAK 6, SAK 2.5, ASK 1.
  - 2. Allen-Bradley
  - 3. Sq. D
  - 4. Or equal
- B. Terminal Blocks: ANSI/NEMA ICS 4.
- C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts. Ground terminal shall be green.
- E. Provide ground bus terminal block, with each connector bonded to enclosure.
- F. Provide a typed legend of cables and terminal numbers with origin and destination.
- G. Boxes where water may drain from the attached conduits shall have drains installed in the bottom or the lowest point of the box. Conduit penetration at such boxes shall be located along the sides or top of the box. Conduits shall not be installed in a manner that water can enter attached pull conduits.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install Products in accordance with manufacturer's instructions.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
- C. Do not attach boxes directly to masonry, concrete, or brick walls but provide a ¼ inch spacer of PVC, nylon, or stainless steel.
- D. Install enclosures and boxes using stainless steel fasteners.

- E. Provide supports where required when no wall or other adequate support is available.

**END OF SECTION 260534**

## **SECTION 260553 - ELECTRICAL IDENTIFICATION**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.

#### **1.2 REFERENCES**

- A. NFPA 70 - National Electrical Code.

#### **1.3 SUBMITTALS**

- A. Submit under provisions of Section 260500.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.

#### **1.4 REGULATORY REQUIREMENTS**

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc.

### **PART 2 - PRODUCTS**

#### **2.1 NAMEPLATES AND LABELS**

- A. Nameplates:
  - 1. Equipment Identification: Engraved three-layer laminated plastic, black letters on white background.
  - 2. Emergency Powered Equipment: Engraved three-layer laminated plastic, black letters on red background. As required by NEC
  - 3. Equipment power source identification: Engraved three-layer laminated plastic, black letters on yellow background.
- B. Locations:
  - 1. Each electrical distribution and control equipment enclosure.
  - 2. Junction box.
- C. Letter Size:

1. Use 1/8 inch letters for identifying individual equipment and loads.
  2. Use 1/4 inch letters for identifying grouped equipment and loads.
- D. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles, and control device stations.

## **2.2 WIRE MARKERS**

- A. Manufacturers:
1. T & B Shrink-Kon HVM wire markers.
  2. Panduit - Pan Code HSDL.
  3. Brady.
- B. Description: Tubing type wire markers.
- C. Locations: Each conductor at panelboard gutters, outlet and junction boxes, terminal strip and each load connection.
- D. Legend:
1. Power and Lighting Circuits: Branch circuit or feeder number indicated on Drawings.
  2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings or on shop drawings.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Degrease and clean surfaces to receive nameplates and labels.

### **3.2 APPLICATION**

- A. Install nameplate parallel to equipment lines.
- B. Secure nameplate to equipment front using stainless steel screws, rivets, or adhesive.
- C. Identify underground conduits using foil backed underground warning tape. Install one tape per trench at 6 inches below finished grade.

**END OF SECTION 260553**

## **SECTION 262419 - MOTOR CONTROL CENTERS**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install motor control centers.

B. Coordination:

1. Obtain motor nameplate data on existing equipment or new equipment being furnished for properly sizing circuit breakers, starters and overloads.
2. Obtain data on motor space heater and other accessories for properly sizing control power transformers.

C. Related Sections:

1. Section 260553, Electrical Identification.
2. Section 264313, Surge Protection Device

#### **1.2 REFERENCES**

A. Standards referenced in this Section are:

1. NEMA ICS 18-2001, Motor Control Centers.
2. International Electrical Testing Association, (NETA) Acceptance Testing Specification.
3. UL 845, Motor Control Centers.
4. ANSI C37.2, Standard Electrical Power System Device Function Numbers.

#### **1.3 QUALITY ASSURANCE**

A. Regulatory Requirements

1. NEC Article 430, Motors, Motor Circuits, and Controllers.

B. Field Quality Control: Field acceptance testing of motor control centers will be manufacturer service tests.

C. Test Equipment, Calibration and Reporting: All test equipment, instrument calibration and test reports shall be in accordance with latest edition of NETA Acceptance Testing Specifications.

## **1.4 SUBMITTALS**

### **A. Shop Drawings: Submit the following:**

1. Product Data: Manufacturer specifications, cut sheets, dimensions, and technical data for all components, materials, and equipment proposed.
2. Outline and summary sheets with schedules of equipment in each unit.
3. One-line diagrams indicating circuit breaker sizes, bus rating, motor controller ratings, and other pertinent information to demonstrate compliance with the Contract Documents.
4. Unit control schematic and elementary wiring diagrams showing numbered terminal points and interconnections to other units.

### **B. Test Plans and Reports: Thirty days in advance of actual factory and field testing, submit proposed testing methods, procedures, and apparatus. Submit reports of completed factory and field testing, including procedures and test results.**

### **C. Operation and Maintenance Data:**

1. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation, and spare parts information.
2. Manuals shall include record drawings of control schematics, including point-to-point wiring diagrams.
3. Furnish operation and maintenance manuals per Section 01781, Operation and Maintenance Data.

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

### **A. Delivery:**

1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
2. Shipping containers shall be designed to be shipped by truck, rail, or ship. Indoor containers shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.
3. Inspect motor control centers for shipping damage or loose parts upon delivery. Check for evidence of water that may have entered equipment during transit.

### **B. Handling:**

1. Lift, roll or jack motor control center equipment into locations shown.
2. Motor control centers shall be equipped to be handled by crane. Where cranes are not available equipment shall be suitable for placement on rollers using jacks to raise and lower the groups.

### **C. Storage:**

1. Store motor control center equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.

## 1.6 MAINTENANCE

### A. Spare Parts:

1. Furnish, tag, and box for shipment and long term storage the following spare parts and special tools for each motor control center lineup:

<b>Item</b>	<b>Quantity per Switchgear Lineup</b>
a. Starters and feeder breakers	Quantities and sizes as shown
b. Fuses	Six of each type and size used
c. Auxiliary control relays	Two, with at least two normally open and two normally closed contacts
d. Control power transformers	Two of each size used
e. Indicating lamps	Twelve
f. Covers for indicating lamps	Six of each color used
g. Starters: Contact kits for Size 1 motor starter	Five sets
h. Starters: Contact kits for Size 2, Size 3, and Size 4 motor starters	One set of each size

- B. Furnish a list of additional recommended spare parts for an operating period of one year. Describe each part, the quantity recommended and current unit price.
  1. Package spare parts in suitable containers bearing labels clearly indicating the contents and equipment with which they are to be used. Deliver spare parts at the same time as the motor control centers.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Provide products of one of the following:

1. Square D Company.
2. Eaton.
3. Or equal.

### 2.2 MATERIALS

- A. General: Motor Control Center lineups shall be provided as shown with the following ratings:
  1. Service: Voltage rating and number of wires shall be as shown on Drawings. Motor control center shall operate from a three-phase, 60 Hertz system.
  2. Wiring: NEMA Class II, Type B.
  3. Enclosure: NEMA 1.



4. Interrupting Capacity Rating: Motor control center shall have an interrupting capacity rating above available fault current, as noted on the drawings. Devices shall be suitable for minimum rating noted.
5. Motor Control Center lineups shall be UL rated as suitable for service entrance where shown on Drawings and as required.

B. Construction:

1. Totally enclosed structure, dead front, consisting of nominal 20-inch deep, 20-inch wide, 90-inch high vertical sections bolted together to form a unit assembly.
2. Vertical sections shall have side sheets extending the full height and depth of section.
3. Removable lifting angles for each shipping section.
4. Two removable floor sills for mounting.
5. Horizontal wireways top and bottom, isolated from horizontal bus and readily accessible.
  - a. Wireway openings between sections shall have rounded corners and rolled edges.
6. Isolated vertical wireways with cable supports, accessible through hinged doors, for each vertical section.
  - a. Wireway shall be separate from each compartment and remain intact when compartment is removed.
7. All metal non conducting parts electrically continuous.

C. Bus System:

1. Rating: Bus bracing and bus current capacities above available fault current, as noted on drawings.
2. All bus bars tin plated copper rated UL heat rise standards.
3. Bus bar connections easily accessible with simple tools.
4. Main Horizontal Bus:
  - a. Continuous edge mounted, and isolated from wireways and working areas.
  - b. Bus shall be mounted in vertical center of motor control center to provide easy access and even heat distribution.
  - c. Bus shall be supported, braced, and isolated by a high strength, non-tracking, glass-filled polyester material.
5. Vertical Bus:
  - a. Continuous, and isolated by a glass polyester barrier.
  - b. Rated for 300 amperes continuous minimum, and at least equal to the full load rating of all installed units in the associated stack.
6. Grounding Bus: Full length mounted across the bottom, drilled with lugs of appropriate capacity as required.

**D. Unit Compartments:**

1. Provide individual front door for each unit compartment. Door shall be fastened to stationary structure, not the unit itself, so that door can be closed when unit is removed.
2. Starter and feeder unit doors interlocked mechanically with unit disconnect device to prevent unintentional opening of door while energized and unintentional application of power while door is open, with provisions for releasing interlock for intentional access and application of power.
3. Padlocking arrangement permitting locking disconnect device in the “OFF” position with at least three padlocks with door closed or open.
4. Compartments shall be equipped as indicated on the Drawings:
  - a. Blank compartments, unused space, and compartments shown on Drawings as “SPACE” shall have bus covers and be complete with all necessary hardware for future installation of a plug-in unit.
  - b. Provide shutters for each compartment that automatically open when unit is inserted and automatically close when unit is removed.
5. Provide wiring and device identification:
  - a. Identify compartment doors, devices, and field wiring in accordance with Section 16075, Electrical Identification.
  - b. Identify all internal control conductors with permanent type wire markers. Each wire shall be identified by a unique number attached to wire at each termination point.
  - c. Identify all internal control devices with permanent type markers. Each device shall be identified by a unique number attached to each device.
  - d. Numbering system for each wire and control device shall be identified on the wiring diagrams and shall reflect the actual designations used in the Work.
6. NEMA 1 minimum motor starter size. Starter units completely draw out type in Sizes 1 and 2 and draw out type after disconnecting power leads only in Sizes 3 and 4.
7. Motor starters shall be NEMA rated and include a magnetic contactor, with encapsulated magnet coils. Wound coils are unacceptable. All control shall be 120 volts AC unless noted otherwise.
  - a. Starters shall be full voltage non-reversing unless shown otherwise on Drawings.
  - b. Reduced Voltage Solid-State Starter:
    - 1) General:
      - a) Provide solid-state, step-less, current limiting, soft-start, motor controllers (RVSS) as shown on Drawings.
      - b) RVSS shall include an overload relay and an isolation contactor.
      - c) Provide subsystems that will protect RVSS from damage due to over-current and over-voltage.
      - d) Current Rating: 115 percent of motor nameplate rated current, continuous, minimum.

## 2) Required Features:

- a) Adjustable current limit of not more than 250 percent of motor nameplate full load current throughout entire motor acceleration period including first three cycles of voltage waveform from instant start signal is engaged.
- b) Adjustable voltage acceleration, from 2 to 30 seconds.
- c) Adjustable voltage deceleration, from 2 to 30 seconds.
- d) Phase loss detection.
- e) LED diagnostic indicators.
- f) Static over-current and over-voltage trip.
- g) Phase reversal, line or fuse loss, and under-voltage protection.
- h) Power unit over temperature protection.
- i) Motor inverse time overload protection.
- j) Input line transient over-voltage protection.

## 3) Enclosure:

- a) Cooling fans, if required, shall incorporate anti-friction bearings and internal impedance type motor protection.
- b) If cooling fans are used, the enclosure for that section shall be NEMA 12 FVF, or NEMA 12 EFVFF force ventilated with filters, per NEMA Standard ICS1-110, installed by motor control center manufacturer.

- 4) On start-up, start driven equipment at zero current and allow driven equipment to accelerate to maximum speed without exceeding the set current limit.
- 5) On normal shutdowns, ramp driven equipment down at set deceleration rate that is non-regenerative for motor prior to shutdown.
- 6) On emergency shutdowns, remove power to motor.
- 7) Diagnostic LEDs: Provide LEDs on unit front that indicate the following:

- a) Control power on.
- b) Motor power on.
- c) Motor starting.
- d) Motor fault.
- e) RVSS fault.

## 8) Control Outputs:

- a) Control output shall be electrically isolated, dry, normally open SPDT contacts, rated 10 amps at 120 volts AC.
- b) Provide the following control outputs:
  - (1) Motor running.
  - (2) Motor fault.
  - (3) RVSS fault.

- 8. Overload Relays: Provide an overload relay for each motor starter. Overload relays shall be in accordance with the following:

- a. Electronic Overload Relays: Relays shall be electronic type. Electronic relays shall be multi-function, adjustable, current sensing type and include overload, phase-unbalance, phase-loss, and equipment type ground fault in one package.
  - b. Each overload relay shall be manual reset type and shall include provisions for resetting by an insulating button on front of starter unit door.
  - c. Each overload relay shall include a normally open auxiliary contact for remote alarm purposes.
  - d. Each overload relay shall be sized for full-load amperes and service factor of actual motors installed.
9. Individual control power transformers for all starters capacity as required for all control circuit devices, 100 VA minimum, Class A insulation, two primary fuses, 120 volt secondary, one secondary fuse, and the other secondary leg grounded.
10. Separate Control: Where control power to starter is provided by a separate power source, a control power fuse shall be provided in unit and main disconnect shall be equipped with a normally open contact to isolate control circuit from source when controller disconnect is open.
11. Motor horsepower shown are per existing available documentation and shall be verified in field by Electrical Contractor to insure proper construction of new control units. Circuit breaker trips and starter overload heaters to be coordinated with the actual equipment installed.
12. Auxiliary contacts, relays, timers as required for specified control functions shall be verified in field by the Electrical Contractor's review of the existing starter units to insure new starter units construction offer the same operation of equipment.
13. Current Sensing Devices:
  - a. Current Switch:
    - 1) Produces a dry contact output when load current exceeds set point.
    - 2) Suitable for use measuring current on motor leads of 480-volt, 60 Hertz., up to 150-amp continuous.
    - 3) Variable trip point and time delay. Trip point settable via calibrated dial.
    - 4) Monitors currents from 10 mA to 150 AC Amps
    - 5) Output relay (Form C) rated up to 20 amps
    - 6) LED trip status indicator
    - 7) Dead band prevents relay chatter
    - 8) Contact Material: Silver-cadmium oxide
    - 9) Mechanical Life: 10 million operations, typical at rated load
    - 10) Electrical Life: 100,000 operations, typical at rated load
  - b. Current Transducer:
    - 1) Produces 4 -20 mA DC output current proportional to the input average RMS AC motor load current.
    - 2) Loop powered
14. All starter devices, including spare contacts, wired to numbered terminal blocks.

15. Terminal blocks for field connections to unit compartments shall be plug-in/pull apart type. Terminals shall be fully accessible from the front. Terminals shall be mounted near the front of vertical wireway.
16. Control devices shall be 600-volt heavy duty, NEMA A600. Relays shall have convertible contacts. Pilot devices shall be oiltight. Pilot lights shall be transformer type with six-volt secondary.
17. Feeder Circuit Breakers: Thermal magnetic type.
  - a. Circuit breakers of 100-amp frame or less shall be mounted in a dual mount compartment (two breakers in one space factor) or shall mount in one-half space factor, unless otherwise indicated on Drawings.
18. Motor Starter Circuit Breakers: Magnetic trip only motor circuit protectors.
19. Provide the following diagrams and tables inside of door for each compartment:
  - a. Elementary wiring diagram.
  - b. Table of overload heater sizes with correct heater highlighted.
  - c. Table of motor circuit protector settings with correct setting highlighted.
20. Where shown on Drawings, incorporate a solid state protective relaying package (SSPRP) into motor starter for motor protection. Unit shall incorporate the following ANSI C37.2 device function numbers and selectable indications and communication modules:
  - a. Product and Manufacturer:
    - 1) GE MultiLin SR469.
    - 2) Or equal.
  - b. Motor Protection Device Functions:
    - 1) Stator winding over-temperature (Device 49).
    - 2) Short circuit (Device 50).
    - 3) Motor overload (Device 49/50/51).
    - 4) Locked rotor - multiple start (Device 48).
    - 5) Phase reversal (Device 46).
    - 6) Ground fault (Device 50G/51G).
    - 7) Mechanical jam.
    - 8) Unbalance/negative sequence currents (Device 46).
    - 9) Undercurrent (Device 37).
    - 10) Motor bearing over-temperature (Device 38).
    - 11) Thrust bearing over-temperature (Device 38).
    - 12) Over-voltage (Device 59).
    - 13) Undervoltage (Device 27).
    - 14) Voltage sequence (Device 47).
    - 15) Main trip and lockout output relay (Device 86).
    - 16) Alarm output relay (Device 74).
  - c. Selectable Indications:

- 1) Average motor current.
- 2) Average motor temperature.
- 3) Motor current for each of the three phases.
- 4) Motor temperature readout for six winding RTDs.
- 5) Motor thrust-bearing temperature readout for two bearing RTDs.
- 6) Ground fault current.
- 7) Percent of motor capacity used.
- 8) Line-to-line and line-to neutral voltages, all three phases.
- 9) Average 15-minute kVA.
- 10) Average 15-minute kW.
- 11) Average 15-minute kVAR.
- 12) Maximum percent full load current since initial startup.
- 13) Hottest RTD and temperature since initial startup.
- 14) Highest percent current unbalance since initial startup.
- 15) Highest ground fault current since initial startup.
- 16) Highest motor bearing temperature since initial startup.
- 17) Highest load bearing temperature since initial startup.
- 18) Maximum line voltage since start.
- 19) Minimum line voltage since start.
- 20) Number of motor starts attempted.
- 21) Number of motor starts completed.
- 22) Hours of operation.
- 23) Number of trips from each of ten protective functions.
- 24) All measured values at the time of a motor trip.
- 25) Values that have been loaded for system inputs and trip points.

- d. Communication Module: RS232 capable of uploading all the above protective function attitudes and all the above listed selectable indications upon being queried by a host PLC hooked up through RS232 communication port.

21. Main and Tie Circuit Breakers: Thermal magnetic, molded case type, unless shown otherwise. Where shown, main and tie breakers shall be equipped with key interlocking. Interlocking shall allow only two of the three breakers to be closed at a time. Provide all locks and keys as required. Main circuit breakers shall be 100 percent amperage rated. Circuit breakers with frame ratings 800 amps and greater shall be electronic type with adjustable parameters and ground fault protection.

E. Surge Protection Device (SPD) Unit:

1. Provide an integral SPD unit for each motor control center. SPD unit shall comply with Section 16282, Surge Protection Device.

## **2.3 MAIN METERING DEVICE**

A. Provide a main meter device as shown on Drawings.

1. Microprocessor based monitoring device shall provide complete electrical metering in one package. Device shall include self-contained potential transformers and self-protected internal fuses.

2. Device shall be mounted on compartment door to allow operator access to meter menu and display.
3. Device shall include trend analysis, event logging, and recording. Device shall also include the following direct reading metered values:
  - a. Volts: 0.2 percent accuracy
  - b. Amperes: 0.2 percent accuracy
  - c. Watts, Vars and VA: 0.5 percent accuracy
  - d. Power Factor: 1.0 percent accuracy
  - e. Frequency: 0.05 percent accuracy
  - f. Watt, and VA Hours: 0.5 percent accuracy
  - g. Var Hours: 1.0 percent accuracy
  - h. Watt, Var and VA Demand: 0.4 percent accuracy
  - i. THD-Voltage: 50<sup>th</sup> harmonic
  - j. THD-Current: 50th harmonic
  - k. Individual Ampere Harmonics: 50th harmonic
  - l. Individual Voltage Harmonics: 50th harmonic
4. Metering device shall have the following additional features:
  - a. Trend analysis that shall display minimum and maximum values for each metered parameter with date and time of each occurrence.
  - b. Input range of device shall accommodate external current transformers with ranges from 100/5 to 5000/5 and potential transformers from a ratio of 120:120 to 500,000:120. Three current transformers suitably rated shall be included.
  - c. Alarm contacts rated five amps at 120 VAC.
  - d. Three analog outputs programmable to reflect the metered parameters, except kilowatt hours and kilovar hours.
  - e. Communication capability, using RS-485, Modbus RTU Protocol.
5. Control power shall be drawn from monitored incoming AC line. Device shall have non-volatile memory and not require battery backup. During a power failure, device shall retain preset parameters.

## 2.4 SOURCE QUALITY CONTROL

- A. Perform factory tests on individual motor control units prior to shipment. Tests shall include manufacturer's standard tests, including:
  1. Physical inspection and checking of all components.
  2. Mechanical operation and device function tests.
  3. Primary, control, and secondary wiring hi-pot tests.
- B. Factory tests as outlined above shall be witnessed by the OWNER's representative:
  1. The manufacturer shall notify the OWNER two (2) weeks prior to the date the tests are to be performed.
  2. The manufacturer shall include the cost of transportation and lodging for up to three (3) OWNER's representatives.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Examine conditions under which Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.
- B. Electrical Contractor shall verify and document all existing components and wiring terminations of each Motor control unit to be replaced within existing Motor Control Centers as shown on Drawings for proper construction of replacement control units.

### **3.2 INSTALLATION**

- A. Install motor control centers on concrete bases in accordance with the Contract Documents and manufacturer's recommendations and instructions.
- B. Do not provide openings in top or side of motor control centers not required for conduit.
- C. Cable circuits together within enclosures and identify with durable tag secured to cabling twine.
- D. Set motor circuit protectors at lowest setting that allows motor starting without nuisance tripping.
- E. Verify that wiring diagrams on inside of door of each compartment reflect the circuitry actually provided and that correct overload heater size and motor circuit protector setting are noted.
- F. Install in conformance with the manufacturer's recommendations, governing codes, and the Contract Documents.
- G. Connections to existing facilities shall be coordinated with Owner's operations.
- H. Verify that all conductors, power and control, have been properly identified per specification section 16075.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform field testing and inspection of motor control centers. Inspect and test each motor control center after installation. All testing and inspection shall be in accordance with the manufacturer's recommendations and be performed by manufacturer's factory-trained representative, who shall inform OWNER and ENGINEER when equipment is correctly installed. Do not energize equipment without permission of OWNER.
- B. Perform the following minimum tests and checks before energizing equipment:
  - 1. Verify all overload and device settings.
  - 2. Inspect all mechanical and electrical interlocks and controls for proper operation.



3. Check tightness of bolted connections.
4. Measure insulation resistance of each bus section, phase-to-phase and phase-to-ground.
5. Measure insulation resistance of each starter, phase-to-phase and phase-to-ground.
6. Measure insulation resistance of each control circuit with respect to ground.
7. Perform other tests recommended by equipment manufacturer.

### **3.4 MANUFACTURER SERVICES**

#### **A. Manufacturer Services:**

1. Unloading and Installation: Manufacturer's factory-trained representative shall be present during unloading of the equipment and installation in the equipment's final location. Representative shall train installing personnel in advance in the proper handling and rigging of the equipment.
2. Manufacturer's factory-trained representative shall test the system as specified in Article 3.3 of this Section. Representative shall operate and test the system in the presence of ENGINEER and verify that the equipment conforms to requirements.
3. Manufacturer's factory-trained representative shall adjust the system to initial settings as specified in Article 3.5 of this Section.
4. Representative shall revisit the Site as often as necessary until all deficiencies are corrected, prior to readiness for final payment.
5. Provide services of manufacturer's factory-trained representatives to correct defective Work within 72 hours of notification by OWNER during the Correction Period specified in the General Conditions as amended by the Supplementary Conditions.
6. Replacement parts or equipment installed during the Correction Period shall be equal to or better than the original.

- #### **B. Training:** Furnish services of qualified factory trained specialists from manufacturer to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of the products.

### **3.5 ADJUSTING**

- #### **A.** Calibrate, set, and program all protective devices. Coordinate protective devices furnished under this Specification section and provide proper settings of all devices

**END OF SECTION 262419**

## **SECTION 262816 - ENCLOSED SWITCHES**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Fusible switches.
- B. Safety Disconnect switches

#### **1.2 RELATED SECTIONS**

- A. Section 260553 – Electrical Identification

#### **1.3 REFERENCES**

- A. NECA - Standard of Installation (published by the National Electrical Contractors Association).
- B. NEMA FU1 - Low Voltage Cartridge Fuses.
- C. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (published by the International Electrical Testing Association).
- E. NFPA 70 - National Electrical Code.

#### **1.4 SUBMITTALS FOR REVIEW**

- A. Follow requirements for submittals, procedures for submittals, in general project requirements.
- B. Product Data: Provide switch ratings and enclosure dimensions.

#### **1.5 SUBMITTALS FOR CLOSEOUT**

- A. Record actual locations of enclosed switches in project record documents.

#### **1.6 REGULATORY REQUIREMENTS**

- A. Conform to requirements of NFPA 70.

- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Follow requirements for material and equipment in general project requirements: Product options and substitutions.
- B. Cutler Hammer.
- C. Eaton
- D. Square D.
- E. Siemens Energy and Automation
- F. General Electric
- G. Substitutions: Engineer Approved Equal.

### **2.2 FUSIBLE SWITCH ASSEMBLIES**

- A. Description: NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.
- B. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.
- C. Short Circuit rating: 200,000 amps

### **2.3 ENCLOSURES**

- A. Fabrication: NEMA KS 1.
  - 1. Interior Dry Locations: Type 1 or 12 as indicated on Drawings.
  - 2. Exterior Locations: Type 4X SS.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with NECA "Standard of Installation."
- B. Install fuses in fusible disconnect switches.
- C. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

### **3.2 FIELD QUALITY CONTROL**

- A. Follow requirements for Starting of Systems in general project requirements: Field inspection, testing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.

**END OF SECTION 262816**

## **SECTION 262923 - VARIABLE FREQUENCY DRIVES**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

A. Scope:

1. Contractor shall provide all labor, materials, equipment, services, and incidentals as shown, specified, and required to furnish and install variable frequency drives, complete and operational.
2. Variable frequency drives required under this Section are low-voltage, voltage source inverter, pulse width modulated. Variable frequency drives shall be customized.

B. Where variable frequency drives are being provided by the vendor of the associated driven equipment, costs for variable frequency drives shall be included in the lump sum price for said equipment. Where variable frequency drives are not being provided by the vendor of the associated driven equipment, costs for variable frequency drives shall be included in the general contract price.

C. Related Sections:

1. Section 260553, Electrical Identification.
2. Section 260520, Shielded Cable.

#### **1.2 REFERENCES**

A. Standards referenced in this Section are:

1. IEEE 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
2. NEMA AB 1, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
3. NEMA ICS 2, Industrial Control and Systems, Controllers, Contactors and Overload Relays Rated 600 Volts.
4. NEMA ICS 7, Industrial Control and Systems Adjustable Speed Drives.
5. NEMA MG 1, Motor and Generator Standard.
6. UL 508, Industrial Control Equipment.
7. ISO 9000, Quality Management Systems, Fundamentals and Vocabulary.
8. ISO 9001, Quality Management Systems, Requirements.
9. ISO 9002, Quality Systems, Model for Quality Assurance in Production, Installation and Servicing.

#### **1.3 QUALITY ASSURANCE**

A. Qualifications:

1. Manufacturer:

- a. Variable frequency drive manufacturer shall have at least five years of experience designing and regularly manufacturing and servicing substantially similar equipment to that specified, and shall submit documentation upon request of at least five installations in satisfactory operation for at least five years.
- b. Manufacturer shall be certified under ISO 9000, ISO 9001, or ISO 9002 for materials and equipment specified.
- c. For all required factory tests, variable frequency drive manufacturer shall use a factory test facility that has calibrated its testing apparatus in the previous twelve months, and is staffed by qualified, experienced technicians.

B. Component Supply and Compatibility:

1. Drives specified under this Section shall employ a low switching frequency or pattern to minimize instantaneous rate of voltage change over time (dv/dt), and the adverse effects of potential bearing currents. Where alternate manufacturers are proposed, obtain manufacturer recommendations regarding bearing currents and provide equipment required at no additional cost to OWNER.
2. Each variable frequency drive shall be totally compatible with associated driven equipment and motors. Variable frequency drives shall be matched to specific load requirements for each system. Operation of variable frequency drive shall not overstress motor insulation.
3. Similar components of drives associated with each system shall be products of a single manufacturer.

## 1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Dimensional information and construction details of enclosures. Enclosure details shall consist of exterior and interior front door with nameplate legends, interior door front and rear views, and terminal block layout.
- b. Three-line power and control schematic diagrams.
- c. Wiring diagrams showing the interconnection of conductors to all devices with terminal assignments for remote devices.
- d. Functional description of system operation.
- e. VFD heat dissipation at full load, including heat rejection/cooling system.
- f. Preliminary Harmonic analysis shall utilize:
  - 1)  $I_L$  shall be 80% of the connected load.
  - 2) The point of common coupling (PCC) shall be the first main breaker of the motor control center which the VFD is powered from.
  - 3) The level of harmonics, at the PCC described above, shall not exceed IEEE 519 limits.

2. Product Data:

- a. Technical specifications.
  - b. Catalog cuts and product literature.
3. Testing Plans:
  - a. At least thirty days prior to source quality control testing, submit descriptions of proposed shop testing methods, procedures, and apparatus.
  - b. At least thirty days prior to field quality control testing, submit descriptions of proposed field testing methods, procedures, and apparatus.
- B. Informational Submittals: Submit the following:
  1. Certificates:
    - a. Certification letters from variable frequency drive manufacturer and motor manufacturer that the approved driven equipment has been reviewed and that variable frequency drive units and motors are compatible, and shall be provided in accordance with the Contract Documents and requirements of the driven equipment.
  2. Source Quality Control Submittals:
    - a. Within 14 days of completing source quality control tests and inspections, submit test results with indication of whether all criteria of the Contract Documents for the specified equipment were met.
  3. Field Quality Control Submittals:
    - a. Within 14 days of completing field quality control tests and inspections, submit test results with indication of whether all criteria of the Contract Documents for the specified equipment were met.
  4. Manufacturer Reports:
    - a. Preliminary and final harmonic analysis.
    - b. Within 14 days of each visit to the Site by manufacturer's representative, submit written report of reason for visit, problems encountered, solutions implemented, and remaining work.
  5. Qualifications Statements:
    - a. Manufacturer.
- C. Closeout Submittals: Submit the following:
  1. Operation and Maintenance Data:
    - a. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation, list of recommended spare parts, and spare parts ordering information.

- b. Manuals shall include record drawings of control schematics, including point-to-point wiring diagrams.
- c. Comply with Section: Operation and Maintenance Data.
- d. Field report of final harmonic testing.

**D. Maintenance Materials Submittals: Submit the following:**

**1. Spare Parts and Extra Stock Materials:**

- a. Furnish, tag, and box for shipment and long term storage, spare parts and special tools for variable frequency drives. Each spare part set shall include manufacturer's recommended spare parts inventory for one year and include, at minimum, the following:

<b>Item</b>	<b>Quantity per Four VFDs per HP Rating</b>
1) Transistor and diode modules with accessories	One set
2) Power supply module	One
3) Fans	One set
4) Power fuses	One set of each size and type used
5) Control power fuses	Two sets of each size and type used
6) Pilot lights	Two per ten of each type used

- 2. Furnish a list of recommended spare parts for an operating period of one year. Describe each part, the quantity recommended, and current unit price.

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

**A. Delivery:**

- 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
- 2. Shipping containers shall be designed to be shipped by truck, rail, or ship. Indoor containers shall be bolted to skids.
- 3. Inspect variable frequency drive equipment for shipping damage or loose parts upon delivery. Check for evidence of water that may have entered equipment during transit.

**B. Handling:**

- 1. Lift, roll or jack variable frequency drive equipment into locations shown.
- 2. Variable frequency drives shall be equipped for handling required for installation. Handle equipment in accordance with manufacturer's requirements.

**C. Storage:**

- 1. Store variable frequency drive equipment in a clean, dry location with controlled, uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.



## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT PERFORMANCE**

#### **A. System Performance:**

1. Driven equipment to be controlled by a variable frequency drive shall be provided with a customized variable frequency drive. Each drive unit shall include an adjustable frequency controller with associated controls for continuous speed adjustment and protection of the driven equipment. Output speed control of motor shall be continuous throughout speed range of two to 60 Hertz under variable torque load or constant torque as specified for the driven equipment.
2. Variable frequency drives associated with each set of driven equipment shall be similar to each other.
3. Variable frequency drives shall be UL-listed or ETL-listed and designed, built, and tested in accordance with NEMA AB 1, NEMA ICS 2, NEMA ICS 7, and UL 508.
4. The VFD shall not emit harmonics that exceed IEEE 519 limits at the PCC.
5. The point of common coupling for all VFDs to be tested and conform to IEEE 519 harmonic limits will be considered the first point of connection to the electrical system, be that the motor control center that the VFD power is being supplied from and not the utility connection point.

### **2.2 MANUFACTURERS**

#### **A. Provide variable frequency drives by one of the following:**

1. Schneider Electric
2. ABB
3. Allen-Bradley
4. Eaton
5. Toshiba
6. Danfoss
7. Or equal.

### **2.3 APPROVED EQUAL: OTHER MANUFACTURERS MUST BE PRE-QUALIFIED BEFORE ONE (1) WEEK PRIOR TO BID OPENING. PREQUALIFICATION SHALL CONSIST OF SUBMITTING INFORMATION LISTED IN PARAGRAPHS 1.3 AND 1.4 ABOVE TO THE ENGINEER A MINIMUM OF TWO (2) WEEKS PRIOR TO THE BID OPENING DATE. APPROVAL OF EQUAL MANUFACTURERS (IF ANY) WILL BE MADE BY ADDENDUM PRIOR TO THE BID OPENING.**

- A. Provide each variable frequency drive with freestanding or wall hanging, front-access, NEMA 1, filtered and gasketed enclosure. Enclosure shall house all components required for the associated variable frequency drive.
- B. Enclosure shall provide adequate cooling for components within and include positive ventilation.

- C. Enclosure shall include circuit breaker disconnect switch. Circuit breakers shall be in accordance with NEMA AB 1. Switch handle shall be suitable for padlocking and be through-the-door type with handle height not exceeding six feet. Operation of switch shall remove the service supply from all internal components. Power devices shall be suitable for interrupting capacity matching that of the upstream Power source in symmetrical amperes. Include current limiting semi-conductor fuses where required for protection of solid state components.
- D. Enclosure door shall include an operator interface for access to controller's digital keypad and display.
- E. Equip enclosure front with nameplates for identification of equipment and operating functions. Nameplates shall be in accordance with Section 16075, Electrical Identification.
- F. Equip enclosure with phenolic type terminal blocks suitably labeled for all internal and remote wiring requirements, plus twenty percent spare.
- G. Data shall be formatted as required to communicate with the plant SCADA system. The VFD's shall communicate via-Ethernet TCP/IP. The manufacturer shall coordinate with the plant integrator to map data for SCADA interface.

## **2.4 ADJUSTABLE FREQUENCY CONTROLLER**

### **A. General:**

1. Adjustable frequency controller shall be microprocessor-based, pulse width modulated design, suitable for operation on a 480-volt, three-phase supply. Controller shall produce an adjustable AC voltage/frequency output to vary speed of driven equipment. Controller shall consist of the following sections:
  - a. The drive shall be a PWM (Pulse Width Modulated) inverter using IGBT transistors.
2. Controller switching frequency shall be adjustable and allow operation at 5,000 Hertz or less. Controller technology shall include a switching scheme that reduces the dv/dt of output supply.
3. Equip controller with a DC bus reactor or input line reactor as required to keep equipment line harmonics to a minimum.
4. Controller's solid state converter input section switching devices shall have 1600-volt PIV rating.
5. Overload rating of 110 percent variable torque, 150 percent constant torque for one minute.
6. RMS harmonic content of output current shall be less than five percent of fundamental current.
7. Able to withstand output terminal line-to-line short circuits without component failure.

### **B. Operating Criteria:**

1. Operating criteria shall be in accordance with the following:
  - a. Ambient temperature range of zero to 40 degrees C.
  - b. Operational humidity of up to 90 percent non-condensing.
  - c. Altitude up to 3,300 feet above sea level.
  - d. Nominal voltage of 480-volts plus or minus ten percent, three-phase, three-wire. Include an under-voltage feature to allow trip-free operation down to 35 percent undervoltage.
  - e. Nominal frequency of 60 Hertz plus or minus three Hertz.
  - f. Input power factor of 95 percent displacement power factor at all operating speeds.
  - g. Efficiency of 96 percent at full speed and full load.

C. Features:

1. Controller shall have the following features:
  - a. Digital keypad and display module shall provide parameter setting, adjustments, and monitoring of control functions and faults. Display messages shall be in English.
  - b. Serial communication port shall allow connecting to programmable controller interface using manufacturer standard protocol.
  - c. Independent acceleration/deceleration rates shall provide two to 600 seconds minimum. When called to stop, motor shall decelerate to minimum speed before stopping.
  - d. Power loss feature shall allow five cycle ride through capability for input supply interruptions.
  - e. Time delay automatic restart shall allow restart after controller fault conditions have been cleared with programmable attempts.
  - f. Coasting motor restart shall allow controller to restart into a coasting motor without damage or tripping. Coasting motor restart feature shall allow switching from bypass mode to variable frequency drive mode while operating, without shutdown.
  - g. Isolated control inputs and outputs.

D. Protection:

1. Controller shall have protective functions as follows:
  - a. Input line metal oxide varistor transient protection.
  - b. Electronic over-current trip, instantaneous and inverse time overload protection with thermal memory retention.
  - c. Over-temperature trip temperature protection.
  - d. Current limit trip protection.
  - e. Input line over- and under-voltage trip protection.
  - f. Ground fault trip protection.
2. Power Line Considerations:

- a. The drive shall be designed to operate in accordance with all performance requirements of the contract documents from a power source which contains a maximum of 5% total Voltage harmonic distortion, meet current distortion as defined by IEEE-519-1992.
- b. Each VFD or multiple sets of VFD's shall be designed and installed such that: the total voltage harmonic distortion reflected back to the power source is a maximum of 5%.
- c. When required line reactors and harmonic filters are required, they shall be provided by VFD supplier and shall be rated for, and compatible with, each VFD. They shall function as a complete system. Additional harmonic filters beyond those shown on drawings may be required in order to comply with the above parameters. The line reactors and harmonic traps shall be mounted inside the respective VFD enclosures. Traps shall be fuse-protected as a minimum and shall protect internal wiring and components on each phase and shall be current limiting. Data on these items shall be included with VFD shop drawings.
- d. The VFD supplier shall perform a computer simulated power system study to verify compliance with the parameters as stated herein. The results of this study shall be submitted to the engineer. At a minimum the submitted results of this study shall include:
  - 1) A results summary sheet which briefly describes the power system configuration analyzed and which states the calculated values of total harmonic distortion.
  - 2) Detailed list of the amplitude of harmonic currents and voltages to the 50th harmonic.
  - 3) This report must show if IEEE 519 is met and where on the power distribution.
- e. The Contractor shall supply the VFD supplier with all power system data required to perform the above described study. These data may include but are not limited to:
  - 1) A complete one-line diagram of the subject electrical distribution system.
  - 2) Complete electrical data on all equipment shown on the one-line diagram is required. At a minimum this data shall consist of:
    - a) Transformers - kVA, Primary voltage, Secondary voltage, Short circuit capacity or impedance.
    - b) Motors - Horsepower, Base speed, Full load RMS current (FLA).
    - c) Generators - Short circuit capacity or Subtransient reactances (Xd), Power factor, kW, X/R Ratio.
  - 3) If the distribution system can function in more than one configuration, the configuration(s) to be analyzed shall be clearly defined. Any other information which may affect the behavior of the distribution system shall also be provided.

## 2.5 OUTPUT FILTER

### A. General:

1. Provide output filter to prevent overstressing motor insulation system. Provide output filter with each variable frequency drive, when cable length between motor and variable frequency drive exceeds the following based on noted switching frequencies.
  - a. One KHZ switching frequency, 200 feet cable length.
  - b. Three KHZ switching frequency, 175 feet cable length.
2. Provide output filters in all other cases, based on recommendations of variable frequency drive and motor manufacturers, when actual voltage peaks at motor terminals exceed NEMA MG 1 limits.

**B. Features and Criteria:**

1. Filter shall be three-phase, 600-volt class motor-protecting type consisting of suitable values of inductance, capacitance and resistance to form a damped, low pass filter.
2. Filter shall be low-loss type specifically designed to reduce voltage wave form dv/dt. Filter shall allow cable lengths at minimum exceeding actual application distances with waveform resulting in voltage spikes at motor terminal that are within NEMA MG 1 Part 31 voltage stress levels.
3. Filter shall be suitable for mounting within variable frequency drive enclosure.

## **2.6 CONTROLS**

**A. General:**

1. Equip each variable frequency drive control system with relays, switches, fuses, indicating lights, and components required for a complete, functional system.
2. Variable frequency drive control shall be powered from a suitably sized and protected control power transformer.
3. Variable frequency drive control shall include status indicators, controller, and system fault condition displays and operating controls. Provide status indicators and operating controls associated with drive control on front door of enclosure.
4. Control arrangement shall be such that variable frequency drive internal electronic supply voltage is isolated from field wiring.

**B. Control and Pilot Devices:**

1. Relays shall be standard, latching type, and pneumatic or solid state time delay type. Provide relays with contacts rated ten amps, quantity as required.
2. Pilot devices shall be heavy duty type, rated 10 amps continuous. Indicating lights shall be push-to-test transformer type with 12-volt secondaries.

**C. Operation:**

1. Controls for each variable frequency drive shall consist of all devices necessary for the following:
  - a. Stop/Start and Speed Control: Stop/start and speed control shall respond to drive-mounted selector switch. With switch in “REMOTE” position, stop/start and speed control shall be based on a stop/start contact and four- to 20-mADC speed

signal from remote process control panel. With switch in “LOCAL” position, stop/start control shall be based on remote stop/start pushbuttons located adjacent to driven equipment, and speed control shall be based on drive-mounted speed potentiometer.

- b. Emergency Stop Control: Emergency stop control shall respond to remote stop pushbutton located adjacent to driven equipment. When activated, driven equipment shall stop immediately in all operating modes.
- c. Motor Over-temperature Shutdown: Motor over-temperature control shall respond to remote contact that activates on motor over-temperature. When over-temperature is detected, driven equipment shall stop. Include provisions to remotely supply 120-volt power to thermistor control module located at motor.
- d. Seal water control (required for pumps and other equipment that require seal water): Seal water control shall include provisions to supply 120-volt power to remote seal water solenoid. Seal water solenoid shall energize when equipment requiring seal water is enabled. Equipment requiring seal water start shall be delayed until remote-located pressure switch verifies seal water flow. Upon loss of seal water, after an adjustable period of time, an alarm shall be initiated but equipment requiring seal water shall not shut down. When equipment requiring seal water is stopped, seal water solenoid shall remain energized for an adjustable period of time.

#### D. Auxiliary Features:

##### 1. Provide each variable frequency drive with the following:

- a. Status Indicators: Status indicators shall include separate pilot lights for indication of motor run (red), and bypass mode (blue).
- b. Shutdown Indicators: Shutdown indicators shall include separate pilot lights (amber) for each shutdown condition. Arrange shutdown indication circuitry so that, when activated, indicator requires manual reset.
- c. Contact Outputs: Contact outputs shall include separate dry contacts for remote indication of motor run, seal water alarm for equipment with seal water systems, each shutdown condition, and controller faults.
- d. Speed Output: Speed output shall include four- to 20-mADC signal for remote indication of motor speed.

#### E. Wiring and Device Identification:

##### 1. Provide control wiring and device identification for each variable frequency drive:

- a. Identify all control conductors with permanent type wire markers. Each wire shall be identified by a unique number and shall be attached to wire at each termination point.
- b. Identify each control device with permanent type marker. Each device shall be identified by a unique number and shall be attached to each device.
- c. Numbering system for each wire and control device shall be identified on wiring diagrams and shall reflect actual designations used in the Work.

## **2.7 SOURCE QUALITY CONTROL**

### **A. Tests:**

1. Perform factory tests on each variable frequency drive prior to shipping. Test shall consist of simulating expected load to be driven by operating load through speed ranges specified for driven equipment, for minimum of two hours per drive unit.
2. Provide factory control and alarm tests on each drive unit by simulating each control signal and each alarm function to verify proper and correct drive unit action.
3. Perform specified tests in addition to standard factory tests typically performed.

### **B. Factory tests as outlined above shall be witnessed by the OWNER's representative:**

1. The manufacturer shall notify the OWNER two (2) weeks prior to the date the tests are to be performed.
2. The manufacturer shall include the cost of transportation and lodging for up to three (3) OWNER's representatives.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

### **3.2 INSTALLATION**

- A. Install equipment in accordance with manufacturer's recommendations and instructions and in conformance with Laws and Regulations, and the Contract Documents.
- B. Unless otherwise shown or indicated, install equipment at existing location of drive unit being replaced.
- C. Install equipment with sufficient access and working space provided for ready and safe operation and maintenance.
- D. For installations against masonry walls, provide an insulation board, 1/4-inch minimum thickness, between equipment and wall for corrosion protection. Trim board neatly within outline of equipment.
- E. Install all terminations, lugs, and required appurtenances necessary to properly terminate power supplies.
- F. Install control wiring terminations and appurtenances necessary to complete installing control and monitoring devices.

### 3.3 FIELD QUALITY CONTROL

#### A. Site Tests:

1. After installation, inspect, adjust, and test each variable frequency drive at the Site. Testing and inspection shall be in accordance with manufacturer's recommendations and be performed by manufacturer's factory-trained representative. Through CONTRACTOR, manufacturer's factory-trained representative shall inform OWNER and ENGINEER when equipment is correctly installed and ready to be energized. Do not energize equipment without permission of OWNER.
2. Perform the following equipment inspection and testing and provide reports documenting procedures and results.
  - a. Verify all device settings and drive adjustments.
  - b. Inspect all mechanical and electrical interlocks and controls for proper operation.
  - c. Test each drive through specified speed ranges and loads for a minimum of two hours per drive unit.
  - d. Test each drive by using actual control signal for remote and local operation.
  - e. Test each drive alarm function.
  - f. Perform other tests recommended by equipment manufacturer.
  - g. Perform Harmonics testing to confirm compliance with IEEE 519 limits.
    - 1) Testing of the Harmonic limits shall be per a VFD system as operating under natural conditions.
    - 2) Utilize the recorded maximum current recorded for the operating VFD system as I Load.
    - 3) Submit all calculations, all collected field data and graphs for review to Engineer.
    - 4) If the VFD system fails to be at or below any or all of the IEEE 519 Harmonic acceptable levels the VFD manufacturer shall incur all costs associated with retesting, additional harmonic mitigation equipment, equipment installation and retesting expenses including costs associated with Engineer travel to witness any and all testing.

#### B. Manufacturer Services:

1. Unloading and Installation: Manufacturer's factory-trained representative shall be present during unloading of equipment and installation at equipment's final location. Representative shall train installing personnel in advance in the proper handling and rigging of equipment. Services by manufacturer's representative under this paragraph shall be at least 2 eight-hour days at the Site.
2. Post-installation Check: Manufacturer's factory-trained representative shall check and approve the installed equipment before initial operation. Manufacturer shall calibrate, set and program variable frequency drives provided. Services by manufacturer's representative under this paragraph shall be at least 2 eight-hour days at the Site. Manufacturer's factory-trained representative shall adjust the system to final settings as specified in Article 3.5 of this section. Manufacturer's factory trained representative shall test as specified in section 3.3.A of this section. Representative shall operate and test the system in presence of ENGINEER and verify that equipment is in conformance with the Contract Documents. Services by



- manufacturer's representative under this paragraph shall be at least 2 eight-hour days at the site.
3. Representative shall revisit the Site as often as necessary until all deficiencies are corrected, prior to readiness for final payment.
  4. Provide services of manufacturer's factory-trained representatives to correct defective Work within 72 hours of notification by OWNER during the correction period specified in the General Conditions as may be amended by the Supplementary Conditions.
  5. Replacement parts or equipment provided during the correction period shall be equal to or better than original.
  6. Training: Provide services of qualified factory trained specialists from manufacturer to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of equipment.

### **3.4 ADJUSTING**

- A. Following Substantial Completion, when inspection and testing are complete and variable frequency drives are operating, manufacturer's representative shall return to the Site and make final adjustments as required to each variable frequency drive furnished under this Section.

**END OF SECTION 262923**

## **SECTION 264313 - TRANSIENT VOLTAGE SUPPRESSION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes TVSSs for low-voltage power, control, and communication equipment.

#### **1.3 DEFINITIONS**

- A. ATS: Acceptance Testing Specifications.
- B. SVR: Suppressed voltage rating.
- C. TVSS: Transient voltage surge suppressor.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.
- B. Product Certificates: For transient voltage suppression devices, signed by product manufacturer certifying compliance with the following standards:
  - 1. UL 1283.
  - 2. UL 1449.
- C. Qualification Data: For testing agency.
- D. Field quality-control test reports, including the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Failed test results and corrective action taken to achieve requirements.
- E. Operation and Maintenance Data: For transient voltage suppression devices to include in emergency, operation, and maintenance manuals.
- F. Warranties: Special warranties specified in this Section.

## **1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, dimensional requirements, and electrical performance of suppressors and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."
- E. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."
- F. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449, "Transient Voltage Surge Suppressors."

## **1.6 PROJECT CONDITIONS**

- A. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.

## **1.7 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within five years from date of Substantial Completion.

## **1.8 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Replaceable Protection Modules: One of each size and type installed.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advanced Protection Technologies, Inc.
  - 2. Atlantic Scientific.
  - 3. Current Technology, Inc.
  - 4. Cutler-Hammer, Inc.; Eaton Corporation.
  - 5. Entrelec International.
  - 6. General Electric Company.
  - 7. Innovative Technology, Inc.
  - 8. Intermatic, Inc.
  - 9. LEA International.
  - 10. Leviton Mfg. Company Inc.
  - 11. Liebert Corporation; a division of Emerson.
  - 12. Northern Technologies, Inc.
  - 13. Siemens Energy & Automation, Inc.
  - 14. Square D; Schneider Electric.
  - 15. Surge Suppression Incorporated.
  - 16. Sutton Designs Inc.
  - 17. Transtector Systems, Inc.
  - 18. Tycor; Cutler-Hammer, Inc.
  - 19. United Power Corporation.
  - 20. Zero Surge Inc.

### **2.2 SERVICE ENTRANCE SUPPRESSORS**

- A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:
  - 1. LED indicator lights for power and protection status.
  - 2. Audible alarm, with silencing switch, to indicate when protection has failed.
  - 3. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.
- B. Surge Protection Device Description: Modular design with field-replaceable modules, sine-wave-tracking type with the following features and accessories:
  - 1. Fuses, rated at 200-kA interrupting capacity.
  - 2. Fabrication using bolted compression lugs for internal wiring.
  - 3. Integral disconnect switch.
  - 4. Redundant suppression circuits.

5. Redundant replaceable modules.
  6. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
  7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
  8. LED indicator lights for power and protection status.
  9. Audible alarm, with silencing switch, to indicate when protection has failed.
  10. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.
  11. Surge-event operations counter.
- C. Peak Single-Impulse Surge Current Rating: 240 kA per phase.
- D. Connection Means: Permanently wired.
- E. Protection modes and UL 1449 SVR for grounded wye circuits with voltages of 480/277, 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 800V for 480/277.
  2. Line to Ground: 800 for 480/277.
  3. Neutral to Ground: 800 for 480/277.

## **2.3 PANELBOARD SUPPRESSORS**

- A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:
1. LED indicator lights for power and protection status.
  2. Audible alarm, with silencing switch, to indicate when protection has failed.
  3. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.
- B. Surge Protection Device Description: Modular design with field-replaceable modules, sine-wave-tracking type with the following features and accessories:
1. Fuses, rated at 200-kA interrupting capacity.
  2. Fabrication using bolted compression lugs for internal wiring.
  3. Integral disconnect switch.
  4. Redundant suppression circuits.
  5. Redundant replaceable modules.
  6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
  7. LED indicator lights for power and protection status.
  8. Audible alarm, with silencing switch, to indicate when protection has failed.
  9. One set of dry contacts rated at 5 A and 250-V, ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.
  10. Surge-event operations counter.
- C. Peak Single-Impulse Surge Current Rating: 120 kA per phase.
- D. Protection modes and UL 1449 SVR for grounded wye circuits with voltages of 208Y/120, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 400V for 208Y/120.
  2. Line to Ground: 400V for 208Y/120.
  3. Neutral to Ground: 400V for 208Y/120.
- E. Protection modes and UL 1449 SVR for 240/120-V, single-phase, 3-wire circuits shall be as follows:
1. Line to Neutral: 400 V.
  2. Line to Ground: 400 V.
  3. Neutral to Ground: 400 V.
- F. Protection modes and UL 1449 SVR for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
1. Line to Neutral: 400 V, 800 V from high leg.
  2. Line to Ground: 400 V.
  3. Neutral to Ground: 400 V.

## **2.4 ENCLOSURES**

- A. NEMA 250, with type matching the enclosure of panel or device being protected.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF SURGE PROTECTION DEVICES**

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install devices for panelboard, Motor Control Center, and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
1. Provide multi-pole, 30A circuit breaker as a dedicated disconnect for suppressor, unless otherwise indicated.

### **3.2 PLACING SYSTEM INTO SERVICE**

- A. Do not energize or connect panelboards, Motor Control Centers to their sources until surge protection devices are installed and connected.

### **3.3 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test and adjust equipment installation, including connections, and to assist in field testing. Furnish all test results.

1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. Testing: Perform the following field tests and inspections and prepare test reports:
  1. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with requirements.
  2. Complete startup checks according to manufacturer's written instructions.
  3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
- C. Remove and replace malfunctioning units and retest as specified above.

### **3.4 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transient voltage suppression devices. Refer to Division 1 Section "Closeout Procedures."

**END OF SECTION 264313**

## **SECTION 323119 – DECORATIVE METAL FENCES**

### **PART 1 – GENERAL**

#### **1.1 SECTION INCLUDES:**

- A. Decorative aluminum fencing, gates, rails, and accessories.

#### **1.2 SYSTEM DESCRIPTION & PREFERENCES**

- A. The manufacturer shall supply an ornamental aluminum fence system of the style, strength, size, and color defined herein. The system shall include all components (pickets, posts, rails, gates, hardware, and accessories) as required, and shall be fabricated, coated, manufactured and assembled in the United States.
- B. Structural Performances for Top Rails. Must provide railing assemblies which, when installed comply with the following requirements:
  - 1. Handrails and Toprails: Capable of withstanding:
    - a. A concentrated load of 200 pounds applied at any point in any direction at the top of the rail.
    - b. A uniform load of 100 pounds per linear foot applied horizontally and concurrently with a uniform load of 100 pounds per linear foot applied vertically downward.
  - 2. Concentrated and uniform loads above need not be assumed to act concurrently.
  - 3. A 200 pound concentrated on a one (1) square foot area at any point.

#### **1.3 QUALITY ASSURANCE**

- A. The Contractor shall provide laborers and supervisors who are familiar with the type of construction involved, and the materials and techniques specified.
- B. Manufacturer of a fence system must have ten (10) years of documented experience in manufacturing the products specified in this section.

#### **1.4 REFERENCES**

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
- B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
- C. ASTM B117 - Practice for Operating Salt Spray Fog Apparatus



- D. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100<sup>9</sup>,5 Relative Humidity
- E. ASTM B221 - Specification for Aluminum Alloy Extruded Bars, Shapes and Tubes
- F. ASTM B85 - Standard Specification for Aluminum-Alloy Die Castings
- G. BOCA - Must be BOCA approved and comply with local requirements

## **1.5 SUBMITTALS**

- A. Manufacturer's submittal package shall be provided prior to fabrication. Copies of shop drawings and complete installation data shall be furnished to the Engineer on all items specified in this section. Submit shop drawings in accordance to project requirements prior to fabrication. For pre-finished items, show materials and finish along with the finish warranty.
- B. Changes in specification may not be made after the bid date.
- C. Reproduction and contract documents in part or entirety for use as shop drawings will not be permitted.
- D. Samples of assembled materials, components, hardware, accessories, and/or colors, if requested.

## **1.6 FIELD MEASUREMENTS**

- A. Take all necessary field measurements to verify or supplement dimensions shown on the drawings show on the drawings. Furnish templates as required or directed. The Contractor shall be responsible for furnishing all necessary instructions for the setting of anchors, bearing plates and miscellaneous items and shall ascertain that all materials are properly set during the progress of work.

## **1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Upon receipt, materials should be checked for damage that may have occurred in the shipping to the job site.
- B. Each package shall bear the name of the manufacturer.
- C. Store product in manufacturer's unopened package.
- D. Store materials in a secure and dry area to protect against damage, weather, vandalism, and theft.
- E. Transport, handle and store products with care to protect against damage before installation.

## **PART 2 – PRODUCTS**

### **2.1 MANUFACTURER**

- A. The fencing system shall be Industrial Strength Aluminum Ornamental Fence as manufactured by Ultra Aluminum Mfg. Inc., 2124 Grand Commerce Drive, Howell, MI 48855, (800)656-4420, fax (800)643-7429, email [www.ultrafence.com](http://www.ultrafence.com), or approved equal.
- B. Substitutions: May be submitted in accordance with Project Sections. This submission shall include architectural specifications and samples that must be sent to the specifying Architect/Designer to show that an equal product has been submitted for pre-approval.
- C. Fencing system shall be a UAF-201 or approved equal.
- D. Fence height shall be 72 inches.
- E. Color shall be Satin Black.

### **2.2 MATERIALS**

- A. Materials listed below are for the UAF-201 and are indicated as a standard of quality that must be met, other materials may be acceptable after approved by the Engineer.)
  - 1. Aluminum Extrusions: All extrusions used in the fence system shall be extruded from Ultrum™ 6063-T5 aluminum alloy having minimum yield strength of 35,000 psi & extruded in the United States.
  - 2. Fasteners: All fasteners shall be stainless steel. Square drive screws shall be used to connect the pickets to the horizontal rails. Rail to post connections shall be made using self-drilling hex-head screws.
  - 3. Fencing: All fencing must be Ultrarail™ and have eight ribs inside to insure product strength.
  - 4. Railing: The Ultra Signature™ double-wall design that is a two-piece top rail with eight rails and hides the fasteners underneath.
  - 5. Security Fence: All industrial security fencing should have double-wall Ultra" ISP rail; provide extra strength (1-5/8" x 1-5/8") reinforced double-wall rail and 1" pickets. The Ultra™ Defender™ shall be the standard.
  - 6. Accessories: Aluminum sand and die castings shall be used for all scrolls, post caps, finials, and miscellaneous hardware. Die castings shall be made from Alloy A360.0 as per ASTM B85 for superior corrosion resistance. Alloy A380.0 is not acceptable.

### **2.3 FINISH**

- A. Pretreatment: A three stage non-chrome pretreatment shall be applied. The first step shall be a chemical cleaning, followed by a water rinse. The final stage shall be a dry-in-place activator which produces a uniform chemical conversion coating for superior adhesion.

- B. Coating: Fence materials shall be coated with Powercoat<sup>™</sup>, Super-Durable TGIC polyester powder-coat finish system applied by Ultra Aluminum Manufacturing Company. Epoxy powder coatings, baked enamel or acrylic paint finishes are not acceptable. The Powercoat<sup>™</sup> finish shall have a cured film thickness of at least 2.0 mils. In addition, any screw heads shall be painted to match the color of the fence.
- C. Tests: The cured finish shall meet or exceed AAMA 2604, which includes the following requirements:
  - 1. Humidity resistance of 3,000 hours using ASTM D2247.
  - 2. Salt-spray resistance of 3,000 hours using ASTM B117.
  - 3. Outdoor weathering shall show no adhesion loss, checking or crazing, with only slight fade and chalk when exposed for 5 years in Florida facing south at a 45-degree angle.
  - 4. All test results from independent testing sources must be certified and provided.
- D. Finishes that only meet AAMA 2603 (or the previous version - AAMA 603) are not acceptable.

## 2.4 FABRICATION

- A. Horizontal rails shall be 1" channels formed in a modified "U" shape. Pickets shall pass through holes punched in the top of the rail. The top wall shall be .070" thick and the side walls .100" thick for superior vertical load strength. There shall be 3 horizontal rails (4 rails for 7' and 8' high fence) in each section.
- B. Pickets shall be fastened to the rails using painted stainless steel screws. Screws shall be used on only one side of the rail, leaving the other side with a clean appearance. Pickets shall be 1" square and have a wall thickness of .062". Welding the pickets to the rails is not permitted. If racking is needed, this will be done at no additional charge.
- C. Posts shall be 2-1/2" square extrusions with pre-punched holes which allow the fence section rails to slide in. Posts shall be spaced 7-1/2" on center and have 0.75" walls. Gate posts shall be 6" square with .125" walls and used on both sides of a gate. Die cast aluminum caps shall be provided with all posts.
- D. Swing gates shall have welded frames and shall support a 300 lb. vertical load on the latch side of the gate without collapsing. Walk gates shall be self-closing and self-latching. Swing and/or walk gates must utilize the Ultrahinge<sup>™</sup> Mylar hinge blocks and J-bolts. All gates must be fastened and 100% welded at all connections and joints.
- E. Assembled sections shall support a 1,000 lb. vertical load at the midpoint of any horizontal rail.
- F. The Ultra logo shall appear on all post caps of the fencing system.

## **2.5 WARRANTY**

- A. The entire fence system shall have a written Limited Lifetime Warranty against rust and defects in workmanship and materials. In addition, the Powercoat™ finish shall be warranted not to crack, chip, peel, or blister for the same period. The warranty shall commence on the date of substantial completion.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Verify areas to receive fencing grades and elevations.
- B. Ensure property lines and legal established.
- C. Remove any surface irregularities interference with the installation fence.

### **3.2 FENCE INSTALLATION**

- A. Install fence in accordance with the manufacturer's instructions.
- B. Excavate post holes to proper depth to suit local conditions for stability and support of the fence system without disturbing the underlying materials. Excavate deeper as required for adequate support in soft and loose soils.
- C. Set fence posts in concrete footers. For installations on a slope, the post spacing must be measured along the grade.
- D. Insert notched horizontal rails in pre-punched holes in post and fastens in place.
- E. Center and align posts in holes to required depth. Place concrete around posts and tamp for consolidation. After tamping, check alignment of posts, and make necessary corrections before the concrete hardens.
- F. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- G. Expansion joints shall be provided at intervals not more than 50 feet on centers or as recommended by the manufacturer. Provide slip joint with internal sleeve extending 2" beyond each side of the joint.

### **3.3 GATE INSTALLATION**

- A. Set gate posts plumb and level for gate openings specified in construction drawings.

Gates shall include:

one (1) – 36” wide swing gate

one (1) – 22’ wide slide gate

- B. Install gates to allow full opening without interference after concrete has hardened around gate posts. Adjust hardware for smooth operation. Install one drop rod for double gates.
- C. Supply lock hasp for City-provided padlock on all gates.

### **3.4 ACCESSORIES**

- A. Install post caps and other accessories to complete fence.

### **3.5 CLEANING**

- A. Contractor shall clean site of debris and excess materials. Post hole excavations shall be scattered uniformly away from posts.
- B. If necessary, clean fence system with mild household detergent and clean water. Excess concrete must be removed from posts and other fencing material before it hardens.
- C. Stained and defective works shall be removed and replaced with material meeting specified requirements.

### **3.6 ERECTION TOLERANCES**

- A. Maximum Variation Form Plumb: 1/4" per foot level, noncumulative.
- B. Maximum offset form true alignments: 1/4".
- C. Maximum out of position: 1/4".

### **END OF SECTION 323119**

**SECTION 330505.30 - LEAKAGE TESTING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

**1.2 DESCRIPTION OF WORK**

- A. The Contractor shall perform sufficient tests to determine that the installation of all pipe materials have been as specified and that test results are in accordance with those required for approval of the installation.
- B. The Contractor shall furnish all pressure gauges, suitable pump or pumps, pipes, test heads, and any other apparatus and materials used for these tests. These tests are to be considered as part of the work, and no additional compensation shall be made.
- C. The tests shall be conducted under the direction of the Engineer or an appointed agent. Any testing done without direction and supervision as specified shall not be considered as a proper means of approval.
- D. The Contractor may obtain water for testing as may be required by observing the rules and regulations enforced in the municipality in which the work is being done.

**1.3 QUALITY ASSURANCE**

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

**PART 2 - INFILTRATION AND EXFILTRATION TESTING****2.1 GENERAL**

- A. All sanitary sewers shall be tested using an exfiltration test or, where specifically allowed in writing by the Engineer, an infiltration test.
- B. All sanitary sewers shall be tested. No visible leakage in the sewers or manholes shall be permitted.
- C. Each manhole run shall be tested separately, unless otherwise approved by the Engineer, as the construction progresses, before surface restoration, and preferably with not more than four (4) manhole runs constructed ahead of testing.

- D. Bulkheads shall be used to isolate the test sections as required to perform the work. All service laterals, stubs and fittings shall be plugged or capped at the connection to the test section.

## **2.2 INFILTRATION TESTING**

- A. An infiltration test shall be conducted for all sections of sewer, only when the ground water level is two (2) feet or more above the elevation of the inside crown of pipe at the upstream limit of the section being tested.
- B. The use of well point pumps or other dewatering devices shall have been discontinued for 24 hours prior to testing to permit the groundwater table to return to a static condition.
- C. The leakage rate shall be measured by a weir, by determination of the time required to fill a container of known volume, or other measuring device approved by the Engineer in the lower end of the sewer section to be tested.
- D. The incoming sewer or sewers in the upper end of the test section shall be securely sealed.

## **2.3 EXFILTRATION TESTING**

- A. The test shall be performed first with a minimum head of water of three (3) feet above the top of the high end of the sewer or two (2) feet above the high end of the highest lateral in the section or sections to be tested, or three (3) feet above the existing groundwater elevation, whichever is higher.
- B. The exfiltration test shall be conducted between two manholes by sealing the downstream end of the test section and all inlet sewers at the upstream manhole with pipe stoppers.
- C. The average internal pressure in the system shall not exceed 11.6 feet of water or 5 psi and the maximum internal pipe pressure at the lowest end shall not exceed 23 feet of water or 10 psi.
- D. Water shall be added to the pipe section at a steady rate from the upstream manhole to allow air to escape from the sewer until the water is at the specified level above the crown of the pipe. The water may stand in the pipe and manhole up to twenty-four (24) hours prior to measurement of leakage to allow for absorption by the pipe and bleeding of air. After absorption into the pipe and manhole has stabilized, the water in the upstream manhole shall be brought to test level.
- E. The leakage rate shall be determined by measurement of the drop in water elevation measured in the upstream manhole and the loss of water calculated. The test period shall be a minimum of sixty (60) minutes duration. Use the following table to determine loss of water as measured in the manhole:

WATER LEVEL CHANGE IN TEST MANHOLE		<u>VOLUME OF LEAKAGE</u>	
		4' DIA. M.H. (GALS.)	5' DIA. M.H. (GALS.)
<u>(INCHES)</u>	<u>(FEET)</u>		
1/8	0.01	0.98	1.53
1/4	0.02	1.96	3.06
3/8	0.03	2.94	4.59
1/2	0.04	3.92	6.12
5/8	0.05	4.90	7.65
3/4	0.06	5.87	9.18
7/8	0.07	6.85	10.71
1	0.08	7.83	12.24
1-1/8	0.09	8.81	13.77
1-1/4	0.10	9.79	15.30
1-3/8	0.11	10.77	16.83
1-1/2	0.12	11.75	18.36
1-5/8	0.13	12.72	19.89
1-3/4	0.14	13.71	21.42
1-7/8	0.16	14.69	22.9
2	0.17	15.67	24.48

- F. When twenty three (23) feet or more difference in grade occurs between manholes, the low air pressure test method shall be used instead of an exfiltration test.

## 2.4 ALLOWABLE LEAKAGE

- A. The maximum allowable leakage for either infiltration or exfiltration shall be 100 gallons per inch of internal pipe diameter per mile per day.
- B. If actual leakage measured exceeds the limits specified, the Contractor must locate and repair or remove and replace the defective pipe sections to the satisfaction of the Engineer and retest the section accordingly at no additional cost to the Owner.

## 2.5 MANHOLES

- A. All sanitary manholes shall be tested separately by using an exfiltration test (or infiltration test where groundwater conditions permit) to two (2) feet above the highest joint with no measurable leakage for a one-hour test.

## PART 3 - LOW PRESSURE AIR TESTING

### 3.1 GENERAL

- A. Sanitary sewers twenty-four (24) inches and less may be air tested as specified.



- B. Each manhole run shall be tested separately, unless otherwise approved by the Engineer, as the construction progresses, before surface restoration, and preferably with not more than four (4) manhole runs constructed ahead of testing.
- C. If the low pressure air test is being conducted on more than one (1) manhole run of pipe, the entire section being tested shall meet the low pressure air test requirements as if only one (1) of the manhole reaches in the section were being tested.
- D. The sewer shall be flushed and cleaned prior to testing to clean out any debris and to wet the pipe surface for more consistent results.
- E. The section of pipe to be tested shall be plugged at each end and the ends of laterals, stubs and fittings to be included in the test section shall be plugged to prevent air leakage, and securely braced to prevent possible blowouts.
- F. Test equipment consists of valves and pressure gages to control air flow and to monitor pressure within the test section.

### **3.2 EQUIPMENT**

- A. Equipment used shall meet the following minimum requirements and be approved by the Engineer:
  - 1. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
  - 2. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
  - 3. All air used shall pass through a single control panel.
  - 4. Three (3) individual hoses shall be used for the following connections:
    - a. From control panel to pneumatic plugs for inflation.
    - b. From control panel to sealed line for introducing the low pressure air.
    - c. From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

### **3.3 PROCEDURES**

- A. All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be used for the test. The sealed pipe shall be pressurized to 5 psig. The plugs must hold against this pressure without having to be braced.
- B. After a manhole to manhole run of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole. Low pressure air shall be slowly introduced into this sealed line until the internal air pressure reaches approximately 4 psig greater than the average ground water back pressure.

- C. In areas where ground water is known to exist, the Contractor must determine the average ground water back pressure. The Contractor shall install a 1/2-inch diameter capped pipe nipple, approximately 10 inches long, through the manhole wall on top of one of the sanitary sewer lines entering the manhole.

This shall be done at the time the sanitary sewer line is installed or install an 8-inch diameter stand pipe outside of the manhole backfilled with a column of clean stone of 2-inch minimum diameter to subgrade. Immediately prior to the performance of the low pressure air test, the ground water back pressure shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the nipple. The plastic tube shall be vertical and a measurement of the height, in feet of water over the invert of the pipe shall be taken after the water has stopped rising in this plastic tube. This height, divided by 2.307, will equal the average groundwater back pressure.

- D. At least two (2) minutes shall be allowed for the air to stabilize when the specified internal air pressure has been obtained. When the pressure has stabilized and is at or above 3.5 psig, the air hose from the control panel to the air supply shall be disconnected. The portion of the line being tested shall be termed "acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average groundwater back pressure calculated) shall not be less than the time in the tables in the following references:

ASTM C828 for clay pipe, ASTM C924 for concrete pipe and for other materials test procedures as approved by the Engineer.

- E. If a one (1) psi drop in pressure does not occur within the test time, the line has passed. If the pressure drop is more than one (1) psi during the test time, the line is presumed to have failed the test. If the line fails the test, segmented testing may establish the location of any leaks.
- F. The Contractor must repair the leak or remove and replace the defective pipe section and re-test the section to the satisfaction of the Engineer at no additional cost to the Owner.

### **3.4 SAFETY**

- A. The pneumatic plugs must be installed in such a way as to prevent blowouts. Inasmuch as a force of 250 pounds is exerted on an 8-inch plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or a plug, which is partially deflated before the pipe pressure is released, can be dangerous.
- B. Pressurizing equipment shall include a regulator, ranging from 1 to 10 psi, to avoid over pressurizing and damaging an otherwise acceptable line.
- C. No one shall be allowed in the trench or manholes during testing.
- D. Plugs shall not be removed until all pressure has been released.

### **3.5 MANHOLES**

- A. All sanitary manholes shall be tested separately by using an exfiltration test (or infiltration test where groundwater conditions permit) to two (2) feet above the highest joint with no measurable leakage for a one-hour test.

## **PART 4 - HYDROSTATIC TESTING**

### **4.1 GENERAL**

- A. The pipe to be tested must be sufficiently backfilled to prevent movement while under test pressure.
- B. Joint restraint at fittings should be permanent and constructed to withstand test pressure. If concrete thrust blocks are used, sufficient time must be allowed before testing to permit the concrete to cure. A cure time of seven (7) days is recommended when Type I Portland cement is used; three (3) days is recommended when Type III high-early Portland cement is used.
- C. Test ends should be restrained to withstand the appreciable thrusts that are developed under test pressure.
- D. Air pressure testing of installed pressure pipe is expressly prohibited.
- E. Any testing performed without the knowledge of the Engineer shall not be considered a test for the purpose of this specification.

### **4.2 FORCE MAINS**

- A. All pipes, valves, fittings, etc. shall be laid in such a manner as to leave all joints watertight. After the pipe is laid and before backfill is placed around the joints, such lengths of the force main as determined by the responsible agency shall be tested under a hydrostatic pressure of 1.25 times the working pressure at the highest point along the test section, but, in no case, shall such force mains be tested at less than 100 pounds per square inch.
- B. Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a booster pump connected to the pipe in a manner satisfactory to the Engineer. The duration of the test shall be for a minimum of sixty (60) minutes.
- C. No pipe installation will be accepted unless the leakage rate for the section of pipe being tested does not exceed a rate of 75 gallons per 24 hours per mile per inch of nominal diameter.
- D. The Contractor shall furnish suitable means for determining the quantity of water lost by leakage during the test.

### 4.3 WATER MAINS

- A. Each section of pipe being tested shall be filled slowly with water, and, before applying the specified test pressure, all air shall be expelled from the pipe. The water may be introduced from lines in service through valved connections or by temporary connections to hydrants or to taps made in the new line or at the connection in the line cap. All such connections should be made at the lowest possible point in the line. The method of obtaining and placing test water into the water main shall be approved by the Engineer.
- B. Flow velocity during line filling should not exceed two (2) feet per second. All air should be expelled from the pipeline during filling and again before making either pressure or leakage tests. Automatic air release valves are recommended.
- C. The test pressure shall be 1.25 times the working pressure at the highest point along the test section or 150 psi whichever is higher unless otherwise specified elsewhere in these specifications or directed by the Engineer. In no case should pressure exceed rating of pipe, valves, fittings or appurtenances, whichever is less.
- D. The test pressure shall be maintained for a sufficient length of time to allow a thorough examination of joints and elimination of leakage where necessary. The pipeline shall be made absolutely tight under the test pressure.
- E. In cold weather, immediately after testing a section of the water main piping, the Contractor shall open all valves, air cocks, by-passes, and drains; shall drain that section of the pipeline, including the bonnets of all valves contained therein, and shall take all other precautions necessary to prevent injury due to freezing to the water main, piping and appurtenances if the water main is exposed.
- F. Every precaution must be taken to remove, valve off or otherwise protect delicate control equipment in or attached to pipelines to prevent damage or injury.
- G. Leakage is defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, as required to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled as specified herein.
- H. In calculating leakage, the Engineer will not make allowance for any leakage at the valves, the removable bulkheads, etc.
- I. The evaluation of actual leakage to standard pressure leakage is calculated by the application of the ratio determined from the square root of respective pressures, other factors being equal.
- J. For cast iron pipe (CIP) or ductile iron pipe (DIP), AWWA C600 shall govern the test. Allowable leakage, as set by AWWA standard, is based on 150 psi test pressure and a leakage rate of 12 gallons per day per mile of pipe per inch of pipe diameter.
- K. All defective materials and construction found in the pipeline as a result of leakage tests shall be corrected by removal of the defective materials and reconstruction with sound materials and construction. The entire section shall then be retested in accordance with these specifications.

- L. The lack of hydrants, branch shut-off valves, or any other attachments to the line being tested shall not preclude the testing of each valved section as it is completed. In the event that hydrants, branch shut-off valves or any other attached appurtenances are not available for installation prior to testing of each valved section, then plugs or other approved means of containing line pressure must be utilized so as to test each valved section of main line as it is completed. A retest of each valved section will then be necessary after all appurtenances are installed. There will be no additional payment for any such retested.

**END OF SECTION 330505.30**

**SECTION 330505.43 – DEFLECTION TESTING****PART 1 - GENERAL****1.1 PIPE TO BE TESTED**

- A. All thermoplastic gravity sanitary sewer pipe shall be tested for allowable deflection.

**1.2 TIMEFRAME FOR TESTING**

- A. Deflection tests shall be performed before final acceptance and no sooner than thirty (30) days after installation of final backfill

**1.3 ALLOWABLE DEFLECTION**

- A. Maximum allowable pipe deflection shall be five (5) percent of the average inside diameter for the size and class of pipe specified.

**1.4 DESCRIPTION OF WORK****A. EQUIPMENT**

1. Acceptance testing shall be performed with a non-adjustable “go, no-go” mandrel with a minimum of eight (8) contact points. Adjustable mandrels for acceptance testing shall be used only with permission of the Engineer.
2. The mandrel size shall be ninety-five (95) percent of the average inside diameter for the size and class of pipe specified.
3. If the "go, no-go" mandrel will not pass through a section of pipe a deflectometer or adjustable mandrel may be used to determine the extent and/or severity of the non-acceptable area. A “go, no-go” mandrel shall be re-run through the pipe section for final acceptance testing at no additional cost to the Owner.

**B. TESTING**

1. The contractor or subcontractor performing the test shall be experienced and qualified to perform deflection testing with the equipment and procedures utilized. The contractor shall provide all labor, materials, tools and equipment necessary to clean and test all sections of sewer pipe, locate deficient areas, repair, deficient areas, and retest all repaired areas.
2. All sewer runs shall be cleaned prior to testing.
3. The acceptance test shall be performed without mechanical pulling devices.

## **1.5 REPAIR OF DEFECTIVE PIPE**

- A. All pipe failing the deflection test shall be exposed and repaired or replaced as approved by the Engineer at no additional cost to the Owner.

**END OF SECTION 330505.43**

## **SECTION 352226 - SLUICE GATES AND SLIDE GATES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

#### **1.2 DESCRIPTION OF WORK**

- A. This section includes the furnishing and installation of wall thimbles, gate frames, sluice gates, slide gates, floor stands, extension stems, stem guides, operating devices, position indicators, wall brackets, floor boxes, anchors, and all appurtenances.

#### **1.3 QUALITY**

- A. Sluice gates and their appurtenances shall conform to applicable portions of AWWA Standard for Sluice Gates, C561.

#### **1.4 PROTECTION**

- A. All gates shall be shipped, stored, and installed in such a way as to avoid warping the frame and to maintain tolerances between seating faces.

#### **1.5 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical data and application instructions.
- B. Sluice gates, slide gates, operators, and appurtenances shall be as shown on the Drawings, scheduled, as specified, or as ordered.

### **PART 2 - EQUIPMENT**

#### **2.1 SLIDE GATES (STAINLESS STEEL)**

- A. Gates shall be as specified herein and have the characteristics and dimensions shown on the Contract Drawings.
- B. The gate shall utilize self-adjusting seals.
- C. All structural components of the frame and slide shall be fabricated of stainless steel having a minimum thickness of 1/4-inch and shall have adequate strength to prevent distortion during normal handling, during installation and while in service.



- D. All welds shall be full and continuous performed by welders with AWS certification for all material grades such as 304, 304L, 316, 316L, duplex, and super duplex.
- E. Finish: Mill finish on stainless steel. Welds shall be sandblasted to remove weld burn and scale accomplished by pickle and passivation. All iron and steel components shall be properly prepared and shop-coated with a primer.

## **2.2 FRAME**

- A. The frame assembly, including the guide members, invert member and yoke members, shall be constructed of stainless plate with a minimum thickness of 1/4-inch.
  - 1. Frame design shall allow for embedded mounting, mounting directly to a wall with stainless steel anchor bolts and grout or mounting to a wall thimble with stainless steel mounting studs a mastic gasket material. Mounting style shall be as shown on the Contract Documents.
  - 2. All wall-mounted or wall thimble-mounted gates shall have a flange frame.
  - 3. Gussets shall be provided as necessary to support the guide members in an unseating head condition.
  - 4. The frame shall extend to accommodate the entire height of the slide when the slide is in the fully opened position on upward opening gates or downward opening weir gates.
  - 5. On self-contained gates, a yoke shall be provided across the top of the frame. The yoke shall be formed by a structural members affixed to the top of the side frame members to provide a one-piece rigid assembly. The yoke shall be designed to allow removal of the slide.
  - 6. A rigid stainless steel invert member shall be provided across the bottom of the opening. The invert member shall be flush bottom type on upward opening gates.
  - 7. A rigid stainless steel top seal member shall be provided across the top of the opening on gates designed to cover submerged openings.
  - 8. A rigid stainless steel member shall be provided across the invert of the opening on downward opening weir glass.

## **2.3 SLIDE**

- A. The slide and reinforcing stiffeners shall be constructed of stainless steel plate. All structural components shall have a minimum thickness of 1/4-inch.
  - 1. The slide shall not deflect more than 1/360 of the span or 1/16 inch, whichever is smaller. Under the maximum design head.
  - 2. Reinforcing stiffeners shall be continuously welded (stitch welding will not be acceptable) to the slide and mounted horizontally. Vertical stiffeners shall be continuously welded on the outside of the horizontal stiffeners for additional reinforcement.
  - 3. The stem connector shall be constructed of two angles or plates. The stem connector shall be continuously welded on the slide. A minimum of two bolts shall connect the stem to the stem connector.

## **2.4 SEALS**

- A. All gates shall be provided with a self-adjusting seal system to restrict leakage in accordance with the requirements listed in this specification.
  - 1. All gates shall be equipped with UHMW polyethylene seat/seals to restrict leakage and to prevent metal to metal contact between the frame and slide.
  - 2. The seat seals shall extend to accommodate the 1-1/2 by the height of the slide when the slide is in the fully closed or fully opened position.
  - 3. All upward opening gates shall be provided with a resilient seal to seal the bottom portion of the gate. The seal shall be attached to the invert member or the bottom of the slide and it shall be held in place with stainless steel attachment hardware.
  - 4. All downward opening weir gates shall be provided with UHMW polyethylene seat/seals across the invert member.
  - 5. The seal system shall be durable and shall be designed to accommodate high velocities and frequent cycling without loosening or suffering damage.
  - 6. All seals must be bolted or otherwise mechanically fastened to the frame or slide.
  - 7. The seals shall be mounted so as not to obstruct the waterway opening.

## **2.5 STEM**

- A. A threaded operating stem shall be utilized to connect the operating mechanism to the slide.
- B. On rising stem gates, the threaded portion shall engage the operating nut in the manual operator or motor actuator. On non-rising stem gates, the threaded portion shall engage the nut on the slide.
  - 1. The threaded portion of the stem shall have a minimum outside diameter of 1-1/2 inches. Stem extension pipes are not acceptable.
  - 2. The stem shall be constructed of solid stainless steel bar for the entire length, the metal having a tensile strength of not less than 90,000 psi for stems that are 3 inches or less in diameter. Stems that are in excess of 3 inches in diameter shall have a tensile strength of 85,000 psi.
  - 3. The stem shall be threaded to allow full travel of the slide unless the travel distance is otherwise shown on the Contract Drawings.

## **2.6 STEM GUIDES**

- A. Stem guides shall be provided when necessary to ensure that the maximum L/R ratio for the unsupported part of the stem is 200 or less.
  - 1. Stem guide brackets shall be fabricated of stainless steel and shall be outfitted with UHMW or bronze bushings.
  - 2. Adjustable in two directions.

## 2.7 MATERIAL OF CONSTRUCTION

Frame Assemble and Retainers:	Stainless Steel, Type 304L, ASTM A 240
Slide and Stiffeners:	Stainless Steel, Type 304L, ASTM A 240
Stem:	Stainless Steel, Type 304, ASTM A 276
Fasteners, Nuts, and Bolts:	Stainless Steel, Type 304, ASTM A 276
Invert Seal (Upward Opening Gates Only):	Stainless Steel, Type 304L, ASTM A 240
Seat/Seals and Facing:	Ultra-High Molecular Weight Polyethylene, ASTM D 4020
Lift Nuts:	Bronze, ASTM B 584
Pedestals and Wall Brackets:	Stainless Steel, Type 304L, ASTM A 276
Operator Housing:	Cast Aluminum or Ductile Iron

## 2.8 MANUAL OPERATORS

- A. Unless otherwise shown on the Drawings, gates shall be operated by a manual handwheel or a manual 2" operating nut. The operator shall be mounted on the yoke of self-contained gates or on the pedestal of non-self-contained gates.
1. The gate manufacturer shall select the proper gear ratio to ensure that the gate can be operated with no more than a 40-lbs. effort when the gate is in the closed position and experiencing the maximum operating head.
  2. An arrow with the word "OPEN" shall be permanently attached or cast onto the operator to indicate the direction or rotation to open the gate.
  3. Handwheel operators shall be fully enclosed and shall have a cast aluminum housing.
    - a. Handwheel operators shall be provided with a threaded cast bronze lift nut to engage the operating alarm.
    - b. Handwheel operators shall be equipped with roller bearings above and below the operating nut.
    - c. Positive mechanical seals shall be provided above and below the operating nut to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.
    - d. The handwheel shall be removable and shall have a minimum diameter of 15 inches.
  4. Crank-operated gearboxes shall be fully enclosed and shall have cast aluminum or ductile iron housing.
    - a. Gearboxes shall have either single or double gear reduction depending upon the lifting capacity required.
    - b. Gearboxes shall be provided with a threaded cast bronze lift nut to engage the operating stem.
    - c. Bearings shall be provided above and below the flange on the operating nut to support both opening and closing thrusts.
    - d. Gears shall be steel with machine cut teeth designed for smooth operation.
    - e. The pinion shaft shall be stainless steel and shall be supported on ball or tapered roller bearings.

- f. Positive mechanical seals shall be provided on the operating but and the pinion shafts to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.
  - g. The crank shall be cast aluminum or cast iron with a revolving nylon grip.
  - h. The crank shall be removable.
- 5. Pedestals shall be constructed of stainless steel. Aluminum pedestals are not acceptable.
  - a. The pedestal shall be such that the handwheel or pinion shaft on the crank-operated gearbox is located approximately 36 inches above the operating floor.
  - b. Wall brackets shall be used to support floor stands where shown on the Drawings and shall be constructed of stainless steel.
  - c. Wall brackets shall be reinforced to withstand in compression at least two times the rated output of the operator with a 4-lbs effort on the crank or handwheel.
  - d. The design and detail of the brackets and anchor bolts shall be provided by the gate manufacturer and shall be approved by the Engineer. The gate manufacturer shall supply the bracket, anchor bolts and accessories as part of the gate assembly.
- 6. Operators shall be equipped with polycarbonate plastic stem covers.
  - a. The top of the stem cover shall be closed.
  - b. The bottom end of the stem cover shall be mounted in a housing or adapter for easy field mounting.
  - c. Stem covers shall be complete with indicator markings to indicate gate position.
  - d. When shown on the Contract Drawings, provide a 2-inch square nut, mounted in a floor box, with a non-rising stem.
  - e. The square nut shall be constructed of stainless steel.
  - f. The floor box shall be constructed of stainless steel or cast iron and shall be set in the concrete floor above the gate as shown.
  - g. Provide one aluminum or stainless steel T-handle wrench for operation.

## **2.9 ANCHOR BOLTS**

- A. Anchor bolts shall be provided by the gate manufacturer for mounting gates and appurtenances.
  - 1. Quantity and location shall be determined by the gate manufacturer.
  - 2. If epoxy type anchor bolts are provided, the gate manufacturer shall provide the studs and nuts.
  - 3. Anchor bolts shall have a minimum diameter of 1/2-inch.

## **2.10 FIELD TESTING**

- A. After installation, all gates shall be field-tested in the presence of the engineer and Owner to ensure that all items of equipment are in full compliance with this Section. Each gate shall be cycled to confirm that they operate without binding, scraping, or distorting. The

effort to open and close manual operators shall be measured and shall not exceed the maximum operating effort specified above. Electric motor actuators shall function smoothly and without interruption. Each gate shall be water tested by the Contractor, at the discretion of the Engineer and Owner, to confirm that leakage does not exceed the specified allowable leakage.

1. The gate manufacturer shall select the proper gear ratio to ensure that the gate can be operated with no more than a 40-lbs. effort when the gate is in the closed position and experiencing the maximum operating head.
2. An arrow with the word “OPEN” shall be permanently attached or cast onto the operator to indicate the direction or rotation to open the gate.
3. Handwheel operators shall be fully enclosed and shall have a cast aluminum housing.

## **2.11 PAINTING AND FINISHING**

- A. All unmachined surfaces of the cast iron sluice gates and slide gates shall be shop cleaned by shop or sandblasting and painted with one coat of a polyester resin primer.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Installation shall be as shown on the Drawings and in conformance with AWWA Standard C501 for sluice gates.

### **3.2 FIELD TESTING**

- A. After installation, all gates shall be field-tested in the presence of the engineer and Owner to ensure that all items of equipment are in full compliance with this Section. Each gate shall be cycled to confirm that they operate without binding, scraping, or distorting. The effort to open and close manual operators shall be measured and shall not exceed the maximum operating effort specified above. Electric motor actuators shall function smoothly and without interruption. Each gate shall be water tested by the Contractor, at the discretion of the Engineer and Owner, to confirm that leakage does not exceed the specified allowable leakage.

### **3.3 OPERATION AND MAINTENANCE MANUALS**

- A. Prior to or with the delivery of equipment, the manufacturer shall provide copies of an operation and maintenance manual including storage, installation, start-up, operating and maintenance instructions and a complete parts list and recommended spare parts list. The O & M manuals shall be in compliance with the General Requirements.

## **END OF SECTION 352226**

## **SECTION 400630 – PUMP STATION CONTROL PANEL AND REMOTE MONITORING SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. General. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this section.
- B. Related Sections include the following:
  - 1. Division 1 – General Requirements
  - 2. Division 26 – Electrical Specifications
  - 3. Division 46 – Process Equipment

#### **1.2 DESCRIPTION OF WORK**

- A. This specification details the functional attributes for a new PLC based Pump Station logic control panel and requirements for remote monitoring and alarming.
- B. Pump Station Control Panel shall be provided by the Control Panel Supplier and shall be capable of interface with the Telemetry Controller.
- C. Telemetry equipment to fit within an allowance of \$4500.00, covering the cost of parts and labor.

#### **1.3 GENERAL REQUIREMENTS**

- A. The specifications and drawings outline certain characteristics of the monitoring and control system but do not set forth all the details of system design and the various functions and equipment required. All equipment shall be new and complete with all necessary software, accessories, and appurtenances required for a properly operating system including all items recommended by respective manufactures and not herein specified.
- B. The Contractor shall assume complete system responsibility and provide all necessary coordination with any and all subcontractors, including control panel builder/ supplier and instrumentation supplier.
- D. The Contractor shall coordinate the work for the installation, interconnection, testing, and calibration of the instruments. The contractor shall be responsible for assuring that this equipment properly meets the functional intent of the specifications. Substitutions on functions specified are subject to review and approval.

## **1.4 EXCEPTIONS AND ALTERNATIVES**

- A. The manufacturer shall offer a system in accordance with this specification. No exceptions written or implied will be made and the vendor shall be capable of meeting this specification as written.
- B. Should any of the specified manufacturers offer alternatives, equipment or materials, he shall do so in accordance with the specifications and he shall, through the shop drawing approval, list each alternative separately defining the advantages of the alternative and the impact on the overall system configuration. The manufacturers shall provide proof that the use of alternatives would improve control system performance and reduce operating and maintenance costs.

## **1.5 QUALITY ASSURANCE**

- A. Codes and Standards. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with the plans and as specified herein.
  - 1. National Electrical Manufacturers Association (NEMA) Compliance.
  - 2. National Electric Code (NEC) Compliance.
  - 3. Instrument Society of America (ISA).
  - 4. Institute of General Construction and Electronic Engineers (IEEE).
  - 5. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with provisions of UL safety standards pertaining to process controller equipment. Provide products and components which have been UL listed and labeled.

## **1.6 EXPANDABILITY**

- A. The system proposed shall be a standard (off-the-shelf) system that is configurable to provide for minor changes and additions during manufacturing, installation, and commissioning phases, and on site by the Owner's operating personnel.

## **1.7 SUBMITTALS**

- A. Submit shop drawings in accordance with specifications.
- B. Drawings of equipment to be supplied shall include, as minimum, overall dimensional details for the control panel including installation arrangements and door mounted operator devices including nameplate designations; complete internal and field wiring diagrams; specific installation wiring responsibilities shall be identified.
- C. Input/output drawings shall indicate terminal numbers and signal identification name.

- D. The software submittal shall cover the detailed control algorithms, process graphic displays, and register mapping for remote variable monitoring.

## **1.8 TESTING AND TRAINING REQUIREMENTS**

### **A. Job Site Demonstration**

- 1. Following final installation and calibration of the system, the Contractor shall perform a demonstration of system performance. Satisfactory performance shall require the system to perform control functions, monitoring and display functions, and alarming, for a period of not less than one (1) month of continuous operation. During this demonstration, any system failure or software-related problem shall be corrected and the demonstration resumed. Acceptance of the control system by the Owner shall require that the system operates continuously for a period of one (1) month without non-field or field repairable hardware or software interruption. Substantial completion shall not be awarded until after the Contractor has successfully completed the above required test.

### **B. Training**

- 1. The Contractor shall include at the site, operator and maintenance training for the department personnel for two one-day periods, one day after initial startup and one day at a later date, after the system has been in operation. The training shall include system operation, programming procedures for the HMI, the input/output subsystem, peripheral devices, troubleshooting, and hands-on instructions.

### **C. System Calibration and Start-up**

- 1. The Contractor shall provide the initial calibration and startup of the control system by providing personnel to perform the following:
  - a. Supervise the installation and verify the final connections of all signal and power wiring to and from the control system.
  - b. Perform all hardware calibration and diagnostic tests, and make all necessary equipment connections.
  - c. Perform all configuration system tests, including diagnostics.
  - d. Perform the acceptance test as described in the “Job Site Demonstration” section of this specification.
  - e. Test the operation of the Communications Control System and Input/Output Subsystem.



## **1.9 OPERATION AND MAINTENANCE MANUALS**

- A. The Contractor shall furnish, clear, typewritten, easy-to-understand, tightly bound, hard cover instruction manuals for daily operation and maintenance of system. Specifically, the manuals shall contain explicit instructions and well-diagrammed procedures for process operations, loop tuning, and systems maintenance. The instruction manuals shall include as a minimum the following information.
1. Photographs and data sheets of major system components.
  2. Input/Output terminal diagrams.
  3. Logic and block diagrams.
  4. Manufacturer published operation and maintenance instructions on all equipment.
  5. Description of systems operation.
  6. Configuration language description.
  7. Names, addresses, and telephone numbers of local equipment manufacturer representatives for each device in the system.

## **1.10 FUNCTIONAL DESCRIPTION – PUMP STATION OPERATION**

- A. Storm Water Pumps: The pumps are controlled by VFDs in the Motor Control Center. Each pump will have a Hand-Off-Auto switch to enable local control in Hand mode. In Auto mode the Starters will receive run commands from the Pump Station Control Panel in regular or emergency modes of operation.
1. In regular mode of operation, the pump station control panel shall use the input from the level sensor to initiate pump start/stop as follows (all values shall be adjustable, elev. in ft):
    - a. 560.50 – Pump Shutoff
    - b. 563.50 – Lead Pump Start
    - c. 565.50 – Lag Pump Start
    - d. 566.50 – Lag 2 Pump Start
    - e. 567.00 – High Level Alarm
    - f. Automatic and adjustable alternation of Lead/Lag/Lag2 pump assignment shall allow for equalization of pump run times.
    - g. It shall be possible to manually toggle the “Out of Service” status within the controller system for any of the pumps, to temporarily exclude it from rotation.
  2. Should the level sensor or the primary pump station controller fail, the back-up control circuit will be activated, once the High-High Level Alarm Float is triggered.
    - a. Under the emergency back-up control, adjustable timers will be used to start and stop pumps, per the control schematic.

## **1.11 FUNCTIONAL DESCRIPTION – REMOTE MONITORING AND ALARMING**

- A. Remote monitoring and alarming of the pump station shall be provided by the Telemetry Supplier: Data-Command of Akron Ohio.
- B. Telemetry Panel shall be stand-alone or part of the Control Panel.
- C. Telemetry panel shall include cellular modem (Cloudgate or equal) and data contract to transmit data to the service provider's server.
- D. Pump station operational data (real time and historical) shall be available to the operator through a web browser based interface. The following parameters shall be available for monitoring and trending (trending graphs for multiple parameters shall be able to be combined on a single graph):
  - 1. Pump Run Status (3 pumps)
  - 2. Pump Fault Status (3 pumps)
  - 3. Totalized Pump Run Times (3 pumps)
  - 4. Normal Power Availability
  - 5. Wet Well Level
  - 6. High Level Float Status
- E. The following alarms shall be transmitted to the operator via phone call, e-mail, and SMS text messages (SMS optional).
  - 1. Power Outage
  - 2. Main Pump Fault
  - 3. Primary Level Control System Fault

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM HARDWARE**

- A. General Panel Requirements
  - 1. Panel shall be completely fabricated, equipment installed, and wired in the manufacturer's factory. All wiring shall be completed and tested prior to shipment. All external connections shall be by way of numbered terminal blocks. Panels shall be UL listed, standard construction, as manufactured by Hoffman or approved equal.
  - 2. In addition to all NEMA standards, the panel shall conform to NEC Article 409 and to the following requirements:
    - a. Minimum metal thickness shall be 14-gauge.
    - b. All doors shall be rubber-gasketed with continuous hinge.

**B. Power Distribution Within Panel**

1. Panel will be provided with a 120 VAC, 60 Hz feeder circuit from the associated circuit breaker distribution panel provided under Electrical. Make provisions for feeder circuit conduit entry and provide a terminal board for termination of the wires. Panel shall have a surge protection device.
2. Provide master circuit breaker and a circuit breaker on each individual circuit distributed from the panel as shown. The circuit breakers shall be grouped on a single subpanel. Provide subpanel placement so that there is a clear view of and access to the breakers when the door is open. Opening the main breaker will interrupt all 120 VAC circuits (there shall be no 120 VAC on terminal blocks from remote devices).

**C. Wiring**

1. All electrical wiring shall be in accordance with the applicable requirements of the NEC. Wires shall be 600-volt class, PVC insulated stranded copper and shall be of the sizes required for the current to be carried, but not below 12 AWG enclosed in either sheet metal raceway or plastic wiring duct. Wiring for 4 – 20 mA signal circuits shall be twisted shielded pairs not smaller than No. 18 AWG, and be separated at least 6 inches from any power wiring.
2. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks.
3. All panel wiring shall be routed in plastic raceway as manufactured by Carlon or equal.

**D. Terminal Blocks**

1. Terminal blocks shall be one-piece molded plastic blocks with screw type terminals and barriers rated for 300 volts. Terminals shall be double sided and supplied with removable covers to prevent accidental contact with live circuits. Terminals shall have permanent, legible identification, clearly visible with the protective cover removed.
2. Wires shall be terminated at the terminal blocks with crimp type, pre-insulated, ring-tongue lugs. Lugs shall be of the appropriate size for the terminal block screws and for the number and size of the wires terminated.
3. Terminal blocks shall be Allen-Bradley Bulletin 1492, Style CD-3 or approved equal.

**E. PLC**

1. The PLC shall include memory and software to allow customer configurable programming in the field.
2. The PLC shall perform all online local control functions by means of a control program maintained within the unit's memory.
3. Supply sufficient number of I/O modules per the approved I/O schedule plus 10% spare capacity. All analog inputs shall be fully isolated

differential types, capable of rejecting General Construction interference normally associated with industrial equipment including, but not limited to, transformers, motor starters contactors, and General Construction heaters. The analog outputs shall be configured for current loop operation (4 – 20 mA).

F. Operator Interface:

1. Provide panel mounted display and controls capable of displaying alarm list and process parameters and allowing the operator to adjust operation.

H. Battery Charger / DC UPS module

1. Max ratings: 30 VDC Input Voltage; 10 A at 14 VDC load current
2. Diode protected for reverse and overvoltage conditions
3. As manufactured by Transtronics (BVUPS24) or equal

I. Sealed Lead-Acid Battery

1. Rating: 12 VDC; 7Ah
2. Float Voltage: 13.8 VDC
3. As manufactured by Transtronics (BAT12V7AH) or equal

J. Power Supply

1. 120 VAC Input; 24 VDC Output
2. Transient Surge Protection via Varistor
3. As manufactured by Phoenix Contact (MACX) or equal

## 2.2 APPROVED MANUFACTURERS

A. Multitrode – MultiSmart Controller – Customized

1. Supplier – Buckeye Pumps, Galion OH – John Miller

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Prior to all work of this section, carefully inspect the existing facilities and install work of all other trades and verify that all such work is complete to the point where installation may properly commence.
- B. The equipment shall be installed in accordance with the control panel supplier's instruction and located as shown on the drawings, or as approved by the Engineer. Local General Construction shutoffs for power supplies to equipment shall be provided.

C. Discrepancies:

1. In the event of a discrepancy, immediately notify the Engineer.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies are have been fully resolved.

### **3.2 EXECUTION**

- A. The contractor shall furnish the services of the serviceman, all special tools, calibration equipment and labor required for the following:
1. Checking the installation of all components before power is applied.
  2. Placing the software and hardware into operation and making necessary adjustments.
- B. Should the equipment fail to operate in accordance with the specifications and manufacturer's data, corrective measures shall be taken by the contractor or the defective equipment shall be removed and replaced with equipment which will satisfy the specified conditions.
- C. When all required approvals of this portion of the work have been obtained, and at a time designated by the Owner, thoroughly demonstrate to the Owner's personnel the operation and maintenance of all items installed under the work of this section.

### **3.3 INSPECTION**

- A. Installation: Supervision and assistance to ensure that proper procedures are following during installation of the system.
- B. Start-up: Energize and verify correct and satisfactory operation of all components of the system. This operation shall include verification of the accuracy of all inter-equipment wiring.
- C. System Commissioning: Calibrate and place into operation the complete system. The validity of all data base information in the system shall be checked and corrected as part of this operation. Calibration of all process control loops external to the equipment being supplied by other equipment suppliers will be the responsibility of the System Integrator prior to system commissioning.

### **END OF SECTION 400630**

## **SECTION 402336 - PIPES AND PIPE FITTINGS**

### **PART 1 - GENERAL**

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

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is Division-15 Basic Materials and Methods section, and is part of each Division-15 section making reference to pipes and pipe fittings specified herein.

#### **1.2 DESCRIPTION OF WORK:**

- A. Extent of pipe, tube, and fittings required by this section is indicated on drawings and/or specified in other Division-15 sections.
- B. Types of pipe, tube, and fittings specified in this section include the following:
  - 1. Steel Pipes.
  - 2. Grooved Piping Products.
  - 3. Miscellaneous Piping Materials/Products.
- C. Pipes and pipe fittings furnished as part of factory- fabricated equipment, are specified as part of equipment assembly in other Division-15 sections.

#### **1.3 QUALITY ASSURANCE:**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
  - 1. Welding: Quality welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping work.

- a. Certify welding of piping work using Standard Procedure
2. accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.
3. NSF Labels: Where plastic piping is indicated to transport potable water, provide pipe and fittings bearing approval label by National Sanitation Foundation (NSF).

#### **1.4 SUBMITTALS:**

- A. Product Data: Submit manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing Manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.
- B. Welding Certifications: Submit reports as required for piping work.
- C. Brazing Certifications: Submit reports as required for piping work.
- D. Maintenance Data: Submit maintenance data and parts lists for each type of mechanical fitting. Include this data, product data, and certifications in maintenance manual; in accordance with requirements of Division 1.

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

- A. Except for concrete, corrugated metal, hub-and-spigot, clay, and similar units of pipe, provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packing with durable, waterproof wrapping.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

- B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

## **2.2 STEEL PIPES AND PIPE FITTINGS**

- A. Cast-Iron Threaded Fittings: ANSI B16.4.
- B. Malleable-Iron Threaded Fittings: ANSI B16.3; plain or galvanized as indicated.
- C. Malleable-Iron Threaded Unions: ANSI B16.39; selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated.
- D. Threaded Pipe Plugs: ANSI B16.14.
- E. Steel Flanges/Fittings: ANSI B16.5, including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.
  - 1. Material Group: Group 1.1.
  - 2. End Connections: Buttwelding.
  - 3. Facings: Raised-face.
- F. Steel Pipe Flanges for Waterworks Service: AWWA C207.
- G. Corrosion-Resistant Cast Flanges/Fittings: MSS SP-51, including bolting and gasketing.
- H. Forged-Steel Socket-Welding and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe.
- I. Wrought-Steel Buttwelding Fittings: ANSI B16.9, except ANSI B16.28 for short-radius elbows and returns; rated to match connected pipe.
- J. Yaloy-Steel Buttwelding Fittings: ASTM A 714.
- K. Stainless-Steel Buttwelding Fittings: MSS SP-43.
- L. Cast-Iron Threaded Drainage Fittings: ANSI B16.12.
- M. Forged Branch-Connection Fittings: Except as otherwise indicated, provided type as determined by Installer to comply with installation requirements.
- N. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1-1/2", and where pipe size is less than 1-1/2", and do not thread nipples full length (no close-nipples).



## **2.3 CAST IRON PRESSURE PIPES AND PIPE FITTINGS**

- A. Ductile-Iron Pipe: ANSI A21.51; AWWA C151.
- B. Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water: ANSI A21.4; AWWA C104.
- C. Polyethylene Encasement for Gray and Ductile Cast-Iron Piping: ANSI A21.5; AWWA C105.

## **2.4 GROOVED PIPING PRODUCTS**

- A. General: As Installer's option, mechanical grooved pipe couplings and fittings may be used for piping systems having operating conditions not exceeding 230 deg F (110 deg C), excluding steam piping and any other service not recommended by manufacturer, in lieu of welded, flanged, or threaded methods, and may also be used as unions, seismic joints, flexible connections, expansion joints, expansion compensators, or vibration reducers.
- B. Coupling Housings: Malleable iron conforming to ASTM A 47.
- C. Coupling Housings: Ductile iron conforming to ASTM A 536.
- D. Coupling Housings Description: Grooved mechanical type, which engages grooved or shouldered pipe ends, encasing an elastomeric gasket which bridges pipe ends to create seal. Cast in two or more parts, secure together during assembly with nuts and bolts. Permit degree of contraction and expansion as specified in manufacturer's latest published literature.
- E. Gaskets: Mechanical grooved coupling design, pressure responsive so that internal pressure serves to increase seal's tightness, constructed of elastomers having properties as designated by ASTM D 2000.
  - 1. Water Services: EDPM Grade E, with green color code identification.
  - 2. Other Services: As recommended by Manufacturer.
- F. Bolts and Nuts: Heat-treated carbon steel, ASTM A 183, minimum tensile 110,000 psi.
  - 1. Exposed Locations: Tamper resistant nuts.
- G. Branch Stub-Ins: Upper housing with full locating collar for rigid positioning engaging machine-cut hole in pipe, encasing elastomeric gasket conforming to pipe outside diameter around hole, and lower housing with positioning lugs, secured together during assembly with nuts and bolts.
- H. Fittings: Grooved or shouldered end design to accept grooved mechanical couplings.
  - 1. Malleable Iron: ASTM A 47.
  - 2. Ductile Iron: ASTM A 536.

3. Fabricated Steel: ASTM A 53, Type F for 3/4" to 1-1/2"; Type E or S, Grade B for 2" to 20".
  4. Steel: ASTM A 234.
- I. Flanges: Conform to Class 125 cast iron and Class 150 steel bolt hole alignment.
1. Malleable Iron: ASTM A 47.
  2. Ductile Iron: ASTM A 536.
- J. Grooves: Conform to the following:
1. Standard Steel: Square cut.
  2. Lightweight Steel: Roll grooved.
  3. Cast Iron: Radius cut grooved, AWWA C606.
- K. Manufacturer: Subject to compliance with requirements, provide grooved piping products of one of the following:
1. ITT Grinnell Corp.
  2. Stockham Valves & Fittings, Inc.
  3. Victaulic Co. of America.

## **2.5 MISCELLANEOUS PIPING MATERIALS/PRODUCTS:**

- A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.
1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
- B. Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated.
- C. Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code.
1. Manufacturer: Subject to compliance with requirements, provide piping connectors of the following:
    - a. Fernco, Inc.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently- leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance.
  - 1. Comply with ANSI B31 Code for Pressure Piping.
- B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of building; limit clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.
- C. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.

### **3.2 PIPING SYSTEM JOINTS**

- A. General: Provide joints of type indicated in each piping system.
- B. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- C. Weld pipe joints in accordance with ASME Code for Pressure Piping, B31.
- D. Weld pipe joints in accordance with recognized industry practice and as follows:
  - 1. Weld pipe joints only when ambient temperature is above 0 deg F (-18 deg C) where possible.

2. Bevel pipe ends at a 37.5 deg angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.
  3. Use pipe clamps or tack-weld joints with 1" long welds; 4 welds for pipe sizes to 10", 8 welds for pipe sizes 12" to 20".
  4. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non-metallic inclusions.
  5. Do not weld-out piping system imperfections by tack- welding procedures; refabricate to comply with requirements.
  6. At Installer's option, install forged branch-connection fittings wherever branch pipe is indicated; or install regular "T" fitting.
  7. At Installer's option, install forged branch-connection fittings wherever branch pipe of size smaller than main pipe is indicated; or install regular "T" fitting.
- E. Weld pipe joints of steel water pipe in accordance with AWWA C206.
- F. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.
- G. Hubless Cast-Iron Joints: Comply with coupling manufacturer's installation instructions.
- H. Grooved Pipe Joints: Comply with fitting manufacturer's instructions for making grooves in pipe ends. Remove burrs and ream pipe ends. Assemble joints in accordance with manufacturer's instructions.

### **3.3 PIPING INSTALLATION**

- A. Install drainage piping (perforated, porous or tile) from lowest end of slope to highest, solidly bedded in filtering or drainage fill. Shape bed for bells of piping (if any). Place bells/hubbs and grooved ends of units up-stream. Lay perforated pipe with perforations down.
- B. Install gray and ductile cast-iron water mains and appurtenances in accordance with AWWA C600.

### **3.4 CLEANING, FLUSHING, INSPECTING**

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.
  1. Inspect pressure piping in accordance with procedures of ASME B31.

### **3.5 PIPING TESTS**

- A. Test pressure piping in accordance with ASME B31.
- B. General: Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.
  - 1. Required test periods is 2 hours.
  - 2. Test long runs of Schedule 40 pipe at 150 psi, except where fittings are a lower Class or pressure rating.
  - 3. Test each piping system at 150% of operating pressure indicated, but not less than 25 psi test pressure.
  - 4. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.
- C. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
- D. Drain test water from piping systems after testing and repair work has been completed.

### **END OF SECTION 402336**

**SECTION 409123.39 – LEVEL SENSORS AND TRANSMITTERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to work of this section.

**1.2 DESCRIPTION OF WORK**

- A. This Section includes furnishing and installing level type sensors and transmitters. This section also includes the furnishing of necessary start-up services and training of plant operating personnel in operation and maintenance of equipment.
- B. It is the intent of this contract that the final installation shall be complete in all respects and the Contractor shall be responsible for minor details and any necessary special construction not specifically included in the Drawings or Specifications.
- C. Refer to Special Provisions for specific requirements.

**1.3 QUALITY ASSURANCE**

- A. All work performed under this section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

**1.4 STANDARDIZATION**

- A. All equipment shall be of the latest and most modern design. All sensor/transmitter assemblies, of the same type, shall be of the same manufacture and general mold type.

**1.5 SUBMITTALS**

- A. The level sensor and the level transmitter shall have an identifying tag (white plastic with black letters engraved on it) mounted on each piece of equipment with the following information:
  - 1. Manufacturer's name
  - 2. Part number
  - 3. Serial number
  - 4. Tag number
  - 5. Calibrated range

## **PART 2 - PRODUCTS**

### **2.1 RESPONSIBILITY AND COORDINATION**

- A. Under this Contract, the Contractor shall be responsible for the purchase, storage, and installation of all level sensors, transmitters and local indicators. Each device shall be completely wired, tested, and be suitable for operation. Conduit and signal wiring for each device shall be installed between each converter and terminals at the designate area panel or as shown on the drawings. The drawings and specifications are intended to illustrate and define the equipment installation; however, the Contractor shall be responsible for all the details which may be necessary to properly install, adjust and place in operation the complete installation. The Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the specifications.
- B. The level sensors and the level transmitters. And level switches provided under this Contract shall conform to the following specifications unless otherwise noted on the instrument schedule.

### **2.2 CAPACITANCE TYPE LEVEL SENSOR AND TRANSMITTER**

- A. Capacitance Type Level Sensor and Transmitter
  - 1. Sensor Operating Principle
    - a. The instrument measures the resistance and capacitance between the level probe (installed in a media) and the vessel electrical ground. The signal measured is proportional to the length of the probe inserted in the liquid.
    - b. The operation of the system shall not be affected by any type of buildup or coating on the probe.
  - 2. Construction
    - a. For all conductive liquid (or media), an insulated type probe shall be used. The insulating material shall be Teflon. Other wetted parts (like mounting flange) shall be made of 316SS or other corrosion resistant material. The probe shall be sufficient strength and rigidity to withstand the process environment. In case of a circular cross-section probe, the immersion length of the probe shall be at least 3/4 in. in diameter. The probe length shall be as specified in the instrument schedule. The probe head shall be designed to accept standard 1-inch NPT mounting bracket or standard flange.
    - b. The junction box or conduit used with the probe for electrical connection shall be NEMA 4 construction and suitable for wall mounting.
  - 3. Mounting: The Contractor shall provide necessary mounting hardware to complete the installation.
  - 4. Operating Temperature: -40°F to +140°F

**B. Transmitter**

1. Operating Principle: The transmitter measures the resistance and capacitance between the probe inserted in the liquid and the ground and converts it to an electrical signal.
2. Enclosure: It shall be a NEMA 12 construction suitable for wall mounting, or as specified under Special Provisions.
3. Power Supply: The transmitter shall be supplied with 120 VAC, 60Hz, single phase.
4. Operating Temperature: -40°F to +140°F
5. Safety Requirements: If the instrument fails to provide a signal, it shall provide an output to indicate with low or high level.
6. All calibrating adjustment knobs shall be accessible for field calibration and shall be adjustable over the entire range.
7. Output: 4-20 ma DC, isolated and direct acting into 0-600 ohms. If indicated in the instrument schedule, provide output relay contacts, DPDT, rated at 5 amps, 120 VAC.
8. Terminal Points: Units shall be provided with terminal points to facilitate field wiring.
9. Conduit Connection: 1/2 inch

**C. Sensor and Transmitter Performance**

1. Range: As indicated in the schedule
2. Accuracy: Plus or minus 1% of full scale
3. Linearity: Plus or minus 0.5% of full scale
4. Repeatability: Plus or minus 0.5% of full scale
5. Distance: Maximum distance between sensor and transmitter shall be 15 feet

**D. Indicator: If indicated in the schedule, an indicator to indicate the level, integral to the transmitter, shall be provided. It shall be calibrated in the units specified in the schedule/data base. Accuracy of the indicator shall be plus or minus 2% full scale.****E. Manufacturer: Endress Hauser, Drexelbrook or equal****2.3 POINT LEVEL MEASUREMENT, CAPACITANCE TYPE**

- A. Operating Principle: The level switches shall measure the resistance and capacitance between the probe inserted in the liquid and the ground converts it to a convert it to a contact output.
- B. Enclosure: The enclosure shall be NEMA 4 construction suitable for wall mounting or as specified in the Instrument Schedule.
- C. Power Supply: 120 VAC, 60 HZ, Single Phase
- D. Operating Temperature: -40°F to +140°F



- E. Safety Requirements: The relay shall be de-energized when the probe is covered with the process liquid.
- F. The setpoint shall be field adjustable over the entire range.
- G. Output: DPDT contacts rated at 5 amps 120 VAC. Contact position to be indicated by a lighted LED when the relay is energized.
- H. Terminal Points: The units shall be provided for power and control wiring connection.
- I. Conduit Connections: 1/2-inch
- J. Manufacturer: Endress Hauser, Drexelbrook or equal

## **2.4 HYDROSTATIC PRESSURE TYPE LEVEL DETECTOR**

- A. Operating Principle
  - 1. Provide a level sensing device which shall operate on the Principle of Hydrostatic Pressure.
- B. The level detector shall consist of a transducer mounted in a wetwell, a signal conditioner and transmitter assembly, mounted as specified and interconnecting cable. The transducer and cable shall be suitable for submergence in raw waste water. The transducer shall be vented to the atmosphere through the transducer cable. The sensor cable shall be terminated in a NEMA 4X stainless steel outdoor weatherproof junction box to facilitate sensor change out. The Contractor shall supply all special cables from the junction box to the transmitter unit.
- C. The PVC sensor housing shall be filled with silicone to protect the element. The transducer shall be mounted to the end of the threaded flexible PVC pipe and shall be attached to a weighted stainless steel chain or cable with all necessary mounting hardware to be provided. The thread size requirement shall be by the manufacturer. The bottom of the transducer shall be mounted 2 inches from the top of the suction pipe.
- D. The transmitter shall be of solid state construction and shall be enclosed in NEMA 4 enclosure, or as specified in Instrument Schedule; with a local indicator, calibrated in feet of water. The meter shall be visible through a transparent glass or plastic window. The enclosure shall be suitable for wall mounting.
- E. The transmitter shall output an isolated 4-20 made signal, in direct proportion to the level, into a load impedance of at least 650 ohms. The transmitter shall have an accuracy of +1% of full scale, or better. Repeatability shall be +0.5%.
- F. The power supply to the transmitter shall be from 120VAC, 60 Hz, single phase power source. Conduit connections shall be 1/2 inch. Provide terminal strip for field wiring.

- G. Include all required equipment needed to provide signal hook-up compatibility.
- H. The level sensor and transmitter shall be manufactured by Magnetoelastic Devices, Inc. (MDI), Ametek, or equal.

## **2.5 FLOATS, SWITCHES**

- A. The level detecting devices shall be at least 5-1/2 diameter or better, PVC or polypropylene float with a mercury switch inside and flexibly supported by a PVC jacketed heavy duty cable.
- B. The float switch shall have a 20-am rating at 120 Vac. The float switch shall close on rising level. Provide one SPDT relay per float switch, with 20-amp rating at 120 VAC-mounted in junction box, or as specified in Special Provisions.
- C. A weatherproof cast aluminum junction box with terminal strips shall be provided for power, float switch and relay connections.
- D. The floats shall be mounted on one (1) inch PVC pipe, using 316 stainless steel clamps. The PVC pipe shall be clamped to the wall using 316 stainless steel clamps. The length of the pipe and float cable shall be sized by the Contractor.
- E. The floats shall be manufactured by Anchor Scientific Company, Consolidated Electric Company or equal.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S SERVICES**

- A. The level sensor and transmitter manufacturer shall provide the services of a qualified service engineer to supervise and inspect the equipment installation to insure that it is installed in accordance with the manufacturer's recommendations.
- B. The manufacturer's service engineer shall field calibrate all equipment specified under this section. This service shall be performed at the request of the Project Engineer at the time of complete plant start-up at the end of the last construction contract. A calibration certificate shall be submitted to the Project Engineer for each piece of equipment. The service engineer shall also make all adjustments necessary to place the equipment in trouble-free operation. In addition, the equipment manufacturer shall provide a qualified manufacturer's service engineer to train the plant operating personnel in the proper care, repair, calibration and operation of the equipment. This service shall be provided at the location and time requested by the Owner.
- C. Install equipment in accordance with approved shop drawings and manufacturer's recommendations, and as shown on the Drawings and specified herein.

- D. Notify the Engineer immediately of all unsatisfactory conditions or discrepancies. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
- E. The Contractor shall be responsible for furnishing and placing all anchorage systems including bolts, nuts, washers, gaskets, and any other items necessary for the proper installation of the equipment. The Contractor shall coordinate with the manufacture in identifying proper size and locations of all anchorage.

### **3.2 INSTALLATION**

- A. The probe installation shall be isolated from vibration and possible physical damage. It shall not be mounted in the direct stream of process fluid. If required, use a deflecting baffle in front of the probe in the direction of flow. The probe shall be easily removable for cleaning or maintenance.
- B. The probe shall be wired using a manufacturer's recommended flexible cable to a junction box close to the probe to facilitate withdrawal of the probe for maintenance. The wiring from the junction box to the transmitter shall be done using manufacturer's recommended wires and rigid conduit.

### **3.3 OPERATION AND MAINTENANCE MANUALS**

- A. Prior to or with the delivery of equipment, the manufacturer shall provide copies of an operation and maintenance manual including storage, installation, start-up, operating and maintenance instructions, and a complete parts list and recommended spare parts list. The O & M Manuals shall be in compliance with the general requirements.

### **3.4 SPECIAL TOOLS AND EQUIPMENTN**

- A. The following shall be provided as part of the equipment package:

1. One (1) spare transmitter chassis

### **3.5 SPECIAL PROVISIONS**

- A. Instrument Schedule:

Tag No.	Description	Probe		Calibration			Relay			Enclosure & Mounting
		Length		Low	Hi	Unit	Ind	Hi	Low	

**END OF SECTION 409123.39**

## **SECTION 432139 – SUBMERSIBLE PUMPS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. The work covered by this Section shall include the furnishing all labor, materials, transportation, tools, supplies, equipment and appurtenances, unless hereinafter specifically excepted, necessary for the complete and satisfactory installation of submersible pumps.
- B. It is the intent of this Section that the final installation be complete in all respects. The Contractor shall be responsible for minor or specific details, coordination with trades, equipment manufacturing, installation and start-up services, and any special construction not specifically included in the Drawings or Specifications.
- C. The work shall include, but is not limited to, three (3) 60 HP submersible pumps.

#### **1.2 RELATED DOCUMENTS**

- A. All Division 1 Sections
- B. Section 402336 – Pipe Joints
- C. Section 402336 – Cast Iron/Ductile Iron Fittings
- D. Section 402336 – Ductile Iron Pipe
- E. Section 099700 – Special Coatings

#### **1.3 REFERENCES**

- A. ASTM A-48 Standard Specification for Gray Iron Castings
- B. IEEE Std 112 Standard Test Procedure for Polyphase Induction Motors and Generators
- C. NEC Article 500 Hazardous (Classified) Locations
- D. NEMA MG-1 Motors and Generators
- E. SSPC SP-1 Solvent Cleaning
- F. SSPC SP-10 Near- White Blast Cleaning

## 1.4 DEFINITIONS

- A. B-10 (or L-10) Bearing Life: The statistical probability that ten percent (10%) of the population of similarly rated bearings will fail within the specified hours in a perfect environment.
- B. BEP: Best Efficiency Point.
- C. Nitrile: Buna-N.
- D. NPSH – Net Positive Suction Head: The absolute pressure plus velocity head, determined at the suction nozzle and corrected to datum, less vapor pressure, all expressed in feet of liquid.

## 1.5 SUBMITTALS

- A. Product Data: Submit a one-page summary listing the following information:
  - 1. Manufacturer: Pump and motor
  - 2. Pump: Weight
  - 3. Casing: Material
  - 4. Motor Jacket: Material
  - 5. Casing Bolts and Nuts: Material
  - 6. Impeller: Materials, design, coating
  - 7. Wear ring: Number, location, material
  - 8. Shaft: Material, diameter, length
  - 9. Mechanical Seals: Type, upper and lower seal materials, spring material, O-ring material, other material of construction
  - 10. Motor: Type, NEC Article 500 rating, insulation class, service factor, continuous duty ambient temperature, starts per hour
  - 11. Thermal Switches: Number, temperature setting
  - 12. Float Switch: Type, material
  - 13. Coatings: Primer type, finish type, number of coats, total dry film thickness, suitability for media being pumped
  - 14. Guide System: Type, size, material
  - 15. Pressure gauges
  - 16. Minimum submergence and NPSH required at all design points
  - 17. Spare Parts: Number and type
  - 18. Motor controls, including enclosure, circuit protection, disconnects, starters, transformers, phase monitor, switches, relays and contacts, lights, meters, timers, alternators, strip heater, alarms, and fuses.
- B. Shop Drawings
  - 1. Dimensions of pump, discharge, and guide system.
  - 2. Plan view of pump indicating clearances required for hatch openings.
  - 3. Pump layout, spacing requirements.

4. Motor control ladder diagram.

C. Quality Control Submittals

1. Design Data

- a. Pump performance curves showing head, capacity, speed, efficiency, NPSH required and brake horsepower required.
- b. The pump manufacturer shall submit a copy of the pump's  $L^3/D^4$  calculation.
- c. The pump manufacturer shall submit a copy of the B-10 bearing life calculation for the bearings to be furnished with the pump. The calculation shall list the bearing manufacturer, model number, and bearing type.

2. Test Reports

- a. Five (5) certified copies of all hydrostatic and performance tests on both pump and motor.

3. Installation Reports

- a. The equipment manufacturer shall also submit a written report stating the equipment:
  - 1.) Is properly installed.
  - 2.) Is in accurate alignment.
  - 3.) Is properly lubricated.
  - 4.) Has been tested and operated satisfactorily,

## 1.6 QUALITY ASSURANCE

A. Pump Testing Requirements

1. Hydrostatic Test:

- a. Each pump shall be hydrostatically tested. The test pressure shall be 1.5 times the shut-off head or twice the discharge design head, whichever is greater. The test pressure shall be applied and released in the following sequence:

Test pressure:	30 minutes
Atmosphere pressure:	5 minutes
Test pressure:	5 minutes
Atmosphere pressure:	5 minutes
Test pressure:	5 minutes

- b. The pump unit shall be considered unacceptable if, during the test, the casing exhibits undue deflection or indicates weakness at any point. Sweating

through porous metal in the casing or leaking through gaskets or cracks or other defects shall also be conditions for rejection of the pump during tests.

2. Performance Test:

- a. The manufacturer shall submit a sketch of the proposed test set up, with a detailed description of the proposed testing procedure, at least ten weeks in advance of testing. No test shall be performed until the Engineer approves the test procedure. The result of these factory performance tests shall be considered official and conclusive for the purpose of determining compliance with the specifications. Final acceptance of the pumps and drives will be based on satisfactory operation after installation
- b. A full size, full speed performance test for each pump unit with its specified driver shall be performed to determine head, capacity, speed, efficiency, and brake horsepower at each point specified in the equipment schedule. Readings shall be taken at a minimum of five (5) evenly spaced capacity points including shut-off, design point, best efficiency point, and minimum head for which the pump is designed to operate.
- c. All tests shall be conducted in accordance with the standards of the Hydraulic Institute Test Code, Paragraph 1.6.5.3, Level B.
- d. Predicted data from model tests will not be accepted.
- e. Test data shall be sufficiently comprehensive to produce guaranteed performance curves showing head versus capacity, efficiency, brake horsepower, and current for the rated speed.

B. Motor Testing Requirements

1. Long Test (NEMA MG 1-12.30)

- a. Motors shall be tested in conformance with IEEE Standard 112, Method B. A certified report of the long test on each actual motor proposed to be furnished shall be submitted to the Engineer for acceptance, including motor efficiency curves at 100, 75, and 50 percent of full load.

C. Certifications

D. Field Samples

E. Pre-Installation Conference

## 1.7 ORDERING, DELIVERY, STORAGE, AND HANDLING

- A. Due to the typically long lead times that accompany the production and delivery of the pumps the contractor shall expedite the shop drawing submittal, review and pump ordering process in order to ensure timely delivery of the pumps.
- B. Packing and Shipping

1. The pumping units shall be shipped to the site F.O.B., in a manner designed to protect the pumping units against damage or damaging stress caused by sudden acceleration and deceleration.
2. A recording accelerometer designed to record the magnitude of any sudden impact in all three directions (x,y,z) on continuous strip charts shall be shipped with and affixed to each assembly or its packing crate.

C. Acceptance at Site

1. Upon arrival at the job site, each accelerometer shall be removed in the presence of the manufacturer and/or Engineer. If the charts indicate acceleration in any direction exceeding nine times the force of gravity, then if directed by the engineer, the assembly shall be dismantled and thoroughly inspected for damage incurred during shipment. All damage shall be repaired at no cost to the Owner before the pumping unit and drive assemblies are installed.

D. Storage and Protection

1. The Contractor shall be responsible for provisions to protect the equipment and associated materials prior to and after installation until final acceptance by the Owner. The Contractor shall remove all protective measures at completion and acceptances.
2. Equipment shall be lubricated for storage as recommended by the equipment manufacturer.

## 1.8 PROJECT CONDITIONS

A. Environmental Conditions

1. Pumped Liquid: Storm water
2. Specific Gravity: 1.0

B. Existing Conditions

1. The pumps and appurtenances are to be installed in new construction.
2. The arrangement shown on the Drawings is based upon the best information available to the engineer at the time of design and is not intended to show exact dimensions for any particular equipment shown on the Drawings. It is anticipated that connecting piping and valves shown may have to be modified in order to accommodate the pumps and appurtenances.

C. Field Measurements

1. The contractor shall be responsible for coordinating with the precastor, pipe suppliers, access hatch suppliers, pavers, control system supplier, data command, etc. required to provide a complete and satisfactory installation.



## **1.9 MAINTENANCE**

- A. Maintenance Service.
- B. Spare Parts
  - 1. Provide one set of spare cable(s), cable ends with leads, and appurtenant glands, epoxies, etc., for each installation. The cable(s) shall be as specified herein and shall be sufficient length to be installed on any of the pumps in the installation.
  - 2. For each pump, supply one set of motor bearings, mechanical seals, and complete set of O-rings and gaskets.
  - 3. For each pump, supply one set of wear rings and one spare impeller.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. The same manufacturer shall produce all submersible pumps for this project.
- B. Submersible pumps shall comply with the requirements for NEC Article 500, Class I, Division 1, Groups C and D, hazardous location, explosion proof.
- C. Submersible pumps requiring NPSH in excess of 37.5 feet shall not be acceptable.

### **2.2 PUMP CASING**

- A. The pump casing shall be close-grained gray cast iron ASTM A-48, Class 35B, free from blowholes, sand holes, or other faults. The casing interior shall be smooth and interior casting imperfections shall not be allowed.
- B. All exposed bolts and nuts shall be Type 304 stainless steel.

### **2.3 IMPELLER**

- A. The impeller shall be of ASTM A-532 (Alloy III A) 25% chrome cast iron dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the gray iron impeller shall be hardened to Rc45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden waster. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impellers shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

## **2.4 VOLUTE / SUCTION COVER**

- A. The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. 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 cast of ASTM A-532 (Alloy III A) 25% chrome cast iron and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

## **2.5 SHAFT**

- A. The shaft shall be solid and machined from a 400-Series stainless steel to be selected by the manufacturer or C1045 carbon steel with 452 stainless steel shaft. The pump/motor shaft shall be designed to minimize deflection over the entire operating range of the pump. The manufacturer shall sue the following ratio to compare the shaft length (L) to diameter (D);  $L^3/D^4$ . An acceptable  $L^3/D^4$  ratio shall be equal to or less than 60. The length (L) shall be measured from the center of the impeller to the center of the lower bearing. The outside shaft diameter (D) shall be measured beneath the lower mechanical seal. If the shaft has a sleeve, “D” shall be measured beneath the sleeve. Both L and D shall be measured in inches.

## **2.6 BEARINGS**

- A. The pump motor shaft shall rotate on at least two sets of greased or permanently lubricated anti-friction bearings. The upper and lower motor bearings shall be designed in accordance with the Anti-Friction Bearing Manufacturing Association (AFBMA) and the Annular Bearing Engineers Committee (ABEC) standards. If a pump is supplied with greasable bearings, the pump shall be furnished with fittings to enable regreasing of the bearings without disassembly of the pump or motor housing.
- B. Each bearing shall be designed to have a B-10 service life of at least 50,000 hours based on the axial and radial loads calculated at the shut-off point of the certified pump curve.

## **2.7 MECHANICAL SEALS**

- A. Each pump shall be furnished with two sets of mechanical seals mounted in a rotating tandem configuration. Cartridge type, duplex mechanical seals are acceptable in lieu of rotating tandem type. Each seal set shall have one stationary face and one positively driven face. The lower seal set shall be immersed in the pumpage. The upper mechanical seal set shall operate in an oil bath. The oil bath shall be designed to be easily drained and flushed of particulate matter without disassembly of impeller and casing. The oil

sump shall be designed to prevent vortexing in the sump and overfilling. A vent space shall be provided above the oil bath.

- B. The O-ring elastomers shall be compatible with the pumped liquid. The selected O-ring elastomer shall have a service life equal to or greater than the predicted service life of the wearing surface.
- C. Acceptable Seal Materials:
  - 1. All metal parts shall be 316 stainless steel.
  - 2. Upper or secondary seal rotating and stationary faces shall be combinations of tungsten carbide vs. tungsten carbide.
  - 3. The lower or main seal rotating and stationary faces shall be tungsten carbide vs. tungsten carbide.
- D. The silicon carbide selected for these seals shall be reaction bonded silicon carbide. The tungsten carbide shall be solid with nickel binders.
- E. The O-rings shall be Viton.

## **2.8 MOTOR**

- A. The motor shall be non-overloading over the entire published pump curve and be able to operate at full load with the motor unsubmerged for a minimum of 10 minutes starting from the pump's normal operating temperature with an ambient air temperature of 80°F.
- B. The pump motor shall be inverter duty rated, explosion proof, NEC Article 500 Class 1, Division 1, Groups c and D.
- C. The design shall be an air-filled induction type with a squirrel cage rotor, shell type design, built to NEMA MG-1, design B specifications.
- D. Stator windings shall be copper, insulated with Class F or Class H insulations and heat shrink fitted into the stator housing.
- E. The motor service factor shall be 1.1 minimum, and capable of up to 10 starts per hour.
- F. The motor and pump shall be designed and assembled by the same manufacturer.
- G. The motor shall be designed for continuous duty pumping at a maximum ambient temperature of 104°F.
- H. If cooling is required by the manufacturer to meet the requirements of this article, the jacket material shall be Type 316 stainless steel, Class 30, 35B, or 40.

## **2.9 SENSORS**

- A. Motor over temperature protection shall be provided by thermal switches embedded in the stator lead coils. The thermal switches shall monitor the temperature of each phase winding and shall be set to open at 125°C.
- B. A mechanical float switch located within the stem shall provide mechanical seal failure protection. Should the mechanical seal fail, liquid shall be directed into the float chamber, in which the rising liquid activates the switch. The float switch components shall be stainless steel material.

## **2.10 CABLE/CABLE ENTRY**

- A. The cable and cable entry seal system shall ensure a watertight seal for a submergence depth equal to the depth of the wet well plus five (5) feet. There shall be a minimum of two watertight and submersible seals in series between the environment and the motor interior.
- B. Elastomer grommets, epoxy, and sealed terminal boards are acceptable components of a cable entry system.
- C. The electrical power cable shall be extra hard usage type suitable for Class I, Division 1, Groups C and D, hazardous location, explosion proof

## **2.11 MOTOR CONTROLS**

- A. The Contractor shall furnish all labor, equipment and materials to install pump control centers as shown on the drawings in a stainless steel NEMA 4X enclosure, for operation on a 480-volt, 3-phase, 60 hertz, 3-wire service. For each pump motor, there shall be included: a combination circuit breaker/overload unit providing overload protection; short circuit protection; manual reset and individual disconnect for all phases; across-the-line magnetic contactor; and a 120-volt control circuit transformer with disconnect and overload protection. Each pump starter shall include a phase monitor relay to monitor phase voltage unbalance, incorrect phase sequence and line under-voltage of a three (3) phase system.
- B. If a motor is disabled, e.g. overload, overtemp, or in “off” position, it shall shut down and lock out. If the faulted motor is lead, an induced alternation shall occur. If the faulted motor is lag, the next motor shall automatically substitute. Overload and disconnect functions shall be provided by a single magnetic-hydraulic, temperature-insensitive component.
- C. Units shall be precalibrated to match motor and control characteristics and factor sealed to insure trip setting is tamper-proof; hand/off/automatic pump operation selector switch; provide all necessary auxiliary isolated contacts for alarms and computer interface; pump running pilot lights on operator control plate; running time meters mounted on operator

control plate; a minimum 100-watt strip heater to provide condensation protections; lightning arrestor; and high level alarm with weatherproof alarm light with guard. A delayed start feature shall be incorporated into the control panel preventing simultaneous starting of both pumps upon restoration of power following an outage.

- D. Terminal strips shall be provided, prewired to the pump motor controls, for wet well level float control wiring.
- E. The pump manufacturer shall provide the pump control center.

## **2.12 DISCHARGE COUPLING**

- A. Each pump shall be connected to the discharge line by means of a quick-disconnect sealed flange mounted on the pump and the outlet line. Fittings shall be such that sealing is accomplished by a metal-to-metal watertight contact without bolts, fasteners, or extreme force.
- B. The base elbow shall be manufactured of the same materials as the pump casing. All cast materials shall have smooth surfaces, free from blowholes and sand holts, and other faults.
- C. The discharge case elbow shall be anchored to the floor of the wet well with Type 304 stainless steel anchor bolts. Anchor bolt type, style, and size shall be as recommended by the pump manufacturer for the type of foundation specified or shown on the drawings.

## **2.13 GUIDE SYSTEM**

- A. The pumps shall come complete with sliding brackets, adequately braced type 304L stainless steel schedule 40-pipe guide rail, stainless steel pull chain reaching ground level with lifting rings located every 5 feet of chain.

## **2.14 PAINTING**

- A. All surfaces shall be cleaned of dirt, grease, oil, rust, scale, or other injurious substances. All ferrous metal surfaces shall be prepared in accordance with SSPC-SP-10. Non-ferrous metal surfaces shall be prepared in accordance with SSPC-SP-1.
- B. All metal surfaces that will be partially or wholly submerged shall receive a factory (shop) applied finish paint system. The paint system shall be applied in accordance with the manufacturer's recommendations, be applied in at least two coats and have a total dry film thickness not less than 10 mils. Paint systems shall be specifically suited and designed for use in the media being pumped.
- C. Manufacturers: Tnemec Company, Inc.; Carboline; Kop-Coat and PPG or approved equivalent.

## 2.15 ACCESSORIES

- A. The manufacturer shall supply one (1) liquid filled pressure gauge with snubber diaphragm seals. Liquid shall be silicone, capable of withstanding a temperature range of -30°F to +150°F. Gauge casings shall have a 4-1/2-inch minimum diameter. The gauges shall be stem-mounted and shall operate over a pressure range of 0 to 100 psig.
- B. Gauges shall be a product of H. O. Tretrice, Ashcroft, or equal.
- C. Diaphragm seal shall be a threaded Ametek M&G type 1/4-inch NPT flushing port or approved equivalent.

## 2.16 EQUIPMENT SCHEDULE

- A. Pump(s)

Location:	Jefferson Street
Number Installed:	Three (3)
Impeller Type:	Semi-open, multi-vane, non-clog
Pumped Liquid:	Storm water
Solid Size, at least:	3.68" sphere
Liquid Temperature Range:	N/A to 104°
Min. Hyd. Efficiency @ Pt. #1:	59%
Design Point #1:	5,150 GPM @ 20.5 ft. TDH @ 50 Hz
Design Point #2:	6,800 GPM @ 21.1 ft. TDH @ 60 Hz
Discharge Size:	12 inches
Motor Hp:	60 HP
Maximum Motor Speed:	1170 RPM
Power Requirements:	480 Vac, 3 Phase, 60 Hz.
Mfr. And Model:	Flygt NP 3202 LT3 or Approved Equal
Submergence @ Low Water Elevation:	2.5 ft.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Prior to installation, carefully inspect the fabricated and installed work of all other trades and verify that all such work is completed to the point that this installation may properly commence.
- B. Inspect all parts of the furnished equipment and verify the system may be installed in strict accordance with all pertinent codes and regulations, original drawings, referenced standards, and the manufacturer's recommendations.

- C. Install equipment in accordance with approved shop drawings and manufacturer's recommendations, and as shown on the Drawings and specified herein.
- D. Notify the Engineer immediately of all unsatisfactory conditions or discrepancies. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
- E. The Contractor shall be responsible for furnishing and placing all anchorage systems including bolts, nuts, washers, gaskets, and any other items necessary for the proper installation of the equipment. The Contractor shall coordinate with the manufacture in identifying tproper size and locations of all anchorage.

### **3.2 ACCESSORIES**

- A. The pump discharge line shall be tapped for 1/2-inch gauge connection. The connection shall include a bass shutoff ball valve and necessary lengths of brass pipe to allow mounting of the pressure gauge. The open end on the gauge connection shall be plugged to prevent accumulation of debris.

### **3.3 MANUFACTURER'S FIELD SERVICE**

- A. After installation of the equipment has been completed, a field service mechanic from the pump manufacturer shall inspect and approve the installation, be present at start-up, and instruct the Owner's personnel in the operation and maintenance of the equipment.

### **3.4 LUBRICATION**

- A. As part of the equipment start-up and testing procedures, the Contractor shall service and lubricate the equipment for continuous duty in accordance with the manufacturer's recommendations.

### **3.5 OPERATION DEMONSTRATION**

- A. The Contractor shall make arrangements to demonstrate continuous cooperation of each pump under normal operating conditions for a period of one (1) hour as a final condition of Owner's acceptance and initiation of the correction period. The Contractor shall be responsible for providing temporary recycle piping, pressure gauges, and sufficient sewage and/or water to operate each pump for the prerequisite demonstration period.
- B. After the pumps have been started and placed in operation, amperage readings shall be taken to check for an unbalanced stator winding. If there is a significant difference in the readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator shall be replaced at no additional cost to the Owner.

**END OF SECTION 432139**



## **SECTION 462100 – MANUAL BAR SCREENS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

#### **1.2 DESCRIPTION OF WORK**

- A. This section includes the furnishing and installation of the bypass bar screen and all pertinent accessories, complete and in place, ready for service as shown in the Drawings and described in this section.

#### **1.3 QUALITY ASSURANCE**

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

#### **1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical data and application instructions.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS AND FABRICATION**

- A. Bar screens shall be fabricated from ASTM A 36 steel bars and shapes. Sizes and spacings shall be as shown on the Drawings. The screen shall occupy the full width of the channel in which it is installed. Bars shall be inclined from the horizontal at the angle shown on the Drawings.
- B. Bars shall be firmly anchored to a frame member running along the channel invert and shall additionally be supported by frame members anchored to the channel side walls to provide a rigid unit capable of withstanding the forces generated in a screen blinding condition.
- C. The framework shall be securely anchored to the walls and channel bottom as detailed.

- D. The drainage plate for bar rack screenings shall be fabricated from 1/4-inch steel plate, supported as shown in the drawings.
- E. The entire bar screen assembly shall be galvanized after fabrication in conformance with ASTM A 123. Galvanizing shall be 2.00 oz./sq. ft.

### **PART 3 - EXECUTION**

#### **3.1 RELATED DOCUMENTS**

- A. The bar screens shall be installed at location shown on the drawings.

**END OF SECTION 462100**

# **ADDITIONAL PROJECT SPECIFICATIONS**



# **SPECIFICATIONS FOR CONSTRUCTION**

In general, unless specifically set forth herein, the work, materials, and methods of measurement and payment shall conform to the specifications included herein as well as the applicable divisions and paragraphs (as noted on the Bid Proposal or in the plans) of the most current edition of the:

**State of Ohio  
Department of Transportation**

1. Construction and Material Specifications
2. Construction and Material Supplemental Specifications
3. Standard Construction Drawings



## **HMA PAVEMENT TEXTURING**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

- A. HMA Pavement texturing is defined as a treatment of the surface of Hot Mixed Asphalt (HMA) pavement by imprinting stable, fully compacted HMA pavement with "grid style" or other styles of depressions to replicate, in relief, the concrete grout depressions common to hand-laid brick or cobblestone, or any other design as shown on the drawings or described in the specifications, and coating the imprinted pavement surface using a coating or system of coatings specifically formulated for HMA pavement.
- B. HMA Pavement texturing is highly suitable for virtually anywhere a decorative pavement solution is required. Paved entranceways, parking lots, residential driveways, sidewalks, plazas, medians, and cross-walks are some examples of successful applications of pavement texturing.
- C. Coatings used in the execution of HMA pavement texturing Work are highly specialized and designed to deliver a "balance of performance properties" unique for use on HMA pavement. HMA pavement coatings are only available from qualified pavement coating suppliers who can provide proof of the performance properties of their coatings. Minimum required performance properties are outlined in Section 2.2, Table 1 below.
- D. Metal wire rope templates are used to create the desired imprint pattern. Templates are available only from a qualified template supplier who has the ability to work with the Owner to design, develop and manufacture templates to match almost any pattern.
- E. A qualified HMA pavement coating supplier can provide their coatings in a variety of colors.
- F. A qualified HMA pavement coating supplier can provide coatings with an SRI greater than 29 and therefore qualify for the LEED program under Section SS Credit 7.1 Heat Island Effect: Non-Roof. Contact your qualified coating supplier for details.
- G. Only qualified applicators with experience in the application of HMA pavement texturing work are qualified to perform this work.

#### **1.2 REFERENCES**

- A. ASTM D-4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Tester.
- B. ASTM D-4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abrasion.
- C. ASTM D522-93A Standard Test Method for Mandrel Bend Test of Attached Organic Coatings.
- D. ASTM G-155 QUV Accelerated Weathering Environment. Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.

- E. ASTM D-2486 MEK rub test for chemical resistance.
- F. ASTM D-570 Standard Test Method for water absorption of plastics.
- G. ASTM E-303 British Pendulum test for friction.
- H. EPA 24 ASTM D3960-05 Volatile Organic Compounds.

### **1.3 DEFINITIONS**

- A. "HMA pavement" is Hot Mix Asphalt pavement.
- B. "Qualified Applicator" is a contractor or applicator who has completed HMA pavement texturing work and can provide references upon request.
- C. "Owner" means the Owner and refers to the representative person who has decision making authority for the Work.
- D. "Imprinting HMA pavement" is defined as pressing flexible metal templates into fully compacted, heated HMA pavement to create the appearance of grout lines or patterns in the HMA pavement surface.
- E. "Textured HMA Pavement" is HMA pavement that has been subjected to imprinting or stamping in a specific pattern.
- F. "Non-textured HMA pavement" is HMA pavement that is unstamped and is sometimes referred to as "flatwork".
- G. "Scuffing" of HMA pavement is a "tear" of the HMA pavement caused by an external force. Stationary vehicle tires turning on the pavement surface is a typical cause.

### **1.4 SUBMITTALS**

Submittals to be made available to the Owner upon request are as follows:

- A. A. HMA pavement mix design.
- B. B. Proof in a form suitable to the Owner of contractor ability to install HMA pavement texturing.
- C. C. ASTM Properties and test results of the coating materials.
- D. D. Confirmation of coating color(s).

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS – COATINGS**

Properly designed HMA pavement coatings have been scientifically formulated to provide the optimal balance of performance properties for a durable, long lasting color and texture to HMA



pavement surfaces. Some of these key properties include wear and crack resistance, color retention, adhesion, minimal water absorption and increased friction properties. As well, the HMA pavement coating must be environmentally safe and meet EPA requirements for Volatile Organic Compounds (VOC).

## 2.2 MINIMUM PERFORMANCE PROPERTIES OF HMA COATING

The following table outlines the minimum required performance properties of the HMA pavement surface coating. These performance properties must be ascertained by a Certificate of Analysis issued by an approved testing facility.

**TABLE 1: Required Performance Properties of HMA Pavement Coating**

Characteristic	Test Specification	Measured Result
Durability: Taber Abrasion Resistance	ASTM D-4060 1 day cure, H-10 wheel: cycles (dry)	<1.5 g/1000
Water sensitivity	ASTM D570 Water absorption after 9 days: Remaining absorption after 1 hour of recovery	<10%
		<1.0%
Color stability	ASTM G-155 QUV 2,000 hours (CIE units)	Brick color AE < 1.5
Flexibility: Mandrel Bend	ASTM D522-93A Flexibility as measured by Mandrel bend 0.5mm thick sample passes 10mm at 21°C 0.5mm thick sample passes 125mm at -18°C	
Chemical resistance	ASTM D-2486 Modified MEK scrubs 16 dry mils, number of scrubs until 50% substrate exposed	>5000
Adhesion to Asphalt	ASTM 0-4541	Substrate Failure
Friction Wet	ASTM E-303 British Pendulum Tester	>55
Environmental Sensitivity	EPA 24 ASTM D3960-05 Volatile Organic Compounds	VOC < 150

## 2.3 EQUIPMENT

The following equipment is to be used in the execution of the Work.

- A. Metal templates manufactured from flexible, woven wire rope cut and welded into the patterns as detailed on the drawings, and used for imprinting HMA pavement.
- B. Only equipment that is specifically designed for the re-heating of HMA pavement may be used in the execution of this work. Re-heat equipment must be designed to gently elevate the temperature of the HMA pavement without adversely affecting it. Re-heat equipment must also allow the operator to monitor the temperature of the HMA pavement at all times during the heating process.

- C. Coating spray equipment must be used in the application of the coating and must be capable of applying the coating to the HMA pavement surface in a thin, controlled film which will optimize the drying and curing time of the coating.
- D. Vibratory Plate Compactors shall be used for pressing the wire templates into the heated asphalt to create the specified pattern.

## PART 3 - EXECUTION

### 3.1 GENERAL

The pavement texturing system shall be supplied and installed by a Qualified Applicator In accordance with the plans and specifications or as directed by the Owner. Do not begin installation without confirmation of Applicator certification.

### 3.2 PRE-CONDITIONS — PAVEMENT

A high quality, highly stable HMA pavement is a pre-requisite for the installation of the pavement texturing system.

This Section 3.2 is to be used as a guide towards achieving a high quality HMA pavement. It does not supersede other specifications pertaining to this Work, nor does it replace recommendations made by the engineer of record for this Work.

- A. **Pre-requisites for new HMA pavement:**
  - i. Stable sub-grade or base over which the HMA concrete is laid.
  - ii. Proper mix design.
  - iii. Proper placement and compaction practices.
- B. **Subgrade:** The sub-grade must be stable and should be inspected to identify any areas of soft or yielding soil that are too weak to properly support the paving equipment. These soft spots must be over-excavated and re-compacted to meet the engineer's requirements. Prior to paving, the sub-grade and base courses must be thoroughly and uniformly compacted, properly graded and constructed in accordance with the engineer's specifications. Please refer to the related sections for more exact requirements of this work.
- C. **Guidelines for HMA pavement mix design**

A durable, stable mix design is a pre-requisite for all long-lasting HMA pavement surfaces, especially those that will experience vehicle traffic. The application of a pavement texturing system does not change this requirement. **Generally, the HMA pavement mix design for roadways as prescribed by the local jurisdiction will be sufficient for the application of the pavement texturing system.** Failure to use a stable mix design may lead to premature failure of the HMA pavement such as raveling, rutting or segregation. The appropriate pavement structure is not within the scope of this specification; however, this specification can offer some general guidelines as follows:

- i. Stability is a good general guide: generally, if the surface course design has a minimum Marshall Stability of 10 KN (about 2250 lbs) and design densities are achieved during compaction, the pavement should perform adequately.
- ii. The mix design should include a nominal maximum aggregate size of 12.5mm (1/2"). For clarity, SuperPave defines nominal maximum aggregate size as "one sieve size larger than the first sieve to retain more than 10 percent of the material".
- iii. For locations that will not experience any vehicle traffic, a more "tender" mix design can be used.

**D. Placement of New HMA Pavement**

- i. Successful placement of HMA pavement includes compacting the mix when it is hot and compacting the mix to achieve the specified air voids. Generally, the first pass of the rollers is to be done when the asphalt mixture is at minimum 230°F (110°C); the compaction process must be completed before the in-place temperature of the mixture cools to 185°F (85°C) or higher depending on the type of asphalt and/or modifiers used. For applications that will experience vehicle traffic and wherever it is possible, compaction is to be completed using a paving machine and a self-propelled roller.
- ii. Handwork, which includes placing and spreading by hand and the use of hand operated compaction equipment, should be restricted to areas that cannot be accessed by the paving machine or the self-propelled rollers. Compaction must be completed when the pavement is hot as described above. Handwork is to be done carefully and the material distributed uniformly so there will be no segregation.
- iii. The pavement must be smooth, without seams and graded to achieve proper drainage.
- iv. Note that additional compaction will not be achieved through the application of the pavement texturing process.

**E. Pre-requisites for existing HMA pavement**

Depending upon the condition and age, existing HMA pavement may or may not be suitable for the successful application of HMA pavement texturing. The Qualified Applicator can advise whether the HMA pavement is suitable or not. The Owner shall make the final determination as to the suitability of the existing HMA pavement.

**F. Mill & Fill: recommended guidelines**

A tack coat must be applied to ensure proper adhesion of the new HMA material to the old pavement substrate. A durable, stable mix design is a pre-requisite for all Mill & Fill applications especially those that will experience vehicle traffic. The application of the HMA pavement texturing process does not change this requirement. A Minimum lift thickness of two inches is recommended. Due to the thin lift thickness placed over a cool substrate, it is especially critical to ensure that the HMA concrete is hot when it is delivered, Installed and compacted. It is generally recommended to not proceed with a Mill & Fill pavement application when the outside air temperature is less than 50°F (10°C).

**G. Pavement Marking Removal**

Pavement markings may be removed by sandblasting, water-blasting, grinding, or other approved mechanical methods. The removal methods should, to the fullest extent possible, cause no significant damage to the pavement surface. The Owner shall determine if the removal

of the markings is satisfactory for the application of the HMA pavement coating. Work shall not proceed until this approval is granted.

### **3.3 LAYOUT**

Layout of the pattern for imprinting into the surface of the HMA pavement shall be as per the drawings and specifications and in accordance to the methods prescribed by the applicator in conjunction with the Owner.

### **3.4 HEATING THE HMA PAVEMENT**

The Applicator shall follow the guideline provided by the qualified equipment supplier for re-heating HMA pavement.

- A. The pavement surface shall be dry and free from all foreign matter, including but not limited to dirt, dust, de-icing materials, and chemical residue.
- B. Pavement temperature: The optimal pavement temperature for imprinting the template is dependent upon mix design, modifiers used in the mix, the age of the pavement and weather. The surface temperature of the pavement should not exceed 325°F as determined by an infrared thermometer reading taken after the heat is applied to the HMA pavement.
- C. In order to achieve the proper depth of Imprint It is important to elevate the HMA pavement temperature to a minimum depth of 1/2 inch (12.5mm) without burning the pavement surface.

### **3.5 SURFACE IMPRINTING**

- A. The pavement surface shall be dry and free from all foreign matter, including but not limited to dirt, dust, de-icing materials, and chemical residue.
- B. Only approved HMA pavement re-heat equipment shall be used to elevate the temperature of the HMA pavement.
- C. Once the HMA pavement has reached imprinting temperature, the templates shall be placed in position and pressed into the surface using vibratory plate compactors. The top of the template is to be flush with the surrounding HMA pavement and can then be removed. Areas that have an imprint depth less than 3/8 inch shall be re-heated and re-stamped prior to applying the coatings. Hand tooling is a permitted method to achieve proper imprint depth in areas difficult to get at with the template.

### **3.6 APPLICATION GUIDELINES OF HMA PAVEMENT COATING**

- A. The qualified applicator shall refer to the HMA pavement coating supplier's recommendations for methods of application. Special care and attention must be paid to ensure HMA pavement coatings are applied in environmental conditions that permit proper cure.
- B. The pavement surface shall be completely dry and thoroughly cleaned prior to application of the HMA pavement coating(s).
- C. Depending upon the condition and age of the pre-existing pavement, primer may be required. Refer to the HMA pavement coating supplier's specifications.

- D. The coating application shall proceed as soon as practical upon completion of the imprinting of the HMA pavement.
- E. The qualified applicator shall use spray equipment specifically designed for the application of the coating(s).
- F. Refer to the HMA pavement coating supplier's recommendations for coating coverage rate, number of recommended passes and recommended thickness

### **3.7 OPENING TO TRAFFIC**

Minimally, the surface coating must be 100% dry before traffic is permitted. Refer to the qualified pavement coating suppliers guide.

## **PART 4 - MEASUREMENT AND PAYMENT**

### **4.1 MEASUREMENT**

The measured area is the actual area that has received the HMA pavement texturing. No deduction will be made for the area(s) occupied by manholes, inlets, drainage structures, bollards or by any public utility appurtenances within the area.

### **4.2 PAYMENT**

Payment will be full compensation for all work completed as per conditions set out in the contract. For unit price contracts, the payment shall be calculated using the measured area as determined above.

## **END OF SECTION**



**STATE OF OHIO  
DEPARTMENT OF TRANSPORTATION  
SUPPLEMENTAL SPECIFICATION 800  
REVISIONS TO THE 2019 CONSTRUCTION & MATERIAL SPECIFICATIONS**

**DATED 10-18-2019**

**101.02**

On page 10, **Replace** "REA Rural Electrification Administration" with the following:  
REA      Rural Electrification Act

**101.02**

On page 10, Delete the following:  
~~QCQC      Quality Control Qualifications Committee~~

**102.16**

On page 22, **Delete** the following:  
**102.16 Certificate of Compliance with Affirmative Action Programs.** Before any Contract is awarded, the Department will require the Bidder to furnish a valid Certificate of Compliance with Affirmative Action Programs, issued by the State EEO Coordinator ~~dated prior to the date fixed for the opening of bids.~~

**107.07**

On page 40, **Add** the following paragraph after the first paragraph:  
Any illegal drugs, drug paraphernalia, mobile drug labs or dumps, weapons or firearms found on the Project Right of Way shall be considered a potential crime scene and shall not be handled or moved. Immediately notify law enforcement and the Project Engineer.

**107.13**

On page 46, **Replace** the last sentence in the last paragraph with the following:  
The decision of the DCE will be made within 14 days and will be administratively final.

**107.15**

On page 47, **Replace** the second paragraph with the following:  
In the event that the Engineer determines that damage to completed permanent items of Work results from traffic using a substantially completed section of Roadway, the Department may compensate the Contractor for repair of the damage as authorized by Change Order. Additionally, if traffic permanently damages beyond use and of the following temporary maintenance of traffic items, the Department may compensate the Contractor for replacement of the item as authorized by Change Order:

1. Arrow board.
2. Work zone signal, pole, or controller.
3. Lighting unit or pole.
4. Changeable message sign.
5. Work Zone Impact Attenuator
6. Truck Mounted Impact Attenuator

## 7. Digital Speed Limit Sign Assembly

### 107.15

On page 47, **Replace** the **A.** through **D.** with the following:

To receive compensation for the damage to permanent items of Work or temporary maintenance of traffic items named above, the Contractor must first meet the following requirements.

**A.** Notify the Engineer of each occurrence of damage in writing within 10 Calendar Days.

**B.** Contact the local law enforcement agency to determine if the accident was investigated and a report filed. If an accident report was filed, obtain the report and notify the motorist, and copy their insurance company, via certified mail informing both that the motorist is responsible for the cost of damage repairs. If the motorist does not respond within 30 days, make a second attempt to contact the motorist and copy the insurance company via certified mail.

**C.** If no response is received from the motorist or insurance company within 30 days of the motorist receipt of the second notice, send a letter to the Engineer within eighteen months of the event and include documentation of good faith effort to seek recovery from responsible parties.

**D.** The Department will make an adjustment according to 108.06 and 109.05 to compensate the Contractor for the added costs and delays, if any, resulting from the repair or replacement of damaged Work.

If there is no accident report on file and no means of identifying the responsible motorist, the Contractor may likewise be compensated to repair the damaged Work.

### 108.06.D.4

On page 64, **Replace** item D.4. with the following:

4. Delays due to acts of the government or a political subdivision other than the Department.

### 108.07

On page 65, **Add** the following paragraph after Item E and before TABLE 18.07-1:

The Contractor may submit a request for waiver of liquidated damages to the Department within 30 days of the assessment of liquidated damages.

### 109.05.C.8.b

On page 81, **Replace** the second paragraph with the following:

b. Trucking that is subject to the prevailing wage law will be compensated according to 109.05.C.1, 109.05.C.2, 109.05.C.4, 109.05.C.6, and 109.05.C.10.

### 109.05.C.10

On page 82, **Replace** the last paragraph with the following:

In the event the Contractor declines to sign the Daily Force Account Record, the Department's records shall govern. Any resulting dispute must be pursued in accordance with 108.02.G.

### 203.04

On page 103, **Replace** the second sentence of the fifth paragraph with the following:

The area is considered to contain hazardous waste or material and must be handled according to Department procedures and appropriate environmental agency regulatory requirements.



### 301.02

On Page 161, **Add** the following paragraph after the last paragraph in the section:

Do not start mix production without a preliminary JMF approval and 48 hour notification to District Testing. Final approval of a JMF will be based upon field verification. The JMF can be rejected for failure to verify in the plant or at the project.

### 302.03

On Page 164, **Add** the following paragraph after the first sentence in the section:

Do not start mix production without a preliminary JMF approval and 48 hour notification to District Testing. Final approval of a JMF will be based upon field verification. According to 441.12 the JMF can be rejected for failure to verify in the plant or at the project.

### 401.04

On Page 174 **Replace** the 4th full paragraph with the following:

Determine RAS properties and usage as follows. Use no more than 3.0 percent RAS by dry weight of mix. When using RAP and RAS in combination use no more than 25 percent RAP. For design assume 12.0 percent available RAS binder. Determine gradation and specific gravity according to AASHTO PP 78-17, Section 5 or subsequent AASHTO applicable standard. Provide the required certification forms in the JMF submittal documenting that the RAS meets AASHTO MP 23-15 (2016), section 4 and that RAS from roofing tearoffs conforms to the EPA's NESHAP, 40 CFR 61 Subpart M, and other applicable agency requirements for asbestos.

### 401.04

On Page 175 **Replace** Table 401.04-1 with the following:

**TABLE 401.04-1 METHOD 1 – STANDARD RAP/RAS LIMITS**

Asphalt Mix Application	Percent RAP by Dry Weight of Mix, Max.	RAS Usage <sup>[1]</sup>	Total Virgin Asphalt Binder Content, Min.	Comments
442 Polymer Surface Course	10%	None	5.2	Polymerized binder is virgin. (For non-polymer virgin binder allow 20% max RAP)
441 Surface Course	20%	None	5.0	Polymer or non-polymer virgin.
441, 442 Intermediate Course	35%	Manufacturing waste and tear-offs	3.0	Any mix type used as an intermediate course.
301 Base Course	50%	Manufacturing waste and tear-offs	2.7	OMM will establish the asphalt binder content.
302 Base Course	40% (30%)	Manufacturing waste and tear-offs	2.0	A lower RAP limit of 30 percent will be required if poor production mixing or coating is evident.

[1]No more than 3.0% RAS by dry weight of mix

**Table 401.04**

On Page 176 **Replace** Table 401.04-2 with the following:

**TABLE 401.04-2 METHOD 2-EXTENDED RAP/RAS LIMITS**

<b>Asphalt Mix Application</b>	<b>Percent RAP by Dry Weight of Mix, Max.</b>	<b>RAS Usage [1]</b>	<b>Total Virgin Asphalt Binder Content, Min.</b>	<b>Comments</b>
442 Polymer Surface Course	15%	None	5.0	Polymerized binder is virgin. (For non-polymer virgin binder allow 25% max RAP)
441 Surface Course	25%	None	5.0	Polymer or non-polymer virgin.
441, 442 Intermediate Course	40%	Manufacturing waste and tear-offs	3.0	Any mix type used as an intermediate course.
301 Base Course	55%	Manufacturing waste and tear-offs	2.5	OMM will establish the asphalt binder content.
302 Base Course	45% (35%)	Manufacturing waste and tear-offs	1.8	A lower limit of 35 percent will be required if poor coating is evident. The virgin requirement of 302.02 does not apply.

[1]No more than 3.0% RAS by dry weight of mix

**401.04.C**

On Page 176, **Replace** the first sentence in the second paragraph with the following:

Ensure RAS is processed to have 100 percent passing the 1/2 inch (12.5 mm) sieve and at least 90 percent passing the No. 4 (4.75 mm) sieve.

**401.08**

On Page 178, **Add** the following paragraph after the first paragraph:

At a minimum, take a split sample of asphalt binder whenever the Department requests a sample. Address in the QCP the QC of mix plant asphalt binder samples and subsequent corrective action of binder test failures of any sample (QC or Department). Failure to perform QC of asphalt binder samples is at the Contractor's risk. Any Department binder sample failures will result in penalties per Supplement 1102. These include remove and replace, pay deductions, or other penalties for the asphalt mix represented by the Department's sample.

#### 402.02

On Page 188, **Replace** the entire section with the following:

**402.02 Calibration.** Ensure the plant is calibrated according to Supplement 1101 when producing any asphalt concrete for the Department. Calibrate the asphalt binder meter according to Supplement 1101.07 Method A or B. When calibrating the asphalt binder meter according to Method B, daily aggregate and RAP weighbridge validations are required to be performed according to Supplement 1101.06. Document which plants follow Supplement 1101.01 Method B in the Quality Control Program (403.03). If issues persist for Method B calibrations or documentation, the Department will require the plant to follow Method A. When performing a complete calibration for ODOT projects notify District Testing 24 hours in advance of the calibration.

#### 403.02

On Page 190, **Replace** the second paragraph with the following:

Restoration of VA procedures will be by the Department's Quality Control Review Group (QC Review Group) based on District recommendation and review of the Contractor problems, resolutions and QCP. The QC Review Group consists of asphalt the Materials Engineer, Office of Materials Management; the Administrator, Office of Materials Management; and the Pavement Engineer, Office of Construction Management.

#### 403.03

On Page 190, **Add** the following sentence to the end of the first paragraph:

Include a revision date on the cover sheet and revision sheet listing the date(s), what section(s) and page(s) a revision was made, and a short description of what was revised, added, or removed.

#### 403.03

On Page 190, **Replace** the third sentence in the second paragraph with the following:

Digital copies of the QCP and letter in pdf format are allowed in each Contractor plant laboratory and plant operation control room with the following requirements: The file icon must be appropriately labeled and be on the computer desktop of a computer in each area. Ensure the QCP contains page numbering and a Table of Contents inside the front cover locating all sections by page number. Remove out-of-date QCPs from the computer desktop.

#### 403.03

On Page 191, **Delete** the second full paragraph.

~~The QCP is a reflection of a Contractor's sincerity and ability in producing a quality product. Development of this program beyond the minimum requirements specified below is encouraged and is taken into consideration by the QCQC when reviewing Contractor plant operation for qualification for VA.~~

#### 403.03

On Page 191, **Replace** the third full paragraph with the following:

As a minimum include in the program:

#### 403.03.B

On Page 191, **REPLACE** subsection B with the following:

**B.** Means for annual training in ethical conduct according to company expectations of all company employees and consultants who are responsible for the mix design, production, testing, and placement of asphalt mix and their supervisors. Document how and when training is given, what the expectations are, how expectations are communicated and list all personnel trained. Describe the QC Manager's and supervisor's responsibilities and methods in ensuring ethical conduct is maintained throughout the year.

#### **403.03.F**

On Page 192, **Replace** the first paragraph with the following:

F. Methods to maintain all worksheets, including all handwritten records, and other test and sample records from all plant(s) and, or project(s) for a minimum of 8 years. Define the test record process. Define company records retention requirements. Provide copies of all test reports and forms used in the quality control process.

#### **403.03.L**

On Page 192, **Add** the following sentence after the last sentence in the paragraph:

Means of handling asphalt binder samples taken at the mix plant including any testing, labeling, and storing of samples.

#### **403.03.N**

On Page 192 **Replace** the paragraph with the following:

N. Define the roles and responsibilities of the Field Quality Control Supervisors. Provide a detailed description of how the FQCS will handle all mat issues including segregation, tenderness, mat tears, debris, holes, etc. List approved Field Quality Control Supervisors.

#### **403.06.F**

On Page 198, **Replace** the last paragraph with the following:

For all other mixes, if repeated problems with poor comparison of tests are not the District's fault; or poor comparison of Contractor tests to the JMF; or with plant operation, input materials, or any of the other requirements of Department specifications occur in a single project or successive projects, the District will request an opinion from the QC Review Group before notifying the Contractor of removal from Department VA. The District will immediately notify the Contractor of the removal with a follow up letter from District Testing. Once notified, acceptance of asphalt mixtures is by Unconditional Acceptance. Restoration of the VA procedures may occur on a future project with a District recommendation to the QC Review Group based on consistent improved plant operation and mix control, a review of the Contractor problems and resolutions, and a review of the QCP by the QC Review Group.

#### **421.02**

On Page 211, **Add** the following sentence directly after Table 421.02-2:

Do not use aggregates designated with "SR" or "SRH."

#### **421.02**

On Page 212, **Replace** the first sentence of the first full paragraph with the following:

For mineral filler, use Supplement 1028 Certified portland cement conforming to ASTM C 150, Type I.

#### **421.03**

On Page 212, **Revise** the third sentence in the second paragraph to the following:

Prepare the mix design by designing the mixture using the minimum, design, and maximum residual binder contents for gradations A or B and present all test data for all tests specified in Table 421.03-1.

#### 421.03

On Page 213, **Replace** Table 421.03-1 with the following:

**TABLE 421.03-1**

ISSA Test No.	Description	Specification
TB-139	Wet Cohesion	
	30 minutes min. (set time)	12 kg-cm min.
	60 minutes min. (traffic)	20 kg-cm min or near spin
TB-114	Wet Stripping	90 percent min.
TB-100	Wet Track Abrasion Loss	
	1-hour soak	450 g/m <sup>2</sup> max.
	6 day soak	650 g/m <sup>2</sup> max.
TB-144	Saturated Abrasion Compatibility	2 g loss max.
TB-113	Mix Time @ 25 °C	Controllable to 120 seconds
	Mix Time @ 40 °C	Controllable to 45 seconds
TB-147	Lateral Displacement (For Leveling and Rut Fill courses only)	5%, max.
TB-109	Excess Asphalt by LWT Sand Adhesion	538 g/m <sup>2</sup> max.

#### 421.03.A

On Page 213, **Replace** the first sentence after Table 421.03-1 with the following:

Check the ISSA TB-139 (set time) and ISSA TB-113 (mix time) tests at the highest and lowest temperatures expected during construction.

#### 421.03.B.8

On Page 213, **Replace** B.8. with the following:

8. Quantitative effects of moisture content on the unit weight of the aggregate per AASHTO T 19 from 0.0 to 10.0% moisture content.

#### 421.04.C

On Page 214, **Replace** paragraph C. with the following:

C. Provisions to meet the Department mix specifications including warning bands and action plans for aggregate, Binder, and tack coat materials to ensure they meet Department testing.

#### 421.09

On Page 217 **Replace** the third and fourth paragraphs of the section with the following:

Remove all existing pavement markings so that less than 5% of the line remains visible. Repair damage to the pavement that results in the removal of more than 1/8 inch of pavement thickness. When a grinder drum is mounted to a skid steer loader, the drum must be able to accommodate a minimum of 150 teeth.

Seal visible joints and cracks longer than 2 feet (600 mm) in length and any joint or crack greater than 1/4 inch (6 mm) in width no matter the length using Item 423 Type II only. Apply crack sealant material at a width of 2 to 4 inches (50 to 100 mm) and at a thickness of not less than 1/16 inch (2 mm) and not greater than 3/16 inch (5 mm).

#### 421.12

On Page 219, **Replace** the next-to-last sentence in the first paragraph with the following:  
Present a revised corrective action plan and obtain the Engineer's approval before resuming work.

#### 421.12.A

On Page 220, **Replace** the entire section with the following:

**A. Binder.** Obtain and label a Binder sample from supply tanker and diluted tack coat sample from the distributor truck at the direction of the Engineer and give the samples to the Engineer the same day. Provide and sample the Binder and diluted tack coat in one-quart (1 L) plastic containers with plastic screw tops. Label and retain one sample per each additional day for the Department. Take more samples when requested by the Engineer.

Visually inspect Binder in supply tanker(s) to ensure uniform material with no separation or contamination. Verify temperature of binder and tack coat. Monitor and verify proportioning of asphalt emulsion and water into distributor and proper mixing before use or sampling. Perform a minimum of one Binder and tack coat cook-off each production day to determine the residue content of the Binder and tack coat and verify compliance. If residue content is in warning band or out of compliance provide the Engineer with corrective actions prior to using.

Ensure mixing equipment is set at design asphalt emulsion percentage during production. Do not exceed a tolerance of  $\pm 0.3\%$  residual content from the design residual content or the minimum and maximum content in the microsurface mix due to fluctuation in residual content in the Binder. If tolerance is exceeded, stop production. Correct the issue by correcting the Binder residual content by methods allowed by Supplement 1032 certified supplier or adjust the asphalt emulsion percent, if approved by the Engineer. Recalibrate the mixing equipment to the new adjusted asphalt emulsion percent to meet the design residual content of the microsurfacing mix for positive displacement mixing equipment.

#### 421.12 B.

On Page 220, **Replace** the second sentence in the third paragraph with the following:  
Obtain three (3) aggregate samples from the stockpile and perform gradation testing on each sample according to AASHTO R 90, AASHTO R 76, Supplement 1004 (AASHTO T 11 where required), and moisture content per AASHTO T 255.

#### 422.02 C.

On Page 225 **Replace** the first sentence in the third paragraph of the section with the following:  
If a staging location will be used for the chip seal aggregate first move the initially tested aggregates from the aggregate source stockpile to the staging location and construct a project-specific staging stockpile.

**422.06**

On Page 228 **Replace** the second paragraph of the section with the following:

Remove all existing pavement markings so that less than 5% of the line remains visible. Repair damage to the pavement that results in the removal of more than 1/8 inch of pavement thickness. When a grinder drum is mounted to a skid steer loader, the drum must be able to accommodate a minimum of 150 teeth.

**422.10 C.**

On Page 231 **Replace** the first sentence of the section with the following:

**C. Coarse Aggregate.** At a minimum test one sample taken from the aggregate spreader box or project-specific stockpile at production start and sample and test one sample from the aggregate spreader box or project-specific stockpile randomly during the day.

**422.10 C.**

On Page 231 **Replace** the fifth sentence of the section with the following:

Sample and test aggregate according to AASHTO R 90, AASHTO R 76, and Supplement 1004 (AASHTO T 11 where required).

**422.13**

On Page 233 **Replace** the first paragraph of the section with the following:

**422.13 Method of Measurement.** The Department will measure Single Chip Seal or Double Chip Seal by the number of square yards (square meters) of aggregate, and the gallons (liters) of polymer emulsified binder, completed and accepted in place. The Department will determine the width by measuring the actual width of the chip seal. The Department will determine the length along the centerline of each roadway or ramp. The Department will determine the gallons (liters) of polymer emulsified binder applied according to Item 109.

**422.14**

On Page 234 **Replace** the Basis of Payment table with the following:

Item	Unit	Description
422	Square Yard (Square Meter)	Aggregate, Single Chip Seal, Type ____
422	Gallons (Liters)	Emulsion, Single Chip Seal, Type ____
422	Square Yard (Square Meter)	Aggregate, Double Chip Seal, Type ____
422	Gallons (Liters)	Emulsion, Double Chip Seal, Type ____

#### 423.02

On page 234 **Delete** the following:

~~Type III..... 702.17.C~~

#### 423.03

On page 235, **Delete** the following from the first sentence of the first full paragraph:

For ~~Type II, III,~~ and IV crack sealants, heat the sealant in a kettle or melter constructed as a double boiler, with the space between the inner and outer shells filled with oil or other heat-transfer fluid.

#### 423.03

On page 235, **Replace** the first sentence of the third full paragraph with:

For ~~Type II and III~~ crack sealants, use a mechanical applicator wand head capable of placing the crack sealant according to the tolerances of 423.07 while filling the cracks.

#### 423.06

On page 236, **Delete** the following:

**Mixing Type II and III.**

#### 423.06

On page 236, **Add** the following sentence after the second sentence:

Type II crack sealant may also be prepackaged per 702.17.B.

#### 423.06

On page 236, **Delete** the last sentence of the section:

~~Do not heat Type III crack sealant to greater than 295 °F (146 °C).~~

#### 423.07

On page 236, **Replace** the first sentence of the fourth paragraph:

For ~~Type II and III~~ crack sealants, place the sealant such that it fills the cracks with a band of sealant within 2 to 4 inches (50 to 100 mm) wide.

#### 423.10

On page 237, **Delete** the following:

~~423 Pound (Kilogram) Crack Sealing, Type III~~

~~or Square Yard~~

~~(Square Meter)~~

~~423 Pound (Kilogram) Crack Sealing, Type II or III~~

~~or Square Yard~~

~~(Square Meter)~~

#### 424.03

On Page 238, **Add** the following sentence to the end of the second paragraph:

Do not use RAS.

#### 441.09

On Page 245, **Replace** the first full paragraph with the following:

Should additional testing as required above not be performed District Testing, after consultation with OMM, will require the testing frequency be increased to all tests every two hours of production for the remainder of the project. If this occurs, District Testing will request an opinion from the QC



Review Group for action(s) against the technician and/or Contractor including but not limited to warning, removal and/or a change of the facility to Unconditional Acceptance.

**443.01**

On Page 253, **Replace** the second paragraph with the following:

The requirements of 442; and 446 or 447 apply except as follows. Do not use the warm mix asphalt method (402.04) for this item.

**443.03**

On Page 253, **Replace** Note [5] after Table 443.03-2 with the following:

[5] VCA = Volume of Coarse Aggregate (Calculated for mix and dry rodded conditions according to AASHTO R 46)

**443.03.E**

On Page 254, **Replace** the section with the following:

**E. Reclaimed Asphalt Concrete Pavement and Shingles.** Do not use reclaimed asphalt concrete pavement except as described in D above. Do not use reclaimed asphalt shingles.

**443.08**

On Page 256, **Replace** the entire section with the following:

**443.08 Acceptance.** After accepting the test strips, the Department will accept SMA according to 446.04; or 447.04, 447.05, and 447.06.

**443.09**

On Page 256, **Replace** the section with the following:

**443.09 Basis of Payment.** The Department will pay for accepted quantities of Stone Matrix Asphalt Concrete, complete in place, including test strip, at the contract price as modified by 446.04; or 447.05 and 447.06, as follows:

Item	Unit	Description
443	Cubic Yard (Cubic Meter)	Stone matrix asphalt concrete, 12.5mm, PG70-22M, (_____)
443	Cubic Yard (Cubic Meter)	Stone matrix asphalt concrete, 12.5mm, PG76-22M, (_____)

**447.05**

On Page 263, **Replace** TABLE 447.05-1 with the following:

**TABLE 447.05-1 MAT DENSITY LOTS**

Mean of Cores <sup>[1]</sup>	Pay Factor
	Surface Course
98.0% or greater	[2]
97.0 to 97.9%	0.94
96.0 to 96.9%	1.00
94.0 to 95.9%	1.04
93.0 to 93.9%	1.00
92.0 to 92.9%	0.98
91.0 to 91.9%	0.90
90.0 to 90.9%	0.80
89.0 to 89.9%	[3]
Less than 89.0%	[2]
[1] Mean of cores as percent of average MSG for the production day.	
[2] Remove and replace.	
[3] The District will determine whether the material may remain in place. If the District determines the course should be removed and replaced, the Contractor will remove and replace this course. The pay factor for such material allowed to remain in place is 0.70.	

**499.02**

On Page 300, **Replace** the materials listing for “Fly ash” with “Fly ash or natural pozzolan”.

**499.03**

On Page 301, in Table 499.03-1, **Replace** notes [5] and [7] with the following:

[5] The maximum fly ash, natural pozzolan, or slag cement content may be increased up to 50%.

[7] Cement or a combination of cement and up to 15% fly ash or natural pozzolan; or up to 30% slag cement.

**499.03**

On Page 302, in Table 499.03-2, **Add** the following row after “Fly Ash”:

Natural pozzolan	25
------------------	----

**499.07**

On Page 307, in Table 499.07-1, **Add** the following row after “Fly ash”:

Natural pozzolan	lb (kg)
------------------	---------

**499.07**

On Page 308, in Table 499.07-2, **Add** the following row after "Fly ash":

Natural pozzolan		
------------------	--	--

**501.04.B**

On Page 311, **Add** the following sentence to the end of the first paragraph;  
Shop Drawings are not required for elastomeric bearings.

## 508.05

On Page 336, **Replace** the last paragraph with the following:

Include the cost for load testing required as per 508.02 in the item for which the falsework support is used.

## 511.03

On page 343, **Revise** the first paragraph to the following:

**511.03 Concrete.** Provide concrete for structures according to 499.03, using Class QC 1, QC 2, QC 3, or QC 4 or QC 5 as specified in the Contract.

## 511.04

On Page 343, **Delete** the third paragraph and table and **Replace** with the following:

When the concrete bid item does not require QC/QA, the Engineer will make at least one set of acceptance test cylinders for each 50 cubic yards (40 m<sup>3</sup>) of concrete.

## 511.15

On page 355, **Replace** the first two paragraphs with the following:

**511.15 Surface Finish.** For concrete that is to be sealed with Epoxy-Urethane according to 512.03, perform surface profiling and surface finish according to 512.03.F.

For all others, finish the concrete surface as detailed below:

### 511.15.A.

On page 355, **Replace** the paragraph with the following:

**A. Standard Finish.** On all surfaces, remove fins and irregular projections with a stone or power grinder, taking care to avoid contrasting surface textures. Repair all cavities produced by form ties and, on visible surfaces, repair all defects using a mortar consisting of one part of hydraulic cement conforming to Item 499 and 1-1/2 parts sand conforming to 703.03, by volume and water conforming to 499.02 with a maximum water/cementitious ratio of 0.4. A defect is an imperfection in the concrete measuring at least 3/4" (19mm) in diameter or at least 1/2" (13 mm) deep but not exceeding a total volume of 1 cubic inch (16.387 mL). Finish all repaired surfaces on the structure in a similar manner and to the extent required to produce a uniform appearance.

### 512.03.F.

On page 364, **Replace** the entire section with the following:

#### **F. Surface Preparation and Profiling.**

##### **1. Non-Epoxy Sealer**

Remove dust, dirt, oil, wax, curing compounds, efflorescence, laitance, coatings and other foreign materials from surfaces to be sealed.

Ensure that all wastes generated by the surface preparation operation are managed in accordance with 107.19.

If the concrete surface had curing compound applied, acid test the surface after blasting to see if the curing compound was removed. Perform the acid test for every 500 square feet (47 square meters). Use a 30%, by weight, solution of hydrochloric acid. Apply 4 to 5 drops to the concrete surface. If foaming/fizzing occurs the curing compound is removed. Rinse the tested location with an ammonia solution to neutralize the concrete area tested (1 cup ammonia to 5 gallons water).

(NOTE: Muriatic acid and ammonia can be bought in a hardware store. Muriatic acid is used to clean masonry. Only dilute by pouring the acid into the water. DO NOT pour the water into the acid.)

When surfaces show intermittent or no foaming, use chemicals or other cleaning compounds to remove the curing compounds. Only use products approved by the sealer manufacturer. Furnish the Engineer documentation of the sealer manufacturer's approval and method to test if materials are removed.

## **2. Epoxy-Urethane Sealer**

Remove dust, dirt, oil, wax, curing compounds, efflorescence, laitance, coatings and other foreign materials from surfaces to be sealed.

Ensure that all wastes generated by the surface preparation operation are managed in accordance with 107.19.

If the concrete surface had curing compound applied, acid test the surface after blasting to see if the curing compound was removed. Perform the acid test for every 500 square feet (47 square meters). Use a 30%, by weight, solution of hydrochloric acid. Apply 4 to 5 drops to the concrete surface. If foaming/fizzing occurs the curing compound is removed. Rinse the tested location with an ammonia solution to neutralize the concrete area tested (1 cup ammonia to 5 gallons water).

(NOTE: Muriatic acid and ammonia can be bought in a hardware store. Muriatic acid is used to clean masonry. Only dilute by pouring the acid into the water. DO NOT pour the water into the acid.)

When surfaces show intermittent or no foaming, use chemicals or other cleaning compounds to remove the curing compounds. Only use products approved by the sealer manufacturer. Furnish the Engineer documentation of the sealer manufacturer's approval and method to test if materials are removed.

After concrete has cured and forms are removed, use one or both of the following methods to produce a surface profile that feels and looks like 100 grit sandpaper or coarser. Provide the Engineer sandpaper for comparison. Perform the ASTM D7682-12, Method B, Standard Test Method for Replication and Measurement of Concrete Surface Profile Using Replica Putty to obtain a replica coupon of the prepared concrete surface on a flat, test section, on the first day of production, and as requested by the Engineer. With a micrometer, measure the surface profile obtained on the coupon, and provide the coupon to the Engineer.

a. Water blast at 7000 psi (48Mpa) minimum, or

b. Abrasive blast, followed by air brooming or power sweeping, to remove dust and sand from the surface and opened pores, or

c. Use a combination of water blast and abrasive blast.

Install suitable traps, filters, drip pans and other separation devices in the cleaning equipment so oil and other foreign material are not deposited on the surface.

Fill all cavities produced by form ties and other single defects or defected areas with a prequalified trowelable mortar in accordance with Supplemental Specification 843.02 and 843.06. Provide a broom/brush finish to all trowelable mortar patches. Cure the trowelable mortar according to Supplemental Specification 843.07.

A defect is an imperfection in the concrete measuring at least 3/4" (19mm) in diameter or at least 1/2" (13mm) deep but not exceeding a total volume of 1 cubic inch (16.387 mL). A defected area is an area with a density of imperfections between 1/4" (6 mm) and 3/4" (19 mm) in diameter or between 1/4" (6mm) and 1/2" (13 mm) deep numbering 10 or more per 1 square foot (0.09 square meters) area.

Air dry for at least 10 days after completion of the manufacturer's recommended cure time for trowelable mortar. Brush abrasive blast, followed by air brooming or power sweeping, to remove dust and sand from the surface and opened pores.

### 512.03.G.

On page 365, **Replace** the first paragraph of the subsection with the following:

**G. Application and Coverage.** Do not apply sealer to surfaces with moisture. Determine moisture on surface in accordance with ASTM D4263 - Indicating Moisture in Concrete by the Plastic Sheet Method. Apply the sealer within 48 hours after moisture testing and brush abrasive blast. Do not apply sealer if rain is anticipated within six (6) hours after application. Clearly mark where the sealer application stops if not continuous.

### 513.13

On page 383, **Replace** the last sentence of the first paragraph with the following:

Weld stiffeners connected to cross frames and/or diaphragms to the top and bottom flange.

### 516.03

On Page 433, **Replace** the second paragraph with the following:

Coat metal parts of expansion joints not part of extensions to existing steel expansion joints with metalized 100 percent zinc wire. Prepare the surface to be coated and apply coating as required by The Society of Protective Coatings SSPC-CS-23.00(1). Apply coating to a minimum thickness of 6 mils. The vertical extensions to existing steel expansion joints are not to have any protection and the horizontal extensions to existing steel expansion joints are to match the existing protection.

### 518

Beginning on page 438 **Replace** the section with the following:

## ITEM 518 DRAINAGE OF STRUCTURES

### 518.01 Description

### 518.02 Fabrication

### 518.03 Materials

### 518.04 General

### 518.05 Porous Backfill

### 518.06 Prefabricated Geocomposite Drain (PGD)

### 518.07 Pipe

### 518.08 Scuppers

### 518.09 Excavation

### 518.10 Method of Measurement

### 518.11 Basis of Payment

**518.01 Description.** This work consists of constructing drainage systems.

**518.02 Fabrication.** Fabricate scuppers according to Item 513. Select a fabricator that is at least pre-qualified at level SF. The Department will base final acceptance of all fabricated members on the Engineer's approval that the fabricated items can be successfully incorporated into the structures. Submit mill test reports for structural steel, steel castings, bronze, and sheet lead certified according to 501.06.

**518.03 Materials.** Furnish materials conforming to:

Scuppers, structural steel and cast steel .....	513
Metal pipe .....	707
Plastic pipe .....	707.33, 707.45
Other metals .....	711
Prefabricated Geocomposite Drain (PGD) .....	712.16

Geotextile fabric, Type A .....	712.09
Reinforced thermosetting resin pipe.....	707.80

Furnish pipe specials of a grade at least as high as the type of pipe specified.

Furnish porous backfill consisting of gravel, stone, or air-cooled blast furnace slag, with a No. 57 size gradation according to Table 703.01-1. The sodium sulfate soundness loss shall not exceed 15 percent.

Furnish ACBFS conforming to Supplement 1027.

**518.04 General.** As shown on the plans, connect all parts to new or existing sewers or other outlets.

When installing to superstructure, take into account the deflection of spans under full dead load.

**518.05 Porous Backfill.** Place porous backfill as shown on the plans. When not shown on the plans, place backfill at least 2 feet (0.6m) thick behind the full length of abutments, wing walls, and retaining walls. Measure the thickness of porous backfill normal to the abutment or wall face. The Contractor may leave undisturbed rock or shale within 18 inches (0.5 m) of the abutment or wall. Place 2 ft<sup>3</sup> (0.23 m<sup>3</sup>) of bagged No. 3 aggregate at each weep hole to retain the porous backfill. Place the porous backfill for the full width of the trench and extend it to the bottom of the approach slab or base, as shown in the plans. Place porous backfill in loose lifts not to exceed 12 inches. Run a plate compactor or tamper over the top of each lift for consolidation of approximately 85% of original layer thickness. If placed in loose lifts greater than 12 inches, flood the porous backfill at the appropriate moisture content for consolidation of approximately 85% of original layer thickness.

**518.06 Prefabricated Geocomposite Drain (PGD)** Do not use PGD on Integral Abutments or above the beam seat elevation on Semi Integral Abutments.

**A. Preparation.** Prepare the surface of the wall or abutment, on which the PGD is to be placed, to be free of soil, debris, and excessive irregularities that prevent continuous contact between the wall surface and the PGD.

**B. Placement.** Place PGD strips to provide continuous coverage over the face of the wall. Unroll PGD directly onto the prepared surface. Do not drag the PGD across the ground. Tension the PGD to remove any creases or wrinkles. Do not expose PGD to weather or direct sunlight for longer than 5 days. Place the geotextile fabric side to face toward the backfill or retained soil.

Construct the PGD in horizontal or vertical courses. Place the PGD in direct contact with the wall and secure to the surface using either adhesives per manufactures recommendation or nails as follows. Secure with 2 inch (51 mm) or longer concrete nails along with washers or wood battens of not less than 9 square inches (5887 square mm). Space the concrete nails no more than 3 feet (0.9 m) apart, both horizontally and vertically. Use at least one horizontal row of nails in each horizontal course of PGD, or use at least one vertical column of nails in each vertical course of PGD. Do not affect the drainage area and the downward flow in the drain by the adhesive or fasteners.

**C. Splicing and covering.** Form horizontal or vertical seams between courses by utilizing the flap of geotextile extending from one course and lapping over the flap on that of the next course. Securely fasten the overlapped flaps with a continuous strip of 3 inch (76 mm) wide, waterproof, plastic tape.

Where splices are necessary without a geotextile flap, place and center a 12 inch (0.3 m) wide continuous strip of geotextile over the seam and fasten with continuous strips of 3 inch (76 mm) wide, waterproof, plastic tape.

As an alternative method of splicing, either horizontally or vertically, rolls of PGD may be joined together by turning back the geotextile flap at the roll edges and interlocking the drainage core approximately two inches. Fold the flap under and tape it beyond the seam with 3 inch (76 mm) wide, waterproof, plastic tape. Shingle lap the core and fabric in the direction of water flow.

To prevent soil intrusion, cover all exposed edges of the PGD core by tucking the geotextile flap over and behind the core edge. Alternatively, a 12 inch (0.3 m) wide strip of geotextile may be used to wrap the edge, taping it to the geotextile side 8 inches (203 mm) in from the edge with a continuous strip of 3 inch (76 mm) wide, waterproof, plastic tape and folding the remaining 4 inches (102 mm) over and behind the core edge. Caps (bottom, top, or end) provided by the manufactures can also be used according to manufacturer's instructions.

Construct all seams, splices, and caps to prevent the backfill material from entering the PGD.

**D. Connecting to Weep Holes and Drainage System.** Connect the PGD to the drainage system as shown on the plans or per manufacturer's recommendations if not shown in the plans. Maintain a positive outlet for the water in the PGD at all locations.

Do not seal, block or restrict weep holes with the PGD. If available, use weep hole fittings provided by the manufacturer and installed to the manufacturer's instructions. If the PGD core is not perforated at the weep hole location, make a hole in the PGD core matching the diameter of the weep hole or larger to accommodate the pipe or fitting. When making holes in the core, do not damage the geotextile fabric.

Use manufacturer provided outlet fittings that transition between the PGD and the outlet pipe, and prevent material from entering the outlet pipe. If manufacturer fittings are not available, provide smooth-lined or corrugated outlet fittings according to manufacturer's recommendations. Fasten and seal outlet fittings to the wall drains according to manufacturer's recommendations.

**E. Repair.** Patch or replace damaged PGD. Remove the damaged area and place a PGD patch and splice the edges according to 518.06.C. If the damaged portion is larger than 50 percent of the PGD roll width, cut across the entire width of the roll to remove the damaged portion and splice according to 518.06.C.

If damage is limited to tears in the geotextile fabric, place a geotextile patch extending 6 inches (152 mm) beyond the damaged area in all directions or to the edge of the roll, and seal the entire perimeter with 3-inch (76 mm) wide, waterproof, plastic tape.

Replace and repair damaged PGD at no additional expense to the Department.

**F. Backfilling.** Replace or repair any PGD component that is damaged during the backfilling operation. Use hand operated compaction equipment to compact the backfill within 1-foot (0.3m) of the PGD.

**518.07 Pipe.** For drain pipe leading down from the superstructure, use either galvanized steel pipe, 748.06, or plastic pipe, 707.45, or reinforced thermosetting resin pipe, 707.80. Provide specials, elbows, tees, wyes, and other fittings essential for a complete and satisfactory installation of the same material and quality as the pipe. Construct watertight joints of adequate strength. In steel pipe, weld joints or use clamp-type couplings having a ring gasket. In plastic pipe, make joints according to the applicable ASTM standard. In reinforced thermosetting resin pipe, make joints according to manufacturer guidelines and procedures. Securely fasten the pipe to the structure with hanger or clamp assemblies that are galvanized according to 711.02.

Place subsurface pipe as shown in the plans. If the plans require drainage pipe in the porous backfill, provide plastic pipe conforming to 707.33.

For corrugated metal pipe, perforated specials are not required and the Contractor may make bends with adjustable elbows conforming to the thickness requirements of the pipe specifications.

**518.08 Scuppers.** Construct secure and watertight connections, including the connections to adjacent concrete. Provide castings, true to form and dimension. Weld the joints of structural steel scuppers. Galvanize scuppers according to 711.02.

**518.09 Excavation.** Excavate all material encountered to the dimensions necessary to provide ample space at least to install pipe or other drainage facility behind abutments and for outlets.

**518.10 Method of Measurement.** The Department will measure Porous Backfill and Porous Backfill with Geotextile Fabric, by the number of Square Yards (Square Meters), Cubic Yards (Cubic Meters) or lump sum. The Department will measure Prefabricated Geocomposite Drain by the number of Square Yards (Square Meters) or lump sum. The Department will measure pipe specials by the same method as the pipe. If pipe is by the foot (meter), the Department will measure the pipe along its centerline.

The Department will measure all Square Yard (Square Meters) items as the area of the abutment or wall being covered for drainage.

**518.11 Basis of Payment.** The cost to backfill, if not separately itemized in the Contract, and excavation is incidental to the drainage facility that necessitates them.

The Department will include bagged aggregate with porous backfill for payment.

The Department considers all items to place the Prefabricated Geocomposite Drain including surface preparation, tape, fasteners, adhesives, outlet fittings or other support material, incidental to the Prefabricated Geocomposite Drain.

The Department will pay for perforated and non-perforated pipes for the Prefabricated Geocomposite Drain as separate pay items per 518.07.

The Department will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
518	Cubic Yard (Cubic Meter)	
	Square Yard (Square Meter) or Lump Sum	Porous Backfill
518	Cubic Yard (Cubic Meter)	
	Square Yard (Square Meter) or Lump Sum	Porous Backfill with Geotextile Fabric
518	Square Yard (Square Meter) or Lump Sum	Prefabricated Geocomposite Drain
518	Foot (Meter)	___ inch (___ mm) ___ Pipe, Including Specials
518	Each	Scuppers, Including Supports
518	Pound or Foot (Kilogram or Meter)	Trough Horizontal Conductors
518	Pound or Foot (Kilogram or Meter)	Pipe Horizontal Conductors
518	Foot (Meter)	___ inch (___ mm) Pipe Downspout Including Specials



## 523.02

On page 451, **Replace** the first sentence of the first paragraph with the following:

**523.02 General.** Perform dynamic tests on two successfully tested piles.

## 605.02

On page 476, **Replace** the first paragraph of 605.02 with the following:

Backfill unclassified pipe underdrains, shallow pipe underdrains, deep pipe underdrains, base pipe underdrains, or rock cut underdrains, with or without a Geotextile Fabric, construction underdrains and aggregate drains with granular material consisting of ACBFS, limestone, or gravel. Furnish granular material meeting Size Nos. 8, 9, or 89. Gradations may be modified in accordance with Supplement 1069.11.C. Use granular material with a maximum sodium sulfate soundness loss of 15 percent.

## 606.02

On page 480, **Revise** the third paragraph to the following:

Type MGS may be constructed using round wooden posts of 72" length until **March 2020**. After that date, round wooden posts shall be 69" in length. Prior to **March 2020**, posts may be trimmed or may extend above the blockout.

## 608.03.E.

On Page 486, **Delete** the last two sentences of paragraph E.

~~After the minimum curing period and a 30 day drying time apply an approved non epoxy sealer (705.23.B) according to Item 512. Ensure any remaining curing compounds that are incompatible with the selected sealer and all foreign materials are removed prior to sealer treatment.~~

## 609.06.E.

On Page 491, **Delete** the last two sentences of paragraph E.

~~After the minimum curing period and a 30 day drying time apply an approved non epoxy sealer (705.23.B) according to Item 512. Ensure any remaining curing compounds that are incompatible with the selected sealer and all foreign materials are removed prior to sealer treatment.~~

## 611.02.B

On page 497, **Delete** the following:

Corrugated steel spiral rib pipe.....707.12

## 611.02.B

On page 497, **Add** the following after the fifth item on the list:

Polymer-precoated corrugated steel spiral rib pipe.....707.11

## 611.02.C

On page 498, **Delete** the following:

Corrugated steel spiral rib pipe.....707.12

## 611.02.C

On page 498, **Add** the following after the fifth item on the list:

Polymer-precoated corrugated steel spiral rib pipe.....707.11

## 611.03

On page 501, **Add** the following to the seventh paragraph between the "707.07" and "707.12" material references:

, 707.11

#### **611.11**

On page 512, **Add** the following sentence to the beginning of the fourth paragraph of the section:  
For all aluminum conduits, prior to placing concrete, coat the area to be paved with a zinc chromate primer or an epoxy paint formulated for applying to aluminum. Extend primer or epoxy 4 inches beyond the proposed paving limits.

#### **611.12 Performance Inspection**

On page 515, **Add** the following to TABLE 611.12.B:

**TABLE 611.12.B**

<b>Conduit Type</b>	<b>Measurement Equipment</b>	<b>Type of Measurement</b>
Rigid conduit and 748.06, steel casing pipe	Crawler mounted camera according to SS902.01 with crack measuring capabilities according to SS902.02 C	Joint gaps Crack widths
Plastic conduit, 707.12, corrugated steel spiral rib conduit, 707.24, corrugated aluminum spiral rib conduit, 748.01, ductile iron pipe, and Circular corrugated metal conduit not listed below	Crawler mounted camera with laser profiler according to SS902.02 A, B, and C or Mandrel according to SS902.03 and Crawler mounted camera according to SS902.01 with crack measuring capabilities according to SS902.02 C	Joint gaps Crack widths Deflection
The following types of corrugated metal conduit: 707.04, precast, galvanized steel culverts 707.05 and 707.07, bituminous coated corrugated steel pipe with paved invert, 707.11 Polymer-precast corrugated steel spiral rib pipe 707.13 and 707.14, bituminous lined corrugated steel pipe	Crawler mounted camera with laser profiler according to SS902.02 A, B, and C	Joint gaps Crack widths Deflection

#### **614.03**

On page 523, **Add** the following title to the beginning of the second paragraph:

**A. Training and Responsible Person.**

### 614.03

On Page 524, **Add** the following title to the beginning of the second paragraph:  
**B. Temporary Traffic Control Devices.**

### 614.03

On Page 524, **Add** the following paragraph after the third paragraph:  
For truck-mounted attenuators and trailer attenuators (TMAs) see 614.03.D.

### 614.03

On Page 525, **Add** the following paragraph after the first paragraph:  
All temporary traffic control devices shall conform to the Quality Standards for Temporary Traffic Control Devices and Acceptable Delineation Methods for Vehicles.

### 614.03

On Page 525, **Add** the following title to the beginning of the second paragraph:  
**C. Conspicuity.**

### 614.03

On Page 525, in the 7<sup>th</sup> paragraph **Replace** the following: “**A.** Apply one” with “1. Apply one”.

### 614.03

On Page 525, in the 8<sup>th</sup> paragraph **Replace** the following: “**B.** Outline” with “2. Outline”.

### 614.03

On Page 525, in the 9<sup>th</sup> paragraph **Replace** the following: “**C.** Outline” with “3. Outline”.

### 614.03.C

On Page 526, **Replace** the second paragraph with the following:  
Acceptable methods for delineating material supply vehicles are depicted in the Quality Standards for Temporary Traffic Control Devices and Acceptable Delineation Methods for Vehicles.

### 614.03

On Page 526, **Add** the following at the end of the subsection:  
**D. Truck-mounted or Trailer Attenuator (TMA).** Furnish a TMA that is NCHRP-350 (manufactured prior to 1/1/20) or MASH TL-3 compliant. Do not use a TMA in place of the arrow board at the beginning of a merge taper, or as a substitute in locations where other positive protection methods are required (portable barrier/impact attenuators, tapering outside of the clear zone, etc.). Use of a TMA for a work area already otherwise protected by positive protection shall be at the Contractor’s expense.

Furnish a TMA to protect each work area in the following situations:

1. When working on a multi-lane highway (45 mph and above) in a closed lane or shoulder without portable or permanent traffic barriers separating the work area from the traveled lanes.
2. Any situation on a multi-lane highway (45 mph and above) where a TMA is depicted or labeled as required or optional on a shadow vehicle in the OMUTCD.

Furnish a TMA for each work area if two or more localized work areas occur within the same stationary work zone and are separated by more than 700 feet.

Attach the TMA to the shadow vehicle in accordance with manufacturer specifications and place in advance of the work area according to recommended spacing in Table 614.03-1. Distances are considered as guidelines. However, engineering judgement should be used to alter distances to take into account traffic conditions, vehicle mix, sight distance, and other site-specific conditions.

**Table 614.03-1**

<b>For Shadow Vehicles Weighing 22,000 lb. or More</b>		
<b>Speed Limit (MPH)</b>	<b>Recommended Spacing <sup>[1]</sup></b>	
	<b>Stationary Operation (Ft)</b>	<b>Moving Operation (Ft) <sup>[2]</sup></b>
Greater than 55	150	172
45-55	100	150
Less than 45	74	100
<b>For Shadow Vehicles Weighing Less than 22,000 lb. but Greater Than 9,900 lb.</b>		
<b>Speed Limit (MPH)</b>	<b>Stationary Operation (Ft)</b>	<b>Moving Operation (Ft) <sup>[2]</sup></b>
Greater than 55	172	222
45-55	123	172
Less than 45	100	100

[1] Recommended spacing is distance between front of shadow vehicle and beginning of work area to provide adequate roll ahead distance and minimize the risk of vehicles cutting in ahead of the shadow vehicle.

[2] Distances are appropriate for speeds up to 15.5 mph.

#### **614.10**

On page 529, **Add** the following sentence to the end of the second paragraph:

Covering of one or more permanent or temporary vehicle or pedestrian signal head(s) shall be according to 632.25, except payment shall be included in Item 614 Maintaining Traffic.

#### **614.10**

On page 529, **Add** the following sentence to end of the second paragraph:

Energized signal covers shall block light from being visible.

#### **614.11.B.1**

On page 530, **Replace** TABLE 614.11-1 and TABLE 614.11-1M with the following:

**TABLE 614.11-1**

<b>Type of Pavement Marking</b>	<b>Line Width (inch)</b>				
	4	6	8	12	24
	<b>Gallon per Mile of Line</b>				
Solid Line	22	33	44	66	132
10-foot Dashed Line	5.5	8.25	--	--	--
4-foot Dashed Line	2.2	3.3	--	--	--
Dotted Line	7.3	10.95	14.6	21.9	--
Arrows, Symbols, and Words	1.4 gallons per 100 square feet				
Glass Beads: 740.09, Type A	15 pounds per 100 square feet				

**TABLE 614.11-1M**

Type of Pavement Marking	Line Width (mm)				
	100	150	200	300	600
	Liter per Kilometer of Line				
Solid Line	52	78	105	157	314
3.0 m Dashed Line	13	19.5	--	--	--
1.2 m Dashed Line	5.2	7.8	--	--	--
Dotted Line	17.3	25.95	34.6	51.9	--
Arrows, Symbols, and Words	0.6 liters per square meter				
Glass Beads: 740.09, Type A	7.3 kg per square meter				

**614.11.B.2**

On page 530, **Replace** TABLE 614.11-2 and TABLE 614.11-2M with the following:

**TABLE 614.11-2**

Type of Pavement Marking	Line Width (inch)				
	4	6	8	12	24
	Gallon per Mile of Line				
Solid Line	12	18	24	36	72
10-foot Dashed Line	3	4.5	--	--	--
Dotted Line	4	6	8	12	--
Arrows, Symbols, and Words	0.75 gallons per 100 square feet				
Glass Beads: 740.09, Type A	7.5 pounds per 100 square feet				

**TABLE 614.11-2M**

Type of Pavement Marking	Line Width (mm)				
	100	150	200	300	600
	Liter per Kilometer of Line				
Solid Line	28	42	56	84	168
3.0 m Dashed Line	7	10.5	--	--	--
Dotted Line	9.4	14.1	18.8	28.2	--
Arrows, Symbols, and Words	0.3 liters per square meter				
Glass Beads: 740.09, Type A	3.7 kg per square meter				

**614.11.G.1.a**

On page 532, **Delete** the third paragraph:

~~Use only sand, shot, or water blasting for removal of all pavement markings in preparation for placing Item 422 Chip Seal or Item 421 Microsurfacing.~~

**614.16.B**

On page 539, **Add** the following language as a new line at the end of the subsection:

6. TMAs.

### 614.16.C

On page 539, **Replace** the subsection with the following:

C. If traffic permanently damages beyond use any of the work zone traffic control items listed in 107.15, the Department will compensate the Contractor for replacement of the damaged item by Change Order provided the Contractor has pursued but failed to obtain compensation from the motorist.

### 614.16

On page 540, **Revise** the section as follows:

Item	Unit	Description
614	Lump Sum	Maintaining Traffic
614	Lump Sum	Detour Signing
614	Each	Replacement Drum
614	Each	Replacement Sign
614	Each	Object Marker, ____ - Way
614	Each, Mile, Foot (Kilometer, Meter)	Work Zone Pavement Markings
614	Each	Work Zone Raised Pavement Marker
614	Sign Month	Portable Changeable Message Sign
614	Each	Work Zone Speed Limit Sign
614	Each	Work Zone Marking Sign
614	Hour	Law Enforcement Officer with Patrol Car
614	Each	Barrier Reflector
614	Each	Work Zone Crossover Lighting System
614	Each	Work Zone Impact Attenuator
614	Mile (Kilometer)	Work Zone Lane Line, Class ____, ____ *, ____ **
614	Mile (Kilometer)	Work Zone Center Line, Class ____, ____ **
614	Foot (Meter)	Work Zone Channelizing Line, Class ____, ____ *, ____ **
614	Mile (Kilometer)	Work Zone Edgeline, Class ____, ____ *, ____ **
614	Foot (Meter)	Work Zone Gore Marking, Class II, ____ **
614	Foot (Meter)	Work Zone Stop Line, Class I, ____ **
614	Foot (Meter)	Work Zone Arrow, Class I, ____ **
614	Foot (Meter)	Work Zone Crosswalk Line, Class I, ____ **
614	Foot (Meter)	Work Zone Dotted Line, Class ____, ____ *, ____ **
614	Cubic Yard (Cubic Meter)	Asphalt Concrete for Maintaining Traffic

\* Width of marking (4" or 6" for Lane Lines, Edgelines and Dotted Lines; 8" or 12" for Channelizing Lines and Dotted Lines).

\*\* Type material (642 paint; 740.06, Type I or Type II; or left blank to allow any of the three.)

### 617.03

On page 544, **Replace** the first paragraph of 617.03 with the following:

**617.03 Prosecution.** If reconditioning shoulders as part of a resurfacing project and traffic is maintained, place shoulder material along with the paving operations as rapidly as possible. Complete all shoulder reconditioning within four days following placement of the surface course and any course that results in a drop-off of 2.0 inches (50 mm) or greater. Adjacent to a safety edge constructed as part of the Work, complete all shoulder reconditioning within ten days following construction of the safety edge.

**618**

On page 546, **Replace the** Item heading with the following:

**ITEM 618 RUMBLE STRIPS**

**618.03**

On page 547, **Replace** the second and third sentences with the following:

The Department will measure lengths along the inside edge of the shoulder, edge line or center line, from the center of the first depression in a segment to the center of the last depression in that segment. If Rumble Strips are provided on more than one shoulder or edge line, the Department will measure lengths separately for each shoulder or edge line segment and add the individual lengths together to obtain the total length for the shoulder or the edge line.

**618.04**

On page 547, **Replace** the pay items with the following:

618	Feet (Meter)	Rumble Strips, Shoulder (Asphalt Concrete)
618	Mile (Kilometer)	Rumble Strips, Shoulder (Asphalt Concrete)
618	Feet (Meter)	Rumble Strips, Shoulder (Concrete)
618	Mile (Kilometer)	Rumble Strips, Shoulder (Concrete)
618	Feet (Meter)	Rumble Stripes, Edge line (Asphalt Concrete)
618	Mile (Kilometer)	Rumble Stripes, Edge line (Asphalt Concrete)
618	Feet (Meter)	Rumble Stripes, Edge line (Concrete)
618	Mile (Kilometer)	Rumble Stripes, Edge line (Concrete)
618	Feet (Meter)	Rumble Stripes, Center line (Asphalt Concrete)
618	Mile (Kilometer)	Rumble Stripes, Center line (Asphalt Concrete)
618	Feet (Meter)	Rumble Stripes, Center line (Concrete)
618	Mile (Kilometer)	Rumble Stripes, Center line (Concrete)

**618.04**

On page 547, **Add** the following paragraph after the first paragraph:

The Department will pay for longitudinal pavement marking material in accordance with Item

641.

**619**

On page 548, **Replace** Table 619.02-1 FIELD OFFICE with the following:

**TABLE 619.02-1 FIELD OFFICE**

<b>Item</b>	<b>Type A</b>	<b>Type B</b>	<b>Type C</b>
Minimum ceiling height, ft (m)	7 (2.1)	7 (2.1)	7 (2.1)
Floor space, ft <sup>2</sup> (m <sup>2</sup> )	150 (14)	500 (46)	1000 (93)
Separate enclosed room, ft <sup>2</sup> (m <sup>2</sup> ) (Part of specified floor space)	0 (0)	0 (0)	100 (9)
Telephone service <sup>[1]</sup>	2	2	2
Internet service connection <sup>[5]</sup>	1	1	1
Multi-Function copier that is setup for scanning, printing and copying. <sup>[2]</sup>	1, 11×17	1, 11×17	1, 11×17
Calculator with tape	1	2	3
Desk and chair set	1	3	5

Item	Type A	Type B	Type C
Work table, 30 × 72-inch (750 × 1800 mm)	1	2	3
4-drawer, legal size, lockable metal file cabinet	---	1	2
2-drawer, metal file cabinet	1	2	2
Portable fire extinguishers <sup>[3]</sup>	1	1	2
Plan rack <sup>[4]</sup>	1	1	2
All-weather parking spaces	8	16	20

- [1] For each telephone and/or computer station specified, all ethernet wiring necessary to connect the phone and/or computer and multi-function copier to the internet company system, ~~and a working separate phone number for the printer for faxing.~~
- [2] Copier must meet minimum specifications provided for each field office type. Contractor responsible for paper supplies, copier supplies, and maintenance of copier.

Type A:

One of the following MFC machines/series:

HP models E77822dn, E77825dn, E77830dn, E87640dn, E87650dn, E87660dn, E77822z, E77825z, E77830z, E87640z, E87650z, E87660z

Type B and C:

One of the following MFC machines/series:

HP Models: E77650dn, E77660dn, E77650dns, E77660dns, E77650z, E77660z, E77650zs, E77660zs, E77660zts, E77650z+, E77660z+, E77822dn, E77825dn, E77830dn, E87640dn, E87650dn, E87660dn, E77822z, E77825z, E77830z, E87640z, E87650z, E87660z

- [3] Type 2-A:10-B:C, 5-pound (2.27 g) size
- [4] Capable of handling the breakdown of 22 × 34-inch (559 × 864 mm) sized plans into ten sections.
- [5] Provide a broadband internet connection capable of minimum download speeds as follows:  
30 Mbps download 5 Mbps upload - Network Latency less than 50 milliseconds. If speeds are not available through an individual or singular circuit, provide the highest speed available in the area and install multiple circuits to achieve the specified speeds. When multiple broadband services are available the following is the preferred order: Cable, DSL, Cellular, and Wireless Radio (Satellite Communication is not compatible with ODOT VPN connection and will not be accepted). If a cellular network is used, provide the cellular equipment, including software and router equipment to connect to the ODOT provided Cisco ASA 5505 firewall. Supply ODOT with all documentation for the broadband circuit including all username/user ids, passwords and account information. Verify that the broadband internet connection is active and working as specified. ODOT IT personnel will confirm that bandwidth and network latency are compliant with the required field office specifications. All field office Internet connections are for ODOT use only.

### 621.03.E

On page 552, **Delete** “or on line” in the first sentence of the second paragraph.

### 632.25

On page 604, **Replace** the first paragraph with the following:

Cover vehicular signal heads if erected at intersections where traffic is maintained before energizing the signals. Cover pedestrian signal heads when specified in the plans. Use a sturdy opaque covering material specifically made for use with traffic signals and ensure that the color of the cover is different than the signal head, tan or beige, so that it is clear to drivers and pedestrians the heads are covered, not dark. Use a method of covering and cover attachment and materials as approved by the Engineer. Covers are to be free of text, pictures, or any type of advertising. Maintain covers and remove them when directed by the Engineer.

### 633

On page 609, **Delete** the following from the table of contents:

**633.01 Description**

**633.02 Contractor Personnel Requirements**

**633.03 Materials and Equipment**

**633.04 Shop Drawings**

**633.05 General**

**633.06 Testing and Prequalification**

**633.07 Controllers**



- 633.08 Cabinets
- 633.10 Foundations
- 633.11 Controller Work Pad
- 633.12 Flasher Controller
- 633.13 Controller, Master, Traffic Responsive
- 633.14 Centrally Controlled Arterial Traffic Signal System
- 633.15 Communications
- 633.16 Training
- 633.18 Uninterruptible Power Supply
- 633.19 Method of Measurement
- 633.20 Basis of Payment

#### 633.03

On page 610, **Delete** the following from the last paragraph:  
Furnish material and equipment conforming to:

Concrete (cabinet foundations and work pads)	
QC Misc or QC 1 .....	499, 511
Conduit .....	725.04, 725.051, 725.052
Controller unit.....	733.02
Cabinet and auxiliary equipment .....	733.03
Cabinet riser.....	733.04
Flasher controller .....	733.05
Controller, master, traffic responsive .....	733.06
Remote monitoring station .....	733.07
Uninterruptible Power Supply .....	733.09

#### 633.06.A.

On page 611, **Delete** the following from the first paragraph:

A. For traffic control equipment required by this specification to meet NEMA Standards Publication ~~TS-1~~ or TS-2, conform to the following:

#### 633.06.A.1.

On page 611, **Delete** the following from the first paragraph:

1. Furnish a certified test report indicating compliance to all requirements of NEMA Standards Publication ~~TS-1~~ or TS-2 as applicable.

#### 633.06.C

On page 611, **Revise** the first sentence to the following:

For **Type 2070** controllers, use conflict monitors listed on the Department's prequalified list as specified in Supplement 1076.

#### 633.07

Beginning on page 611, **Delete** the entire section.

**633.07 — Controllers.** Install controller units, consisting of the timing unit, software, and signal timing, into the specified type of prewired cabinet.

Program controller units as shown on the plans unless otherwise directed by the Engineer. If the plan timing data or the supplemental timing data supplied by the Engineer does not exactly fulfill the timing requirements of the installed equipment, notify, in writing, the Engineer of the problem and

identify the discrepancies. The Engineer will consult with the maintaining agency and notify the Contractor within 2 weeks. After programming, briefly operate controllers, with the signals turned off by means of the signal shutdown switch, to ensure that operation is reasonable and conforms to the plans.

If the plans show two or more intersection controllers operated in a progressive signal system, coordinate signals by relating the various controller cycle start times to a zero time base, or other cycle start time at an adjacent signalized intersection. Ensure that the controller unit software provides coordination capability to allow associated controllers to be operated within the progressive traffic system. Coordination equipment shall supervise the operation of its associated controller by causing the end of certain phases and the beginning of the following phases to occur at set points. Program coordination timing according to the coordination timing data shown on the plans or provided by the Engineer.

### 633.19

On page 615, **Delete** the first two paragraphs:

The Department will measure Controller Unit, Type \_\_\_\_, with Cabinet, Type \_\_\_\_ by the number of each complete unit, and will include controller unit with software, all required auxiliary equipment, loop detector units, and a prewired cabinet, with all items completely wired and tested. Ground mounted cabinets will include anchor bolts and conduit ells for installation in the foundation. Pole mounted cabinets will include pole mounting hardware.

The Department will measure Controller Unit, Type \_\_\_\_ by the number of each controller timing unit with software, and will include any signal timing programming or installation. The Department will measure Controller Unit, Type \_\_\_\_, Furnish Only by the number of each controller timing unit with software, and will exclude any signal timing programming or installation

### 633.19

On page 615, **Delete** the first three pay items:

633 Each \_\_\_\_\_ Controller Unit, Type \_\_\_\_, with Cabinet, Type \_\_\_\_  
633 Each \_\_\_\_\_ Controller Unit, Type \_\_\_\_  
633 Each \_\_\_\_\_ Controller Unit, Type \_\_\_\_, Furnish Only

### 641

On page 627, **Revise** the table of contents to the following:

641.01 Description

641.02 Materials

641.03 General

641.04 Equipment

641.05 Pavement Preparation

641.06 Layout and Premarking

641.07 Line Placement Tolerance

641.08 Marking Types

641.09 Two-Way Radio Communication

641.10 Removal of Pavement Markings

641.11 Unsatisfactory Materials and Deduction for Deficiency

641.12 Method of Measurement

641.13 Basis of Payment

**641.11**

On page 632, **Revise** the header to the following:

**641.11 Unsatisfactory Materials and Deduction for Deficiency.****641.11**

On page 632, **Replace** the second paragraph with the following:

The Department will consider materials unsatisfactory if conformance to at least one of the following:

- A. Deficiency of marking material or glass beads is 20 percent or more.
- B. Materials applied outside the temperature or application requirements in Items 642, 643, and 646 without written approval of the Engineer.
- C. Markings not meeting the performance parameters contained in Supplement 1047, Appendices C, D, E, and G.
  - 1. Numerical rating of 8 or lower for Daytime Color (Appendix C)
  - 2. Composite rating of 8 or lower for Night Visibility (Appendix D)
  - 3. Numerical rating of 9 or lower for Durability (Appendix E)
  - 4. Less than the initial measurement for Retroreflectivity (Appendix G)

Replace pavement markings and glass beads in all sections determined to be unsatisfactory by retracing over the unsatisfactory markings at the full thickness specified in Items 642, 643 and 646.

**642.02**

On page 633, **Add** the following to the to the end of the first sentence of the first paragraph:  
“in accordance with supplement 1089.”

**643.02**

On page 636, **Add** the following to the to the end of the first sentence of the second paragraph:  
“in accordance with supplement 1089.”

**643.04**

On page 636, **Delete** the first sentence of the third paragraph.

~~After sampling of resin is completed, transfer the entire contents of each material container to the striper tanks.~~

**644.02**

On page 638, **Add** the following to the to the end of the first sentence of the second paragraph:  
“in accordance with supplement 1089.”

**644.04**

On page 640, **Replace** the fifth full paragraph with the following:

The Department will consider materials unsatisfactory if conformance to at least one of the following:

- A. Deficiency of thermoplastic marking material or glass beads is 20 percent or more.
- B. Materials applied outside the temperature or application requirements in 644.04 without written approval of the Engineer.
- C. Markings not meeting the performance parameters contained in Supplement 1047, Appendices C, D, E, and G.
  - 1. Numerical rating of 8 or lower for Daytime Color (Appendix C)
  - 2. Composite rating of 8 or lower for Night Visibility (Appendix D)
  - 3. Numerical rating of 9 or lower for Durability (Appendix E)
  - 4. Less than the initial measurement for Retroreflectivity (Appendix G)

Replace thermoplastic markings and glass beads in all sections determined to be unsatisfactory by entirely removing the unsatisfactory thermoplastic material by grinding as per 641.10 and then reapplying at the

full thickness specified in 644.04. Do not apply a layer of sprayed thermoplastic to sections determined to be unsatisfactory to achieve the required thickness.

**646.02**

On page 643, **Add** the following to the to the end of the first sentence of the second paragraph:  
“in accordance with supplement 1089.”

**647.01**

On page 648, **Add** the following to the first sentence of the first paragraph after "740.08":  
, 740.09

**647.02**

On page 648, **Add** the following sentence after the second sentence:  
Glass beads, Type E .....740.09

**648.02**

On page 650, **Add** the following to the to the end of the first sentence of the second paragraph:  
“in accordance with supplement 1089.”

**648.05**

On page 652, **Replace** the sixth paragraph with the following:  
The Department will consider materials unsatisfactory if conformance to at least one of the following:

- A. Deficiency of spray thermoplastic marking material or glass beads is 20 percent or more.
- B. Materials applied outside the temperature or application requirements in 648.05 without written approval of the Engineer.
- C. Markings not meeting the performance parameters contained in Supplement 1047, Appendices C, D, E, and G.
  - 1. Numerical rating of 8 or lower for Daytime Color (Appendix C)
  - 2. Composite rating of 8 or lower for Night Visibility (Appendix D)
  - 3. Numerical rating of 9 or lower for Durability (Appendix E)
  - 4. Less than the initial measurement for Retroreflectivity (Appendix G)

Replace or reapply spray thermoplastic markings and glass beads in all sections determined to be unsatisfactory.

**700.00**

On Page 687 **Add** the following table row after specification 409:

421	Microsurfacing Emulsion and Tack Coat	CSS-1hM: Certified Material. At the refinery or source as directed by OMM. Project and/ or Plant Sample per 421.12. Non-certified material is sampled and approved by OMM before use. 421 Tack Coat per 421.09: Project and/ or Plant Sample per 421.12. Tag and ship sample to the District lab for OMM Asphalt section testing. Document in SM.	CSS-1hM: Certified material; Submit to OMM. Non-certified material: Submit to OMM. Do not use until approved. 421 Tack Coat per 421.09. Dilute per 421.09. Do not use non-certified material to dilute.
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**700.00**

On Page 689, for Spec. Number 701.11, **Replace** “Ground Granulated Blast Furnace Slag (GGBFS)” with “Slag Cement”.

**700.00**

On Page 689, for Spec. Number 701.13 **Replace** “Fly Ash” with “Fly Ash/Natural Pozzolan”.

**700.00**

On Page 690 **Replace** the second full table row with the following:

702.02	Cut Back Asphalt	Certified material:	Certified material: Submit to OMM.
702.03			
702.04	Cut Back Asphalt	At the refinery or source as directed by OMM.	
702.07	Emulsions	Project and/ or Plant: One sample per each	
702.12		25,000 gallons. None for less than 300 gallons.	
702.13	Emulsified Asphalts		Non-certified material: Submit to OMM. Do not use until approved.
	Asphalt Emulsion MWS	Non-certified material:	
	Non-Tracking Asphalt Emulsion	Will be sampled and approved by OMM before use.	
	SBR Asphalt Emulsion	702.13 – Provide Certified Test Data per specification requirements.	

**700.00**

On Page 690 **Add** the following table row after the third full table row:

702.08	Cold Liquid-Applied Elastomeric Waterproofing Membrane	Provide Certified Test Data per specification requirements.	
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**700.00**

On Page 693 **Add** the following row after 705.26:

705.27	Carbonate Micro-fines	Verify manufacturer on Concrete Plant Batch Ticket is on Certified List for S 1016 maintained by OMM. Verify material against bill of lading description. Document in SM
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**700.00**

On page 696, **Replace** 707.11 with the following:

707.11	Polymer-precoated corrugated steel spiral rib pipe	Products will be supplied by a source on the Certified List for S 1019 maintained by OMM. Receive with TE-24. Check dimensions and markings. Document in SM.	Notify District Testing and OMM Structural Welding and Metals section, if rejecting material because material non-performs or looks defective during use.
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**700.00**

On page 709, **Delete** 732.07 A from the table.

<del>732.07.A</del>	<del>Loop Detector Units NEMA TS 1</del>	<del>Verify type and brand name of material is on TAP at the time of use. Inspect for conformance to dimension and condition. Document in SM.</del>	<del>Notify District Testing if rejecting material. If material non performs or looks defective during use notify District Testing and OMM.</del>
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**700.00**

On page 711, **Delete** 733.02 E, 733.02 F, and 733.03 A from the table.

<del>733.02. E</del>	<del>Controller Unit Type 2070L</del>	<del>Verify type and brand name of material is on TAP at the time of use. Inspect for conformance to dimension and condition. Document in SM.</del>	<del>Notify District Testing if rejecting material. If material non performs or looks defective during use notify District Testing and OMM.</del>
<del>733.02. F</del>	<del>Controller Unit Type 2070E</del>	<del>Verify type and brand name of material is on TAP at the time of use. Inspect for conformance to dimension and condition. Document in SM.</del>	<del>Notify District Testing if rejecting material. If material non performs or looks defective during use notify District Testing and OMM.</del>

<del>733.03.A</del>	<del>Cabinet Type TS 1</del>	<del>Verify type and brand name of material is on TAP at the time of use. Inspect for conformance to dimension and condition. Document in SM.</del>	<del>Notify District Testing if rejecting material. If material non performs or looks defective during use notify District Testing and OMM.</del>
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**700.00**

On page 711, **Revise** 733.03 D as follows:

733.03 D	Cabinet Type 336L	Verify type and brand name of material is on TAP at the time of use. Inspect for conformance to dimension and condition. Document in SM.	Notify District Testing if rejecting material. If material non-performs or looks defective during use notify District Testing and OMM.
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**700.00**

On page 711, **Delete** 733.03 E:

<del>733.03.E</del>	<del>Cabinet Type 336</del>	<del>Verify type and brand name of material is on TAP at the time of use. Inspect for conformance to dimension and condition. Document in SM.</del>	<del>Notify District Testing if rejecting material. If material non performs or looks defective during use notify District Testing and OMM.</del>
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**700.00**

On page 711, **Revise** 733.04 A as follows:

733.04 A	Cabinet Riser for <del>TS-1</del> TS-2 cabinet	Field inspect for 1/4 aluminum thickness and accept.	Notify District Testing if rejecting material.
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**701.00**

On Page 714 **Replace** section 701.00 with the following:

**701.00 Acceptance.** Provide cements meeting 701.01, 701.02, 701.04, 701.05, 701.07 and 701.09 and certified according to Supplement 1028; fly ash or natural pozzolan meeting 701.13 and certified according to Supplement 1026; slag cement meeting 701.11 and certified according to Supplement 1034; and micro silica meeting 701.10 and certified according to Supplement 1045, without prior sampling, testing and approval by the Department. Lists for certified cement, fly ash, natural pozzolan, slag cement and micro silica sources are maintained by the Laboratory.

**701.11**

On Page 714 **Replace** section 701.11 with the following:

**701.11 Slag Cement.** Provide slag cement according to ASTM C 989, Grade 100 minimum.

**701.13**

On Page 714 **Replace** the first paragraph of section 701.13 with the following:

**701.13 Fly Ash or Natural Pozzolan for Use in Portland Cement Concrete.** Provide fly ash or natural pozzolan according to ASTM C 618, Class C, F, or N, except ensure a maximum loss on ignition (LOI) of 3 percent for fly ash and 5 percent for natural pozzolan.

**702.01**

On Page 715, **Replace** the first sentence with the following:

General. According to AASHTO M 320-10 Table 1 and Supplement 1105 except as follows.

**702.01**

On Page 716, **Add** before the next-to-last sentence of the first full paragraph the following:

Do not use paraffin wax, organic wax, or like materials.

**702.12**

On Page 721, **Replace** the section with the following:

**702.12 Non-Tracking Asphalt Emulsion.** Provide certified non-tracking asphalt emulsion material meeting Table 702.12-1 and Supplement 1128 and Supplement 1032. Emulsion will comply with all specification requirements for at least 30 days after sample date.

**Table 702.12-1**

Tests on emulsion, AASHTO T 59, unless otherwise designated:	
Viscosity, Saybolt Furol at 77 °F (25 °C) (SFS)	20 to 100
Storage Stability Tests, 24-hr (% difference), max.	1.0
Settlement tests, 5-day (% difference), max.	5.0
Sieve Tests (%) (Distilled Water), max.	0.30

Distillation, Residue % solids, min. [1]	50
Oil distillate, %, max.	3

[1] Products may use residual by evaporation to perform residual and may use the material to perform residual tests but must be submitted during approval process in S-1128. Will be required to perform residual by distillation to obtain oil distillate %.

### 703.05.C

On page 733, **Add** the following sentence to the end of the paragraph:

Should the sample contain less than 10 percent of any of the sizes specified in AASHTO T104 Section 5.1, that individual size shall not be held to the above maximum loss requirement.

### 706.05

On page 772, **Replace** the second paragraph with the following:

7.1 For the following box sizes, span by rise, refer to ASTM C1577: 6x4, 5, 6; 7x4, 5, 6, 7; 8x4, 5, 6, 7, 8; 9x4, 5, 6, 7, 8, 9; 10x4, 5, 6, 7, 8, 9, 10; 11x4, 5, 6, 7, 8, 9, 10, 11; and 12x4, 5, 6, 7, 8, 9, 10, 11, 12 feet. For the following box sizes, span by rise, refer to SS940: 14x4, 5, 6, 7, 8, 9, 10; 16x4, 5, 6, 7, 8, 9, 10; 18x4, 5, 6, 7, 8, 9, 10; and 20x4, 5, 6, 7, 8, 9, 10 feet.

### 707.01

On page 788, **Replace** the table with the following:

Pipe			Pipe-Arch	
Diameter	Wall Thickness		Size	Wall Thickness
(inch)	(inch)		(inch)	(inch)
6	0.052			
8	0.064			
10	0.064			
12	0.064			
15	0.064		17 × 13	0.064
18	0.064		21 × 15	0.064
21	0.064		24 × 18	0.064
24	0.064		28 × 20	0.064
27	0.064			
30	0.064		35 × 24	0.064
33	0.064			
36	0.064		42 × 29	0.064
42	0.064		49 × 33	0.079
48	0.064		57 × 38	0.109
54	0.079		64 × 43	0.109
60	0.109		71 × 47	0.138
66	0.138		77 × 52	0.168
72	0.138		83 × 57	0.168
78	0.168			
84	0.168			



**707.01**

On page 789, **Replace** the first table with the following:

<b>Pipe</b>	
<b>Diameter</b>	<b>Wall Thickness</b>
<b>(mm)</b>	<b>(mm)</b>
150	1.32
200	1.63
250	1.63
300	1.63
375	1.63
450	1.63
525	1.63
600	1.63
675	1.63
750	1.63
825	1.63
900	1.63
1050	1.63
1200	1.63
1350	2.01
1500	2.77
1650	3.51
1800	3.51
1950	4.27
2100	4.27

<b>Pipe-Arch</b>	
<b>Size</b>	<b>Wall Thickness</b>
<b>(mm)</b>	<b>(mm)</b>
430 × 340	1.63
530 × 380	1.63
610 × 460	1.63
710 × 510	1.63
885 × 610	1.63
1060 × 740	1.63
1240 × 840	2.01
1440 × 970	2.77
1620 × 1100	2.77
1800 × 1200	3.51
1950 × 1320	3.51
2100 × 1450	4.27

**707.11**

On page 792, **Revise** the following to:

**707.11 Polymer-Precoated Corrugated Steel Spiral Rib Conduits.** Provide conduits that have a center-to-center rib spacing of 7 1/2 inches (190 mm). Provide conduits and fittings according to AASHTO M 36, Type IR, with the following modifications:

6.1 Fabricate pipe from polymer-precoated, on both sides, steel sheet according to AASHTO M 246.

7.2.2 The ribs shall conform to AASHTO M 196, Section 7.2.2.

7.7.1 Reroll the ends of the individual pipe sections to form at least two annular corrugations on each end. Paint the rerolled end with zinc rich paint.

8.1.2 Ensure that the minimum wall thickness (coated) of steel pipe is as follows:

<b>Pipe</b>				
<b>Diameter</b>	<b>Wall Thickness</b>		<b>Diameter</b>	<b>Wall Thickness</b>
<b>(inch)</b>	<b>(inch)</b>		<b>(mm)</b>	<b>(mm)</b>
18	0.064		450	1.63
21	0.064		525	1.63
24	0.064		600	1.63
30	0.064		750	1.63
36	0.064		900	1.63
42	0.064		1050	1.63
48	0.064		1200	1.63
54	0.079		1350	2.01
60	0.079		1500	2.01
66	0.109		1650	2.77
72	0.109		1800	2.77
78	0.109		1950	2.77
84	0.138		2100	3.51
90	0.138		2250	3.51

9.1 Coupling bands shall have annular corrugations.

9.2 Coupling bands shall conform to 707.01.

9.3 A bell and spigot joint according to ASTM A 760 (A760M) may be used with the following modifications:

9.3.1 These joints may be used for conduits ranging in size from 18 (450mm) to 48 (1200mm) inches in diameter.

9.3.2 Ensure the bell and spigot has a soil tight joint by use of a shop applied gasket on the bell end and a field applied gasket on the spigot end.

9.3.3 Provide a minimum of 0.064 (1.63mm) inch nominal sheet thickness or not more than two (2) nominal sheet thickness thinner than the thickness of the pipe to be joined.

14.1 Ensure that the certification and sampling conform to 707.01.

**707.12**

On page 793, **Replace** the table with the following:

Pipe				
Diameter	Wall Thickness		Diameter	Wall Thickness
(inch)	(inch)		(mm)	(mm)
18	0.064		450	1.63
21	0.064		525	1.63
24	0.064		600	1.63
30	0.064		750	1.63
36	0.064		900	1.63
42	0.064		1050	1.63
48	0.064		1200	1.63
54	0.079		1350	2.01
60	0.079		1500	2.01
66	0.109		1650	2.77
72	0.109		1800	2.77
78	0.109		1950	2.77
84	0.138		2100	3.51
90	0.138		2250	3.51

**707.62**

On page 802, **Replace** the first paragraph with the following:

**Polypropylene Corrugated Single Wall Pipe.** Provide polypropylene corrugated single wall pipe for drainage pipe from 3 to 30-inch diameters according to ASTM F 3219, with the following modification:

**707.65**

On page 803, **Replace** the first paragraph with the following:

**Polypropylene Corrugated Double Wall Pipe.** Provide polypropylene corrugated double wall pipe for non-pressure storm sewer pipe from 12 to 60-inch diameters according to ASTM F 2881 with the following modification:

**707.69**

On page 803, **Replace** the entire section with the following:

**Polypropylene Triple Wall Pipe.** Provide polypropylene triple wall pipe and fittings for non-pressure sanitary sewer pipe from 30 to 60-inch diameters according to ASTM F 2764, with the following modifications:

1.2 Provide pipe and fittings for underground use for non-pressure sanitary sewer and storm sewer systems.

10.1 Provide a letter for certification to cover each shipment of material verifying that it meets specification requirements.

**708.01**

On Page 804, **Replace** the second paragraph with the following:

5.1 A green colorant approximately AMS-595A-34159.

**708.02 B.1.f**

On page 804, **Replace f.** with the following.

- f. Color.** Greenish gray, approximating AMS-595A-34159, visual comparison.

**708.02 C.1.a**

On page 805, **Replace a.** with the following.

- a. Color.** White, meeting or exceeding, AMS-595A-37875 according to ASTM E 1347.

**708.02 D.1.a**

On page 806, **Replace a.** with the following.

- a. Finish, Specular gloss, ASTM D 523.** Use AMS-595A-16440 Gray: 70 % minimum after 3000 hours weathering resistance. Color change less than 2.0  $\Delta E^*$ , (C.I.E 1976  $L^*a^*b^*$ ) ASTM D2244.

**708.02.D.1.f**

On page 806, **Replace f.** with the following:

- f. Colors.**

- (1) **Specified.**<sup>[2]</sup>

Brown	AMS-595A, 10324
Green	AMS-595A, 14277
Blue	AMS-595A, 15526
<sup>[2]</sup> If not defined in the plans, the Engineer will specify from the list.	

- (2) **Elective.** As specified on the plans.

**710.06**

On page 815, **Replace** the first sentence of the first paragraph with the following:

Furnish deep beam rail according to AASHTO M 180, Type II or VI, Class A, with the following modifications:

**712.16**

On page 835, **Insert** Item 712.16 after the last paragraph of Item 712.15:

**712.16 Prefabricated Geocomposite Drain (PGD).** Furnish Prefabricated Geocomposite Drain (PGD) consisting of a drainage core with geotextile fabric bonded to one side. Use drainage core material consisting of a preformed, stable, polymer plastic material with a cusped or geonet structure. Use drainage core that supports the geotextile and provides a bonding surface for the geotextile at intervals not exceeding 1-1/8 inches (29 mm) in any direction. Supply core that provides at least 14 square inches per square foot of flat area in contact with the geotextile.

Furnish a geotextile fabric composed of over 85% of polyester, polypropylene, polyolefin, or polyamide fibers by weight, that are formed into a stable network to ensure the performance during handling, installation, and service life. Use geotextile fabric that is resistant to chemical attack, rot, and mildew. Use geotextile fabric that is free of treatments or coatings that would adversely change the hydraulic properties of geotextile after installation. Furnish PGD that has the geotextile fabric covering the full length of the drainage core and has minimum 3 inch (76 mm) wide flaps/flanges of

fabric extending beyond both longitudinal edges of the drainage core. Do not supply PGD that has ripped or torn geotextile fabric.

Furnish PGD in rolls, or in another acceptable manner, wrapped with an opaque, waterproof wrapping. Label or tag each roll or package to provide product identification sufficient to determine the product type, manufacturer, quantity, lot number, roll number, and date of manufacture. Prior to installation, protect the PGD from mud, dirt, dust, debris, harmful ultraviolet light, direct sunlight or temperature greater than 140 °F (60 °C). Furnish 3 inch (76 mm) wide, plastic tape for the sealing, seaming, and splicing the PGD. Furnish waterproof tape designed for underground applications that provides a strong bond that does not deteriorate over time in a buried condition. Furnish fittings and accessories provided by the manufacturer if available.

Submit Certified Test Data showing the product will meet or exceed the requirements listed in Tables 712.16-1 and 712.16-2.

**TABLE 712.16-1 REQUIRED PGD CORE PROPERTIES**

Property	Test Method	Unit	Required Value		
			Conventional Abutment/Wall Height		
			<10 ft (3m)	10 to 30 ft (3 to 9m)	30 to 50 ft (9 to 15m)
Thickness	ASTM D5199	in (mm)	0.4 to 1.0 (10 to 25)		
Minimum Compressive Strength	ASTM D1621	psf (kPa)	4625 (221)	10625 (508)	16625 (796)
Minimum In-Plane Flow Rate*	ASTM D4716	gal/min/ft (l/min/m)	5 (62)	15 (186)	25 (310)

\* Tested under a confining pressure of 3,600 psf (172 kPa) and a hydraulic gradient of 1.0.

**TABLE 712.16-2 REQUIRED PGD GEOTEXTILE PROPERTIES**

Property	Test Method	Unit	Required Value		
			Percent <i>In Situ</i> Soil Passing 0.075 mm		
			<15	15 to 50	>50
Minimum Permittivity	ASTM D 4491	sec <sup>-1</sup>	0.5	0.2	0.1
Apparent Opening Size	ASTM D 4751	mm	AOS ≤ 0.43	AOS ≤ 0.25	AOS ≤ 0.22
Minimum Grab Strength	ASTM D 4632	lb (N)	157 (700)		
Maximum Elongation	ASTM D 4632	%	50		
Minimum Trapezoidal Tear Strength	ASTM D 4533	lb (N)	56 (250)		

Minimum Puncture Strength	ASTM D 6241	lb (N)	309 (1375)
	or ASTM D 4833	lb (N)	58 (260)

#### 720.01

On page 836, in the second paragraph, **Replace** “730.192 or 730.192” with “730.192 or 730.193”

#### 721.03

On page 836, **Replace** the section in its entirety with the following:

**721.03 Casting Adhesive.** Furnish casting adhesives that conform to Supplement 1062.07 - Raised Pavement Marker Casting Adhesive Acceptance Procedure.

Only furnish material listed on the Department’s QPL.

#### 725.20

On page 848, **Replace** the entire section with the following:

**725.20 Multiple Cell Conduit and Fittings.** Ensure that fittings are factory made couplings that couple inner ducts and the outer conduit simultaneously, maintain the continuity and indexing of the inner ducts and are of a push fit design mechanically locked in place.

Furnish materials according to the Department’s QPL.

**A. Polyvinyl Chloride.** Ensure that the multiple cell conduit consists of inner ducts conforming to NEMA TC-8 type DB in an outer conduit conforming to NEMA TC-2 (type EPC-40 or EPC-80 as specified except that size shall be the true inside diameter) in a factory preassembled unit.

**B. High Density Polyethylene.** Ensure that the multiple cell conduit consists of inner ducts conforming to ASTM F2160 with smooth or ribbed inside, and Superglide permanent friction layer, in an outer conduit conforming to ASTM F2160 in a factory preassembled unit.

#### 731.06

On page 861, **Revise** the first paragraph to the following:

**731.06 Sign Flasher Assembly.** Furnish beacons consisting of single traffic signal sections with 8 or 12-inch (200 or 300 mm) yellow lenses. Ensure that the flasher control unit flashes the beacons at a rate for each beacon of between 50 to 60 times per minute with the light period from one-half to two-thirds of the total cycle. Furnish flasher control units that have all solid state components and that meet **NEMA TS-2**. House control units within a weatherproof corrosion-resistant enclosure with a lockable door. Include the LED lamps.

#### 731.07

On page 861, **Revise** the first paragraph to the following:

**731.07 School Speed Limit Sign Assembly.** Furnish yellow beacons that are 8 inches (200 mm) or 12 inches (300 mm). Ensure that the flashers flash the beacons alternately at a rate for each beacon of 50 to 60 times per minute with the light period from one-half to two-thirds of the total cycle. Furnish flashers that have all solid state components and that meet **NEMA TS-2**. Ensure that the backing members with hardware are compatible with the method of support.

### 732.06

On page 869, **Replace** the last sentence of the second paragraph with the following:  
Furnish housing with manufacturers applied external surfaces **black Color 17038 or yellow Color 13655**, Federal Standard 595, unless specified otherwise in the Plans.

### 732.06

On page 869, **Replace** the third paragraph with the following:  
The pushbutton shall be a minimum of 2 inches across in at least one dimension. The force required to activate the pushbutton shall be no greater than 3.5 pounds (15.5N) and operate with a closed fist. There shall be a visible and audible indicator that the button press has occurred.

### 732.06

On page 869, **Replace** the fourth paragraph with the following:  
Furnish materials according to the Department's **QPL**.

### 732.07.A.

Beginning on page 869, **Delete** the entire section.

**A. NEMA TS-1.** ~~Ensure that the loop detector units comply with the requirements of NEMA TS-1, section 15, with the following modifications. Furnish shelf mounted loop detector units that are powered from 120 volts. Use solid state isolated output units for all controller applications where directly connected to a solid state digital controller unit. Ensure that the conductors in the cable harness for loop input pins are twisted three to five times per 1 foot (300 mm).~~

~~Ensure that the electrical connections for four channel shelf mounted units either are the 19-pin MS connector, as required by the foregoing specification, or consist of four connectors of the type required for single channel shelf mounted detector units.~~

~~If specified, design detector unit electrical connection plugs or wiring harness such that any multi-channel shelf mounted detector unit may be readily replaced with single channel detector units. Accomplish this by furnishing only units with the connector type required for single channel shelf mounted detector units, or by wiring the controller back panel to single channel harnesses which are, in turn, plug connected to an adapter harness which is mated to the multi-channel connector of the detector unit.~~

~~Furnish loop detector unit with an LED or LCD display indication of call strength (AL/L or equivalent). This display shall be a bar graph or numerical display with at least eight (8) discrete levels indicated.~~

~~Furnish materials according to the Department's TAP List.~~

### 732.08

On page 870, **Revise** the first sentence to the following:

**732.08 Loop Detector Units, Delay and Extension Type.** Ensure that the loop detector units of this type comply with the requirements of **NEMA TS-2**.

### 732.22

On page 875, **Revise** the first sentence to the following:

**732.22 Backplates.** Furnish louvered backplates constructed of wrought sheet aluminum, according to ASTM B 209 (B 209M), 6061-T6, **0.050 inch (1.3 mm)** minimum thickness.

## 732.22

On page 875, **Replace** the tenth sentence with the following:  
Reflective sheeting shall be Type J, ASTM D4956 Type XI.

## 733.01

On page 875, **Delete** the second definition.  
**“NEMA TS-1” and “Type TS-1”** refers to equipment manufactured in conformance with the National Electrical Manufacturers Association (NEMA) Standards Publication No. TS-1.

## 733.02.B.1.d

On page 877, **Delete** the following:  
d. ~~TS-1 Conflict Monitors~~

## 733.02.B.2.b

On page 877, **Replace** the entire subsection with the following.  
b. 2070LX Controller Units including the following subassembly units:  
(1) 2070-1C CPU Board  
(2) 2070-3B Front Panel.  
(3) 2070-6A,B.

## 733.02.D

On page 877, **Delete** the second sentence in the first paragraph:  
~~Furnish a controller unit that includes all ports and input/output connectors for complete interchangeability between NEMA TS-1 and TS-2 cabinets.~~

## 733.02.E

On page 878, **Delete** the entire section.  
**E. Type 2070L.** ~~Furnish controller units that meet the specifications for “Transportation Electrical Equipment Specifications”, California Department of Transportation, including all addenda. Furnish a controller unit that is listed on the ODOT TAP.~~

~~The Type 2070L version controller unit consists of the following assembled modules:~~

Unit Chassis	
Model 2070-1B:	CPU module, single board
Model 2070-2A:	Field I/O module
Model 2070-3B:	Front panel, Display B (8 lines of 40 char.)
Model 2070-4B:	Power supply module, 3.5 amp. [Power supply Model 2070-4A (10 amp) may be supplied in lieu of Model 2070-4B]
Model 2070-7A:	Async. Serial Communication Module

## 733.02.F

On page 878, **Delete** the entire section.  
**F. Type 2070E.** ~~Furnish controller units that meet the specifications for “Transportation Electrical Equipment Specifications”, California Department of Transportation, including all addenda. Furnish a controller unit that is listed on the ODOT TAP.~~

~~The Type 2070E version controller unit consists of the following assembled modules:~~

Unit Chassis	
--------------	--



Model 2070-1E	CPU Module, Single Board
Model 2070-2A	Field I/O for 170 Cabinet
Model 2070-3B	Front Panel, Display B (8 lines of 40 characters)
Model 2070-4A or Model 2070-4B	Power Supply
Model 2070-7A	Asyene Serial Communication

### 733.02.G

On page 878, **Revise** the second paragraph to the following:

The Type 2070LX version controller unit consists of the following assembled modules:

Unit Chassis	
Model 2070-1C	CPU Module, Single Board
Model 2070-2A	Field I/O for 2070 Cabinet
Model 2070-3B	Front Panel, Display B (8 lines of 40 characters)
Model 2070-4A or Model 2070-4B	Power Supply
Model 2070-7A	Async Serial Communication

### 733.03

On page 879, **Delete** the following from the second paragraph:

Supply two through four phase controller operation with a minimum twelve position backpanel, configured for four pedestrian movements and four overlaps, with a ~~twelve channel NEMA TS-1 conflict monitor or~~ NEMA TS-2 malfunction management unit.

### 733.03

On page 879, **Delete** the following from the fourth paragraph:

For signal phasing configurations that require a larger capacity backpanel or conflict monitor, supply a 16 position backpanel with a ~~16 channel NEMA TS-1 conflict monitor or~~ NEMA TS-2 malfunction management unit.

### 733.03.A.

Beginning on page 880, **Delete** the entire section.

#### ~~A. Type TS-1.~~

~~1. Cabinets. Furnish a cabinet size that provides ample space for housing the controller unit and all associated electrical devices furnished with it, together with any other auxiliary devices that are specified. Furnish a cabinet with sufficient shelf space to accommodate all existing, proposed, and designated future equipment. Ensure that the space provided accommodates the appropriate controller unit frame as designated in NEMA TS-1, Section 14.~~

~~Construct the cabinets of cast aluminum or sheet aluminum, drawn or formed, with aluminum support and stiffening of members provided as necessary. Ensure that the exterior is smooth with no sharp edges. Weld all joints. Ensure that the cabinet is rigid and is designed to support all components. Ensure that the application of the following loads do not result in breakage, deformation, or loss of weatherproof qualities: a 100-pound (445 N) load applied to any 1-inch (25 mm) square surface of the cabinet or door (open or closed), in any direction; or a 300-pound (1.3 kN) load applied vertically downward to any 4-inch (100 mm) square of the top surface or to the top edge of the closed and latched door.~~

~~Provide cabinet exterior surfaces of bare aluminum. When the plans specify a cabinet color, prime and finish all cabinet exteriors with two coats of high-grade enamel paint of the specified color. Ensure that the cabinet interior surfaces are the same as the exterior, or may be painted flat white.~~

Ensure that the cabinet contains at least one rain-tight louvered vent equipped with a replaceable filter. Install vents to allow for the release of excessive heat and any explosive gases that might enter the cabinet.

Ensure that the cabinets are functional in design and have a door in the front providing access to substantially the full interior area. Attach a gasket of elastomeric material to the cabinet or door to form a weatherproof seal. Furnish door hinge pins of stainless steel or equivalent corrosion resistant material. Furnish a door stop to retain the door in at least a 90-degree open position.

Include a small, hinged, and gasketed door in door (police door) on the outside of the main controller door. Ensure that the door in door does not allow entrance to the controller mechanism nor to exposed electrical terminals, but provides access to a small switch panel and compartment (police panel).

Fit the cabinet with the necessary provisions for mounting, with a bottom conduit connection provided for pole-mounted cabinets. Furnish suitable hardware and equipment for each cabinet mounting method, including bolts for drilled and tapped holes on metal supports, pole attachment clamps, pedestal slipfitter, and anchor bolts and conduit ells for installation in concrete foundations. Furnish steel anchor bolts that are galvanized at least 1 inch (25 mm) beyond the threads. Certified cabinet anchor bolts are not required.

Directly place all equipment designed for shelf mounting on a shelf except for loop detector units (amplifiers) and similar devices designed for stacking on each other. Arrange components on shelves and devices on the door so that a 1-inch (25 mm) minimum space separates them when the door is shut. Ensure that plugs, wires, controls, or similar items do not compromise this space.

Reserve a minimum 4-inch (100 mm) clear area on the bottom of the cabinet for the routing of cables. Do not locate panel-mounted equipment in the bottom 6 inches (150 mm) of the cabinet. Do not locate shelves or components within 6 inches (150 mm) of the bottom of foundation-mounted cabinets.

Arrange all equipment for easy withdrawal and replacement, without the necessity of disturbing adjacent equipment. Permanently locate devices within the cabinet to allow free circulation of air and that do not restrict air flow from fan ducts or vents.

Ensure that the auxiliary equipment operates within a weatherproof cabinet at ambient temperatures between -30 and 165 °F (-34 and 74 °C).

When terminals and panel-mounted devices with exposed electrical contact points are located next to shelf-mounted equipment, provide spacers, shelf lips, or other means to assure that component units cannot be accidentally moved into contact with any exposed electrical terminal points.

Ensure that load switches, relays, flashers, fuses, switches, terminal blocks, and other equipment mounted or plugged into the back or side panels are readily accessible. Ensure that switches, controls, and indicator lights are visible and easily operable without moving the components from their normal shelf positions.

Furnish an aluminum shelf with integral storage compartment in the space immediately below the controller. Ensure the storage compartment has telescoping drawer guides for full extension. Ensure the compartment top has a non-slip plastic laminate attached.

Furnish LED-strip lighting for internal illumination.

Furnish materials according to the Department's TAP List.

## **2. Accessory Equipment**

**a. Ventilating Fan.** Equip all cabinets with a forced air ventilating fan. Furnish a fan that provides a capacity of at least 100 cubic feet (2.8 m<sup>3</sup>) per minute. Furnish a fan that is thermostatically controlled and adjusted to start at cabinet temperatures above 120 °F (49 °C) and to stop when the temperature has dropped below 100 °F (38 °C).

**b. Load Switches.** Furnish all cabinets with solid state, triple-signal load switches complying with NEMA TS-1, Section 5. Additionally, ensure that all load switches have both input and output indicators.

**c. Conflict Monitor.** Furnish all cabinets with a separate solid-state conflict monitor device. Ensure that the cabinet wiring, in the event of monitor disconnection, transfers the signals to a flashing condition. Furnish conflict monitors that comply with NEMA TS-1, Section 6. Additionally, ensure that all conflict monitors are capable of causing the signals to flash as a result of the following events:

(1) All red lamps associated with a load switch are burned out;

(2) Within one second when red and green, or yellow and green color pairings are displayed on the same phase;

(3) The absence of a minimum yellow interval.

Ensure that the monitor indicates the exact load switch output channel upon which the failure event occurred. Furnish conflict monitors that are capable of storing a minimum of nine fault events (event logging feature). Furnish a monitor that utilizes a LCD display and has a RS-232 port for connection to a laptop computer. Furnish software and connector cables to diagnose the conflict monitor.

**d. Flashers.** Furnish solid-state flashers that comply with NEMA TS-1, Section 8. When signals have a normal stop-and-go sequence that includes flashing, either ensure that the controller unit generates that flashing display or provide flashers. For this purpose, provide separate flashers from those provided for emergency back-up. Furnish flashers that are designed with two circuits of at least 10 amperes each.

Equip each controller cabinet with terminals that are wired so that, by an interchange of jumpers, the flashing operation is arranged to display either flashing yellow or flashing red on the vehicular signals.

**e. Relays.** Ensure that the relays required for proper operation of the specified equipment are furnished and completely wired. Furnish relays that are enclosed, readily replaceable, and designed for one million operations without failure or need for adjustment.

**f. Surge Protection Devices.** Furnish surge protection on incoming power lines, interconnect lines, and detector leads.

The primary surge protection device (SPD) shall be an EDCO SHA-1250 or approved equal. A plug-in base shall be used to hold the device. All wiring connections shall be made to the base, and appropriate cabinet clearances maintained, to allow the SPD module to be replaced by hand without the use of tools.

Furnish loop detector lead-in cable protection that consists of devices installed in each detector circuit where the lead-in connects to the terminal block. House each device in a case that consists of two stages; a 3-electrode gas tube arrestor and a semiconductor circuit. Ensure that the arrestor shunts to ground a common mode transient with a 1,000 ampere peak and an 8/20 microsecond wave shape, ionizing at 400 volts within 100 nanoseconds when subjected to a 1,000 volt per microsecond transient. Furnish a semiconductor circuit that clamps a differential transient to 30 volts within 40 nanoseconds of the appearance of the transient, and a common mode transient to 30 volts within 500 nanoseconds of the ionization of the gas tube arrestor. Ensure that the second stage is able to withstand a peak current of 13 amperes. Furnish a device that has impedance characteristics compatible with the detector unit so as not to cause false calls or increase the loop impedance above the sensitivity of the detector unit.

Furnish pedestrian pushbutton inputs with the same protection as specified for the loop detector lead-in cables.

Protect interconnect cable against transients by devices across each conductor of the cable and ground. The devices may be either 2 or 3 terminal devices. If 3 terminal devices are used, connect two

conductors and ground to the same device. Furnish a protection device that consists of a gas tube arrester with a maximum ionization voltage of 1000 volts on a 10,000 volt per microsecond transient or a maximum ionization voltage of 950 volts on a 3000 volt per microsecond transient. Ensure that the maximum time from beginning of the transient to ionization is 1.1 microseconds on a 10,000 volt per microsecond transient. Ensure that the device is not ionized by normal voltage variations on a 120-volt AC line. Furnish a device that is able to withstand a 10,000-ampere peak with an 8/20 microsecond waveshape.

**g. Main Power Breaker.** Furnish an incoming AC+ power line that is controlled by a main circuit breaker rated at 240 volts and an auxiliary breaker, with capacity and wiring as specified in NEMA TS-1, Section 10.3.2.2 and Figure 10-4.

If a power service disconnect switch is located before the controller cabinet, the neutral (AC-) and the grounding bar in the controller cabinet shall not be connected together as shown in NEMA TS-1, Figure 10-4.

**h. Radio Interference Filter.** Furnish an incoming AC+ power line that contains a radio frequency interference (RFI) filter installed between the main circuit breaker and the solid state equipment. Also, provide RFI filtering for the load switches and flasher, unless the equipment furnished provides signal and flasher circuits switching at the zero voltage point of the power line sinusoid wave form.

**i. Convenience Outlet and Light.** Wire a convenience outlet into the cabinet for use by electrical maintenance equipment. Ensure that the outlet contains at least one standard duplex three-wire NEMA 5-15 receptacle of the ground fault circuit interrupting (GFCI) type. Wire a second non-GFCI convenience outlet, not fed thru the UPS system (if used). Furnish and mount a white LED lamp in the upper portion of the cabinet. Furnish a door switch to control the convenience light.

**j. Manual Control and Pushbutton.** When required by the plans, provide intersection controller units with means for substituting manual operation of interval timing for automatic interval timing. Ensure that manual operation provides the same interval sequence as when the controller unit is operating automatically.

Obtain manual interval timing by a momentary pushbutton contact switch mounted on a 5-foot (1.5 m) minimum flexible weatherproof extension cord. Store that switch and cord behind the small door-in-door.

**k. Switches.** Furnish completely wired switches that are required for proper operation of specified equipment. Clearly and permanently label switches as to function and setting position, and ensure that they are accessible without the necessity of moving components.

**(1) Signal Shutdown Switch.** Furnish a cabinet with a signal shutdown switch for turning off the power to the signals at the intersection. Ensure that this switch only affects the power to the signals, and allows the controller to continue in operation. Locate the switch in the panel behind the small door-in-door (police door).

**(2) Auto/Flash Switch.** Furnish a cabinet with a flash control switch for activating the flashing of vehicular signals in a preselected emergency flash display. Ensure that the operation of the flash control switch causes a flashing display even under conditions of controller unit malfunction or of its removal from the cabinet. Ensure that the operation of the switch overrides any operation commands from a local or remote time switch. Locate the switch in the panel behind the small door-in-door (police door).

Program the transfer to and from flashing operation, when called remotely or by a local time switch, to occur only at points in the cycle allowed by the OMUTCD.

**(3) Automatic/Manual Transfer Switch.** Furnish a cabinet with an automatic/manual transfer switch. In the automatic position, ensure that the controller unit automatically sequences the

signal head displays. In the manual position, ensure that the signal phase or interval sequencing occurs only upon manual activation of the manual control pushbutton. Locate the switch in the door-in-door (police door). Ensure that it is unnecessary, when switching from manual to automatic operation, or vice versa, to do so at any certain time or to make any time adjustments.

**(4) Run/Stop Time Switch.** Furnish a cabinet with a run/stop time switch that activates the controller stop time feature when in the “stop time” position. Locate the run/stop time switch on a switch panel in the cabinet.

**(5) Controller Shutdown Switch.** Furnish a cabinet with a controller shutdown switch that cuts off power to the controller unit, conflict monitor, and detector units. Ensure that power is not cut off to those components required to maintain flashing operation. Locate the controller shutdown switch on a switch panel in the cabinet.

**(6) Coordinated/Free Switch.** Furnish controllers operated in a coordinated system with a coordinated/free switch. Ensure that this switch allows the choice of operating the controller under the supervision of a coordination device or operating the controller independently of coordination control. Locate the coordinated/free switch on a switch panel in the cabinet.

**(7) Detector Test Switches.** Furnish momentary contact switches that will enter a vehicular or pedestrian call for any actuated phase. Furnish a switch for each actuated phase vehicular and pedestrian detection input. Conveniently group and label the switches.

**l. Terminal Blocks.** Furnish cabinets that include terminal blocks mounted on panels on the walls of the cabinet. Ensure that the blocks are not obstructed by shelf-mounted devices. Furnish sufficient terminal sets for each individual harness wire as well as for contacts of signal load switches, flasher transfer relays, flasher, and other components. Also, provide separate terminal sets for field wiring connections, including power, signal, interconnection, and detector lead-in cables. Group terminal sets to separate higher voltage (120 VAC) from lower voltage, and arrange them into logical groups. Protect terminal blocks from accidental contact during the installation and removal of shelf-mounted equipment. Locate the blocks no closer than 4 inches (100 mm) from the bottom of pole and pedestal-mounted cabinets, and no closer than 6 inches (150 mm) from the bottom of foundation-mounted cabinets.

Ensure that the terminal points are UL listed as suitable to carry the rated loading. Ensure that the capacity and size of the terminals are as specified in NEMA TS-1, Section 10.2.5. Ensure that the terminal points for signal field wiring for each circuit accommodates at least four 12 AWG conductors with spade type terminals.

Furnish terminal points for incoming power wiring that accepts either spade terminals or bare stranded wire and are suitable for either aluminum or copper conductors.

Space terminal sets for easy wiring. Furnish at least six reserve terminal sets for controllers. Harnesses may terminate on the back of terminal blocks using through-panel terminals. Clearly mark terminal sets for ready identification including through-panel terminals that are identified on both sides. Ensure that the contact between adjacent terminal points are made by bus bar, or by wire jumpers having spade type terminals securely attached to each end.

**m. Terminal Buses.** Furnish a cabinet with supply terminal buses fed from the line side of the incoming 120 VAC power line, after the phase wire has passed through the main power switch. Ensure that the requirements for use of radio interference filters are according to Item 8 of this Section, with the buses supplying load switches and with flashers being filtered when required. Ensure that a signal bus relay controls power to the bus supplying power for the signal load switches. The following overrides NEMA requirements for signal bus relays. A solid state relay shall be used for the signal bus relay. The signal bus relay shall maintain output equal to or above the rating of the cabinet main overcurrent

protection device over the NEMA TS-2 Environmental Operating Range of -50 to +185 degrees F (-45 to +85 degrees C).

Furnish a common terminal bus for the connection of the neutral wire of the incoming 120 VAC power line. Ensure that the common bus has sufficient terminal points to accommodate all potential cabinet wiring as well as field wiring. Use a separate common terminal, insulated from the panel, for the interconnect common.

Furnish bus terminal points that comply with Item 12 of this Section for conductor accommodation, attachment and identification.

**n. Grounding System/Bus Bars.** Furnish a cabinet that includes a grounding system as specified in NEMA TS-1, Section 10.3.2.1 with an adequate number (minimum of three) of ground terminal points.

**o. Wiring.** Neatly organize and route the harnesses and wiring bundles to individual terminals. Ensure that the harness provides a wire for each pin or contact of the device. Connect each wire to a marked terminal position. Use labeled spade type terminals or plug connections on all harness wiring. Group and lash or restrain wire bundles in such a manner that they will not interfere with the access to components, terminal blocks or buses, or the legibility of terminal identification. Ensure that the harnesses are of sufficient length to reach any point within the cabinet. Ensure that the cables and harness bundles are easily traced through the cabinet to their terminations. Route all wiring terminated on printed circuit boards (as commonly done for BIU backpanel connectors) at right angles to the pin array; no wires shall pass over the connector pins.

Wire the cabinet so that controller pin connections associated with a given phase number matches the phase number assigned to the specified traffic movement as shown on the plans.

Furnish all wiring with stranded conductors. Ensure that the wiring is adequate for the voltage and load that represents the ultimate load of the devices connected. Ensure that the ampacity rating of the wires are as specified in NEMA TS-1, Section 10.3.3.1. Ensure that the wiring is color coded as follows:

- (1) Solid white, AC common.
- (2) Solid green or green with yellow stripes, equipment ground.
- (3) Solid black, AC line side power (AC+).

**p. Loop Detector Units.** Furnish loop detector units that comply with the requirements of NEMA TS-1, Section 15, with the following modifications:

- (1) Furnish loop detector units that are shelf mounted and powered from 120 volts.
- (2) Ensure that the unit uses solid state isolated output devices.
- (3) Furnish conductors in the cable harness for loop input pins that are twisted three to five times per foot (300 mm).
- (4) Furnish detector unit electrical connection plugs or wiring harness that are designed such that any multi-channel shelf mounted detector unit is readily replaced with single channel detector units. Furnish only units with the connector type required for single channel shelf mounted detector units, or by wiring the controller back panel to single channel wiring harnesses which are, in turn, plug connected to an adapter harness that is mated to the multi-channel connector of the detector unit.
- (5) When shown on the plans, supply delay and extension timing capability on the detector unit; otherwise, the controller unit software requirements of 733.02 will provide these features.
- (6) Ensure that the harness provides a wire for each pin or contact of the device.

~~(7) Furnish loop detector unit with an LED or LCD display indication of call strength (AL/L or equivalent). This display shall be a bar graph or numerical display with at least eight (8) discrete levels indicated.~~

~~If vehicle detector types other than "loop" detectors are required by the plans, provide these detectors by separate bid item.~~

~~Furnish TS-1 cabinets according to the Department's TAP List.~~

#### 733.03.D

On page 900, **Delete** 733.03.D in its entirety.

#### 733.03

On page 901, **Replace "E. Type 336L."** with the following:

**D. Type 336L.**

#### 733.05

On page 903, **Revise** the first sentence to the following:

**733.05 Flasher Controller.** Furnish solid-state flasher that complies with NEMA TS-2, Section 8, and have two circuits, each rated at 10 amperes.

#### 733.06.B.1.

On page 903, **Replace** the first paragraph with the following.

**1. Design.** Furnish a solid state, digital microprocessor master controller design. Furnish a controller that uses menu driven prompts. If the master controller is used with Type 2070 controllers, provide software unless otherwise shown on the plans.

#### 733.09.A.

On page 907, **Replace** the second paragraph with the following:

Furnish a UPS compatible with all of the following traffic signal equipment; NEMA TS-2 controllers and cabinets, Model 332 & 336 cabinets, 2070 controller and electrical service pedestals.

#### 733.09.D.

On page 909, in the first paragraph, **Replace** the first sentence with the following.

Furnish an enclosure mountable to a standard Model 332, NEMA TS-2 traffic signal cabinet and be constructed of natural unpainted aluminum.

#### 740.04.G

On page 913, **Replace** the first sentence of the section with the following:

Furnish yellow material containing a minimum of 5 percent by weight of primary yellow lead free pigment (measured according to ASTM D 126 or Department approved lab method).

#### 740.08

On page 916, **Replace** the section in its entirety with the following:

**740.08 Heat-Fused Preformed Thermoplastic Pavement Marking Material.** Furnish heat-fused preformed thermoplastic pavement marking materials conforming to the following:

Material Type	Thickness	Pre-heat	Post-heat
Type A90	90 mil (2.29 mm)	Yes	Yes
Type B90	90 mil (2.29 mm)	No	Yes



Type A125	125 mil (3.18 mm)	Yes	Yes
Type B125	125 mil (3.18 mm)	No	Yes

Furnish heat-fused preformed thermoplastic pavement marking materials conforming to AASHTO M249 with the following the following requirements:

**A. Pigments.** Furnish white material with sufficient titanium dioxide pigment to meet FHWA Docket No. FHWA-99-6190 Table 5 and Table 6 as revised and corrected. Furnish yellow material with sufficient pigment to meet FHWA Docket No. FHWA-99-6190 Table 5 and Table 6 as revised and corrected. The yellow pigments must be organic and must be heavy-metal free.

**B. Heating indicators.** Furnish the material with the top surface of the material (same side as the factory applied surface beads) shall have regularly spaced indents. The closing of these indents during application, shall act as a visual cue that the material has reached a molten state allowing for satisfactory adhesion and proper bead embedment, and as a post-application visual cue that the application procedures have been followed.

**C. Skid Resistance.** Furnish the material with properly applied and embedded surface beads, must provide a minimum resistance value of 45 BPN when tested according to ASTM E 303.

**D. Environmental Resistance.** Furnish the material that must be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to oil and gasoline.

Ensure that the material contains reflective glass beads, 740.09 Type E. Prequalify materials according to Supplement 1047. Furnish materials according to the Department's Approved List.

#### **740.09.E**

On page 918, **Add** the following new section after section 740.09.D. Type D.:

**E. Type E.** Furnish heat-fused preformed plastic pavement marking materials that contain a minimum of thirty percent (30%) intermixed graded glass beads by weight and factory applied coated surface beads in addition to the intermixed beads at a rate of 1 lb. ( $\pm 10\%$ ) per 10 sq. ft.

Furnish factory applied coated surface beads with the following specifications:

- 1) Minimum 80% rounds
- 2) Minimum refractive index of 1.50

Furnish intermixed graded glass beads and factory applied coated surface beads that conform to Type 1 and/or Type 3 AASHTO M247 as recommended by the manufacturer.

Use materials certified according to Supplement 1089.



**STATE OF OHIO  
DEPARTMENT OF TRANSPORTATION**

**SUPPLEMENTAL SPECIFICATION 832  
TEMPORARY SEDIMENT AND EROSION CONTROL**

**October 19, 2018**

- 832.01 Description**
- 832.02 Definitions**
- 832.03 SCD References**
- 832.04 Requirements and Provisions**
- 832.05 Locate and Furnish BMP**
- 832.06 Temporary Access Fills (Causeway and Access Fills).**
- 832.07 Temporary Access Fills Construction**
- 832.08 Maintenance**
- 832.09 Storm Water Pollution Prevention Plan**
- 832.10 SWPPP Acceptance**
- 832.11 Inspections and SWPPP Updates**
- 832.12 Compensation**
- 832.13 Method of Measurement**
- 832.14 Basis of Payment**

**832.01 Description.** This work consists of locating, furnishing, installing, and maintaining temporary sediment and erosion control Best Management Practices (BMP) for earth disturbing activity areas, developing a Storm Water Pollution Prevention Plan (SWPPP), performing SWPPP Storm Water Pollution Prevention Inspections, filing a Co-Permittee form as required. Furnish a SWPPP if required prior to any earth disturbing activity. Furnish and install temporary sediment and erosion control BMPs in compliance with all National Pollutant Discharge Elimination System (NPDES) and surface water permits. Amend the SWPPP in accordance with the Ohio Environmental Protection Agency (Ohio EPA) General Construction Stormwater NPDES Permit. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other Federal, State, or local agencies, adhere to the more restrictive laws, rules, or regulations.

**832.02 Definitions**

**Alternative BMP.** Temporary structural BMP recommended for use by the SWPPP Designer when traditional BMP listed in Appendix F are determined to be “not-appropriate” based on design considerations listed in 832.05. Alternative BMP selected by the SWPPP Designer must be compliant with the OEPA NPDES Permit and be accepted for use by the Engineer.

**BMP.** Temporary structural sediment and erosion control best management practices designed and installed by methods compliant with the Ohio EPA NPDES Permit (Appendix E of this specification Part III. G. 2.), by this specification and location shown on the SWPPP.

**C&MS.** Construction and Material Specifications of the Ohio Department of Transportation dated as shown on the plans.

**CECI.** Contractor's Erosion Control Inspector. Must have active CESSWI or CPESC certification.

**CESSWI.** Certified Erosion, Sediment, and Storm Water Inspector sponsored by the Soil and Water Conservation Society and International Erosion Control Association. Information on certified individuals is available at [www.cesswi.org](http://www.cesswi.org).

**CPESC.** Certified Professional in Erosion and Sediment Control as sponsored by the Soil and Water Conservation Society and International Erosion Control Association. Information on certified individuals is available at [www.cpesc.net](http://www.cpesc.net).

**Co-Permittee.** A requirement of OEPA NPDES Permit (Appendix E of this specification, Part I. F. Notice of Intent Requirements).

**EDA.** Earth Disturbing Activity is any activity that exposes bare ground or an erodible material to storm water, including any "Disturbance" as defined in OEPA NPDES Permit, Part VII, Definition H.

**Contractor EDA.** Any EDA that is not shown on the plans as part of the project. EDA not shown on the plans and occurring within the project limits is also Contractor EDA.

**Project EDA.** Any EDA that is shown on the plans as part of the project.

**Total EDA.** Combined Project EDA and Contractor EDA.

**EPA.** Environmental Protection Agency.

**Isolated Wetland Permit.** OEPA permit allowing the discharge of fill material into an isolated wetland.

**NOI.** Notice of Intent.

**NOT.** Notice of Termination.

**NPDES.** National Pollutant Discharge Elimination System.

**OEPA.** Ohio Environmental Protection Agency.

**OEPA NPDES Permit.** OEPA Storm Water Construction General Permit (OHC000005) Appendix E of this specification.

**OES.** Office of Environmental Services-ODOT.

**OHWM.** The line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas or defined in accordance with the most current version of 33 CFR 328.

**Operator.** As defined in OEPA NPDES Permit (Appendix E of this specification, Part VII. Definitions, Q.)

**OWPCA.** Ohio Water Pollution Control Act (Ohio Revised Code 6111.01 et seq.).

**Post-Construction BMP.** Permanent water quality or water quantity best management practices required by the EPAOEPA NPDES Permit.

**PCN.** Pre-Construction Notification for 404 permit.

**SCD.** Standard Construction Drawing.

**SWPPP.** Storm Water Pollution Prevention Plan.

**SWPPP Designer.** The Ohio licensed Professional Engineer that also maintains a current CPESC certification who developed the Storm Water Pollution Prevention Plan.

**SWPPPTrack.** Software subscription service version SWPPPTrack LTIS OH developed and provided by Storm Water Simplified Ltd. for use on construction projects that require coverage under the OEPA NPDES Permit.

**USACE.** United States Army Corps of Engineers.

**404 Permit.** USACE permit authorizing discharge of fill material into Waters of the US, per Section 404 of the Clean Water Act.

**401 Water Quality Certification (401 WQC).** OEPA permit authorizing discharge of fill material, per Section 401 of the Clean Water Act.

**Waters of the United States.** Defined in Code of Federal Regulations, 33 CFR Part 328.

**832.03 SCD References.** Construct the following features according to the SCDs as listed on the plan title sheet.

Construction Fence.....	DM-4.3
Dikes.....	DM-4.3
Filter Fabric Ditch Check .....	DM-4.4
Inlet Protection.....	DM-4.4
Perimeter Filter Fabric Fence .....	DM-4.4
Rock Channel Protection Type C or D with/without Filter .....	DM-4.3/4.4
Sediment Basins and Dams .....	DM-4.3
Slope Drains.....	DM-4.3
Construction Entrance (Type 1 Driveway).....	BP 4.1

**832.04 Requirements and Provisions.** Furnish a SWPPP meeting all the requirements of this specification and that maintains compliance with OEPA NPDES Permit (See Appendix E), related rules, specifications, SCD, and permits. The Department will furnish the Contractor a copy of the NOI and the OEPA approval letter at or before the Pre-Construction meeting.

Locate, furnish, install, and maintain temporary sediment and erosion control Best Management Practices (BMP) that maintain compliance with the OEPA NPDES Permit, Clean Water Act (33 USC Section 1251 et seq.), the OWPCA, the 404 permit, the 401 WQC, the Isolated Wetland Permit, local government agency requirements, specifications, SCD, and other related rules and permits.

File a Co-Permittee form when the project requires a Notice of Intent (NOI) to the OEPA. Information about electronic filing of the Co-Permittee notice can be found at <http://www.epa.state.oh.us/dsw/permits/gpfact#137794352-applying-for-coverage>. Submit a copy of the Contractor's OEPA Co-Permittee approval notice or a copy of the submitted application to the Engineer at or before the Pre-Construction meeting.

The following provisions survive the completion and/or termination of the contract.

**Provision 1.** If a governmental agency or a local governmental authority finds a violation of the above noted requirements, or that the BMP are incomplete, or that the SWPPP is incomplete or that the implementation of the SWPPP is not being performed correctly or completely, full responsibility is borne by the Contractor to make all corrections.

**Provision 2.** If a governmental agency or a local governmental authority furnishes an assessment, damage judgment or finding, fine, penalty, or expense for a violation of the above noted requirements, or that the BMP are incomplete, or that the SWPPP is incomplete or that the implementation of the SWPPP is not being performed correctly or completely, the Contractor will reimburse the Department within 10 Calendar Days of the amount for any of the above. The Department may withhold the amount of money requested for the above from the Contractor's next pay estimate and deliver that sum to the governmental agency or local governmental authority issuing the assessment, damage judgment or finding, fine, penalty or expense.

**Provision 3.** The Contractor agrees to indemnify and hold harmless the Department, and will reimburse the Department for any assessments, damage judgment or finding, fine, penalty, or expense as a result of the failure of performing this portion of the Contract. The Department may withhold the amount of any assessments, damage judgment or finding, fine, penalty or expense from the Contractor's next pay estimate.

**Provision 4.** If a governmental agency or a local governmental authority furnishes a stop work order for any of the following: a violation of the above noted requirements; BMP are incomplete; SWPPP is incomplete; implementation of the SWPPP is not being performed correctly or completely, the Department will find the Contractor in default.

**Provision 5.** If the Department or any government regulatory agency finds a violation of the above noted requirements, or that the BMP are incomplete, or that the SWPPP is incomplete or that the implementation of the SWPPP is not being performed correctly or completely, the Contractor shall correct and mitigate the conditions within 48 hours of notification by the Department or regulatory agency. Failure to correct non-compliant site conditions may result in the Department suspending work for the entire project until the corrections are performed. Repeated non-compliance with the SWPPP or failure to regularly update the SWPPP as needed to match the site conditions may result in removal of the Contractor's Superintendent in accordance with C&MS 108.05.

**EDA Requirements.** Furnish appropriate BMP for all EDA. Unless otherwise indicated, BMP will be compensated provided that the BMP are designed, installed and maintained appropriately. For projects that do not require a SWPPP as indicated in the table below, furnish a written plan for acceptance by the Engineer that identifies the location, extent and purpose of the BMP proposed. Compensation will not be provided for the written plan.

An estimated amount is established in the proposal for BMP to be used for project EDA and estimated Contractor EDA as outlined below:

<b>Scenarios for Routine Maintenance Projects</b> (as identified on the Plan Title Sheet)			
Project EDA (acres)	Estimated Contractor EDA (acres) <sup>[1]</sup>		
	EDA = 0	0 < EDA < 1	1 ≤ EDA < 5
EDA = 0	A	B	C
0 < EDA < 5	B	B	C

<b>Scenarios for Non-Routine Maintenance Projects</b>			
Project EDA (acres)	Estimated Contractor EDA (acres) <sup>[1]</sup>		
	EDA = 0	0 < EDA < 1	EDA ≥ 1
EDA = 0	A	B	D
0 < EDA < 1	E	<sup>[2]</sup>	F
EDA ≥ 1	F	F	F

- [1] If the actual Contractor EDA in the SWPPP exceeds the estimated Contractor EDA on the Title Sheet resulting in a Total EDA > 1 acre (0.4 ha), use Scenario D.
- [2] If project EDA and estimated Contractor EDA are less than 1 acre (0.4 ha), use Scenario E. If Project EDA and Estimated Contractor EDA are greater than 1 acre (0.4 ha), use Scenario F. If the actual Contractor EDA exceeds the estimated Contractor EDA and results in the Total EDA exceeding 1 acre (0.4 ha), use Scenario D.

Scenario A:	No requirements for SWPPP, NOI and NOT. Furnish written to plan Engineer.
Scenario B:	Provide BMP for Contractor EDA. No SWPPP, NOI or NOT are required. BMP used for Contractor EDA will not be compensated. Furnish written plan to Engineer.
Scenario C:	Furnish a BMP, SWPPP, NOI, and NOT for Contractor EDA only. BMP used for Contractor EDA, SWPPP, NOI and NOT will not be compensated.
Scenario D:	Furnish a NOI, SWPPP with BMP, and a NOT for all EDA areas. The NOI, SWPPP, BMP, and the NOT will not be compensated.
Scenario E:	Furnish BMP for all EDA. No SWPPP, NOI or NOT are required. BMP used for the Project EDA will be compensated. Furnish written plan to Engineer.
Scenario F:	Furnish a SWPPP with BMP for all EDA areas and file a Co-Permittee form. The SWPPP and these BMP will be compensated. The Department will furnish a NOI and NOT.

**832.05 Locate and Furnish BMP.** Locate and furnish the BMP in accordance with the OEPA NPDES Permit requirements and the Accepted SWPPP.

The Contractor's SWPPP Designer is responsible for selecting appropriate BMP that are designed in compliance with the OEPA NPDES Permit. SWPPP Designers shall utilize BMP listed in Appendix F as the first option when selecting BMP. If the SWPPP designer determines that the BMP listed in Appendix F are not appropriate based on design limitations, constructability constraints or if the BMP may cause a safety hazard, the Department may accept other materials (Alternative BMP) recommended by the SWPPP Designer. Provide design criteria supporting the selection of Alternative BMP on the SWPPP. Utilize cost effective Alternative BMP that meet each location's design requirements.

All Alternative BMP must be evaluated through the Office of Materials Management New Product Development Standard Procedure 515-001(SP) Appendix 2 and be accepted by the Office of Construction Administration prior to being used on ODOT projects. The Department may reject any Alternative BMP determined to be inappropriate, cost excessive or not effective based on the opinion of ODOT's Office of Construction Administration.

ODOT's Office of Construction Administration maintains compensation rates for commonly used and accepted Alternative BMP. For all other Alternative BMP accepted by the Engineer, the Department will compensate the Contractor at agreed unit prices based on material cost, labor and equipment costs as outlined in C&MS 109.05 B.

Furnish filter fabric ditch checks, inlet protection, perimeter filter fabric fence, sediment basins and dams, dikes, slope drains, construction entrances, erosion control mat and rock channel protection materials as specified on the SCD.

Post-Construction BMP as defined in 832.02 are not temporary erosion control features. Construction requirements and compensation for Post-Construction BMP are detailed in the project plans. Provide protective measures that ensures sediment, debris and any contamination will not enter the Post-Construction BMP.

**A. Sediment Controls.** Install sediment controls immediately prior to earth disturbing activities. Ensure that ponding of water from sediment controls will not damage property or threaten human health or safety. All stormwater from disturbed areas is required to pass through a sediment control prior to being discharged from the project. Remove sediment controls when their tributary areas have been stabilized with at least 70% permanent vegetation.

**1. Perimeter Filter Fabric Fence.** Provide perimeter filter fabric fence to pond stormwater and trap sediment from sheet flow runoff. Use perimeter filter fabric fence as prescribed in the OEPA NPDES Permit.

**2. Inlet Protection.** Provide inlet protection on storm sewer inlets to pond stormwater and trap sediment from entering the storm system. Install inlet protection for new inlets once the inlet has potential to accept runoff. Utilize BMP that are capable of bypassing high flow events to avoid flooding of public streets or private properties.

**3. Curb Inlet Protection.** Utilize Alternative BMP for Curb Inlet Protection in accordance with this Section and 832.10 SWPPP Acceptance. Provide curb inlet protection on storm sewer inlets to pond stormwater and trap sediment from entering the storm system. Install inlet protection for new inlets once the inlet has potential to accept runoff. Utilize BMP that are capable of bypassing high flow events to avoid flooding of public streets or private properties. Use

accepted below grade inlet protection products as Alternative BMP when ponding water onto public streets may cause hazardous conditions or snow and ice equipment may damage the BMP.

**4. Excavated Drop Inlet Protection.** Provide excavated drop inlets as appropriate for phased construction. Construct per the Ohio Rainwater and Land Development manual with weep holes and #57 gravel filter. Provide stormwater ponding storage at 135 CY per acre of tributary drainage area. Do not use this control next to open traffic without a traffic control barrier.

**5. Sediment Trap/Dam.** Provide sediment traps/dams where feasible to intercept and treat concentrated runoff from tributary areas of 5 acres or less. Sediment traps/dams contain a dewatering zone, sediment storage zone and a rock filter outlet. Design the sediment trap/dam to meet the requirements of the OEPA NPDES Permit.

**6. Sediment Basin.** Provide sediment basins where feasible to intercept and treat concentrated runoff from tributary areas of 5 acres or more. Sediment basins contain a dewatering zone, sediment storage zone and a designed outlet with surface dewatering device. Design the sediment basin to meet the requirements of the OEPA NPDES Permit. Sediment traps/dams may be used to treat runoff from tributary areas of 5 acres or less.

**7. Filter Fabric Ditch Check.** Provide filter fabric ditch checks where feasible to intercept and treat concentrated runoff from tributary areas of 2 acres or less. Filter fabric ditch checks contain geotextile fabric with stone backing (or straw bales only when allowed by the Engineer per SCD DM-4.4). Use this control only when sediment traps/dams are impractical or may cause safety hazards. A maximum of two filter fabric ditch checks may be placed in series for a maximum treatment area up to 4 acres.

**B. Erosion Controls.** Install erosion controls concurrent with the work areas to protect against surface erosion and sediment loss. Erosion controls are not intended to remove sediment suspended in stormwater. All stormwater discharges from erosion controls are required to be directed to an appropriate sediment control.

**1. Construction Seed and Mulch.** Furnish commercial fertilizer, seed, and mulch materials conforming to C&MS 659. Apply seed and straw mulch materials according to C&MS 659 as modified below.

Apply straw mulch at a rate of 3 tons per acre (0.7 metric ton/1000 m<sup>2</sup>). This BMP may only be installed after March 15 and before October 15. Use wood fiber or compost mulch only with concurrence of the Department. Fertilize construction seeding areas at one-half the application rate specified in C&MS 659. If project conditions prevent fertilizing the soil, then the fertilizing requirements of C&MS 659 may be waived. Do not place construction seed or fertilizer on frozen ground. Apply seed and mulch for this BMP at the rates shown below.:

Seed Mixture	Number of Bales
Annual Ryegrass 2 lb./1000 ft <sup>2</sup> (10 kg/1000 m <sup>2</sup> )	2 / 1000 ft <sup>2</sup> (0.01 ha)

**2. Winter Seed and Mulch.** Apply seed and straw mulch materials according to C&MS 659 as modified below. Apply straw mulch at a rate of 3 tons per acre (0.7 metric ton/1000 m<sup>2</sup>). Winter Seed and Mulch is required for EDA operations occurring between October 15 and

March 15 and can only be installed during that time. When straw mulch is used in this BMP, it is required to be crimped in place. Crimped mulch is required to be anchored into the soil surface with a mechanical crimping implement or other suitable implement accepted by the Engineer. Bonded Fiber Matrix (BFM) may be used instead of straw mulch. BFM product and application rates should be selected to ensure extended periods of stabilization protection during winter months. Select BFM or alternative mulch products with an expected functional longevity of 6 months or more. Provide maintenance of the BMP throughout the winter seed and mulch period. Utilize slope drains, stormwater diversions or other erosion control BMP with winter seed and mulch to provide appropriate protection of the winter seed and mulch areas. The Department will not compensate for repairs or reapplication of winter seed and mulch resulting from inappropriate application or failure to appropriately protect the winter seed and mulch areas. The use of other seed and/or mulch materials in this time period requires specific Department approval. The use of winter seeding and mulching is not an acceptable practice for protecting the subgrade surface where pavement is anticipated.

Seed Mixture		Number of Bales
Fawn Tall Fescue	3.0 lb./1000 ft <sup>2</sup> (15 kg/1000 m <sup>2</sup> )	2 / 1000 ft <sup>2</sup> (0.01 ha)
Annual Ryegrass	2 lb./1000 ft <sup>2</sup> (10 kg/1000 m <sup>2</sup> )	

**3. Construction Mulch.** Construction Mulch is the application of straw mulch applied directly to the disturbed soil surface. Use straw according to C&MS 659. C&MS 659 wood fiber or compost mulch may only be used with concurrence of the Department. Apply Construction Mulch to areas that require temporary stabilization and where temporary vegetation is not considered desirable. Use a mechanical crimping implement or other suitable implement accepted by the Engineer when installing Construction Mulch on exposed subgrade. Apply Construction Mulch at a rate of 3 tons per acre (0.7 metric ton/1000 m<sup>2</sup>).

**4. Slope Drain.** Provide slope drains to temporarily convey stormwater and protect cut and fill slopes from surface erosion. Use earthen dikes/berms to direct stormwater to the slope drains. Design the slope drains to adequately convey stormwater for a 10-year storm event where practicable.

**5. Earthen Dike/Berm.** Provide earthen dikes/berms to temporarily divert and convey stormwater. Construct earthen dikes/berms prior to cut slope construction and concurrently with fill slope construction.

**6. Construction Entrance.** Furnish Construction Entrance materials conforming to C&MS 712.09 Type D Filter Blankets for Rock Channel Protection and C&MS 703.01, Size Number 1 and 2, CCS aggregate. Furnish Construction Entrance protection at the locations shown on the SWPPP and as required below:

- a. At locations where construction vehicles enter or leave EDA areas.
- b. At all points of egress to public roads.
- c. At all access locations where runoff from the construction access road is not protected by sediment controls.



Provide the appropriate size culvert as needed to prevent water from flowing onto paved surfaces and from overtopping the construction entrance surface. Identify the culvert size on the SWPPP. Install a maximum of three Construction Entrances per mile along the length of the project. The length of the project is the plan length along the project's longest axis. Additional construction entrances in excess of the maximum require acceptance from the Engineer.

Provide a configuration consisting of 6 inches of aggregate over geotextile fabric. Provide geometry according to a Type 1 Driveway as shown in the SCD. Provide a minimum 10 foot width and length measuring a minimum of 150 feet and not exceeding 200 feet from edge of pavement.

Construction Entrance removal includes the appropriate disposal of geotextile fabric and pipe. Aggregate may be incorporated into embankment work in accordance with C&MS 203 when approved by the Engineer.

**7. Rock Ditch Check.** Provide rock ditch checks in open channel conveyances for velocity control and to protect against surface erosion of the channel. Install rock ditch checks concurrently with channel grading. Remove rock ditch checks once 70% permanent vegetation has established in the channel.

**8. Rock Channel Protection.** Provide rock channel protection without fabric for rock ditch checks. Provide rock channel protection with fabric for all other BMP. Provide rock channel protection as recommend by the SWPPP Designer and accepted by the Engineer for other applications to prevent surface erosion.

**9. Temporary Stabilization Matting.** Provide temporary matting on permanent slopes and permanent open channel conveyances for temporary stabilization and for the establishment of permanent vegetation. Provide temporary matting per C&MS 671. Install temporary matting on slopes and open channel conveyances after final surface preparation within timeframes listed in the OEPA NPDES Permit for permanent stabilization.

**C. Aquatic and Environmental Resource Protection.** Provide construction fence for demarcation of aquatic and environmental resources when shown on the SWPPP and accepted by the Engineer. Alternative types of demarcation may be allowed when accepted by the Engineer. Provide appropriate sediment and erosion control protection to all environmental and aquatic resources on and, adjacent to the project. Aquatic and environmental resource protection may include diverting project water flow using dikes and slope protection and using sediment controls to intercept project runoff. The Contractor may use a combination of BMP as appropriate. Show all aquatic and environmental resources located within & adjacent to the Project and all Contractor EDA on the SWPPP.

**D. Stream Relocation, Temporary Diversion Channels that carry Waters of the United States.** Perform this work in compliance with the OEPA NPDES Permit and in conformance with all contract requirements (Waterway Special Provisions). Stabilize Stream Relocation, Temporary Diversion Channels with appropriate stabilization BMP or 70 percent vegetative growth before diverting flow into the new channel.

**E. Concrete Washout Area BMP.** Compensation for this BMP is incidental to the concrete work.

**F. Dewatering BMP.** Compensation for this BMP is incidental to the corresponding work. This BMP does not include a Surface Dewatering Device installed as part of a Sediment Basin.

**G. Project fueling and refueling BMP locations.** Compensation for this BMP is incidental to the project.

The SWPPP shall include BMP to prevent and respond to spills or leaks as required by the OEPA NPDES Permit.

The Contractor will provide a separate Spill Prevention Control & Countermeasure Plan (SPCC) if required as described in 40 CFR Part 112. The Contractor will not be compensated for the SPCC Plan. Spill response protocols are to be included in the SWPPP when not included in a SPCC.

**H.** All other BMP that are required and not specifically referenced in Appendix F or not accepted as an Alternative BMP in accordance with this section will not be paid as a separate item, but will be included by the Contractor as part of the total project cost.

**832.06 Temporary Access Fills (Causeways and Access Fills).** Fording of jurisdictional waters, including all streams and rivers is not allowed. Evaluate the Waterway Special Provisions to determine whether or not temporary access fills are permitted in the contract. If temporary access fills have been permitted by the Department, construct fill(s) consistent with the Waterway Special Provisions and additional contract requirements. Only the footprint area (acreage), linear impact limits and volume of temporary fill as permitted and contained in the Waterway Special Provisions will be allowed. If the Contractor proposes temporary access fill(s) which has not been permitted by the Department, the Contractor will coordinate procurement of the permits with the appropriate regulatory agency/agencies. All costs and time associated with the procurement of the permits are incidental to the Work. If the Contractor requests modification of the Department procured permits, coordinate the request with the Engineer and OES. The Department makes no guarantee to grant the permit modification request.

**832.07 Temporary Access Fills Construction.** Begin planning and installing temporary access fills as early in construction as possible to avoid conflicts with the Waterway Special Provisions or other environmental commitments that have been included in the contract documents.

Temporary access fills in aquatic resources may include, but are not limited to, causeways, cofferdams, access pads, sheet piling, temporary bridges, access fills, etc.

Make every attempt to minimize disturbance to aquatic resources during construction, maintenance and removal of the temporary access fills. The Contractor must make every attempt to minimize disturbance to waterbodies, stream banks, stream beds and riparian zones during the construction, maintenance, and removal of the temporary access fills. Construct the temporary access fills as narrow as practical and perpendicular to the stream banks. Make the temporary access fills in shallow areas rather than deep pools where possible. Minimize clearing, grubbing,

and excavation of stream banks, bed, and approach sections. Construct the temporary access fills as to not erode stream banks or allow sediment deposits in the channel.

Prior to the initiation of any in-stream work, establish a monument upstream of proposed temporary access fill to visually monitor the water elevation in the waterway where the fill is permitted. Maintain the monument throughout the project. Provide a visual mark on the monument that identifies the elevation 1 foot above the Ordinary High Water Mark (OHWM). If the OHWM is not shown on the plans, the Department will establish the OHWM based on the definition of OHWM (832.02) or the peak discharge from the 2 year event, using the method described in the most current version of the Department's Location and Design Manual Volume II. Ensure that the monument can be read from the bank of the waterway. Ensure that this work is supervised by an Ohio Registered Surveyor. All costs associated with furnishing and maintaining the above referenced monument is incidental to the Work.

Construct the temporary access fills to a water elevation at least 1 foot (0.3 m) above the OHWM. If more than one-third of the width of the waterway is filled, then use culvert pipes to allow the movement of aquatic life. Maintain normal downstream flows. Ensure that any ponding of water behind the causeway and access fills will not damage property or threaten human health and safety.

The following minimum requirements apply to causeways where culverts are used.

- A. Furnish culverts on the existing stream bottom.
- B. Avoid a drop in water elevation at the downstream end of the culvert.
- C. Furnish a sufficient number of culverts in addition to stream openings to providing a discharge equal to twice the highest monthly flow without producing a rise in the backwater above the OHWM.
- D. Furnish culverts with a minimum diameter of 18 inches (0.5 m)

All temporary access fills must be constructed of suitable materials. Causeways and access fills must be encapsulated with clean, non-erodible, nontoxic Dumped Rock Fill, Type A, B, C, or D, as specified in C&MS 703.19.B. Extend rock fill up the slope from original stream bank for 50 feet (10 m) to catch and remove erodible material from equipment.

All portions of the temporary access fills will be removed in its entirety. Do not dispose of temporary access fill material in other aquatic resources or where erosion into another aquatic resource is possible. The stream bottom affected by the temporary access fills will be restored to its pre-construction elevations. The temporary access fills will not be paid as a separate item but will be included by the Contractor as part of the total project cost.

All environmental protection and sediment and erosion controls associated with the Waterway Special Provisions or Contractor procured permits are incidental to the work within the boundaries of the permits.

**832.08 Maintenance.** Properly maintain all BMP throughout all phases and sequencing of construction activities. Dispose of silt removed from BMP according to C&MS 105.16. When the

Contractor properly places the erosion control Items then the Department will pay for the cost to maintain or replace these items of work by the following:

If a recorded rain event is greater than 0.5 inches (13mm), the Department will pay to replace all BMP that have been damaged as a result of the rain event at the unit price for those BMP including Sediment Removal as described in Appendix F. Record BMP replacement quantities using the SWPPPTrack software inspection software application. Replacement quantities not recorded in the SWPPPTrack software inspection software application will not be compensated. Restoration maintenance necessary to restore the BMP as a result of a rain event is included in the unit price for the BMP.

If a recorded rain event is less than or equal to 0.5 inches (13mm), the Department will pay to remove the sediment per the unit price for Sediment Removal as described in Appendix F. No compensation will be provided for BMP that are damaged as a result of rain events less than or equal to 0.5 inches (13mm).

*Example: A 0.6 inch rain event damaged a 300 ft. segment of filter fabric fence. A 200 ft. segment was knocked over but was still functional and could be restored. The 300 ft. damaged segment was replaced and the sediment was removed. The 200 ft. segment was picked up, retrenched and the sediment removed. How do we pay for the 300 ft. damaged segment and the 200 ft. restored segment and the sediment removal?*

*Pay for 300 ft. of new Item Perimeter Filter Fabric Fence and Item Miscellaneous Sediment Removal. Do not pay for restoration of the 200 ft. segment of restored filter fabric fence. Pay for Item Miscellaneous Sediment Removal for the 200 ft. segment.*

For all Perimeter Filter Fabric Fence, Filter Fabric Ditch Checks, Rock Checks, and Inlet Protection, Dikes, remove trapped sediment and any other debris which has accumulated when sediment reaches a height of one-half the BMP. Compensation will be paid at the unit price for Miscellaneous Sediment Removal as described in Appendix F.

When the sediment fills the sediment storage zone (as described in the OEPA NPDES Permit) of a Sediment Basin or Sediment Trap/Dam, remove deposited sediment per the unit price for Basin Sediment Removal as described in Appendix F. Remove Sediment Basins and Sediment Traps/Dams after the contributing drainage area has been stabilized.

When erodible materials accumulate at the surface of the construction entrance, furnish additional stone as needed to prevent tracking. Compensation for additional stone needed to maintain the Construction Entrance will be paid at the unit price for Construction Entrance. If tracking occurs, restore and clean the affected roadway surface at no additional cost to the Department.

Maintain the BMP until 70% permanent vegetation is established in the EDA portion of the tributary area contributing runoff to the BMP in accordance with the OEPA NPDES Permit (See Appendix E, Part VII, J). Remove BMP after 70% permanent vegetation is established. The Engineer may allow early removal of BMP, when necessary, due to BMP inaccessibility. Dispose of the removed materials including sediment according to C&MS 105.16 and C&MS 105.17.

**832.09 Storm Water Pollution Prevention Plan.** If required, prepare the SWPPP as outlined in this specification. Submit the SWPPP to the Engineer for acceptance using the SWPPPTrack software web platform. Allow 14 days for the initial review of the SWPPP. Address all comments from the Engineer and submit any required revisions, modifications, phases and updates using the SWPPPTrack software web platform. Allow an additional 7 days for subsequent reviews. All activity identified by the SWPPP that is not specifically identified as a pay item elsewhere shall be included in the Lump Sum price bid for the Storm Water Pollution Prevention Plan. At a minimum, the design and information requirements that must be included in the SWPPP are as follows:

**A.** Include the following general information:

1. Provide a site specific SWPPP designed and sealed by a Professional Engineer who holds a current CPESC certification.
2. Furnish the names of the individuals on site who will serve as the PE/CPESC SWPPP designer and CECI.
3. Describe the type of construction activities that will be taking place.
4. Furnish signatures of all contractors and subcontractors involved in BMP practices (see Appendix B).
5. Furnish the total EDA areas in acres and identify the immediate receiving stream or surface water for each drainage area.
6. Furnish installation details of all proposed Alternative BMP.
7. Provide construction and grading details for all Sediment Trap/Dam and Basins.

**B.** Include Existing Condition Plan sheets (maximum 1" = 50' scale) showing the following information at a minimum:

1. Temporary sediment control BMP to be installed prior to or concurrent with early earth disturbing activities (including but not limited to clearing and grubbing, mobilization, staging areas, demolition, grading activities, etc.)
2. Existing contours shown at a 2-foot maximum interval for all Project and Contractor EDA areas
3. Stormwater runoff tributary areas to all sediment controls intercepting concentrated flows (Tributary areas for sheet flow sediment controls are not required to be shown on the plan.)
4. Existing conditions of the Project and Contractor EDA including drainage patterns, ditches, drainage system, utilities
5. Project construction limits
6. All Contractor EDA areas

7. Labels of all direct discharge locations receiving runoff from Project and Contractor EDA to waters of the State or U.S throughout the Project and Contractor EDA. Direct discharges may include but are not limited to, storm sewer outfalls, open channel conveyances, direct sheet flow.

8. Provide a table of existing condition BMP and direct discharge locations in tabular format on the plan which can be exported to .csv file and is consistent with SWPPPTrack software

**C.** Include Proposed Condition Plan sheets (maximum 1" = 50' scale) showing the following information at a minimum:

1. Temporary sediment and erosion control BMP based on modified drainage patterns as needed to represent construction phasing prior to reaching final buildout conditions.

2. Temporary sediment and erosion control BMP based on final buildout conditions and drainage patterns. Include BMP to be installed during previous phasing which is intended to be left in place through final buildout.

3. Proposed contours shown at a 2-foot maximum interval for all Project and Contractor EDA areas. If proposed surfaces cannot be obtained from the Department provided electronic files, provide clear representation of the proposed drainage patterns in sufficient detail to select, design and locate appropriate BMP.

4. Stormwater runoff tributary areas to all sediment controls intercepting concentrated flows (Tributary areas for sheet flow sediment controls are not required to be shown on the plan.)

5. Project construction limits

6. All Contractor EDA areas

7. Label existing, relocated and proposed direct discharge locations

8. Provide a table of proposed condition and interim BMP in tabular format on the plan which can be exported to .csv file and is consistent with SWPPPTrack software

**D.** Include BMP estimated quantities in BMP tables.

**E.** Show the location of the following support activities. Ensure the following activities are located a minimum of 100 feet (30 m) from any aquatic resource:

1. Concrete or asphalt plant areas

2. Material and equipment staging or storage areas

3. Dewatering Areas

4. Concrete truck wash out BMP areas

5. Construction access BMP locations

6. Vehicle fueling and refueling locations

- F. Provide an implementation schedule for BMP based on the Contractor's proposed construction sequence.
- G. Show locations of Post-Construction BMP. Include Post-Construction BMP in the schedule of construction sequence.
- H. Include a schedule of cover practices meeting the requirements of the Ohio NPDES Permit.
- I. Include erosion control BMP to be installed for protecting erosive areas, provide temporary or permanent stabilization and control stormwater. Stormwater erosion control BMP shall be sized based on tributary runoff area and consistent with Ohio's Rainwater and Land Development Manual.
- J. Show all environmental preservation areas, wetlands and waterways within or adjacent to the Project and Contractor EDA as illustrated in the Plans.
- K. Furnish an estimated quantity for Basin Sediment Removal and Miscellaneous Sediment Removal for removing sediment from sediment controls.
- L. Include project area soil types and identify any potentially highly erodible locations.
- M. Label all sediment Trap/Dam and Basins with tributary area, sediment storage zone volume, dewatering zone volume, outlet size and type, etc.

Electronic design files, necessary to develop the SWPPP with the required information listed in this section, shall be made available to the awarded Contractor upon request.

**832.10 SWPPP Acceptance.** Furnish the SWPPP to the Department for acceptance. The Department will allow work to begin upon receiving an acceptable SWPPP. See Appendix C for a sample acceptance checklist. The Department may assess critically the following:

- A. The type and location of BMP with totals.
- B. The SWPPP is specific for this project.
- C. There is no language in the SWPPP about any BMP being directed for use by the Engineer.
- D. The total estimated BMP quantities agree with the (per Each) "Erosion Control" amount identified in the proposal.
- E. The SWPPP accounts for the various phases of construction and the associated degree of earthwork disturbance over the life of the project.
- F. The SWPPP delineates overall watershed areas and individual BMP watersheds. Enough detail is shown in the SWPPP to verify that the BMP are appropriate for the application. If topographic mapping contained in the plans is not sufficient to identify and delineate the watersheds associated with the work, provide the appropriate mapping.

**G.** The SWPPP identifies the locations and specific geometry of the required Sediment Traps/Dams, Basins and related control structures. Provide the following information for each Sediment Trap/Dam and Basin:

1. Calculations demonstrating compliance with the 48 hour draw down time (if required by the OEPA NPDES Permit),
2. Size of the contributing drainage area,
3. Volume of the Sediment Storage Zone
4. Volume of the Dewatering Zone
5. Basin excavation quantity or dam embankment quantity
6. Quantity of rock channel protection
7. Riser Pipe, outlet structure details and surface dewatering device

Revise the accepted SWPPP as needed to maintain compliance with OEPA NPDES Permit. Revisions and amendments (See Appendix E, Part III, D) to the accepted SWPPP will be at no additional cost to the Department.

832.11 Inspections and SWPPP Updates. Perform the OEPA NPDES Permit required inspections utilizing a mobile device capable of running the latest version of the SWPPPTrack LTIS inspection software application developed by Storm Water Simplified Ltd. Contact Storm Water Simplified Ltd. at (888) 401-1993 or OHSupport@SWPPPTrack.com for project setup coordination, payment, and for mobile device requirements.

Perform OEPA NPDES Permit required inspections with the SWPPPTrack inspection application and populate all inspection fields accurately to represent current project conditions until final stabilization.

The inspections must be performed by one of the following parties:

- A.** The PE/CPESC who signed and sealed the SWPPP.
- B.** The CPESC inspector who is under the supervision of the Engineer who signed and sealed the SWPPP.
- C.** The CESSWI inspector who is under the supervision of the Engineer who signed and sealed the SWPPP.

Prepare the inspection reports for projects that require a SWPPP. Utilize the SWPPPTrack inspection software application to prepare and submit inspection reports to the Engineer every 7 days and within 24 hours of a 0.5 inch (13 mm) or greater rainfall event until final stabilization has been established with a minimum of 70 percent permanent vegetation. The inspection occurrence may be delayed or the inspection frequency may be reduced per the OEPA NPDES Permit Part III.G.2.i.



The reporting CECI, under supervision of the PE/CPESC, will update, amend and revise the SWPPP as the contractor's operations and site conditions warrant. Identify all revisions and updates to the SWPPP and indicate what measures will be taken to maintain OEPA NPDES Permit compliance. Record BMP condition, modifications, installations, additions, removals and SWPPP modifications with the SWPPPTrack inspection software application. Record all BMP locations utilizing the SWPPPTrack inspection software application.

Document BMP inspections utilizing photos as required by the SWPPPTrack inspection software application. Perform a monthly inspection of the project utilizing the SWPPPTrack inspection software application. The monthly inspection is required to be performed by the PE/CPESC who maintains responsibility over the SWPPP. The monthly inspection may be performed by an individual employed by the PE/CPESC company who is under the direct supervision of the PE/CPESC. If the inspection is performed by an individual other than the PE/CPESC, the individual shall maintain an active CPESC certification. The PE/CPESC is required to review and certify all monthly inspections through the SWPPPTrack software inspection application. The PE/CPESC shall review the weekly and rainfall event inspections and all CECI changes to the SWPPP. The PE/CPESC is required to re-sign and seal the SWPPP when significant changes warrant an updated SWPPP be developed. Submit the latest SWPPP update to the SWPPPTrack software web platform.

The CECI is required to notify the Department within 24 hours of any compliance deficiencies or verified complaints related to the SWPPP or OEPA NPDES Permit. Weekly, rainfall event and monthly inspections will document BMP deficiencies as Open Work Items in the SWPPPTrack inspection software application. Within 48 hours of the Department's or CECI's notice of deficiency/Open Work Item, the contractor is required to construct, install, repair or correct the BMP measures needed to close the deficiency/Open Work Items. The CECI will close Open Work Items only after the BMP measures have been appropriately addressed and inspected utilizing the SWPPPTrack inspection software application.

**832.12 Compensation.** The Department will furnish Item 832 Each, Erosion Control with an amount in the proposal to pay for BMP work. The fixed amount shown in the proposal is included (as any other bid items) in the Total Bid Amount. This fixed amount is the Department's estimate of the total cost of BMP work required to be performed for the project. If the BMP work exceeds this amount, the BMP work will still be paid at the pre-determined prices. All BMP work will be paid at the proposal pre-determined unit price times the correctly installed BMP number of units. The payment due will be deducted from Item 832 Each, Erosion Control. C&MS Table 104.02-2 does not apply to reductions in this contract item. Compensation for BMP will not be provided until the BMP location and quantity is recorded in the SWPPPTrack inspection software application and an initial inspection is performed by the CECI indicating that the BMP meets the installation requirements.

The Lump Sum amount bid for the SWPPP includes all work associated with development, design, revisions, modifications, amendments and submittals of the SWPPP. Changes made to the SWPPP, but not caused by the Department, are the financial responsibility of the Contractor. Additional compensation will only be permitted for Department accepted amendments to the SWPPP resulting from revisions to the contract documents as per sections 104.02.B, 104.02.D and 104.02.F. Provide the additional costs for the amended SWPPP to the Department prior to

beginning the associated revised work. The Department will only pay for one accepted SWPPP regardless of the number of Construction phases, revisions, amendments or project redesigns.

The Lump Sum amount bid for the Storm Water Pollution Prevention Inspections includes all work associated with NPDES required inspections, monthly inspections, and reporting. All costs associated with providing and maintaining the required CPESC and CESSWI personnel, conducting the NPDES required inspections utilizing the SWPPPTrack inspection software application and support engineering services are included in the contract Lump Sum bid for Storm Water Pollution Prevention Inspections.

The Lump Sum amount bid for the Storm Water Pollution Prevention Inspection Software includes all costs for the SWPPPTrack inspection software and services. The Contractor is responsible for purchasing and contracting with Storm Water Simplified Ltd. for the use of the SWPPPTrack software application and services until final stabilization.

### **832.13 Method of Measurement.**

The Department will measure the SWPPP as a Lump Sum.

The Department will measure the Storm Water Pollution Prevention Inspections as a Lump Sum.

The Department will measure the Storm Water Pollution Prevention Inspection Software services as Lump Sum.

The Department will measure Construction Seeding and Mulching by the number of square yards (square meters).

The Department will measure Slope Drains by the number of feet (meters) of conduit.

The Department will measure Sediment Basins by the number of cubic yards (cubic meters) of excavation or embankment.

The Department will measure Sediment Basin surface dewatering device by each.

The Department will measure Sediment Traps/Dams by the number of cubic yards (cubic meters) of excavation or embankment.

Any pipe required for the outlet structure of a Sediment Basin or Trap/Dam is incidental to the unit price paid for Sediment Basins and Traps/Dams.

The Department will measure Perimeter Filter Fabric Fence, and Construction Fence by the number of feet (meters).

The Department will measure Filter Fabric Ditch Check by the number of feet (meters).

The Department will measure Excavated Drop Inlet Protection by the number of cubic yards (cubic meters) of excavation.

The Department will measure Inlet Protection by the number of feet (meters).

The Department will measure Curb Inlet Protection by each or feet (meters).

The Department will measure Earthen Dike/Berm by the number of cubic yards (cubic meters) of embankment.

The Department will measure Temporary Stabilization Matting by the number of square yards (square meters).

The Department will measure Rock Ditch Check, Type C or D (without filter) by the number of cubic yards (cubic meters).

The Department will measure Rock Channel Protection, Type C or D (with or without filter) by the number of cubic yards (cubic meters).

The Department will measure Sediment Removal by the number of cubic yards (cubic meters).

The Department will measure Construction Mulching by the number of square yards (square meters) regardless if the application is crimped or not.

The Department will measure Winter Seeding and Mulching by the number of square yards (square meters).

The Department will measure Construction Entrance protection by the number of cubic yards (cubic meters)

**832.14 Basis of Payment.** The Department will pay the contract Lump Sum price bid for the Storm Water Pollution Prevention Plan. The Department will make partial payments for the Storm Water Pollution Prevention Plan according to C&MS Section 109.09 and as modified by the following schedule:

**A.** The Department will release 60 percent of the lump sum amount bid for Storm Water Pollution Prevention Plan to the Contractor with the first regular estimate payable after the Engineer has accepted the Storm Water Pollution Prevention Plan submission.

**B.** The Department will release 30 percent of the lump sum amount bid for Storm Water Pollution Prevention Plan to the Contractor with the first regular estimate payable after 50 percent of the project is complete.

**C.** The Department will release the remaining 10 percent of the lump sum amount bid for Storm Water Pollution Prevention Plan to the Contractor with the first regular estimate payable after 90 percent of the project is complete.

The Department will make partial payment for the Storm Water Pollution Prevention Inspections according to C&MS Section 109.09.

The Department will make partial payments for the Storm Water Pollution Prevention Inspection Software services according to C&MS Section 109.09 and as modified by the following schedule:

**A.** The Department will pay 60 percent of the lump sum amount bid for the Storm Water Pollution Prevention Inspection Software with the first regular estimate.

**B.** The Department will pay the remaining 40 percent of the lump sum amount bid for the Storm Water Pollution Prevention Inspection Software services according to 109.09.

The Department will pay for appropriately selected, designed, properly installed and accepted BMP per Item 832 Each, Erosion Control. BMP compensation will be based on the unit prices shown in Appendix F or accepted unit prices for Alternative BMP by the Engineer.

The Department will not pay for BMP Items which are required as a result of the Contractor's negligence, carelessness, or failure to install permanent controls.

The Department will not pay for any causeway and access fills.

The Department will not pay to replace BMP that have failed as a result of improper maintenance or installation.

The Department will not pay for concrete washout area BMP. Concrete washout area BMP are considered incidental to the concrete work.

The Department will not pay for BMP which are required as a part of the work and are not specifically identified as a separate item. Compensation for BMP that are required for NPDES Permit compliance and are not included in Appendix F or not accepted as an Alternative BMP in accordance with Section 832.05 are considered incidental to the work.

The Department will not pay for Post-Construction BMP as a part of this specification.

<b>Item</b>	<b>Unit</b>	<b>Description</b>
832	Lump Sum	Storm Water Pollution Prevention Plan
832	Lump Sum	Storm Water Pollution Prevention Inspections
832	Lump Sum	Storm Water Pollution Prevention Inspection Software
832	Each	Erosion Control

## Appendix A

### BMPBMP Inventory Naming Validation

Ohio Department Of Transportation, SS 832 – BMP ID and Naming Validation Form				
Sediment Control BMP				
BMP ID Type	BMP ID Type (Extended Name)	Standard BMP Description	Alternative BMP Description	Unit of Measure
IP	Inlet Protection	Filter Fabric Inlet Protection		LF
CIP	Curb Inlet Protection	Alternative BMP	Dandy Curb Bag for 3A inlet	EA
EDIP	Excavated Drop Inlet Protection	Drop Inlet Excavation w/ gravel		EA
PFFF	Perimeter Filter Fabric Fence	Filter Fabric Fence		LF
FFDC	Filter Fabric Ditch Check	Filter Fabric Ditch Check		LF
SB	Sediment Basin	Sediment Basin w/ Surface Dewatering		CY
ST	Sediment Trap	Sediment Trap		CY
DWT	Dewatering Discharge	Dewatering Sediment Control		EA
SDWTD	Sediment Basin Surface Dewatering Device	Surface Dewatering Device		EA
Erosion Control BMP				
BMP ID Type	BMP ID Type (Extended Name)	Standard BMP Description	Alternative BMP Description	Unit of Measure
SD	Slope Drain	Slope Drain		LF
DI	Dike	Earthen Dike		CY
CE	Construction Entrance	Rock Construction Entrance		CY
RDC	Rock Ditch Check	Rock Ditch Check		CY
ECM	Erosion Control Matting	Erosion Matting, Type____		SY
RCP	Rock Channel Protection	Rock with Geotextile Fabric		CY
TS	Temporary Stabilization	Construction Seed and Mulch		SY
PS	Permanent Stabilization	Permanent Stabilization		SY
Miscellaneous Control BMP				
BMP ID Type	BMP ID Type (Extended Name)	Standard BMP Description	Alternative BMP Description	Unit of Measure
CF	Construction Fence	Construction Fence		LF
CWO	Concrete Washout	Concrete Washout		EA
TAF	Temporary Access Fill	Causeway, Cofferdam, Dewatering Fill, etc.		EA
Outfalls				
BMP ID Type	BMP ID Type (Extended Name)	Standard BMP Description	Alternative BMP Description	Unit of Measure
DSWD	Direct Surface Water Discharge	Direct Surface Water Discharge		

**Designer Note:** SWPPP Designers should utilize the BMP ID Type (short) naming conventions for BMP callouts and populating the BMP Inventory Tables shown in this appendix. BMP ID's should be numbered sequentially by Type (PFFF1, PFFF2, IP1, SB1, etc.). BMP ID Type (Extended Names) are not used in the BMP Inventory Tables and are included for reference only.

BMP ID Type and Standard BMP Descriptions will be used for validation when uploading the tables to SWPPPTrack. Ensure BMP Types and Standard BMP Descriptions above are used to create the BMP Inventory Tables. When Alternative BMP materials are proposed, the Alternative BMP Description name should be filled in with the proprietary device proposed on the SWPPP. The Alternative BMP Description should accurately describe the BMP with appropriate units. (i.e. 12" Compost Filter Sock, LF.) Curb Inlet Protection only utilize Alternative BMP and will always require an alternative description. Coordinate uploading of the inventory table with SWPPPTrack. BMP Inventory Table templates can be downloaded on ODOT's Office of Construction Administration website: <http://www.dot.state.oh.us/Divisions/ConstructionMgt/Admin/Pages/InspectionForms.aspx>

## Appendix A

### Existing Conditions BMP Inventory Table

Ohio Department Of Transportation, SS 832 - Existing Conditions - BMP Inventory Table											
Name:					Date Created:						
Company Name:											
Contract#	Part Code	BMP	Standard BMP Description	Alternative BMP Description	Plan Page	Quantity	Unit Of Measure	Roadway Name	Location Station	Road Orientatio	Project Discharge
		PFFF1	Perimeter Filter Fabric Fence		4	375	LF	SR 7	145+32	RT	Y
		PFFF2	Perimeter Filter Fabric Fence		4	235	LF	SR 7	145+85	LT	Y
		PFFF3	Alternative BMP	12" Compost Filter Sock	11	305	LF	SR 14	96+50	RT	N
		IP1	Inlet Protection		5, 10	20	LF	SR 14	94+00	RT	Y
		IP2	Inlet Protection		5, 10	20	LF	SR 14	94+00	LT	Y
		CIP1	Alternative BMP	Dandy Curb Bag (3A Inlet)	5, 10	1	EA	SR 14	93+00	LT	Y
		CIP2	Alternative BMP	FlexStorm Catch It	6	1	EA	SR 14	155+55	LT	Y
		CIP3	Alternative BMP		6	1	EA	SR 14	155+50	RT	Y
		FFDC1	Filter Fabric Ditch Check		8	15	LF	SR 14	86+50	RT	Y

### Proposed BMP Inventory Table

Ohio Department Of Transportation, SS 832 - PROPOSED - BMP Inventory Table											
Name:					Date Created:						
Company Name:											
Contract#	Part Code	BMP ID	Standard BMP Description	Alternative BMP Description	Plan Page	Quantity	Unit Of Measure	Roadway Name	Location Station	Road Orientation	Project Discharge
		PFFF4	Perimeter Filter Fabric Fence		6,7	250	LF	SR 7	155+00	RT	Y
		CF1	Construction Fence		4	100	LF	SR 7	145+32	RT	N
		CF2	Construction Fence		4	230	LF	SR 7	145+85	LT	N
		CIP4	Alternative BMP	Dandy Curb Bag (3A Inlet)	4	1	EA	SR 7	146+25	LT	N
		CIP5	Alternative BMP	Dandy Curb Bag (3A Inlet)	4	1	EA	SR 7	146+40	LT	N
		CIP6	Alternative BMP	Dandy Curb Bag (3A Inlet)	4	1	EA	SR 7	146+60	LT	N
		CIP7	Alternative BMP	Dandy Curb Bag (3A Inlet)	4	1	EA	SR 7	146+40	RT	N
		CIP5	Alternative BMP	Dandy Curb Bag (3A Inlet)	4	1	EA	SR 7	146+60	RT	N
		CIP6	Alternative BMP	FlexStorm Catch It	4	1	EA	SR 7	148+35	LT	N
		CIP7	Alternative BMP	FlexStorm Catch It	4	1	EA	SR 7	148+40	LT	N
		CIP8	Alternative BMP	FlexStorm Catch It	4	1	EA	SR 7	148+35	RT	N
		CIP9	Alternative BMP	FlexStorm Catch It	4	1	EA	SR 7	148+35	RT	N
		CIP10	Alternative BMP	FlexStorm Catch It	5	1	EA	SR 7	150+35	RT	N
		CIP11	Alternative BMP	FlexStorm Catch It	5,10	1	EA	SR 14	94+40	RT	N
		CIP12	Alternative BMP	Dandy Curb	5,10	1	EA	SR 7	150+70	RT	N
		CIP13	Alternative BMP	Dandy Curb	5,10	1	EA	SR 7	150+85	LT	N
		CIP15	Alternative BMP	Dandy Curb	5,10	1	EA	SR 14	94+50	LT	N
		IP3	Alternative BMP	42" SedCatch SedCage	5,10	1	EA	SR 7	92+85	LT	Y
		IP4	Filter Fabric Inlet Protection		5,10	1	LF	SR 7	152+50	LT	N

Appendix B

**SIGNATURE LIST**

NPDES and Surface Water Pollution Prevention Plan  
Contractors and Sub-contractors responsible for any Earth Disturbing Activity  
Duty to inform contractors and subcontractors  
(OEPA Permit No.:OHC000005 Part III. E)

Signature	Printed Name	Title	Company	Date



**Appendix C  
SWPPP Review  
Form**

ODOT Project Ct.-Rt.-Sec: \_\_\_\_\_  
Proj. #/PID: \_\_\_\_\_  
Date: \_\_\_\_\_

Question #	Question	YES	NO	N/A	Comments
1	Is the SWPPP specific to the purposed project?				
2	Has the Contractor filed for a Co-Operator's notice to OPEA?				
3	Does the SWPPP list "Operators" and contain signatures of responsible parties? (Any Contractor or sub who has day-to-day operational control over sediment and erosion control activities)				
4	Was the plan developed by a P.E./CPESC qualified individual?				
5	Does the SWPPP list the CECI?				
6	Does the SWPPP show installation details of all proposed Alternative BMP?				
7	Have the proposed Alternative BMP been accepted for use by the Engineer?				
8	Does the SWPPP include existing conditions plan sheets identifying BMP's to be installed with early earth disturbing activities? (i.e. mobilization, clearing and grubbing, tree clearing, contractor staging, demolition, etc.) (Ref. 832.09 B.)				
9	Does the SWPPP include proposed conditions plan sheets identifying BMP's to be installed based on final buildout drainage patterns? (Ref. 832.09 C.)				



Question #	Question	YES	NO	N/A	Comments
10	Have all discharge points, having a direct connection to a waterway, been labeled on the SWPPP? (Direct connections include ditches, channels, storm sewer outlets, direct sheet flow.)				
11	Have sediment controls been included on the SWPPP, intercepting all potential runoff from project and contractor disturbed areas?				
12	Have drainage tributary areas been identified for all sediment controls intercepting concentrated flows? (i.e. sediment traps/basins, FFDC, inlet protection) (Verify tributaries for existing condition BMP and tributaries for proposed condition BMP, Ref. 832.09)				
13	Are the selected sediment control BMP's appropriate for their tributary area? (i.e. 5 Ac max for sediment traps, 2 Ac max for FFDC, 1 Ac max for inlet protection)				
14	Are sediment traps/basin used for tributary areas exceeding 2 acres? (Sediment traps and basins should be used for larger drainage areas unless ponding water may cause a safety hazard to the public. Sediment traps/basins should be a SWPPP Designer's first option for sediment treatment.)				
15	Are volume sizing calculations shown on the SWPPP for all sediment traps/basins? (Traps/basins require a minimum 67 CY per acre dewatering zone plus 37 CY per acre sediment storage zone.)				
16	Does the SWPPP show preservation areas, wetlands, waterways within and adjacent to the project?				

Question #	Question	YES	NO	N/A	Comments
17	Does the SWPPP include all contractor EDA? (i.e. borrow/waste, staging areas, etc.)				
18	Does the SWPPP include a BMP implementation schedule that aligns with the Contractor's construction sequence?				
19	Does the SWPPP show fuel storage locations and list procedures for spill prevention and countermeasures?				
20	Are concrete washouts, fuel storage, staging areas shown on the plan? (Ensure these activities are a minimum 100-feet away from a waterway.)				
21	Are construction entrances shown at all points of egress?				
22	Does the SWPPP show a schedule of stabilization practices? (i.e. temporary and permanent seeding based on dormant areas)				
23	Does the SWPPP show soil types and identify any highly erodible areas? (i.e. steep slopes requiring additional erosion control BMP)				
24	Do all BMP include adequate details for installation? (Ensure all BMP can be appropriately installed as shown on the plans)				

## Appendix D



# Co-Permittee Notice of Intent for Coverage Under Ohio EPA Storm Water Construction General Permit

Submission of this NOI constitutes notice that the party identified in Section I of this form intends to be authorized by Ohio's NPDES general permit for storm water associated with construction activity. Becoming a permittee obligates a discharger to comply with the terms and conditions of the permit. **NOTE:** All necessary information must be provided on this form. Read the accompanying instructions *carefully* before completing the form. Do not use correction fluid on this form. Forms transmitted by fax will not be accepted. There is no fee associated with submitting this form.

### I. Applicant Information/Mailing Address

Company (Applicant) Name: \_\_\_\_\_

Mailing (Applicant) Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_

Contact Person: \_\_\_\_\_ Phone: \_\_\_\_\_ Fax: \_\_\_\_\_

Contact E-Mail Address: \_\_\_\_\_

### II. Facility/Site Location Information

Existing Ohio EPA Facility Permit Number:   \_\_ GC \_\_ \_\_ \_\_ \_\_ \_\_ \* \_\_ G           OR    OHR1 \_\_ \_\_ \_\_ \_\_ \_\_

Initial Permittee Name: \_\_\_\_\_ Phone: \_\_\_\_\_

Facility/Site Name: \_\_\_\_\_

City: \_\_\_\_\_ Township(s): \_\_\_\_\_

County(ies): \_\_\_\_\_ State: Ohio Zip Code: \_\_\_\_\_

Facility Contact Person: \_\_\_\_\_ Phone: \_\_\_\_\_ Fax: \_\_\_\_\_

Facility Contact E-Mail Address: \_\_\_\_\_

### III. Certification

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 gather and evaluate 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.

Applicant Name: \_\_\_\_\_ Title: \_\_\_\_\_

Applicant Signature: \_\_\_\_\_ Date: \_\_\_\_\_

## Appendix E

[http://www.epa.state.oh.us/portals/35/permits/OHC000005/Final\\_OHC000005.pdf](http://www.epa.state.oh.us/portals/35/permits/OHC000005/Final_OHC000005.pdf)



Page 1 of 60  
Ohio EPA Permit No.: OHC000005

Issuance Date: April 23, 2018  
Effective Date: April 23, 2018  
Expiration Date: April 22, 2023

Ohio EPA APP 23/18  
Entered Directors Journal

### OHIO ENVIRONMENTAL PROTECTION AGENCY

#### GENERAL PERMIT AUTHORIZATION FOR STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the federal Water Pollution Control Act, as amended (33 U.S.C. Section 1251 et. seq. hereafter referred to as "the Act") and the Ohio Water Pollution Control Act [Ohio Revised Code ("ORC") Chapter 6111], dischargers of storm water from sites where construction activity is being conducted, as defined in Part I.B of this permit, are authorized by the Ohio Environmental Protection Agency, hereafter referred to as "Ohio EPA," to discharge from the outfalls at the sites and to the receiving surface waters of the state identified in their Notice of Intent ("NOI") application form on file with Ohio EPA in accordance with the conditions specified in Parts I through VII of this permit.

It has been determined that a lowering of water quality of various waters of the state associated with granting coverage under this permit is necessary to accommodate important social and economic development in the state of Ohio. In accordance with OAC 3745-1-05, this decision was reached only after examining a series of technical alternatives, reviewing social and economic issues related to the degradation, and considering all public and intergovernmental comments received concerning the proposal.

This permit is conditioned upon payment of applicable fees, submittal of a complete NOI application form, development (and submittal, if applicable) of a complete Storm Water Pollution Prevention Plan (SWP3) and written approval of coverage from the director of Ohio EPA in accordance with Ohio Administrative Code ("OAC") Rule 3745-38-02.

A handwritten signature in black ink, appearing to read "Craig W. Butler".

Craig W. Butler  
Director

Total Pages: 60

I certify this to be a true and accurate copy of the  
official documents as filed in the records of the Ohio  
Environmental Protection Agency.

By: Date: 4-23-18

## Appendix F

### Temporary Sediment and Erosion Control Best Management Practices (BMP) Unit Price Schedule, October 2018

#### EROSION CONTROL PRICES

			Project Identified EDA (acres)					Fixed Price (\$)	Comment
			<5	5 to 10	10 to 15	15 to 20	>20		
Item	Unit	Description	Price (\$)						
832	Sq. Yd.	Construction Seeding and Mulching	1.00	0.92	0.83	0.75	0.74		Based on NOI acres
832	Feet	Slope Drains						12.00	
832	Cu. Yd.	Sediment Basins and Dams						13.50	[3]
832	Cu. Yd.	Excavated Drop Inlet Protection						13.50	
832	Feet	Perimeter Filter Fabric Fence	4.05	3.10	2.85	2.55	2.30		Based on NOI acres
832	Feet	Filter Fabric Ditch Check						11.00	
832	Feet	Inlet Protection						11.25	
832	Cu. Yd.	Earthen Dike/Berm						3.00	
832	Sq. Yd.	Temporary Stabilization Matting						2.50	
832	Cu. Yd.	Rock Ditch Check, Type C or D without Filter						50.00	[1]
832	Cu. Yd.	Rock Channel Protection, Type C or D with Filter						55.00	[1]
832	Cu. Yd.	Rock Channel Protection, Type C or D without Filter						50.00	[1]
832	Cu. Yd.	Basin Sediment Removal						10.00	
832	Cu. Yd.	Miscellaneous Sediment Removal						15.50	
832	Feet	Construction Fence						5.75	
832	Sq. Yd.	Construction Mulching	0.79	0.71	0.58	0.56	0.54		Based on NOI acres
832	Sq. Yd.	Winter Seeding and Mulching	1.08	1.00	0.92	0.85	0.81		Based on NOI acres
832	Cu. Yd.	Construction Entrance						75.25	

[1] Add the following amount per cubic yard for the cost of Type C or D Rock materials.

[3] Add the amount for the appropriately sized surface dewatering device for sediment basin outlet.

## Appendix F

### BMP ROCK MATERIAL SCHEDULE

District <sup>[2]</sup>	Purchase & Delivered to Job		Produced on Job	
	Type C	Type D	Type C	Type D
1	\$ 60.00	\$ 58.00	\$ 27.50	\$ 27.50
2	\$ 60.00	\$ 58.00	\$ 27.50	\$ 27.50
3	\$ 67.00	\$ 65.00	\$ 27.50	\$ 27.50
4	\$ 71.00	\$ 68.00	\$ 27.50	\$ 27.50
5	\$ 63.00	\$ 60.00	\$ 27.50	\$ 27.50
6	\$ 65.00	\$ 63.00	\$ 27.50	\$ 27.50
7	\$ 65.00	\$ 63.00	\$ 27.50	\$ 27.50
8	\$ 65.00	\$ 63.00	\$ 27.50	\$ 27.50
9	\$ 66.00	\$ 65.00	\$ 27.50	\$ 27.50
10	\$ 70.00	\$ 68.00	\$ 27.50	\$ 27.50
11	\$ 65.00	\$ 63.00	\$ 27.50	\$ 27.50
12	\$ 71.00	\$ 68.00	\$ 27.50	\$ 27.50

[2] Based on the District in which the project is administered.

### SEDIMENT BASIN SURFACE DEWATERING DEVICE

Device Size	Purchase & Delivered to Job
1 1/2"	\$598.00
2"	\$750.00
2 1/2"	\$915.00
3"	\$1,100.00
4"	\$1,590.00
5"	\$2,375.00
6"	\$3,650.00
8"	\$6,000.00

[3] Surface dewatering device sized appropriately for sediment basin

**STATE OF OHIO  
DEPARTMENT OF TRANSPORTATION  
SUPPLEMENTAL SPECIFICATION 895  
MANUFACTURED WATER QUALITY STRUCTURE**

**April 18, 2014**

**895.01 Description**

**895.02 Materials**

**895.03 Installation**

**895.04 Installation plan**

**895.05 Method of Measurement**

**895.06 Basis of Payment**

**895.01 Description.** This work consists of constructing a precast water quality structure, a reinforced concrete slab as required by the installation plan, manholes as required by the installation plan, and all necessary conduit connections. Use all suitable materials in the work. Alternatively legally use, recycle, or dispose of all excavated material according to C&MS 105.16 and 105.17.

**895.02 Materials.** Furnish materials conforming to:

Epoxy Reinforcing Steel ..... C&MS 509

Precast Water Quality Structure ..... SS 995

Furnish a precast water quality structure that is on file with the Office of Materials Management.

The Contractor may furnish a manufactured water quality structure with a larger treatment capacity at no additional cost to the Department if the larger manufactured water quality structure can be constructed within the reserved area provided in the plans.

**895.03 Installation.** Install the precast water quality structure according to the Manufacturer's recommendations within the delineated footprint shown in the plans. Construct a reinforced concrete slab conforming to C&MS 511 as required in the installation plan. Construct all manholes conforming to C&MS 611. Construct all manholes within the delineated footprint shown in the plans at the location and elevation shown in the installation plan.

A manufactured water quality structure installation drawing may require low strength mortar backfill according to Item 613, Type 3. Refer to the manufacturer's installation drawings on file at the Office of Materials Management to determine if low strength mortar backfill is required. Any low strength mortar backfill required is incidental to the cost of the manufactured water quality structure. Any manufacturer installation requirements are furnished at no additional cost to the Department.

Construct all necessary conduit connections as shown in the installation plan using a Type B conduit conforming to C&MS 611.08, unless otherwise specified.

**895.04 Installation plan.** Prior to shipping each precast water quality structure to the project, furnish a copy of the installation plan to the project. Provide the installation plan on 8.5 × 11-inch (216 × 292 mm) sheets. The installation plan includes the following:

- A. All material specifications.
- B. The Manufacturer's recommended installation procedures.
- C. Plan view of water quality structure, reinforced concrete slab, additional manholes, and the conduit connections to the manholes. Include the delineated footprint as shown in the plans along with the storm sewer and the provided manhole with diversion weir labeled by others.
- D. Elevation view of precast water quality structure, reinforced concrete slab, additional manholes, and the conduit connections to the manholes.
- E. All dimensions. Manhole dimensions shown in the installation plan that differ from the manhole dimensions in the plans Ensure manholes conform to C&MS 611.
- F. Volume of storm water required to be pumped out of the precast water quality structure for routine maintenance.
- G. Structural design loads including the dead load and live load.
- H. Structural calculations for the reinforced concrete slab if utilized.

**895.05 Method of Measurement.** The Department will measure manufactured water quality structures by the number of each in place (including all manholes), completed and accepted.

A single manhole is provided in the plans for the water quality system. If an additional manhole is provided, the size of the manholes may be reduced per the manufacturer. There is no Item cost change for this structure change.

**895.06 Basis of Payment.** The Department will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
895	Each	Manufactured Water Quality Structure, Type ____.



**STATE OF OHIO  
DEPARTMENT OF TRANSPORTATION**

**SUPPLEMENTAL SPECIFICATION 995  
PRECAST WATER QUALITY STRUCTURE**

**July 17, 2015**

**995.01 Precast Water Quality Structure**

**995.01 Precast Water Quality Structure.** Furnish precast water quality structures according to the following criteria:

- A. An external structure conforming to C&MS 611. Alternative materials may be used with approval from the Office of Hydraulic Engineering.
- B. Internal components conforming to C&MS 611 or the following table:

**TABLE 995.01-1**

	Aluminum Plate	Stainless Steel	Fiber Reinforced Polymer
ASTM Standard	B209	A276	D4097
Alloy/ Type	5052	304	—
Temper	H32	—	—

Alternative materials may be used with approval from the Office of Hydraulic Engineering.

- C. Capable of being placed in an off-line configuration.
- D. No scour and no re-suspension of material previously collected will occur.
- E. Provide 80 percent capture of the total suspended solids at the water quality flow discharges shown in Table 995.01-2. Provide third party verification including a signed letter from the third party confirming total suspended solids removal efficiency. Ensure testing conforms to the following:
  - 1. The laboratory test influent concentration is 0.028 lb/ft<sup>3</sup> (450 mg/L) or less.
  - 2. Use an OK110 or F110 particle distribution with a specific gravity of 2.65 or less.
  - 3. Measure hydraulic characteristics according to ASTM C1745.

**TABLE 995.01-2**

ODOT Type	Maximum Water Quality Flow		Minimum Sediment Storage	
	ft <sup>3</sup> /sec	(m <sup>3</sup> /sec)	ft <sup>3</sup>	(m <sup>3</sup> )
1	1	(0.028)	10	(0.28)
2	2	(0.056)	20	(0.56)
3	3	(0.084)	32	(0.91)
4	6	(0.168)	65	(1.84)

- F. Capture of all floatable free oil.
- G. Sediment storage capacity as listed in Table 995.01-2.
- H. A water-lock feature to prevent the introduction of trapped oil and floatable contaminants to the downstream piping during routine maintenance.
- I. Direct access to the sediment and floatable contaminant storage chambers. Provide a maximum distance of 36 inches (915 mm) from the interior wall to the outside edge of the first access hole. Furnish additional access holes at a maximum spacing of 66 inches (1675 mm) measured from center of access hole to center of access hole. Alternate spacing of access holes requires approval from the Office of Hydraulic Engineering.
- J. Confined space entry is not a requirement for routine maintenance.
- K. No special tools or attachments are required to provide routine maintenance with a vacuum pumping truck.
- L. A minimum access hole of 30 inches (762 mm) in diameter. Provide bolt down, non-gasketed manhole covers when required. Provide countersunk bolts.
- M. Capable of supporting a traffic load of HS-25 and a dead load as required in the plans. A reinforced concrete slab conforming to C&MS 511 with epoxy coated reinforcing steel constructed per C&MS 509 may be provided to achieve the loading requirements.
- N. Completely housed within one structure excluding the structure containing the diversion weir and necessary structures to ensure connectivity to the storm sewer trunk.

Furnish, manufacture certified, precast water quality structure, hydraulic and structural product test data, to the Department as required by the Office of Materials Management QPL listing for SS 995 for review to determine if the precast water quality structure is compliant with sections A through N. Approved and accepted precast water quality structures will be posted into the Qualified Products List under SS 995. Provide recertification documentation to the Department as outlined above upon making any changes to the approved precast water quality structure, or at the request of the Department.