

**FOLS**  
**Fort Larned National Historic Site**  
**Larned, Kansas**

**Replace the VC Septic Tank and Leach Field**  
PMIS 226825

**PROJECT SPECIFICATIONS**



NATIONAL PARK SERVICE  
FEBRUARY 2022

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00 01 07 - SEALS AND SIGNATURES

<p>Travis Heier, PE License No. 21598</p>  <p>A circular professional engineer seal for Travis Heier, PE, License No. 21598, Kansas. The seal includes the text "TRAVIS HEIER", "LICENSED", "21598", "KANSAS", and "PROFESSIONAL ENGINEER". A handwritten signature "Travis Heier" and the date "2/25/22" are present in blue ink.</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <p>Divisions 00, 01, 31, 32, 33, 40.</p>
<p>Nathan W. Witte, PE License No. 26486</p>  <p>A circular professional engineer seal for Nathan W. Witte, PE, License No. 26486, Kansas. The seal includes the text "NATHAN W. WITTE", "LICENSED", "26486", "KANSAS", and "PROFESSIONAL ENGINEER". A handwritten signature "Nathan Witte" and the date "2/25/2022" are present in blue ink.</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <p>Division 26.</p>

END OF SEALS AND SIGNATURES

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# DIVISION 01

## GENERAL REQUIREMENTS



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## SECTION 01 10 00

### DIVISION 1 SHORT FORM GENERAL REQUIREMENTS

#### PART 1 – GENERAL

##### ITEM 1 - DESCRIPTION OF WORK

1.1 Background: The original septic system and drain field for the Visitor's Center was constructed in 1974 and has reached the end of its useful life. The drain field is no longer functioning properly requiring frequent pumping of the septic tank to prevent overflows. The drain field will be abandoned in place, a new septic tank and lift station installed with new force main directionally drilled under the river to the northwest and a new drain field installed on the northwest side of the KS State Highway 242 Park's Entrance road.

##### 1.2 Work Covered by the Contract Documents:

- A. Project Location: Fort Larned National Historic Site, 1767 KS Hwy 156, Larned, KS 67550.
- B. Work consists of: Removing the existing septic tank and capping the existing sewer line to the drain field, install a new septic tank and lift station, directionally drill a new force main from the lift station northwest under the river and access road, install a new drain field northwest of the access road, seed and restore surface following construction.
- C. All work will be performed under a single contract.

Period of performance: Work shall be completed within **90** calendar days of the start date provided on the Notice to Proceed. The period of performance is inclusive of **10** weather days.

##### ITEM 2 - EXISTING UTILITIES

2.1 Existing Utilities: Notify Contracting Officer (CO), Contracting Officer's Representative (COR) and utility companies to coordinate proposed locations, times for excavation and request location services prior to any digging operation.

2.2 Contractor shall be responsible for locating and preventing damage to known utilities. If contractor damage occurs, alert CO and COR as soon as safely possible, and repair utility at no additional expense to the Government. If damage occurs to an unknown utility, contact CO and COR as soon as safely possible.

2.3 Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated below:

2.3.1 Notify CO and COR not less than two business days in advance of proposed utility interruptions.

2.3.2 Hours for Utility Shutdowns: Shut downs shall not exceed 2 to 3 hours. Temporary provisions will be needed by the Contractor for periods longer than stated allowance or if required for critical systems as determined by COR.

2.3.3 For the connection to the electrical transfer switch the contractor will have to coordinate the power shutdown with the COR and Park staff. This may need to be completed after hours to minimize service disruptions. Note that there has been electric power bleed back when the switch is turned off in the past so contractor shall take extra precautions during this work.

### ITEM 3 - CONTRACTOR'S USE OF PREMISES

3.1 Conduct of Operations: At all times the contractor shall conduct his operations in conformance with the rules and regulations promulgated by the Secretary of the Interior for the National Park Service, and applicable park rules and regulations prescribed by the Park Superintendent.

<https://www.nps.gov/fols/learn/management/superintendent-s-compendium.htm>.

- A. No signs or advertisements (except those specified herein and as required for safety) shall be displayed on the construction site or within the park unless approved by the Contracting Officer.
- B. Smoking is not permitted within any Federal building or within 25 feet of entrances, operable windows, or outdoor air intakes.
- C. Public Use of Site: Contractor shall at all times conduct operations to ensure the least inconvenience to the public. Contractor shall not block any walking paths on the site during construction operations.

3.2 On-site work hours: Work shall be generally performed during normal business working hours of 7 a.m. to 4:30 p.m., Monday through Friday, except when otherwise indicated.

- A. Work on Saturdays, Sundays, Federal holidays, early morning, or at night may not be performed without prior consent from the CO and COR. Submit requests for work outside of the stated normal business hours to the CO and COR for approval at least 48 hours in advance of the work.

The following Federal holidays are observed by the National Park Service:

New Year Day  
Martin Luther King, Jr's Birthday  
Washington's Birthday  
Memorial Day  
Juneteenth National Independence Day  
Independence Day  
Labor Day  
Columbus Day  
Veterans Day  
Thanksgiving Day  
Christmas Day

- B. Note: Any of the above holidays falling on a Saturday will be observed on the preceding Friday; holidays falling on Sunday will be observed on the following Monday. The specific day that each holiday is recognized for each year can be found at the following site: [Federal Holidays \(opm.gov\)](https://www.opm.gov).

### 3.3 Contractor Use of Site:

- A. General: Contractor shall have limited use of the site for construction operations. Limit use of premises to construction area as shown on site plan. Do not disturb portions of Project site beyond areas in which the Work is indicated.
- B. Limits: Construction area shall be as shown on the plan sheets, contractor shall not disturb any areas outside the work limits.
- C. Driveways and Entrances: Keep driveways, access roads, and entrances serving premises clear and available to Government, Government's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize use of driveways and entrances.
- D. Limit site disturbance, including earthwork and clearing of vegetation, to:
  - a. 10 feet beyond surface walkways, patios, surface parking, and utilities less than 12 inches in diameter.
  - b. 15 feet beyond primary roadway curbs and main utility branch trenches.
  - c. Limits shown on the plans for the new drain field, staging, and access area shall be the limits of disturbance for work in that area.
- E. Utilities
  - a. General: Cost or use charges for temporary facilities shall be included in the Contract Sum as required.
  - b. Water Service: Water from existing water system is not available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations without any additional permit costs. Use resources wisely and minimize waste of water.
  - c. Electric Power Service: Electric power from existing system is not available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations without any additional permit costs. Power may or may not meet your construction power tool requirements, provide generators if questionable. Use power in a resourceful manner and avoid excess power waste.
  - d. Toilets: Contractor provided for contracting personnel, sufficiently lighted and ventilated toilet facilities in weatherproof, sight proof, handicap accessible (if required), sturdy enclosures with privacy locks. Coordinate with COR for approved location if not shown on attached site plan.
- F. Security and Protection facilities:
  - 1. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with state and federal environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  - 2. Cleaning of Equipment: The Contractor shall ensure that prior to moving on to the Project Area, all equipment, is free of soil, seeds, vegetative matter, or other debris that could contain or hold seeds. Ensure that all equipment has been pressure washed and is free of exotic species prior to start-up of operations and moving of equipment to Project Area. Equipment shall be considered free of soil, seeds, and other debris when a visual inspection does not disclose such material. Disassembly of equipment components or specialized inspection tools are not required.

- a. Clean vehicles and construction equipment prior to entry into the Park to minimize the potential for introduction and/or proliferation of invasive non-native weeds through project actions. The contractor is required to wash equipment, with emphasis on undercarriages, with a high-pressure spray prior to transporting such equipment to Fort Larned National Historic Site.
  - b. All vehicles and construction equipment entering Fort Larned National Historic Site shall be inspected and approved by the Contracting Officer Representative prior to entering the park.
  - c. Equipment not deemed clean by the Contracting Officer Representative will not be allowed to enter the park. The contractor remains liable for additional transportation fees incurred when equipment fails inspection.
  - d. Use approved native seed and/or plants and revegetate areas disturbed by construction.
3. Tree and Plant Protection: Provide Tree Protection fence at drip line of trees impacted in construction area. Coordinate with COR.
- a. Restore damaged areas to original condition, repairing or replacing damaged trees and plants, at no additional expense to the Government.
  - b. Provide temporary barriers to protect existing trees and plants and root zones.
  - c. Do not remove, injure, or destroy trees or other plants without prior approval. Consult with Contracting Officer Representative and remove agreed-on roots and branches that interfere with construction.
  - d. Do not fasten ropes, cables, or guys to trees.
  - e. Carefully supervise excavating, grading, filling, and other construction operations near trees to prevent damage.
4. Pest Control: Follow best practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at project completion. Perform control operations lawfully, using environmentally safe materials.
5. Temporary Fencing: Provide temporary fencing as required for protection of construction in progress and completed, in particular any open excavations near the Visitor's Center.

#### 3.4 Storage - Staging Areas:

- A. Confine Storage of materials and equipment to the project staging area noted on the plans/aerial. Specific storage and staging area's may be discussed at the preconstruction briefing. Limits of use and control shall be subject to Contracting Officer's approval. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

#### 3.5 Preservation of Natural Features: N/A

3.6 Hauling Restrictions: Contractor to verify path to site and meet state and county road requirements and height restrictions for all park work/access.

### 3.7 Housekeeping:

- A. Keep project neat, orderly, and in a safe condition at all times.
  - a. Dispose of waste materials and recycling legally outside the park. The contractor shall not use park dumpsters
  - b. Address Recycling: Government goal is to salvage and recycle as much nonhazardous construction waste as possible. Use sustainable methods to extent possible during this project, recycling material as is probable with local means. Maintain accurate documentary records for submittal of all recycled materials used including fly ash and slag cement.

### 3.8 Occupancy Requirements for Buildings:

#### A. Existing Buildings:

1. Full Government Occupancy: Government will occupy buildings adjacent to construction during the entire contract period. Cooperate with Government during construction operations to minimize conflicts and facilitate Government usage. Perform the Work so as not to interfere with Government's day-to-day operations. Maintain existing exits, unless otherwise indicated.
  - a. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from the CO or COR.
  - b. Maintain existing building in a weather tight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

### 3.9 Photo Documentation:

Contractor must provide existing condition, progress and completion photos. All photos shall be in focus, show maximum range of depth of field general photo and then close up detail photo as needed. Shall be in JPEG digital form and submitted electronically via CD-R Archival Gold or DVD-R Archival Gold media with printed labels and 8 mega pixels minimum within 7 days from time of taken or as approved by COR.

#### A. Existing Condition Images:

Before starting construction, take color, dated, digital images of project site and adjacent property/roads/etc. that may be impacted by construction activity/traffic. Include existing items to remain or be salvaged from different vantage points and with context for location identification.

#### B. Construction Progress Images:

1. Document all sub-surface work/ trenches etc. prior to backfill with photos covering enough overall field view to show location and then zoom in for details. (Locations and dimensions shall also be noted on as built drawing set.).
2. Maintain organized index for photos with date, description, etc.
3. Additional images as needed when questions or emergency situations occur. Submit within 24 hours.

C. Completion Images:

1. Document all completed work within scope of work.
2. Maintain organized index for photos with date, description, etc.
3. Additional images as needed when questions or emergency situations occur. Submit within 24 hours.

3.10 Fire and Life Safety:

As a minimum, conduct one weekly 15 minute "toolbox" safety meetings. These meetings shall be conducted by a foreman or supervisor and attended by all construction personnel at the worksite. Topics need to coincide with work scheduled for the following week. Document and submit meeting minutes to the CO and COR within one day after the meeting and document the meetings on the daily reports.

- A. Comply with the requirements of NFPA 241 (Standard for Safeguarding Construction, Alteration, and Demolition Operations). Take all necessary precautions to prevent fire during construction. Provide adequate ventilation during use of volatile or noxious substances.
- B. Store and handle hazardous materials in accordance with manufacturer's and OSHA 29CFR1926 Subpart D requirements [1926 | Occupational Safety and Health Administration \(osha.gov\)](http://www.osha.gov). Maintain readily available, on site, MSDS/Safety Data Sheets (SDS) for each chemical.
  - i. Immediately report all spills of hazardous materials to the CO, COR and park.
  - ii. Maintain a spill emergency response kit.
  - iii. Train employees how to respond to a spill and use the emergency response kit.

3.11 Noise and Acoustics Management

- A. Noise Control: Perform noise-producing work in less sensitive hours of the day or week as directed by the Contracting Officer or COR.
- B. Repetitive and/or intermittent, high-level noise: Permitted only during Daytime.

1. Do not exceed the following dB(A) limitations at 50 feet:

<u>Sound Level in dB(A)</u>	<u>Time Duration of Impact Noise</u>
70	More than 12 minutes in any hour
80	More than 3 minutes in any hour

2. Maximum permissible construction equipment noise levels at 50 feet:

<u>EARTHMOVING</u>	<u>dB(A)</u>	<u>MATERIALS HANDLING</u>	<u>dB(A)</u>
Compressors	75	Pneumatic Tools	80
Pumps	75	Saws	75
Generators	75	Vibrators	75

C. Ambient Noise:

1. Maximum noise levels (dB) for receiving noise area at property line shall be as follows:
  - a. Residential receiving area :  
Daytime: 65 dB    Nighttime: 45 dB

- b. Commercial/Industrial receiving area:  
Daytime: 67 dB Nighttime: 65 dB

#### ITEM 4 - COMMENCEMENT, PROSECUTION, AND COMPLETION

4.1 The Contractor shall commence work in accordance with the terms and conditions of the contract. Contractor shall coordinate and incorporate long lead and delivery time items within the schedule.

#### ITEM 5 - EXAMINATION OF THE SITE

5.1 All bidders are urged to visit the job site and examine existing conditions before submitting bids. Contractors will be accountable for understanding existing conditions. No cost changes for items viewable during site visit will be allowed.

#### ITEM 6 - ABBREVIATIONS

6.1 The list of abbreviations, standards and organizations which may be used in/referred within the Construction Specifications or Special Provisions, may be found linked from the listed page below. On the home page, follow the link under “**Contracting and Procurement**” labeled “**NPS Reference Standards.**”

<https://www.nps.gov/orgs/1671/do-business-with-us.htm>

#### ITEM 7 - ACCIDENT PREVENTION

7.1 Description: The work of this section consists of establishing and implementing an effective accident prevention program (APP) and providing a safe environment for all personnel and visitors.

##### 7.2 Submittals:

- A. Accident Prevention (Safety) Plan (APP): Submit a **site specific** accident prevention (safety) plan. The Plan shall be written to comply with OSHA and project requirements (a generic plan is not acceptable) including but not limited to the following:
1. Name and qualifications of responsible supervisor to carry out the program.
  2. First aid and rescue procedures.
  3. Training, both initial and continuing.
  4. Outline of each phase of the work, the hazards associated with each major phase, and the methods proposed to provide for property protection and safety of the public, National Park Service personnel, and Contractor's employees. Identify the work included under each phase, with a Job Hazard Analysis (JHA)/Job Safety Analysis (JSA), etc. A sample JHA template may be provided upon request.
  5. Planning for possible emergency situations, such as cave-ins, earthquake, explosions, fires, floods, power outages, slides, and wind storms. Such planning shall take into consideration the nature of construction, site conditions, and degree of exposure of persons and property.
  6. Contractor to identify nearest location of medical facility for emergencies
  7. Recognition that work will be performed in remote areas with limited communication or cell phone coverage if applicable.
  8. Supplemental hazard specific plans may be required IAW 29 CFR 1926 or 1910.

- B. Meeting and Inspection Reports: Safety Meetings: As a minimum, conduct 15 minute "toolbox" safety meetings. These meetings shall be conducted by a foreman and attended by all construction personnel at the worksite. Submit a report of safety meetings and inspections to CO and COR within one day after the meeting and document the meetings on the daily reports.

### 7.3 Qualification of Employees:

- A. Ensure that employees are physically qualified to perform their assigned duties in a safe manner to include operators of vehicles and equipment. Provide operating instructions for all equipment.

- B. Do not allow employees to work whose ability or alertness is impaired because of drugs, fatigue, illness, intoxication, or other conditions that may expose themselves or others to injury.

7.4 Accident Reporting: The Contractor shall report all accidents to the CO and COR as soon as safely possible and assist the CO and COR and other officials as required in the investigation of the accident.

7.5 First Aid Facilities: Provide access to facilities for the number of employees and appropriate to the hazards associated with the types of ongoing construction work at the site.

7.6 Emergency Instructions: Post telephone numbers and reporting instructions for ambulance, physician, hospital, fire department, and police in conspicuous locations at the work site.

7.7 Personal Protective Equipment (PPE): It is the Contractor's responsibility to require all those working on or visiting the site to wear necessary protective equipment at all times.

- A. PPE must meet requirements of applicable ANSI standards. Selection shall conform to OSHA 29CFR 1926 Subpart E.
- B. A hard hat use area shall be designated by the Contractor. The hard hat area shall be posted by the Contractor in a manner satisfactory to the Contracting Officer.
- C. All PPE will be serviceable at all times. At a minimum, maintain four sets of PPE including hard hats and all other Accident Prevention Plan required equipment.

7.8 Hazardous Materials: It shall be the responsibility of all operators and contractors, functioning within the park to properly cleanup, mitigate and remediate if necessary, all unauthorized discharges of hazardous materials or non-hazardous chemical and biological products released from fleet and/or other support vehicles or stationary sources. Response shall be consistent with guidelines established by federal, state and local regulations, and as outlined within the operator's Safety or Hazardous Materials Business Plan.

- A. If a spill, leak or other release occurs, the operator shall as soon as possible, without impeding cleanup, notify the National Park Service Emergency Dispatch.

ITEM 8 - PRECONSTRUCTION CONFERENCE: If the Contracting Officer decides to conduct a preconstruction conference, the successful offeror will be notified and will be required to attend. The Contracting Officer's notification will include specific details regarding the date, time, and location of the

conference, any need for attendance by subcontractors, and information regarding the items to be discussed. See Item 9.1C below.

## ITEM 9 - SUBMITTALS

### 9.1 General Submittal Procedures:

- A. General: Prepare and submit submittals required by individual Technical Specification Sections. Types of submittals are indicated in individual specific sections.
  - 1. CM-16 Transmittal Form: All submittals shall be transmitted via electronic email using National Park Service form CM-16 form. The form will be provided by the Contracting Officer. No action will be taken on a submittal item unless accompanied by the CM-16 transmittal form. Submit completed CM-16 forms to the CO and the COR
- B. Submittal List: administrative required submittals are listed below in 9.1.C and does not include technical section submittal requirements included in each technical section.
- C. Preconstruction Conference Submittal: Satisfactory evidence of liability insurance coverage and workman's compensation, and any applicable bonds, must be submitted within 10 calendar days of Notice of Award. The following items shall be submitted a minimum of one week prior to the Preconstruction Conference. If all of these documents have not been received one week prior to the scheduled Pre-Construction Conference date, the conference will be cancelled, Notice to Proceed may not be issued, and the Contracting Officer will consider other contractual remedies. Work shall not commence until written Notice to Proceed has been issued. Contracting Officer will notify Contractor of tentative date for the Pre-Construction Conference:
  - 1. Letter designating Project Superintendent.
  - 2. Construction Schedule. (Must include shop drawings, procurement time including long lead time items, mobilization, trade work progression and completion at minimum.)
  - 3. A comprehensive breakdown of the Schedule of Values.
  - 4. Accident Prevention (Safety) Plan (see section 7 of this document).
  - 5. A list of Subcontractors for this project.
  - 6. Written statements from subcontractors certifying compliance with applicable labor standard clauses (SF1413).
  - 7. Quality Control Plan.
  - 8. Waste Management Plan.
  - 9. List of Required Construction Permits. Include the following information for each permit:
    - a. LEPG Septic Permit.
    - b. Kansas LEPG.
    - c. NPS has obtained this permit.
  - 10. Temporary Storm Water Pollution Prevention Plan (SWPP or UPPP) Submitted to AHJ (Authority Having Jurisdiction). AHJ is Kansas Department of Health and Environment.
    - a. Description: The work of this section consists of implementing measures to prevent discharges of pollutants, including temporary storm water pollution during construction activities, either through compliance with the NPDES permit program; Or in conformance with NPS guidance for UPPPs.

- b. After contract award and before the pre-construction conference, prepare and submit a SWPPP showing that the SWPPP satisfies all Federal and KDHE NPDES permit requirements and includes the following information and forms.
  - i. Site description.
  - ii. Identification and contract information for Pollution Prevention and Erosion Control Manager.
  - iii. Expected sequencing of operations and construction schedule.
  - iv. Weather monitoring procedure.
  - v. Descriptions and details BMPs for of pollution prevention and erosion controls, including dust control.
  - vi. Pollution prevention and erosion control plans.
  - vii. Controls for other potential onsite storm water pollutants.
  - viii. Applicable specifications.
  - ix. Maintenance and inspection procedures and forms.
  - x. Description of potential non-storm water discharges at site.
  - xi. Notice of Intent (NOI) form.
  - xii. Notice of Termination (NOT) form.
  - xiii. Contractor and Sub-contractor Certification forms.
  - xiv. Other record keeping forms and procedures.
  - xv. Housekeeping Best Management Practices, including vehicle wash-down areas, protection of equipment storage and maintenance areas, and sweeping of roadways related to hauling activities.
  
- c. Notice of Intent (NOI): The Contractor shall file a Notice of Intent and formal SWPPP as required by KDHE.  
<https://www.kdhe.ks.gov/DocumentCenter/View/6311/Notice-of-Intent---Construction-Activities-PDF>
  
- d. Notice of Termination (NOT): After Substantial Completion of the construction project, file a Notice of Termination (NOT) with KDHE.
  
- e. COR Notification: The Contractor shall notify the COR in writing and by telephone of the following events:
  - i. The required erosion and sediment control meeting/briefing.
  - ii. Following installation of required sediment control structures.
  - iii. Prior to removal of or modification to sediment control structures.
  - iv. Prior to removal of all sediment control structures.
  
- f. Review and Acceptance: The Contractor and the COR will jointly review the draft Plan and agree to any needed revisions. The Contractor shall incorporate all revisions, sign, and submit the final Plan to the COR. The final Plan will be the document enforced on the project.
  - i. The accepted Plan will describe and ensure implementation of the practices which will be used to reduce the pollutants in storm water discharges.
  - ii. The Contractor shall maintain a current copy of the Plan and all associated records and forms at the jobsite throughout the duration of the project.

- iii. The Plan shall be available at all times for public inspection and for the inspection and use of the COR.
- iv. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.
- v. Implementation: Implement the Plan as required throughout the construction period and maintain all erosion control elements in proper working order.
- vi. Do not perform clearing and grubbing or earthwork until the Plan has been implemented.
- vii. The SWPPP (including inspection forms) and all data used to complete the NOI shall be provided to the COR after Substantial Completion of the project.

g. REPORTING

- i. If a discharge occurs or if the project receives a written notice or order from any regulatory agency, the Contractor will immediately notify the COR and will file a written report to the Agency(ies) with Jurisdiction within 7 days of the discharge event, notice, or order. Corrective measures shall be implemented immediately following the discharge, notice, or order. The report to the Agency(ies) with Jurisdiction shall contain the following items at a minimum:
  - ii. The date, time, location, nature of operation, and type of discharge, including the cause or nature of the notice or order.
  - iii. The BMPs deployed before the discharge event, or prior to receiving the notice or order.
  - iv. The date of deployment and type of BMPs deployed after the discharge event, or after receiving the notice or order, including additional BMPs installed or planned to reduce or prevent re-occurrence.
  - v. An implementation and maintenance schedule for any affected BMPs.

h. SEDIMENT DISPOSAL

- i. Sediment excavated from temporary sediment control structures shall be disposed on the site with general fill, or with topsoil. Sediment shall be allowed to dry out as required before reuse.
- ii. Contractor shall place the sediment removed from traps and other structures where it will not enter a storm drain or watercourse and where it will not immediately reenter the basin.

i. REMOVAL OF TEMPORARY STORM WATER POLLUTION CONTROL MEASURES

- i. All temporary control measures shall be removed with permission of the COR within 20 working days after final acceptance of the project, and/or once grading is completed and slopes have stabilized.

9.2 Shop Drawings, Product Data, and Samples: Contracting Officer will provide sample cover sheet.

- A. Shop Drawings: Indicate all coordinating materials and work impacting the installation coordination, connection details, anchorage requirements, hardware locations, and installation details and locations.

1. Submit Shop Drawings according to Part 9.1 of this section to include one digital file (.PDF or .TIF) and two full size hardcopy documents to COR.
- B. Product Data: Provide component construction and specification data sheets, anchorage requirements and any other product specific data.
  1. Submit Product Data according to Part 9.1 of this section to include one digital file (.PDF or .TIF) to COR.
- C. Samples: Submit 2 color samples 4" x 6" minimum in size for all color and product selection. Paint samples shall be actual paint finish drawdown for all project colors.
  1. Submit Samples CM-16 Transmittal Form according to Part 9.1 of this section to include one digital file (.PDF or .TIF) and physical samples of actual material to COR.
- D. For submittals specified above, forward submittals to Contracting Officer and COR at least 15 days before need for approval (depends on length of project).
- E. After approving submittals, Contracting Officer and/or COR will return one copy to the Contractor. If submittals are not approved, Contracting Officer will return all copies to Contractor with reasons for rejection. Resubmit, identifying changes. Any work done before approval shall be at Contractor's own risk.

9.3 Approved Equals: If an item in this solicitation is identified as "brand name or equal" or lists more than 1 manufacturer, the description of the proposed item must reflect the characteristics and level of quality that will satisfy the Government's needs as demonstrated by the salient physical, functional, or performance characteristics that "equal" products must meet and/or exceed that as specified in the solicitation or relevant specification.

- A. For each item proposed as an "approved equal," submit supporting data, including:
  1. Drawings and samples as appropriate.
  2. Comparison of the characteristics of the proposed item with that specified and with the salient characteristics provided.
  3. Changes required in other elements of the work because of the substitution.
  4. Name, address, and telephone number of vendor.
  5. Manufacturer's literature regarding installation, operation, and maintenance, including schematics for electrical and hydraulic systems, lubrication requirements, and parts lists. Describe availability of maintenance service, and state source of replacement materials.
- B. A request for approval constitutes a representation that Contractor:
  1. Has investigated the proposed item and determined that it is equal or superior in all respects to that specified.
  2. Will provide the same warranties for the proposed item as for the item specified.
  3. Has determined that the proposed item is compatible with interfacing items.
  4. Will coordinate the installation of an approved item and make all changes required in other elements of the work because of the substitution.
  5. Waives all claims for additional expenses that may be incurred as a result of the substitution.

C. Approved Equals will be evaluated and approved/disapproved during the submittal process.

9.4 Progress Reporting: The initial Construction Schedule and Schedule of Values are required a minimum of one week prior to the Preconstruction Conference. After the Notice to Proceed is issued and after on-site work begins, progress will be documented via daily logs and by providing an updated Construction Schedule and Schedule of Values when requested; but minimally with each pay application. Submit digital copy electronically (PDF preferred) of all required documents. Construction Schedules are normally in bar chart form and indicate estimated starting and completion dates for each part of the work. For a pay application to be reviewed and processed in a timely manner, the following information must either be submitted prior to or accompany submission of the pay application:

- A. Daily/weekly progress reports during construction as part of the administration process.
- B. Updated Schedule of Values: Breakdown each lump-sum item into component work activities used in the schedule, for which progress payments may be requested. The Schedule of Values will form the basis for payment. The work activities broken out within the schedule of values shall be integrated into and made a logical part of the construction baseline schedule submitted under this specification. The total costs for the component work activities shall equal the contract price for that lump-sum item. The Contracting Officer may request data to verify accuracy of dollar values. A sample Schedule of Values format may be provided upon request.

#### ITEM 10 – TEMPORARY SERVICES

10.1 It is the Contractor's responsibility to provide temporary services, equipment, tools, and skilled labor as required for the chosen means and methods to perform the work in accomplishing this Contract.

#### ITEM 11 - PROJECT CLOSEOUT

11.1 Description: The work of this section consists of final cleanup, closeout submittals, final inspection procedures working toward Final Acceptance.

11.2 Cleaning: Remove all tools, equipment, surplus materials, and rubbish. Move attic stock to location coordinated with COR. At time of final inspection, project shall be thoroughly clean and ready for intended use. Inspector holds the right to reschedule if project is not ready for inspection.

11.3 Completion and Final Inspection: Contractor shall submit written certification of project completion and request a final inspection to the Contracting Officer and COR. The Contracting Officer or designee will make an inspection within 10 days of receipt of request or at a mutually agreeable time.

- A. If the work is determined to be complete following the final inspection with minor comments, the COR will prepare and provide the Contractor a Punch List noting outstanding items to be addressed.
- B. If the work is not determined to be complete following the final inspection, the Contracting Officer will notify Contractor in writing, stating reasons. Contractor, after completing the work according to the Contract Documents, shall resubmit completion and request a new final inspection. Re-inspection costs may be charged against the Contractor in accordance with the Inspection of Construction contract clause.

- C. Contractor shall complete the Punch List within 30 calendar days or a time directed by the CO.
- D. Once Contractor completes all items of work on the Punch List and all contractually required items are accepted, Contracting Officer will issue Letter of Final Acceptance of Work and request the final pay application.
- E. If the Contractor fails to complete the work within the time frame, the Contracting Officer may correct the work with an appropriate reduction in contract price or charge for re-inspection costs in accordance with the Inspection of Construction contract clause.
- F. Disposition of any permits and warranties required by the specifications in this section.

11.4 Final Acceptance of the Work: After all punch list deficiencies have been corrected, a Letter of Final Acceptance will be issued. A Release of Claims document must be executed and submitted to the Contracting Officer before final payment can occur.

#### 11.5 Warranties

- A. Construction Warranty shall be based on date of final acceptance of the work and remain in effect for one year
- B. Provide all manufacturer warranty information of products installed organized by Division. All contact information, extent of coverage and conditions shall be clearly noted as well as date of overall final acceptance.
- C. Information shall include operation and maintenance manuals for each warranted product.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXCUTION (NOT USED)

END OF SECTION



DIVISION 26

ELECTRICAL



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## SECTION 26 05 00 - ELECTRICAL - BASIC REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Basic requirements for electrical systems.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
  - 2. Section 26 05 33 - Raceways and Boxes.

#### 1.2 QUALITY ASSURANCE

- A. Referenced Standards:
  - 1. American Institute of Steel Construction (AISC):
    - a. Steel Construction Manual.
  - 2. American National Standards Institute (ANSI).
  - 3. ASTM International (ASTM):
    - a. A36/A36M, Standard Specification for Carbon Structural Steel.
    - b. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - c. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. C2, National Electrical Safety Code (NESC).
  - 5. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 6. National Electrical Manufacturers Association (NEMA):
  - 7. Underwriters Laboratories, Inc. (UL).
- B. Products to be listed by a Nationally Recognized Testing Laboratory (NRTL) in accordance with applicable product standards.
  - 1. Applicable product standards including, but not limited to, ANSI, FM, IEEE, NEMA and UL.

2. NRTL includes, but is not limited to, CSA Group Testing and Certification (CS), FM Approvals LLC (FM), Intertek Testing Services NA, Inc. (ETL), and Underwriters Laboratories, Inc. (UL).

### 1.3 DEFINITIONS

- A. For the purposes of providing materials and installing electrical work the following definitions shall be used.
  1. Outdoor area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
  2. Corrosive area: Areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
  3. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
  4. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

### 1.4 SUBMITTALS

- A. Shop Drawings:
  1. See individual specification sections for submittal requirements for products defined as equipment.
  2. General requirements:
    - a. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
    - b. Include data sheets that include manufacturer's name and product model number.
      - 1) Clearly identify all optional accessories.
    - c. Acknowledgement that products are NRTL listed or are constructed utilizing NRTL recognized components.
    - d. Manufacturer's delivery, storage, handling and installation instructions.
    - e. Product installation details.
    - f. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
    - g. See individual specification sections for any additional requirements.
- B. Operation and Maintenance Manuals:
  1. See Division 1 Specification for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content process of Operation and Maintenance Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect nameplates on electrical equipment to prevent defacing.

1.6 AREA DESIGNATIONS

- A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.
  - 1. Outdoor areas:
    - a. Wet.
    - b. Also, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, refer to specific Electrical Specification Sections and specific material paragraphs below for acceptable manufacturers.
- B. Provide all components of a similar type by one (1) manufacturer.

2.2 MATERIALS

- A. Electrical Equipment Support Pedestals and/or Racks:
  - 1. Manufacturers:
    - a. Modular strut:
      - 1) Unistrut Building Systems.
      - 2) B-Line by Eaton.
      - 3) Globe Strut.
      - 4) Superstrut by Thomas & Betts.
  - 2. Material requirements:
    - a. Modular strut:
      - 1) Galvanized steel: ASTM A123/123M or ASTM A153/A153M.
    - b. Structural members (e.g., I beams, L and C channels):
      - 1) Galvanized steel: ASTM A36/A36M steel with galvanizing per ASTM A123/A123M.

- c. Mounting plates:
    - 1) Galvanized steel: ASTM A36/A36M steel with galvanizing per ASTM A123/A123M.
  - d. Mounting hardware:
    - 1) Galvanized steel.
- B. Field touch-up of galvanized surfaces.
- 1. Zinc-rich primer.
    - a. One coat, 3.0 MILS, ZRC by ZRC Products.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install and wire all equipment, including prepurchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specification Sections and ensure that equipment is ready and safe for energization.
- B. Install equipment in accordance with the requirements of:
  - 1. NFPA 70.
  - 2. IEEE C2.
  - 3. The manufacturer's instructions.
- C. In general, conduit routing is not shown on the Drawings.
  - 1. The Contractor is responsible for routing all conduits including those shown on one-line and control block diagrams and home runs shown on floor plans.
  - 2. Conduit routings and stub-up locations that are shown are approximate; exact routing to be as required for equipment furnished and field conditions.
- D. When complete branch circuiting is not shown on the Drawings:
  - 1. A homerun indicating panelboard name and circuit number will be shown and the circuit number will be shown adjacent to the additional devices (e.g., light fixture and receptacles) on the same circuit.
  - 2. The Contractor is to furnish and install all conduit and conductors required for proper operation of the circuit.
  - 3. The indicated home run conduit and conductor size shall be used for the entire branch circuit.
  - 4. See Specification Section 26 05 19 for combining multiple branch circuits in a common conduit.
- E. Do not use equipment that exceed dimensions or reduce clearances indicated on the Drawings or as required by the NFPA 70.

- F. Install equipment plumb, square and true with construction features and securely fastened.
- G. Install electrical equipment, including pull and junction boxes, minimum of 6 IN from process, gas, air and water piping and equipment.
- H. Install equipment so it is readily accessible for operation and maintenance, is not blocked or concealed and does not interfere with normal operation and maintenance requirements of other equipment.
- I. Avoid interference of electrical equipment operation and maintenance with structural members, building features and equipment of other trades.
  - 1. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments of up to 6 IN in equipment location with the Engineer's approval.
- J. Provide electrical equipment support system per the following area designations:
  - 1. Wet areas:
    - a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
    - b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
- K. Provide all necessary anchoring devices and supports rated for the equipment load based on dimensions and weights verified from approved submittals, or as recommended by the manufacturer.
- L. Provide non-metallic corrosion resistant spacers to maintain 1/4 IN separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas..
- M. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents and insects.
- N. Do not use materials that may cause the walls or roof of a building to discolor or rust.
- O. Identify electrical equipment and components:
  - 1. Trenches with direct-buried conduit, or direct-buried wire and cable.
    - a. Underground Warning Tape.
    - b. Letter height: 1-1/4 IN minimum.
    - c. Location:
      - 1) Where trench is 12 IN or more below finished grade: In trench 6 IN below finished grade.
      - 2) Where trench is less than 12 IN below finished grade: In trench 3 IN below finished grade.

- d. Electrical power (e.g., low voltage):
  - 1) Color: Red with black letters.
  - 2) Legend:
    - a) First line: "CAUTION CAUTION CAUTION".
    - b) Second line: "BURIED ELECTRIC LINE BELOW".
  
- P. Provide field markings and/or documentation of available short-circuit current (available fault current) and related information for equipment as required by the NFPA 70 and other applicable codes.
  
- Q. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
  - 1. Determine the SCCR rating by one of the following methods:
    - a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
    - b. Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
    - c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
  
  - 2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
  
  - 3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

### 3.2 FIELD QUALITY CONTROL

- A. Verify exact rough-in location and dimensions for connection to electrified equipment, provided by others.
  
- B. Replace equipment and systems found inoperative or defective and re-test.
  
- C. Cleaning:
  - 1. See Division 1 Specification.
  
- D. The protective coating integrity of support structures and equipment enclosures shall be maintained.
  - 1. Repair galvanized components utilizing a zinc rich paint.
  - 2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
  - 3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the component.
  - 4. Repair surfaces which will be inaccessible after installation prior to installation.

5. See Specification Section 26 05 33 for requirements for conduits and associated accessories.

E. Replace nameplates damaged during installation.

END OF SECTION

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## SECTION 26 05 19 - WIRE AND CABLE - 600 VOLT AND BELOW

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

###### 1. Material and installation requirements for:

- a. Building wire.
- b. Power cable.
- c. Control cable.
- d. Instrumentation cable.
- e. Wire connectors.
- f. Insulating tape.
- g. Pulling lubricant.

##### B. Related Specification Sections include but are not necessarily limited to:

1. Section 26 05 00 - Electrical - Basic Requirements.

#### 1.2 QUALITY ASSURANCE

##### A. Referenced Standards:

###### 1. Insulated Cable Engineers Association (ICEA):

- a. S-58-679, Standard for Control Cable Conductor Identification.

###### 2. National Electrical Manufacturers Association (NEMA):

- a. ICS 4, Industrial Control and Systems: Terminal Blocks.

###### 3. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):

- a. WC 57/S-73-532, Standard for Control Cables.
- b. WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

###### 4. National Fire Protection Association (NFPA):

- a. 70, National Electrical Code (NEC).
- b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

5. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
  - a. 568, Commercial Building Telecommunications Cabling Standard.
6. Underwriters Laboratories, Inc. (UL):
  - a. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
  - b. 83, Standard for Safety Thermoplastic-Insulated Wires and Cables.
  - c. 467, Standard for Safety Grounding and Bonding Equipment.
  - d. 486A, Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors.
  - e. 486C, Standard for Safety Splicing Wire Connections.
  - f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
  - g. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
  - h. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.
  - i. 2250, Standard for Safety Instrumentation Tray Cable.

### 1.3 DEFINITIONS

- A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
- B. Instrumentation Cable:
  1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
  2. The following are specific types of instrumentation cables:
    - a. Analog signal cable:
      - 1) Used for the transmission of low current (e.g., 4-20mA DC) or low voltage (e.g., 0-10 VDC) signals, using No. 16 AWG and smaller conductors.
      - 2) Commonly used types are defined in the following:
        - a) TSP: Twisted shielded pair.
        - b) TST: Twisted shielded triad.
    - b. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc.
- C. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 8 AWG and larger.
- D. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14, No. 12 or No. 10 AWG.

- E. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

#### 1.4 SUBMITTALS

##### A. Shop Drawings:

###### 1. Product technical data:

- a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
  - 1) Wire connectors.
  - 2) Insulating tape.
  - 3) Cable lubricant.
- b. See Specification Section 26 05 00 for additional requirements.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 26 05 00.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

###### 1. Building wire, power and control cable:

- a. Aetna Insulated Wire.
- b. Alphawire.
- c. Cerrowire.
- d. Encore Wire Corporation.
- e. General Cable.
- f. Okonite Company.
- g. Southwire Company.

###### 2. Instrumentation cable:

- a. Analog cable:
  - 1) Alphawire.
  - 2) Belden Inc.
  - 3) General Cable.

3. Wire connectors:
  - a. Burndy Corporation.
  - b. Buchanan.
  - c. Ideal.
  - d. IlSCO.
  - e. 3M Co.
  - f. Teledyne Penn Union.
  - g. Thomas and Betts.
  - h. Phoenix Contact.
  
4. Insulating and color coding tape:
  - a. 3M Co.
  - b. Plymouth Bishop Tapes.
  - c. Red Seal Electric Co.

## 2.2 MANUFACTURED UNITS

### A. Building Wire:

1. Conductor shall be copper with 600 V rated insulation.
2. Conductors shall be stranded, except for conductors used in lighting and receptacle circuits which may be stranded or solid.
3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 for type THHN/THWN and THHN/THWN-2 insulation.
5. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 for type XHHW-2 insulation.

### B. Power Cable:

1. Conductor shall be copper with 600 V rated insulation.
2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
3. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 and UL 1277 for type THHN/THWN insulation with an overall PVC jacket.
4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and UL 1277 for type XHHW-2 insulation with an overall PVC jacket.
5. Number of conductors as required, including a bare ground conductor.
6. Individual conductor color coding:
  - a. ICEA S-58-679, Method 4.
  - b. See PART 3 of this Specification Section for additional requirements.
  
7. Conform to NFPA 70 Type TC.

C. Control Cable:

1. Conductor shall be copper with 600 V rated insulation.
2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
3. Conform to NEMA/ICEA WC 57/S-73-532 and UL 83 and UL 1277 for type THHN/THWN insulation with an overall PVC jacket.
4. Conform to NEMA/ICEA WC 57/S-73-532 and UL 44 and UL 1277 for type XHHW-2 insulation with an overall PVC jacket.
5. Number of conductors as required, provided with or without bare ground conductor of the same AWG size.
  - a. When a bare ground conductor is not provided, an additional insulated conductor shall be provided and used as the ground conductor (e.g., 6/c No. 14 w/g and 7/c No. 14 are equal).
6. Individual conductor color coding:
  - a. ICEA S-58-679, Method 1, Table E-2.
  - b. See PART 3 of this Specification Section for additional requirements.
7. Conform to NFPA 70 Type TC.

D. Electrical Equipment Control Wire:

1. Conductor shall be copper with 600 V rated insulation.
2. Conductors shall be stranded.
3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
4. Conform to UL 44 for Type SIS insulation.
5. Conform to UL 83 for Type MTW insulation.

E. Instrumentation Cable:

1. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
2. Analog cable:
  - a. Tinned copper conductors.
  - b. 300 V or 600 V PVC insulation with PVC jacket.
  - c. Twisted with 100% foil shield coverage with drain wire.
  - d. Six (6) twists per foot minimum.
  - e. Individual conductor color coding: ICEA S-58-679, Method 1, Table E-2.
  - f. Conform to UL 2250, UL 1581 and NFPA 70 Type ITC.

F. Wire Connectors:

1. Twist/screw on type:
  - a. Insulated pressure or spring type solderless connector.
  - b. 600 V rated.

- c. Ground conductors: Conform to UL 486C and/or UL 467 when required by local codes.
    - d. Phase and neutral conductors: Conform to UL 486C.
  - 2. Compression and mechanical screw type:
    - a. 600 V rated.
    - b. Ground conductors: Conform to UL 467.
    - c. Phase and neutral conductors: Conform to UL 486A.
  - 3. Terminal block type:
    - a. High density, screw-post barrier-type with white center marker strip.
    - b. 600 V and ampere rating as required, for power circuits.
    - c. 600 V, 20 ampere rated for control circuits.
    - d. 300 V, 15 ampere rated for instrumentation circuits.
    - e. Conform to NEMA ICS 4 and UL 486A.
- G. Insulating and Color Coding Tape:
- 1. Pressure sensitive vinyl.
  - 2. Premium grade.
  - 3. Heat, cold, moisture, and sunlight resistant.
  - 4. Thickness, depending on use conditions: 7, 8.5, or 10 MIL.
  - 5. For cold weather or outdoor location, tape must also be all-weather.
  - 6. Color:
    - a. Insulating tape: Black.
    - b. Color coding tape: Fade-resistant color as specified herein.
  - 7. Comply with UL 510.
- H. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. Permitted Usage of Insulation Types:

- 1. Type XHHW-2:
  - a. Building wire and power and control cable in architectural and non-architectural finished areas.
  - b. Building wire and power and control cable in conduit in outdoor areas and below grade.
  - c. Building wire and power and control cable in cable tray in outdoor areas.

2. Type THHN/THWN and THHN/THWN-2:
  - a. Building wire and power and control cable No. 8 AWG and smaller in architectural and non-architectural finished areas.
3. Type SIS and MTW:
  - a. For the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers.

B. Conductor Size Limitations:

1. Feeder and branch power conductors shall not be smaller than No. 12 AWG unless otherwise indicated on the Drawings.
2. Control conductors shall not be smaller than No. 14 AWG unless otherwise indicated on the Drawings.
3. Instrumentation conductors shall not be smaller than No. 18 AWG unless otherwise indicated on the Drawings.

C. Color Code All Wiring as Follows:

1. Building wire:

	240 V, 208 V, 240/120 V, 208/120 V	480 V, 480/277 V
Phase 1	Black	Brown
Phase 2	Red *	Orange
Phase 3	Blue	Yellow
Neutral	White	White or Gray
Ground	Green	Green

\* Orange when it is a high leg of a 120/240 V Delta system.

- a. Conductors No. 6 AWG and smaller: Insulated phase, neutral and ground conductors shall be identified by a continuous colored outer finish along its entire length.
- b. Conductors larger than No. 6 AWG:
  - 1) Insulated phase and neutral conductors shall be identified by one of the following methods:
    - a) Continuous colored outer finish along its entire length.
    - b) 3 IN of colored tape applied at the termination.
  - 2) Insulated grounding conductor shall be identified by one of the following methods:
    - a) Continuous green outer finish along its entire length.
    - b) Stripping the insulation from the entire exposed length.
    - c) Using green tape to cover the entire exposed length.

- 3) The color coding shall be applied at all accessible locations, including but not limited to: Junction and pull boxes, wireways, manholes and handholes.
  2. Power cables ICEA S-58-679, Method 4 with:
    - a. Phase and neutral conductors identified with 3 IN of colored tape, per the Table herein, applied at the terminations.
    - b. Ground conductor: Bare.
  3. Control cables ICEA S-58-679, Method 1, Table E-2:
    - a. When a bare ground is not provided, one of the colored insulated conductors shall be re-identified by stripping the insulation from the entire exposed length or using green tape to cover the entire exposed length.
    - b. When used in power applications the colored insulated conductors used as phase and neutral conductors may have to be re-identified with 3 IN of colored tape, per the Table herein, applied at the terminations.
- D. Install all wiring in raceway unless otherwise indicated on the Drawings.
- E. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable tray, junction or pull box, except as permitted in the following:
  1. Where specifically indicated on the Drawings.
  2. Where field conditions dictate and written permission is obtained from the Engineer.
  3. Control circuits shall be isolated from feeder and branch power and instrumentation circuits but combining of control circuits is permitted.
    - a. The combinations shall comply with the following:
      - 1) 12 VDC, 24 VDC and 48 VDC may be combined.
      - 2) 125 VDC shall be isolated from all other AC and DC circuits.
      - 3) AC control circuits shall be isolated from all DC circuits.
  4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.
    - a. The combinations shall comply with the following:
      - 1) Analog signal circuits may be combined.
    - b. Do not combine control device circuits with power circuits.
    - c. Contractor is responsible for making the required adjustments in conductor and raceway size, in accordance with all requirements of the NFPA 70, including but not limited to:
      - 1) Up sizing conductor size for required ampacity de-ratings for the number of current carrying conductors in the raceway.
      - 2) The neutral conductors may not be shared.

- 3) Up sizing raceway size for the size and quantity of conductors.
- F. Ground the drain wire of shielded instrumentation cables at one end only.
1. The preferred grounding location is at the load (e.g., control panel), not at the source (e.g., field mounted instrument).
- G. Splices and terminations for the following circuit types shall be made in the indicated enclosure type using the indicated method.
1. Feeder and branch power circuits:
    - a. Device outlet boxes:
      - 1) Twist/screw on type connectors.
    - b. Junction and pull boxes and wireways:
      - 1) Twist/screw on type connectors for use on No. 8 and smaller wire.
      - 2) Compression, mechanical screw or terminal block or terminal strip type connectors for use on No. 6 AWG and larger wire.
    - c. Motor terminal boxes:
      - 1) Twist/screw on type connectors for use on No. 10 AWG and smaller wire.
      - 2) Insulated mechanical screw type connectors for use on No. 8 AWG and larger wire.
    - d. Manholes or handholes:
      - 1) Twist/screw on type connectors pre-filled with epoxy for use on No. 8 AWG and smaller wire.
      - 2) Watertight compression or mechanical screw type connectors for use on No. 6 AWG and larger wire.
  2. Control circuits:
    - a. Junction and pull boxes: Terminal block type connector.
    - b. Manholes or handholes: Twist/screw on type connectors pre-filled with epoxy.
    - c. Control panels and motor control centers: Terminal block or strips provided within the equipment or field installed within the equipment by the Contractor.
  3. Instrumentation circuits can be spliced where field conditions dictate and written permission is obtained from the Engineer.
    - a. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
    - b. Junction and pull boxes: Terminal block type connector.

- c. Control panels and motor control centers: Terminal block or strip provided within the equipment or field installed within the equipment by the Contractor.
- 4. Non-insulated compression and mechanical screw type connectors shall be insulated with tape or hot or cold shrink type insulation to the insulation level of the conductors.

H. Insulating Tape Usage:

- 1. For insulating connections of No. 8 AWG wire and smaller: 7 MIL vinyl tape.
- 2. For insulating splices and taps of No. 6 AWG wire or larger: 10 MIL vinyl tape.
- 3. For insulating connections made in cold weather or in outdoor locations: 8.5 MIL, all weather vinyl tape.

I. Color Coding Tape Usage: For color coding of conductors.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing: Cable - Low Voltage:

- 1. Perform inspections and tests per NETA ATS 7.3.2.

END OF SECTION

## SECTION 26 05 26 - GROUNDING AND BONDING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Material and installation requirements for grounding and bonding system(s).

##### B. Related Specification Sections include but are not necessarily limited to:

1. Section 26 05 00 - Electrical - Basic Requirements.
2. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
3. Section 26 05 33 - Raceways and Boxes.

#### 1.2 QUALITY ASSURANCE

##### A. Referenced Standards:

1. ASTM International (ASTM):
  - a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - a. 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.
3. National Fire Protection Association (NFPA):
  - a. 70, National Electrical Code (NEC).
4. Underwriters Laboratories, Inc. (UL):
  - a. 467, Grounding and Bonding Equipment.

##### B. Assure ground continuity is continuous throughout the entire Project.

### 1.3 SUBMITTALS

#### A. Shop Drawings:

1. Product technical data.
  - a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
    - 1) Grounding clamps, terminals and connectors.
    - 2) Exothermic welding system.
  - b. See Specification Section 26 05 00 for additional requirements.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

#### A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Ground rods and bars and grounding clamps, connectors and terminals:
  - a. ERICO by Pentair.
  - b. Harger Lightning & Grounding.
  - c. Heary Bros. Lightning Protection Co. Inc.
  - d. Burndy by Hubbell.
  - e. Robbins Lightning, Inc.
  - f. Blackburn by Thomas & Betts.
  - g. Thompson Lightning Protection, Inc.
2. Exothermic weld connections:
  - a. ERICO by Pentair - Cadweld.
  - b. Harger Lightning & Grounding - Ultraweld.
  - c. Burndy by Hubbell - Thermoweld.
  - d. FurseWELD by Thomas & Betts.

### 2.2 COMPONENTS

#### A. Wire and Cable:

1. Bare conductors: Soft drawn stranded copper meeting ASTM B8.
2. Insulated conductors: Color coded green, per Specification Section 26 05 19.

#### B. Conduit: As specified in Specification Section 26 05 33.

C. Ground Bars:

1. Solid copper:
  - a. 1/4 IN thick.
  - b. 2 or 4 IN wide.
  - c. 24 IN long minimum in main service entrance electrical rooms, 12 IN long elsewhere.
2. Predrilled grounding lug mounting holes.
3. Stainless steel or galvanized steel mounting brackets.
4. Insulated standoffs.

D. Ground Rods:

1. 3/4 IN x 10 FT.
2. Copper-clad:
  - a. 10 MIL minimum uniform coating of electrolytic copper molecularly bonded to a rigid steel core.
  - b. Corrosion resistant bond between the copper and steel.
  - c. Hard drawn for a scar-resistant surface.

E. Grounding Clamps, Connectors and Terminals:

1. Mechanical type:
  - a. Standards: UL 467.
  - b. High copper alloy content.
2. Compression type for interior locations:
  - a. Standards: UL 467.
  - b. High copper alloy content.
  - c. Non-reversible.
  - d. Terminals for connection to bus bars shall have two bolt holes.
3. Compression type suitable for direct burial in earth or concrete:
  - a. Standards: UL 467, IEEE 837.
  - b. High copper alloy content.
  - c. Non-reversible.
  - d. Factory filled with oxide inhibiting compound.

F. Exothermic Weld Connections:

1. Copper oxide reduction by aluminum process.
2. Molds properly sized for each application.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. General:

1. Install products in accordance with manufacturer's instructions.
2. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250, except where larger sizes are indicated on the Drawings.
3. Remove paint, rust, or other non-conducting material from contact surfaces before making ground connections. After connection, apply manufacturer's approved touch-up paint to protect metallic surface from corrosion.
4. Where ground conductors pass through floor slabs or building walls provide nonmetallic sleeves and install sleeves per manufacturer recommendations.
  - a. Seal the sleeve interior to stop water penetration.
5. Do not splice grounding electrode conductors except at ground rods.
6. Install ground rods and grounding electrode conductors in undisturbed, firm soil.
  - a. Provide excavation required for installation of ground rods and conductors.
  - b. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
  - c. Unless otherwise specified, connect conductors to ground rods with compression type connectors or exothermic weld.
  - d. Provide sufficient slack in conductor to prevent conductor breakage during backfill or due to ground movement.
  - e. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.
7. Do not use exothermic welding if it will damage the structure the grounding conductor is being welded to.

#### B. Grounding Electrode System:

1. Provide a grounding electrode system in accordance with NFPA 70, Article 250 and as indicated on the Drawings.
2. Grounding electrode conductor terminations:
  - a. Ground bars in electrical equipment: Use compression type conductor terminal and bolt it to the ground bar or manufacturer's provided mechanical type termination device.
  - b. Ground rod: Compression type or exothermic weld, unless otherwise specified.

C. Supplemental Grounding Electrode:

1. Provide the following grounding in addition to the equipment ground conductor supplied with the feeder conductors whether or not shown on the Drawings.
  - a. See Grounding Electrode System paragraph for conductor termination requirements.
  - b. Grounding conductor: Bare #6 AWG minimum.
2. Equipment support rack and pedestals mounted outdoors:
  - a. Connect metallic structure to a ground rod.
  - b. Grounding conductor: #6 AWG minimum.

D. Raceway Bonding/Grounding:

1. Install all metallic raceway so that it is electrically continuous.
2. Provide an equipment grounding conductor in all raceways with insulation identical to the phase conductors, unless otherwise indicated on the Drawings.
3. NFPA 70 required grounding bushings shall be of the insulating type.
4. Provide double locknuts at all panels.
5. Bond all conduits, at entrance and exit of equipment, to the equipment ground bus or lug.
6. Provide bonding jumpers if conduits are installed in concentric knockouts.
7. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.

E. Equipment Grounding:

1. Ground all utilization equipment with an equipment grounding conductor.

3.2 FIELD QUALITY CONTROL

- A. Leave grounding system uncovered until observed by Owner.

END OF SECTION

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## SECTION 26 05 33 - RACEWAYS AND BOXES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Material and installation requirements for:
  - a. Conduits.
  - b. Conduit fittings.
  - c. Conduit supports.
  - d. Wireways.
  - e. Outlet boxes.
  - f. Pull and junction boxes.

##### B. Related Specification Sections include but are not necessarily limited to:

1. Section 26 05 00 - Electrical - Basic Requirements.
2. Section 26 05 43 - Electrical - Exterior Underground.

#### 1.2 QUALITY ASSURANCE

##### A. Referenced Standards:

1. Aluminum Association (AA).
2. American Iron and Steel Institute (AISI).
3. ASTM International (ASTM):
  - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - c. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
4. National Electrical Manufacturers Association (NEMA):
  - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - b. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  - c. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
  - d. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
  - e. TC 14.AG, Aboveground Reinforced Thermosetting Resin Conduit and Fittings.

- f. TC 14.BG, Belowground Reinforced Thermosetting Resin Conduit and Fittings.
5. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
    - a. C80.1, Electric Rigid Steel Conduit (ERSC).
    - b. C80.3, Steel Electrical Metallic Tubing (EMT).
    - c. C80.5, Electrical Aluminum Rigid Conduit (ERAC).
    - d. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
  6. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  7. Underwriters Laboratories, Inc. (UL):
    - a. 1, Standard for Flexible Metal Conduit.
    - b. 6, Electrical Rigid Metal Conduit - Steel.
    - c. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
    - d. 360, Standard for Liquid-Tight Flexible Metal Conduit.
    - e. 467, Grounding and Bonding Equipment.
    - f. 514A, Metallic Outlet Boxes.
    - g. 514B, Conduit, Tubing, and Cable Fittings.
    - h. 651, Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
    - i. 797, Electrical Metallic Tubing - Steel.
    - j. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
    - k. 1203, Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.
    - l. 2420, Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
    - m. 2515, Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

### 1.3 SUBMITTALS

#### A. Shop Drawings:

1. Product technical data:
  - a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
    - 1) Conduit fittings.
    - 2) Support systems.
  - b. See Specification Section 26 05 00 for additional requirements.

2. Fabrication and/or Layout Drawings:
  - a. Identify dimensional size of pull and junction boxes to be used.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 26 05 00.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Rigid metal conduits and electrical metallic tubing:
    - a. Allied Tube and Conduit.
    - b. Western Tube and Conduit Corporation.
    - c. Wheatland Tube.
    - d. Patriot Aluminum Products, LLC.
  2. PVC coated rigid metal conduits:
    - a. Ocal by Thomas & Betts.
    - b. Robroy Industries.
  3. Rigid nonmetallic conduit:
    - a. Prime Conduit.
    - b. Cantex, Inc.
    - c. Osburn Associates, Inc.
    - d. Champion Fiberglass, Inc.
    - e. United Fiberglass of America, Inc.
  4. Wireway:
    - a. Hoffman Engineering.
    - b. Wiegmann by Hubbell.
    - c. Square D by Schneider Electric.
  5. Conduit fittings and accessories:
    - a. Appleton by Emerson Electric Co.
    - b. Carlon by Thomas & Betts.
    - c. Cantex, Inc.
    - d. Crouse-Hinds by Eaton.
    - e. Killark by Hubbell.
    - f. Osburn Associates, Inc.

- g. O-Z/Gedney by Emerson Electric Co.
  - h. Raco by Hubbell.
  - i. Steel City by Thomas & Betts.
  - j. Thomas & Betts.
6. Support systems:
- a. Unistrut by Atkore International, Inc.
  - b. B-Line by Eaton.
  - c. Kindorf by Thomas & Betts.
  - d. Minerallac Company.
  - e. CADDY by Pentair.
  - f. Superstrut by Thomas & Betts.
7. Outlet, pull and junction boxes:
- a. Appleton by Emerson Electric Co.
  - b. Crouse-Hinds by Eaton.
  - c. Killark by Hubbell.
  - d. O-Z/Gedney by Emerson Electric Co.
  - e. Steel City by Thomas & Betts.
  - f. Raco by Hubbell.
  - g. Bell by Hubbell.
  - h. Hoffman Engineering.
  - i. Wiegmann by Hubbell.
  - j. B-Line by Eaton.
  - k. Adalet.
  - l. RITTAL North America LLC.
  - m. Stahlin by Robroy Enclosures.

## 2.2 RIGID METAL CONDUITS

### A. Rigid Galvanized Steel Conduit (RGS):

- 1. Mild steel with continuous welded seam.
- 2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
- 3. Threads galvanized after cutting.
- 4. Internal coating: Baked lacquer, varnish or enamel for a smooth surface.
- 5. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6.

### B. PVC-Coated Rigid Steel Conduit (PVC-RGS):

- 1. Nominal 40 MIL Polyvinyl Chloride Exterior Coating:
  - a. Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to NEMA/ANSI C80.1.
  - b. The bond between the PVC coating and the conduit surface: Greater than the tensile strength of the coating.
- 2. Nominal 2 mil, minimum, urethane interior coating.

3. Urethane coating on threads.
4. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
5. Female Ends:
  - a. Have a plastic sleeve extending a minimum of one pipe diameter or 2 IN, whichever is less beyond the opening.
  - b. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used with it.
6. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6, NEMA RN 1.

## 2.3 RIGID NONMETALLIC CONDUIT

### A. Schedules 40 (PVC-40) and 80 (PVC-80):

1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve weatherability and heat distribution.
2. Rated for direct sunlight exposure.
3. Fire retardant and low smoke emission.
4. Shall be suitable for use with 90 DEGC wire and shall be marked "maximum 90 DEGC".
5. Standards: NFPA 70 Type PVC, NEMA TC 2, UL 651.

## 2.4 WIREWAY

### A. General:

1. Suitable for lay-in conductors.
2. Designed for continuous grounding.
3. Covers:
  - a. Hinged or removable in accessible areas.
  - b. Non-removable when passing through partitions.
4. Finish: Rust inhibiting primer and manufacturer's standard paint inside and out except for stainless steel type.
5. Standards: UL 870, NEMA 250.

### B. Raintight (NEMA 3R) Wiring Trough:

1. 14 or 16 GA galvanized steel without knockouts.
2. Cover: Non-gasketed and held in place by captive screws.

## 2.5 CONDUIT FITTINGS AND ACCESSORIES

### A. Fittings for Use with RGS:

1. General:
  - a. Finish: Electrostatically applied epoxy powder coat.
2. Locknuts:
  - a. Threaded steel or malleable iron.
  - b. Gasketed or non-gasketed.
  - c. Grounding or non-grounding type.
3. Bushings:
  - a. Threaded, insulated metallic.
  - b. Grounding or non-grounding type.
4. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
5. Couplings:
  - a. Threaded straight type: Same material and finish as the conduit with which they are used on.
  - b. Threadless type: Gland compression or self-threading type, concrete tight.
6. Unions: Threaded galvanized steel or zinc plated malleable iron.
7. Conduit bodies (ells and tees):
  - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
  - b. Standard and mogul size.
  - c. Cover:
    - 1) Clip-on type with stainless steel screws.
    - 2) Gasketed or non-gasketed galvanized steel, zinc plated cast iron or cast copper free aluminum.
8. Conduit bodies (round):
  - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
  - b. Cover: Threaded screw on type, gasketed, galvanized steel, zinc plated cast iron or cast copper free aluminum.
9. Expansion couplings:
  - a. 2 IN nominal straight-line conduit movement in either direction.
  - b. Galvanized steel with insulated bushing.
  - c. Gasketed for wet locations.
  - d. Internally or externally grounded.

10. Expansion/deflection couplings:
  - a. 3/4 IN nominal straight-line conduit movement in either direction.
  - b. 30 DEG nominal deflection from the normal in all directions.
  - c. Metallic hubs, neoprene outer jacket and stainless steel jacket clamps.
  - d. Internally or externally grounded.
  - e. Watertight, raintight and concrete tight.

11. Standards: UL 467, UL 514B, UL 1203.

B. Fittings for Use with PVC-RGS:

1. The same material and construction as those fittings listed under paragraph "Fittings for Use with RGS" and coated as defined under paragraph "PVC Coated Rigid Steel Conduit (PVC-RGS)."

C. Fittings for Use with Rigid Nonmetallic PVC Conduit:

1. Coupling, adapters and conduit bodies:
  - a. Same material, thickness, and construction as the conduits with which they are used.
  - b. Homogeneous plastic free from visible cracks, holes or foreign inclusions.
  - c. Bore smooth and free of blisters, nicks or other imperfections which could damage the conductor.
2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
3. Standards: ASTM D2564, NEMA TC 3, UL 651, UL 514B.

D. Weather and Corrosion Protection Tape:

1. PVC based tape, 10 MILS thick.
2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.
3. Used with appropriate pipe primer.

## 2.6 ALL RACEWAY AND FITTINGS

A. Mark Products:

1. Identify the nominal trade size on the product.
2. Stamp with the name or trademark of the manufacturer.

## 2.7 OUTLET BOXES

A. Metallic Outlet Boxes:

1. Hot-dip galvanized steel.
2. Conduit knockouts and grounding pigtail.

3. Styles:
  - a. 2 IN x 3 IN rectangle.
  - b. 4 IN square.
  - c. 4 IN octagon.
  - d. Masonry/tile.
4. Accessories:
  - a. Flat blank cover plates.
  - b. Barriers.
  - c. Extension, plaster or tile rings.
  - d. Box supporting brackets in stud walls.
  - e. Adjustable bar hangers.
5. Standards: NEMA/ANSI OS 1, UL 514A.

B. Cast Outlet Boxes:

1. Zinc plated cast iron or die-cast copper free aluminum with manufacturer's standard finish.
2. Threaded hubs and grounding screw.
3. Styles:
  - a. "FS" or "FD".
  - b. "Bell".
  - c. Single or multiple gang and tandem.
4. Accessories: 40 MIL PVC exterior coating and 2 MIL urethane interior coating.
5. Standards: UL 514A, UL 1203.

## 2.8 PULL AND JUNCTION BOXES

A. NEMA 4 Rated:

1. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
2. Seams continuously welded and ground smooth.
3. No knockouts.
4. External mounting flanges.
5. Hinged or non-hinged cover held closed with stainless steel screws and clamps.
6. Cover with oil resistant gasket.

B. Miscellaneous Accessories:

1. Rigid handles for covers larger than 9 SQFT or heavier than 25 LBS.
2. Split covers when heavier than 25 LBS.
3. Weldnuts for mounting optional panels and terminal kits.
4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.

- C. Standards: NEMA 250, UL 50.

## 2.9 SUPPORT SYSTEMS

- A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:

- 1. Material requirements.
  - a. Galvanized steel: ASTM A123/A123M or ASTM A153/A153M.

- B. Single Conduit and Outlet Box Support Fasteners:

- 1. Material requirements:
  - a. Zinc plated steel.

## PART 3 - EXECUTION

### 3.1 RACEWAY INSTALLATION - GENERAL

- A. Shall be in accordance with the requirements of:

- 1. NFPA 70.
- 2. Manufacturer instructions.

- B. Size of Raceways:

- 1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.
- 2. Unless specifically indicated otherwise, the minimum raceway size shall be:
  - a. Conduit: 3/4 IN.
  - b. Wireway: 2-1/2 IN x 2-1/2 IN.

- C. Field Bending and Cutting of Conduits:

- 1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.
- 2. Do not reduce the internal diameter of the conduit when making conduit bends.
- 3. Prepare tools and equipment to prevent damage to the PVC coating.
- 4. Degrease threads after threading and apply a zinc rich paint.
- 5. Debur interior and exterior after cutting.

- D. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.

- E. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.
  - 1. Repair galvanized components utilizing a zinc rich paint.
  - 2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
  - 3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the conduit; or a self-adhesive, highly conformable, cross-linked silicone composition strip, followed by a protective coating of vinyl tape.
    - a. Total nominal thickness: 40 MIL.
  - 4. Repair surfaces which will be inaccessible after installation prior to installation.
- F. Remove moisture and debris from conduit before wire is pulled into place.
  - 1. Pull mandrel with diameter nominally 1/4 IN smaller than the interior of the conduit, to remove obstructions.
  - 2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
  - 3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.
- G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.
- H. Where portions of a raceway are subject to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.

### 3.2 RACEWAY ROUTING

- A. Raceways shall be routed in the field unless otherwise indicated.
  - 1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
  - 2. Run in straight lines parallel to or at right angles to building lines.
  - 3. Do not route conduits:
    - a. Through areas of high ambient temperature or radiant heat.
    - b. In suspended concrete slabs.
    - c. In concrete members including slabs, slabs on grade, beams, walls, and columns unless specifically located and detailed on structural Drawings.
  - 4. Locate sleeves or conduits penetrating floors, walls, and beams so as not to significantly impair the strength of the construction. Do not place conduit penetrations in columns.
  - 5. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.

6. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 DEG of bends in the conduit run or in long straight runs to limit pulling tensions.
- B. All conduits within a structure shall be installed exposed except as follows:
    1. As indicated on the Drawings.
    2. Concealed above gypsum wall board or acoustical tile suspended ceilings.
    3. Conduits in architecturally finished areas shall be concealed.
  - C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 FT:
    1. Between instrumentation and telecommunication: 1 IN.
    2. Between instrumentation and 125 V, 48 V and 24 VDC: 2 IN.
    3. Between instrumentation and 600 V and less AC power or control: 6 IN.
    4. Between instrumentation and greater than 600 VAC power: 12 IN.
    5. Between telecommunication and 125 V, 48 V and 24 VDC: 2 IN.
    6. Between telecommunication and 600 V and less AC power or control: 6 IN.
    7. Between telecommunication and greater than 600 VAC power: 12 IN.
    8. Between 125 V, 48 V and 24 VDC and 600 V and less AC power or control: 2 IN.
    9. Between 125 V, 48 V and 24 VDC and greater than 600 VAC power: 2 IN.
    10. Between 600 V and less AC and greater than 600 VAC: 2 IN.
  - D. Conduits shall be installed to eliminate moisture pockets.
    1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.
  - E. Conduit shall not be routed on the exterior of structures except as specifically indicated on the Drawings.
  - F. Where sufficient room exists within the housing of roof-mounted equipment, the conduit shall be stubbed up inside the housing.

### 3.3 RACEWAY APPLICATIONS

- A. Permitted Raceway Types Per Wire or Cable Types:
  1. Power wire or cables: All raceway types.
  2. Control wire or cables: All raceway types.
  3. Instrumentation cables: Metallic raceway except nonmetallic may be used underground.
- B. Permitted Raceway Types Per Area Designations:
  1. Wet areas:
    - a. RGS.

- C. Permitted Raceway Types Per Routing Locations:
  - 1. Direct buried conduits and ductbanks:
    - a. PVC-80.
    - b. Long sweeping bends greater than 15 DEG:
      - 1) PVC-RGS.
- D. NEMA 3R Wiring Trough:
  - 1. Surface mounted in exterior locations.
- E. Underground Conduit: See Specification Section 26 05 43.

### 3.4 CONDUIT FITTINGS AND ACCESSORIES

- A. Rigid nonmetallic conduit and fittings shall be joined utilizing solvent cement.
  - 1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.
- B. Install Expansion Fittings:
  - 1. Where conduits are exposed to the sun and conduit run is greater than 200 FT.
  - 2. Elsewhere as identified on the Drawings.
- C. Threaded connections shall be made wrench-tight.
- D. Conduit joints shall be watertight:
  - 1. Where subjected to possible submersion.
  - 2. In areas classified as wet.
  - 3. Underground.
- E. Terminate Conduits:
  - 1. In metallic outlet boxes:
    - a. RGS:
      - 1) Conduit hub and locknut.
      - 2) Insulated bushing and two locknuts.
      - 3) Use grounding type locknut or bushing when required by NFPA 70.
  - 2. In NEMA 4 and NEMA 4X rated enclosures:
    - a. Watertight, insulated and gasketed hub and locknut.

- F. Threadless couplings shall only be used to join new conduit to existing conduit when the existing conduit end is not threaded and it is not practical or possible to cut threads on the existing conduit with a pipe threader.

### 3.5 CONDUIT SUPPORT

- A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit types:
  - 1. Wet areas:
    - a. Galvanized system consisting of: Galvanized steel channels and fittings, nuts and hardware and conduit clamps.
    - b. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with stainless steel nuts and hardware.
  - 2. Conduit type shall be compatible with the support system material.
    - a. Galvanized steel system may be used with RGS .
- B. Permitted single conduit support fasteners per area designations and conduit types:
  - 1. Wet areas:
    - a. Material: Zinc plated steel, stainless steel and malleable iron.
    - b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
  - 2. Conduit type shall be compatible with the support fastener material.
    - a. Zinc plated steel, steel protected with zinc phosphate and oil finish and malleable iron fasteners may be used with RGS.
- C. Conduit Support General Requirements:
  - 1. Maximum spacing between conduit supports per NFPA 70.

### 3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION

- A. General:
  - 1. Install products in accordance with manufacturer's instructions.
  - 2. See Specification Section 26 05 00 and the Drawings for area classifications.
  - 3. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.
  - 4. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits connected to the box.

B. Outlet Boxes:

1. Permitted uses of cast outlet boxes:
  - a. Housing of wiring devices surface mounted in wet areas.
  - b. Pull and junction box surface mounted in wet areas.
2. Mount device outlet boxes where indicated on the Drawings and at heights as scheduled in Specification Section 26 05 00.
3. Set device outlet boxes plumb and vertical.
4. When an outlet box is connected to a PVC coated conduit, the box shall also be PVC coated.

C. Pull and Junction Boxes:

1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.
  - a. Make covers of boxes accessible.
2. Permitted uses of NEMA 4 enclosure:
  - a. Pull or junction box surface mounted in areas designated as wet.

END OF SECTION

## SECTION 26 05 43 - ELECTRICAL - EXTERIOR UNDERGROUND

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Material and installation requirements for:
  - a. Handhole.
  - b. Underground conduits.

##### B. Related Specification Sections include but are not necessarily limited to:

1. Section 26 05 26 - Grounding.
2. Section 26 05 33 - Raceways and Boxes.
3. Section 31 23 33 - Trenching, Backfilling and Compacting for Utilities.

#### 1.2 QUALITY ASSURANCE

##### A. Referenced Standards:

1. American Association of State Highway and Transportation Officials (AASHTO):
  - a. HB-17, Standard Specifications for Highway Bridges.
2. ASTM International (ASTM):
  - a. A536, Standard Specification for Ductile Iron Castings.
3. National Fire Protection Association (NFPA):
  - a. 70, National Electrical Code (NEC).
4. Society of Cable Telecommunications Engineers (SCTE):
  - a. 77, Specifications for Underground Enclosure Integrity.

#### 1.3 DEFINITIONS

##### A. Direct-Buried Conduit(s):

1. Individual (single) underground conduit.
2. Multiple underground conduits, arranged in one or more planes, in a common trench.

#### 1.4 SUBMITTALS

##### A. Shop Drawings:

1. Product technical data:
  - a. Provide submittal data for all products specified in PART 2 of this Specification Section.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

##### A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Prefabricated composite handholes:
  - a. Armorcast Products Company.
  - b. Quazite by Hubbell.
  - c. Synertech by Oldcastle Enclosure Solutions.

#### 2.2 HANDHOLES

##### A. Prefabricated Composite Material Handholes:

1. Handhole body and cover: Fiberglass reinforced polymer concrete conforming to all test provisions of SCTE 77.
2. Minimum load ratings: SCTE 77 Tier 5.
3. Open bottom.
4. Stackable design as required for specified depth.
5. Cover:
  - a. Engraved legend of "ELECTRIC" or "COMMUNICATIONS".
  - b. Non-gasketed bolt down with stainless steel Penta head bolts.
  - c. Lay-in non-bolt down, when cover is over 100 LBS.
  - d. One or multiple sections so the maximum weight of a section is 125 LBS.
6. Cover lifting hook: 24 IN minimum in length.

#### 2.3 UNDERGROUND CONDUIT AND ACCESSORIES

##### A. Conduit: See Specification Section 26 05 33.

##### B. Duct Spacers/Supports:

1. High density polyethylene or high impact polystyrene.
2. Interlocking web or mesh design.

3. Provide 3 IN minimum spacing between conduits.
4. Accessories, as required:
  - a. Hold down bars.
  - b. Ductbank strapping.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Drawings indicate the intended location of handholes and routing of direct buried conduit.
  1. Field conditions may affect actual routing.
- B. Handhole Locations:
  1. Approximately where shown on the Drawings.
  2. As required for pulling distances.
  3. As required to keep pulling tensions under allowable cable tensions.
  4. As required for number of bends in ductbank routing.
  5. Shall not be installed in a swale or ditch.
  6. Determine the exact locations after careful consideration has been given to the location of other utilities, grading, and paving.
  7. Locations are to be approved by the Contracting Officer or delegated authority prior to excavation and placement or construction of manholes and handholes.
- C. Install products in accordance with manufacturer's instructions.
- D. Install handholes in conduit runs where indicated or as required to facilitate pulling of wires or making connections.
- E. Comply with Specification Section 31 23 33 for trenching, backfilling and compacting.

### 3.2 HANDHOLES

- A. Prefabricated Composite Material Handholes:
  1. For use in areas subjected to occasional non-deliberate vehicular traffic.
  2. Place handhole on a foundation of compacted 1/4 to 1/2 IN crushed rock or gravel a minimum of 8 IN thick and 6 IN larger than handholes footprint on all sides.
  3. Provide concrete encasement ring around handhole per manufacturers installation instructions (minimum of 10 IN wide x 12 IN deep).
  4. Install so that the surrounding grade is 1 IN lower than the top of the handhole.
  5. Size: As indicated on the Drawings or as required for the number and size of conduits.
  6. Provide cable rails and pulling eyes as needed.

### 3.3 UNDERGROUND CONDUITS

#### A. General Installation Requirements:

1. Direct-buried conduit(s):
  - a. As indicated in the Drawings.
2. Do not place concrete or soil until conduits have been observed by the Contracting Officer or delegated authority.
3. Ductbanks shall be sloped a minimum of 4 IN per 100 FT or as detailed on the Drawings.
  - a. Low points shall be at handholes.
4. During construction and after conduit installation is complete, plug the ends of all conduits.
5. Provide conduit supports and spacers.
  - a. Place supports and spacers for rigid nonmetallic conduit on maximum centers as indicated for the following trade sizes:
    - 1) 1 IN and less: 3 FT.
    - 2) 1-1/4 to 3 IN: 5 FT.
    - 3) 3-1/2 to 6 IN: 7 FT.
  - b. Place supports and spacers for rigid steel conduit on maximum centers as indicated for the following trade sizes:
    - 1) 1 IN and less: 10 FT.
    - 2) 1-1/4 to 2-1/2 IN: 14 FT.
    - 3) 3 IN and larger: 20 FT.
  - c. Securely anchor conduits to supports and spacers to prevent movement during placement of concrete or soil.
6. Stagger conduit joints at intervals of 6 IN vertically.
7. Make conduit joints watertight and in accordance with manufacturer's recommendations.
8. Accomplish underground changes in direction of runs exceeding a total of 15 DEG by long sweep bends having a minimum radius of 10 FT.
  - a. Sweep bends may be made up of one or more curved or straight sections or combinations thereof.
9. Furnish manufactured elbows at end of runs as the conduit transitions to above grade.
  - a. Minimum radius of 18 IN for conduits less than 3 IN trade size and 36 IN for conduits 3 IN trade size and larger.

10. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.
11. After the conduit run has been completed:
  - a. Prove joint integrity and test for out-of-round duct by pulling a test mandrel through each conduit.
    - 1) Test mandrel:
      - a) Length: Not less than 12 IN.
      - b) Diameter: Approximately 1/4 IN less than the inside diameter of the conduit.
    - b. Clean the conduit by pulling a heavy duty wire brush mandrel followed by a rubber duct swab through each conduit.
  12. Pneumatic rodding may be used to draw in lead wire.
    - a. Install a heavy nylon cord free of kinks and splices in all unused new ducts.
    - b. Extend cord 3 FT beyond ends of conduit.
  13. Transition from rigid nonmetallic conduit to rigid metallic conduit, per Specification Section 26 05 33, prior to entering a structure or going above ground.
    - a. Except rigid nonmetallic conduit may be extended directly to manholes, handholes, pad mounted transformer boxes and other exterior pad mounted electrical equipment where the conduit is concealed within the enclosure.
    - b. Terminate rigid PVC conduits with end bells.
    - c. Terminate steel conduits with insulated bushings.
  14. Place warning tape in trench directly over direct-buried conduit, and direct-buried wire and cable in accordance with code requirements.
  15. Placement of conduits stubbing into handholes and manholes shall be located to allow for proper bending radiuses of the cables.

B. Direct-Buried Conduit(s):

1. Install so that the top of the uppermost conduit, at any point:
  - a. Is not less than 30 IN below grade.
  - b. Is below pavement sub-grading.
2. Provide a uniform minimum clearance of 3 IN between conduits or as required in Specification Section 26 05 33 for different cabling types.
  - a. Maintain the separation of multiple planes of conduits by one of the following methods:

- 1) Install multilevel conduits with the use of conduit supports and separators to maintain the required separations, and backfill with flowable fill (100 PSI) per Specification Section 31 23 33 or concrete per Division 03 specifications.
- 2) Install the multilevel conduits one level at a time.
  - a) Each level is backfilled with the appropriate amount of soil and compaction, per Specification Section 31 23 33, to maintain the required separations.

END OF SECTION



DIVISION 31

EARTHWORK



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## SECTION 31 10 00 - SITE CLEARING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Site clearing, tree protection, stripping topsoil and demolition.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 32 91 13 - Topsoiling and Finished Grading.

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

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Protect existing trees and other vegetation to remain against damage.
  - 1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
  - 2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
  - 3. Provide temporary protection as required.
- B. Repair or replace trees and vegetation damaged by construction operations.
  - 1. Repair to be performed by a qualified tree surgeon/licensed arborist.
  - 2. Remove trees which cannot be repaired and restored to full-growth status.
  - 3. Replace with new trees of minimum 4 IN caliper or as required by local tree ordinance.
- C. Contractor shall obtain authority for removal and alteration work on adjoining property, as applicable.

#### 3.2 SITE CLEARING

- A. Topsoil Removal:
  - 1. Strip topsoil to depths encountered or as specified within the soils report, 4 IN minimum.
    - a. Remove heavy growths of grass before stripping.
    - b. Stop topsoil stripping sufficient distance from such trees to prevent damage to main root system.

- c. Separate from underlying subsoil or objectionable material.
  2. Stockpile topsoil where directed by Engineer.
    - a. Construct storage piles to freely drain surface water.
    - b. Seed or cover storage piles to prevent erosion.
  3. Do not strip topsoil in wooded areas where no change in grade occurs.
  4. Borrow topsoil: Reasonably free of subsoil, objects over 2 IN DIA, weeds and roots.
- B. Clearing and Grubbing:
  1. Clear from within limits of construction all trees not marked to remain.
    - a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.
  2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.
- C. Disposal of Waste Materials:
  1. Do not burn combustible materials on site.
  2. Remove all waste materials from site.
  3. Do not bury organic matter on site.

END OF SECTION

## SECTION 31 23 33 - TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Excavation, trenching, backfilling and compacting for all underground utilities.

##### B. Related Specification Sections include but are not necessarily limited to:

1. Division 26 - Electrical.
2. Section 33 05 16 - Precast Concrete Manhole Structures.

#### 1.2 QUALITY ASSURANCE

##### A. Referenced Standards:

##### 1. ASTM International (ASTM):

- a. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/FT<sup>3</sup> (600 kN-M/M<sup>3</sup>)).
- b. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
- c. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

##### B. Qualifications: Hire an independent soils laboratory to conduct in-place moisture-density tests for backfilling to assure that all work complies with this Specification Section.

#### 1.3 DEFINITIONS

##### A. Excavation: All excavation will be defined as unclassified.

#### 1.4 SUBMITTALS

##### A. Shop Drawings:

##### 1. Product technical data including:

- a. Acknowledgement that products submitted meet requirements of standards referenced.
- b. Manufacturer's installation instructions.

2. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.
  3. Submit sieve analysis reports on all granular materials.
- B. Informational Submittals:
1. Trench shield (trench box) certification if employed:
    - a. Specific to Project conditions.
    - b. Re-certified if members become distressed.
    - c. Certification by registered professional structural engineer, registered in the state where the Project is located.
    - d. Engineer is not responsible to, and will not, review and approve.
  2. Submit test reports and fully document each with specific location or stationing information, date, and other pertinent information.

## 1.5 SITE CONDITIONS

- A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving.
1. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property owners.
- B. Provide full access to public and private premises and fire hydrants, at street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
- C. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner and controlling agency.
- D. Verify location of existing underground utilities
1. Obtain Global Positioning System (GPS) x/y/z coordinates where exposed and where crossed by Work of this Project.
    - a. Record on Record Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Material:

- 1. As approved by Engineer.
  - a. Free of rock cobbles, roots, sod or other organic matter, and frozen material.
  - b. Moisture content at time of placement:  $\pm 3\%$  of optimum moisture content as specified in accordance with ASTM D698.
- 2. Gravel trench backfill materials:
  - a. Uniformly graded pea gravel defined below:

Sieve Size	1 IN	3/4 IN	3/8 IN	No. 4	No. 20
Percent Passing by Weight	100	60	25	5	0

B. Subgrade Stabilization Materials: Provide subgrade stabilization material consisting of 4-6" crushed stone.

C. Bedding Materials:

- 1. As approved by the Contracting Officer Representative (COR).
- 2. Granular bedding materials:
  - a. Granular material is generally utilized as follows:
    - 1) PVC, FRP, PE, steel pipe and ABS truss embedment.
    - 2) Trench stabilization.
  - b. Two general gradation classifications used for granular bedding are:
    - 1) Uniformly graded
    - 2) Well graded.
  - c. ASTM D2321 Class 1B.
    - 1) Well-graded crushed stone.
  - d. ASTM C33/C33M, gradation 67 (3/4 IN to No. 4 sieve) defined below:

Sieve Size	1 IN	3/4 IN	3/8 IN	No. 4	No. 20
Percent Passing by Weight	100	90-100	20-55	0-10	0

- 1) Well-graded crushed stone.
  - 2) Well graded crushed gravel.
  - 3) Well graded gravel.
3. Flowable fill:
- a. Description: Flowable fill shall be a mixture of cement, fly ash, fine sand, water, and air having a consistency which will flow under a very low head.
  - b. Material characteristics:
    - 1) The approximate quantities of each component per cubic yard of mixed material shall be as follows:
      - a) Cement (Type I or II): 50 LBS.
      - b) Fly ash: 200 LBS.
      - c) Fine sand: 2,700 LBS.
      - d) Water: 420 LBS.
      - e) Air content: 10%.
    - 2) Actual quantities shall be adjusted to provide a yield of 1 cubic yard with the materials used.
    - 3) Approximate compressive strength should be 85 to 175 PSI.
    - 4) Fine sand shall be an evenly graded material having not less than 95% passing the No. 4 sieve and not more than 5% passing the No. 200 sieve.
    - 5) Mixing and handling of the material shall be in accordance with Specification Section 03 31 31.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Remove and dispose of unsuitable materials as directed by Contracting Officer Representative (COR) to site provided by Contractor.

#### 3.2 EXCAVATION

- A. Unclassified Excavation: Remove rock excavation, clay, silt, gravel, hard pan, loose shale, and loose stone as directed by Contracting Officer Representative (COR).
- B. Excavation for Appurtenances:
  1. 12 IN (minimum) clear distance between outer surface and embankment.
  2. See Specification Section 33 05 16 for applicable requirements.
- C. Groundwater Dewatering:

1. Where groundwater is, or is expected to be, encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade to allow subgrade stabilization, pipe, bedding and backfill material to be placed in the dry, and to maintain a stable trench wall or side slope.
2. Groundwater shall be drawn down and maintained at least 3 FT below the bottom of any trench or manhole excavation prior to excavation.
3. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
  - a. Employ dewatering specialist for selecting and operating dewatering system.
4. Keep dewatering system in operation until dead load of pipe, structure and backfill exceeds possible buoyant uplift force on pipe or structure.
5. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
6. Install groundwater monitoring wells as necessary.
7. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
8. Cost of groundwater dewatering shall be included in the lump sum bid price for the project.

D. Trench Excavation:

1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
  - a. Support existing utility lines and yard piping where proposed work crosses at a lower elevation.
    - 1) Stabilize excavation to prevent undermining of existing utility and yard piping.
2. Open trench outside buildings, units, and structures:
  - a. No more than the distance between two manholes, structures, units, or 200 LF, whichever is less.
  - b. Field adjust limitations as weather conditions dictate.
3. Any trench or portion of trench, which is opened and remains idle for seven calendar days, or longer, as determined by the Owner, may be directed to be immediately filled, without completion of work, at no additional cost to Owner.
  - a. Said trench may not be reopened until Owner is satisfied that work associated with trench will be prosecuted with dispatch.
4. Observe following trenching criteria:
  - a. Trench size:
    - 1) Excavate width to accommodate free working space.

- 2) Maximum trench width at top of pipe or conduit may not exceed outside diameter of utility service by more than the following dimensions:

OVERALL DIAMETER OF UTILITY SERVICE	EXCESS DIMENSION
33 IN and less	18 IN
more than 33 IN	24 IN

- 3) Cut trench walls vertically from bottom of trench to 1 FT above top of pipe, conduit, or utility service.
- 4) Keep trenches free of surface water runoff.
  - a) Include cost in Bid.
  - b) No separate payment for surface water runoff pumping will be made.

E. Trenching for Electrical Installations:

1. Observe the preceding Trench Excavation paragraph in PART 3 of this Specification Section.
2. Modify for electrical installations as follows:
  - a. Open no more than 600 LF of trench in exterior locations for trenches more than 12 IN but not more than 30 IN wide.
  - b. Any length of trench may be opened in exterior locations for trenches which are 12 IN wide or less.
  - c. Do not over excavate trench.
  - d. Cut trenches for electrical runs with minimum 30 IN cover, unless otherwise specified or shown on Drawings.
  - e. See Division 26 for additional requirements.

F. Flowable Fill:

1. Flowable fill shall be:
  - a. Discharged from a mixer by any means acceptable to the Engineer into the area to be filled.
  - b. Placed in 4 FT maximum lifts to the elevations indicated.
    - 1) Allow 12 HR set-up time before placing next lift or as approved by the Engineer.
    - 2) Place flowable fill lifts in such a manner as to prevent flotation of the pipe.
2. Flowable fill shall not be placed on frozen ground.
3. Subgrade on which flowable fill is placed shall be free of disturbed or softened material and water.

4. Flowable fill batching, mixing, and placing may be started if weather conditions are favorable, and the air temperature is 34 DEGF and rising.
5. At the time of placement, flowable fill must have a temperature of at least 40 DEGF.
6. Mixing and placing shall stop when the air temperature is 38 DEGF or less and falling.
7. Each filling stage shall be as continuous an operation as is practicable.
8. Prevent traffic contact with flowable fill for at least 24 HRS after placement or until flowable fill is hard enough to prevent rutting by construction equipment.
9. Flowable fill shall not be placed until water has been controlled or groundwater level has been lowered in conformance with the requirements of the preceding Groundwater Dewatering paragraph in PART 3 of this Specification Section.

### 3.3 PREPARATION OF FOUNDATION FOR PIPE LAYING

#### A. Over-Excavation:

1. Backfill and compact to 90% of maximum dry density per ASTM D698.
2. Backfill with granular bedding material as option.

#### B. Rock Excavation:

1. Excavate minimum of 6 IN below bottom exterior surface of the pipe or conduit.
2. Backfill to grade with suitable earth or granular material.
3. Form bell holes in trench bottom.

#### C. Subgrade Stabilization:

1. Stabilize the subgrade when directed by the Contracting Officer Representative (COR).
2. Observe the following requirements when unstable trench bottom materials are encountered.
  - a. Notify Contracting Officer Representative (COR) when unstable materials are encountered.
    - 1) Define by drawing station locations and limits.
  - b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or Contractor operations.
    - 1) Replace with subgrade stabilization with no additional compensation.

### 3.4 BACKFILLING METHODS

- A. Do not backfill until tests to be performed on system show system is in full compliance with specified requirements.
- B. Carefully Compacted Backfill:

1. Furnish where indicated on Drawings, specified for trench embedment conditions and for compacted backfill conditions up to 12 IN above top of pipe or conduit.
2. Comply with the following:
  - a. Place backfill in lifts not exceeding 8 IN (loose thickness).
  - b. Hand place, shovel slice, and pneumatically tamp all carefully compacted backfill.
  - c. Observe specific manufacturer's recommendations regarding backfilling and compaction.
  - d. Compact each lift to specified requirements.

C. Common Trench Backfill:

1. Perform in accordance with the following:
  - a. Place backfill in lift thicknesses capable of being compacted to densities specified.
  - b. Observe specific manufacturer's recommendations regarding backfilling and compaction.
  - c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.

D. Water flushing for consolidation is not permitted.

E. Backfilling for Electrical Installations:

1. Observe the preceding Carefully Compacted Backfill paragraph or Common Trench Backfill paragraph in PART 3 of this Specification Section or when approved by the Contracting Officer Representative (COR).
2. Modify for electrical installation as follows:
  - a. Observe notes and details on electrical drawings for fill in immediate vicinity of direct burial cables.

### 3.5 COMPACTION

A. General:

1. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
2. In no case shall degree of compaction below minimum compactions specified be accepted.

B. Compaction Requirements:

1. Unless noted otherwise on Drawings or more stringently by other Specification Sections, comply with following minimum trench compaction criteria.
  - a. Bedding material:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All locations	Cohesionless soils	75% relative density by ASTM D4253 and ASTM D4254

b. Carefully compacted backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All applicable areas	Cohesive soils	95% of maximum dry density by ASTM D698
	Cohesionless soils	75% relative density by ASTM D4253 and ASTM D4254

c. Toe drain bedding and backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All locations	Cohesionless soils	75% relative density by ASTM D4253 and ASTM D4254

d. Common trench backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
Under pavements, roadways, surfaces within highway right-of-ways	Cohesive soils	95% of maximum dry density by ASTM D698
	Cohesionless soils	75% of relative density by ASTM D4253 and ASTM D4254
Under turfed, sodded, plant seeded, nontraffic areas	Cohesive soils	95% of maximum dry density by ATM D698
	Cohesionless soils	75% of relative density by ASTM D4253 and ASTM D4254

### 3.6 FIELD QUALITY CONTROL

A. Testing:

1. Perform in-place moisture-density tests as directed by the Contracting Officer Representative (COR).

2. Perform tests through recognized testing laboratory approved by Contracting Officer Representative (COR).
  3. Costs of "Passing" tests paid by Contractor.
  4. Perform additional tests as directed until compaction meets or exceeds requirements.
  5. Cost associated with "Failing" tests shall be paid by Contractor.
  6. Assure Contracting Officer Representative (COR) has immediate access for testing of all soils related work.
  7. Ensure excavations are safe for testing personnel.
- B. Prior to backfilling, obtain Global Positioning System (GPS) x/y/z coordinates at each change of direction and change of elevation for pipelines, conduits and ductbanks constructed for this Project.
1. Record on Record Documents.

END OF SECTION



DIVISION 32

EXTERIOR IMPROVEMENTS



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## SECTION 32 91 13 - TOPSOILING AND FINISHED GRADING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Topsoiling and finished grading.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 31 10 00 - Site Clearing.
  - 2. Section 32 92 00 - Seeding, Sodding and Landscaping.
- C. Location of Work: All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

#### 1.2 SUBMITTALS

- A. Shop Drawings: Project Data: Test reports for furnished topsoil.

#### 1.3 SITE CONDITIONS

- A. Verify amount of topsoil stockpiled and determine amount of additional topsoil if necessary, to complete work.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Topsoil:
  - 1. Original surface soil typical of the area.
  - 2. Existing topsoil stockpiled under Specification Section 31 10 00.
  - 3. Friable, loamy soil capable of supporting native plant growth.

#### 2.2 TOLERANCES

- A. Finish Grading Tolerance:  $\pm 0.1$  FT from required elevations.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Correct, adjust and/or repair rough graded areas.
  - 1. Cut off mounds and ridges.
  - 2. Fill gullies and depressions.
  - 3. Perform other necessary repairs.
  - 4. Bring all sub-grades to specified contours, even and properly compacted.
- B. Loosen surface to depth of 2 IN, minimum.
- C. Remove all stones and debris over 2 IN in any dimension.

### 3.2 ROUGH GRADE REVIEW

- A. Reviewed by Contracting Officer in Specification Section 31 10 00.

### 3.3 PLACING TOPSOIL

- A. Do not place when subgrade is wet or frozen enough to cause clodding.
- B. Spread and lightly compact to a depth of 4 IN for all disturbed earth areas.
- C. If topsoil stockpiled is less than amount required for work, furnish additional topsoil at no cost to Owner.
- D. Provide finished surface free of stones, sticks, or other material 1 IN or more in any dimension.
- E. Provide finished surface smooth and true to required grades.
- F. Restore stockpile area to condition of rest of finished work.

### 3.4 ACCEPTANCE

- A. Upon completion of topsoiling, obtain Engineer's acceptance of grade and surface.
- B. Make test holes where directed to verify proper placement and thickness of topsoil.

END OF SECTION

## SECTION 32 92 00 - SEEDING, SODDING AND LANDSCAPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Seeding, sodding and landscape planting: Soil preparation.
  - a. Lawn-type seeding.
  - b. Native grass seeding.
  - c. Pruning and repairing existing trees.
  - d. Replacement of dead or impaired materials at the end of the first growing season.
  - e. Preparation of a maintenance plan for Owner.

##### B. Related Specification Sections include but are not necessarily limited to:

1. Section 32 91 13 - Topsoiling and Finished Grading.

#### 1.2 QUALITY ASSURANCE

##### A. Referenced Standards:

1. American Nursery and Landscape Association/American National Standards Institute (ANLA/ANSI):
  - a. Z60.1, American Standard for Nursery Stock.
2. AOAC International (AOAC).
3. ASTM International (ASTM):
  - a. D2028, Standard Specification for Cutback Asphalt (Rapid-Curing Type).
  - b. D5276, Standard Test Method for Drop Test of Loaded Containers by Free Fall.

##### B. Quality Control:

1. Fertilizer:
  - a. If Engineer determines fertilizer requires sampling and testing to verify quality, testing will be done at Contractor's expense, in accordance with current methods of the AOAC.
  - b. Upon completion of Project, a final check of total quantities of fertilizer used will be made against total area seeded.

- c. If minimum rates of application have not been met, Contractor will be required to distribute additional quantities to make up minimum application specified.

### 1.3 SUBMITTALS

#### A. Shop Drawings:

1. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.
  - c. Signed copies of vendor's statement for seed mixture required, stating botanical and common name, place of origin, strain, percentage of purity, percentage of germination, and amount of Pure Live Seed (PLS) per bag.
  - d. Listing of type of cover crop to be used and rates and procedures for planting if fall planting of Native Grass is anticipated.
  - e. Type of herbicide to be used during first growing season to contain annual weeds and application rate.
2. Certification that each container of seed delivered will be labeled in accordance with Federal and State Seed Laws and equals or exceeds Specification requirements.
3. Test reports.

#### B. Maintenance Plan:

1. Type written maintenance plan and schedule for Owner's use following Contractor's maintenance period.
2. Submit prior to final acceptance.

#### C. Informational Submittals:

1. Copies of invoices for fertilizer used on Project showing grade furnished, along with certification of quality and warranty.

#### D. Furnish seed in sealed standard containers labeled with producer's name and seed analysis.

1. Remove from the site seed which has become wet, moldy, or otherwise damaged in transit.

#### E. Furnish fertilizer uniform in composition, free flowing and suitable for application with approved equipment, delivered to site in bags or other containers, each fully labeled and bearing the name, and warranty of the producer.

1.4 SEQUENCING AND SCHEDULING

A. Installation Schedule:

1. Show schedule of when lawn type and other grass areas are anticipated to be planted.
2. Indicate planting schedules in relation to schedule for finish grading and topsoiling.
3. Indicate anticipated dates Engineer will be required to review installation for initial acceptance and final acceptance.

B. Pre-installation Meeting:

1. Meet with Engineer and other parties as necessary to discuss schedule and methods, unless otherwise indicated by Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND SUPPLIERS

- A. Subject to compliance with the Contract Documents, the manufacturers and suppliers listed in the applicable Articles below are acceptable.

2.2 MATERIALS

A. Seed Quality:

1. Fresh, clean, new-crop seed labeled in accordance with USDA Rules and Regulations under the Federal Seed Act in effect on date of bidding.
2. Provide seed of species, proportions, and minimum percentages of purity, germination and maximum percentage of weed seed as specified.
3. Seed shall be approved by the park and sourced from an approved local seed supplier.
4. Approval of all seed for use shall be based on the accumulative total of PLS specified for each phase of work.

B. Lawn-Type Seed Mixture:

BOTANICAL AND COMMON NAME	PERCENT BY WEIGHT (PLS)	MINIMUM PERCENT GERMINATION	MINIMUM PERCENT PURITY
Buffalograss (Buchloe dactyloides)	20.0	52,000	Buffalograss (Buchloe dactyloides)

- C. Native Grass Seeding: Certified seed of locally adapted strains. Contractor to submit seed mix from local supplier to park for approval. See mix shall contain the following grasses, exact mix may vary.

1. Seed mixture:

GRASSES	LBS PLS PER ACRE	APPROXIMATE NUMBER OF SEEDS PER LB (PLS)
Big bluestem(Andropogon gerardi)	4.8	165,000
Purple prairieclover (Petalostemen purpureum)	1.0	278.000
Sideoats grama(Bouteloua curtipendula)	2.4	191,000

- D. Mulch:

1. For seeded areas:
- a. Clean, seed-free, threshed straw of oats, wheat, barley, rye, beans, peanuts, or other locally available mulch material which does not contain an excessive quantity of matured seeds of noxious weeds or other species that will grow or be detrimental to seeding or provide a menace to surrounding land.
  - b. Do not use material which is fresh or excessively brittle, or which is decomposed and will smother or retard growth of grass.
2. Native grass seeded areas: Weed-free hay, excluding brome or bluegrass hay, used on slopes 4:1 or greater.

- E. Fertilizer:

1. Commercial fertilizer meeting applicable requirements of State and Federal law.
2. Cyanic compound or hydrated lime not permitted in mixed fertilizers.
3. For lawn-type seeding: 5-10-5 analysis.
4. For Crownvetch seeding: 8-16-16 analysis.
5. For sprigged or plugged lawns: 8-8-8 analysis.
6. For pasture seeding: 23-9-12 analysis.

- F. Water:

1. Water free from substances harmful to grass growth.
2. Provide water from source approved prior to use.

## PART 3 - EXECUTION

### 3.1 SOIL PREPARATION

#### A. General:

1. Limit preparation to areas which will be planted soon after.
2. Provide facilities to protect and safeguard all persons on or about premises.
3. Protect existing trees designated to remain.
4. Verify location and existence of all underground utilities.
  - a. Take necessary precaution to protect existing utilities from damage due to construction activity.
  - b. Repair all damages to utility items at sole expense.
5. Provide facilities such as protective fences and/or watchmen to protect work from vandalism.
  - a. Contractor to be responsible for vandalism until acceptance of work in whole or in part.

#### B. Preparation for Lawn-Type Seeding, Sprigging, Plugging or Sodding:

1. Loosen surface to minimum depth of 4 IN.
2. Remove stones over 1 IN in any dimension and sticks, roots, rubbish, and other extraneous matter.
3. Prior to applying fertilizer, loosen areas to be seeded with a double disc or other suitable device if the soil has become hard or compacted.
4. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.
5. Distribute fertilizer uniformly over areas to be seeded:
  - a. For lawn-type seeding: 30 LBS per 1000 SQFT.
  - b. For pasture seeding: 200 LBS per acre.
6. Incorporate fertilizer into soil to a depth of at least 2 IN by disking, harrowing, or other approved methods.
7. Remove stones or other substances from surface which will interfere with turf development or subsequent mowing operations.
8. Grade lawn areas to a smooth, even surface with a loose, uniformly fine texture.
  - a. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
  - b. Limit fine grading to areas which can be planted soon after preparation.
9. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and before planting.
10. Distribute fertilizer as specified uniformly over areas to be seeded at a rate of 12 LBS per 1000 SQFT.

C. Native Grass Seeding:

1. Seeding without cover crop:
  - a. Plow areas to be seeded to shallow depth as soon as ground can be worked without clodding.
  - b. Leave ground fallow until weeds germinate, approximately 3 to 4 weeks later.
  - c. Disc entire area again to turn over weeds.
  - d. Disc at least twice prior to planting.
  - e. Cultipack entire area immediately following final disking.
2. Seeding with cover crop:
  - a. Plant cover crop (4 to 8 LBS per acre in rows not exceeding 42 IN width) over all areas to be seeded (optimum planting time - June 1 through July 15).
  - b. Allow cover crop to mature and harvest completely leaving stubble at least 18 IN in field.
  - c. Field is then ready for seeding of native grasses.
3. Leave surface (seedbed) hard to discourage weed growth and erosion.
  - a. Ground should be undisturbed and uncultivated.

3.2 INSTALLATION

A. Lawn-Type and Pasture Seeding:

1. Do not use seed which is wet, moldy, or otherwise damaged.
2. Perform seeding work from April 20 to May 15 for spring planting, and August 1 to September 15 for fall planting, unless otherwise approved by Engineer.
3. Employ satisfactory methods of sowing using mechanical power-driven drills or seeders, or mechanical hand seeders, or other approved equipment.
4. Distribute seed evenly over entire area at rate of application not less than 4 LBS (PLS) of seed per 1000 SQFT, 50% sown in one direction, remainder at right angles to first sowing.
5. Stop work when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds excessive moisture, or other factors.
  - a. Resume work only when favorable conditions develop.
6. Lightly rake seed into soil followed by light rolling or cultipacking.
7. Immediately protect seeded areas against erosion by mulching.
  - a. Spread mulch in continuous blanket using 1-1/2 tons per acre to a depth of 4 or 5 straws.

8. Protect seeded slopes against erosion with erosion netting or other methods approved by Engineer.
    - a. Protect seeded areas against traffic or other use by erecting barricades and placing warning signs.
  9. Immediately following spreading mulch, anchor mulch using a rolling coulter or a wheatland land packer having wheels with V-shaped edges to force mulch into soil surface or apply evenly distributed emulsified asphalt at rate of 10-13 GAL/1000 SQFT.
    - a. SS-1 emulsion in accordance with ASTM D5276 or RC-1 cutback asphalt in accordance with ASTM D2028 are acceptable.
    - b. If mulch and asphalt are applied in one treatment, use SS-1 emulsion with penetration test range between 150-200.
    - c. Use appropriate shields to protect adjacent site improvements.
  10. If hydroseeding is used, machinery must be approved, modern, properly equipped and operated by an experienced operator.
    - a. Seed and fertilize at the rate specified.
    - b. Use appropriate shields to protect adjacent site improvements.
- B. Native Grass Seeding:
1. Planting seasons:
    - a. Warm-season grasses: Late spring or early summer; avoid late summer or fall planting.
    - b. Cool-season grasses: Early spring or early fall, before or after hot weather.
  2. Seed with a grass drill.
    - a. Operate drill as near to contour as practical (a Nisbet grass drill has been proven to be successful in this operation).
  3. Areas of 1 acre or less may be sown by hand-broadcasting, mixing seed with generous amount of damp sand to ensure even distribution.
    - a. Harrow or rake seed into ground following seeding to minimum 1/4 IN and maximum 1 IN depth.
  4. Seed grasses and forbs at rates prescribed in previous table.
    - a. Minimum seeding rate is 20 PLS/SQFT.
  5. If area is seeded without cover crop, protect newly seeded areas from erosion by mulching with weed-free straw in a continuous blanket using 2 tons per acre and anchor to ground with rolling coulter or a wheatland land packer.
  6. Provide initial watering after installation as appropriate for planting conditions.

### 3.3 MAINTENANCE AND REPLACEMENT

#### A. General:

1. Begin maintenance of planted areas immediately after each portion is planted and continue until final acceptance or for a specific time period as stated below, whichever is the longer.
2. Provide and maintain temporary piping, hoses, and watering equipment as required to convey water from water sources and to keep planted areas uniformly moist as required for proper growth.
3. Protection of new materials:
  - a. Provide barricades, coverings or other types of protection necessary to prevent damage to existing improvements indicated to remain.
  - b. Repair and pay for all damaged items.
4. Replace unacceptable materials with materials and methods identical to the original specifications unless otherwise approved by the Engineer.

#### B. Seeded or Sodded Lawns:

1. Maintain seeded lawns: 90 days, minimum, after installation and review of entire project area to be planted.
2. Maintenance period begins at completion of planting or installation of entire area to be seeded.
3. Engineer will review seeded lawn area after installation for initial acceptance.
4. If project area will be seeded over more than one season:
  - a. Engineer must agree to limits of seeded areas per season.
  - b. If Engineer agrees to limits, maintenance period will be applicable to these limits for that planting.
5. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, and replanting as required to establish a smooth, uniform lawn, free of weeds and eroded or bare areas.
6. Lay out temporary lawn watering system and arrange watering schedule to avoid walking over muddy and newly seeded areas.
  - a. Use equipment and water to prevent puddling and water erosion and displacement of seed or mulch.
7. Mow lawns as soon as there is enough top growth to cut with mower set at recommended height for principal species planted.
  - a. Repeat mowing as required to maintain height.
  - b. Do not delay mowing until grass blades bend over and become matted.
  - c. Do not mow when grass is wet.
  - d. Time initial and subsequent mowings as required to maintain a height of 1-1/2 to 2 IN.
  - e. Do not mow lower than 1-1/2 IN.

8. Remulch with new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose.
  - a. Anchor as required to prevent displacement.
9. Unacceptable plantings are those areas that do not meet the quality of the specified material, produce the specified results, or were not installed to the specified methods.
10. Replant bare areas using same materials specified.
11. Engineer will review final acceptability of installed areas at end of maintenance period.
12. Maintain repaired areas until remainder of maintenance period or approved by Engineer, whichever is the longer period.

C. Crownvetch:

1. Maintain all seeded areas for two years after planting is complete.
2. Regrade and replant eroded or bare areas as they become apparent and at end of two year period.
3. Do not mow.
  - a. Shred weeds at end of first season with rotary shredder.
4. Water as needed according to conditions to maintain survival of planting.

D. Native Grass Seeding:

1. Maintain all seeded areas for 90 days after planting is complete.
2. Do not mow bed native grass.
3. When weeds are shading out 70% of (minimum 6 IN) native grass seed, shred weeds back to height of seedlings with a rotary shredder.
4. Do not allow weeds to exceed a height of 8 IN.

END OF SECTION

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DIVISION 33

UTILITIES



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## SECTION 33 05 07 - HORIZONTAL DIRECTIONAL DRILLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Furnish all labor, equipment, and materials necessary to install a pressure pipe for recycled water application as shown on the Drawings utilizing horizontal directional drilling (HDD) as the trenchless installation method of construction.
2. The pipe shall be installed in a single reach of pipeline within the limits as shown on the Drawings.

##### B. Related Specification Sections include but are not necessarily limited to:

1. Section 33 05 33 - Polyethylene Utility Pipe.

#### 1.2 QUALITY ASSURANCE

##### A. Referenced Standards:

1. ASTM International (ASTM):
  - a. F1962-11, Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossing
2. Occupational Safety and Health Administration (OSHA):
  - a. OSHA-3075, Controlling Electrical Hazards.
3. Plastic Pipe Institute (PPI):
  - a. TR-46, 2009, Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High Density Polyethylene Pipe.

##### B. Daily Logs and Records:

1. Maintain daily logs and records to document the following: Drilling lengths, location of drill head, drilling fluid pressures and flow rates, drilling fluid losses, inadvertent returns, drilling times required for each pipe joint, any instances of retraction and redrilling segments of the pilot bore, and any other relevant observations.

2. The position of the drill head shall be continuously tracked and recorded. A plot of actual drill path relative to design line and grade shall be maintained and updated daily, or more frequently as directed by the Contracting Officer. Any pipe sections not meeting specified tolerances will be replaced or repaired to the Contracting Officer's satisfaction at no additional cost to the Contracting Officer.

C. Advance Notice and Inspections:

1. Provide at least 72 HRS advance written notice (not including holidays or weekends) to the Contracting Officer of planned major drilling operations including pilot bore launch, reaming, and pipe pullback. Immediately notify the Contracting Officer in writing when any significant problems are encountered or if ground conditions are construed as being materially and significantly different than the conditions presented in the geotechnical investigation report.
2. Perform all work in the presence of the Contracting Officer, unless Contracting Officer grants prior written approval to perform such work in Contracting Officer's absence.

1.3 PERMITS/APPROVALS

- A. Comply with applicable requirements of the National Park Service, Corps of Engineers, and other local, state and federal agencies having jurisdiction.

1.4 DEFINITIONS

A. General:

1. Back Reamer: A cutting head attached to the leading end of a drill string to enlarge the pilot bore diameter by removing the surrounding rock or soil by excavation during the pull-back operation and enable the carrier pipe to be installed.
2. Ballast: Water that is used to fill the pipe during installation to reduce the net buoyant force uplifting the pipe.
3. Bent Sub: An offset section of drill stem located close behind the drill head that allows steering corrections to be made by positioning the cutting head. Frequently used in directional drilling in rock.
4. Bits: Replaceable cutting tools on the cutting head or drill string.
5. Bore or Borehole: The small diameter tunnel created by the initial pilot drilling operation, and subsequent reaming or expanding operations.
6. Carrier Pipe: The pipe that carries the transported product for operational use.
7. Coating: A thin, non-structural coating material applied to the outside surface of a pipe wall to provide protection against corrosion and minor damage during handling and installation.
8. Cover or Overburden: The vertical depth from finish grade (top of pavement, top of railroad ties, natural ground surface, river bed, etc.) to the top of the casing or bore hole.
9. Crossing: A pipe reach installed using a trenchless method of construction in which the primary purpose is to provide a passage beneath a surface obstruction.

10. Cutterhead/Cutting Head: A tool or system of tools on a common support apparatus that excavates at the face of a bore. Usually applies to mechanical methods of excavation.
11. Drill Bit: A tool that cuts the subsurface strata at the head of a drill string, usually by mechanical means.
12. Drill String or Drill Stem:
  - a. An assembly of drill rods or drill pipes, a cutterhead, and sonde housing used to drill a pilot bore.
  - b. An assembly of drill rods or drill pipes, and a back reamer or expander used to enlarge a borehole.
  - c. System of rods used with cutting bit or compaction bit attached to the drive chuck.
13. Drilling Fluid/Mud: Typically a mixture of water, bentonite, and/or polymer continuously pumped to the cutting head to facilitate the removal of cuttings through suspension of excavated material in the mixture, and stabilization of the borehole. In directional drilling, the fluid also cools the head and lubricates the installation of the product pipe.
14. Down-hole: Inside the borehole.
15. Entry/Exit Angle: The angle relative to the horizontal plane at which the drill string enters and exits the ground in forming the pilot bore.
16. Entry Pit: The work area where a trenchless technology excavation tool enters the ground. The work area where a pilot bore operation commences. The entry pit may be at grade or below grade within an excavated work pit. See launch pit.
17. Exit Pit: The work area where a trenchless technology excavation tool exits the ground. The work area where a pilot bore operation terminates. The exit pit may be at grade or below grade within an excavated work pit.
18. Expander: A tool that enlarges a bore during a pull-back operation by displacing the surrounding soil by compaction soil rather than removing the surrounding soil by excavation, sometimes used during a thrusting process as well as during pull-back.
19. Frac-out: A leakage of the pressurized drilling fluid from the borehole to the ground surface or body of water through a fissure in the surrounding soil or rock strata.
20. Fluid Assisted Boring/Drilling: A type of guided boring technique using a combination of mechanical drilling and pressurized fluid jets to provide the soil cutting action.
21. Grade: The elevations shown on plans and/or survey stakes for the installation of the carrier pipe. It is occasionally used to give elevations for casing. In most cases, it is given to the flow line but can also be given to the top of the pipe or casing.
22. Ground Mat: Metal mats rolled out on either side of drill rack for operators and crew to stand on during operation to provide grounding protection in case of electrical strike.
23. Ground Mat Cables: Cables connecting the drill rack to the ground mats.
24. Ground Rod: A copper/brass rod which is hand driven into the ground and is connected to the drill rack and mats to provide adequate grounding of unit and personnel.
25. Ground Rod Cable: Cable connecting the mats and drill rig to the ground rod.

26. Grout: A material such as cement slurry, sand or pea gravel that is pumped into voids.
27. Grouting: Filling of the annular space between the casing and carrier pipe; filling of voids and fissures in the surrounding soil or rock strata.
28. Guided Boring: A pilot boring system with steering capabilities for the installation of pipes, conduits and cables using a drilling rig. A pilot bore is drilled using a rotating drill string and is then enlarged by a back reamer to the size required for the product pipe. The necessary deviation during pilot boring is provided by a slanted face to the drill head, an asymmetric drill head, eccentric fluid jets, or a combination of these, usually in conjunction with a locator.
29. Horizontal Directional Drilling: A trenchless method of construction that consists of drilling a small diameter pilot hole along a predetermined path and then developing the pilot hole into a stable and suitable sized borehole and then pulling the new utility into place. The HDD process has steering and tracking capabilities during the pilot drill operation. The vertical profile of the borehole is typically in the shape of a sag arc entrapping drilling fluid to provide continuous support to the borehole.
30. FPVC: Fusible Poly Vinyl Chloride.
31. Launch Pit: The work area used for "launching" a trenchless technology excavation tool; the horizontal directional drill process begins at this location. The launch pit may be at grade or below grade within an excavated work pit. See entry pit.
32. Line:
  - a. The specified direction of the proposed bore in a horizontal plane.
  - b. The distance between two points as laid out by a survey crew for the installation of pipelines and their bores and tunnels.
33. Lining: A thin, non-structural coating material applied to the inside surface of a pipe wall to provide protection against corrosion.
34. Locator: An electronic instrument used to determine the position and strength of electro-magnetic signals emitted from a transmitter sonde in the pilot head of a boring system, in an impact moling tool or from existing utilities which have been energized. Sometimes referred to as a walkover system.
35. Marsh Funnel: An instrument used to determine viscosity. For trenchless applications, used to determine slurry viscosity. The Marsh funnel test is performed by pouring a slurry sample through a screen at the top of the funnel to trap large particulates. After the funnel is filled, the bottom of the funnel is opened and the slurry is allowed to flow. The flow rate is calculated as the time period counted in seconds for a quart of slurry to drain out of the funnel.
36. Measurement While Drilling (MWD): Borehole survey instrumentation that provides continuous information simultaneously with drilling operations, usually transmitting to a display at or near the drilling rig.
37. Mixed Face: A soil condition that presents two or more different types of subsurface geologic composition in the cross-section of the bore.
38. Muck:
  - a. As a noun: The same as spoil.
  - b. As a verb: To clean out mud as in "muck out the hole."
39. Mud: Same as drilling fluid and slurry.

40. Open Cut: Trench excavation to the required underground line and grade for the installation, maintenance or inspection of a pipe, conduit or cable. The excavation is then backfilled and compacted, and the surface restored.
41. Ovality: The difference between the maximum diameter divided by the mean diameter at any one cross section of a pipe, generally expressed as a percentage.
42. Pilot Bore: The operation of drilling the initial small-diameter pass of a boring process with steering capabilities to achieve the desired line and grade of the drill path that is subsequently enlarged using back reaming or similar enlargement method. Most commonly applied to horizontal directional drilling and guided boring.
43. Pipe String: The assembled sections of carrier pipe whose total length is equal to or greater than the length of the borehole.
44. Product Pipe: Same as carrier pipe.
45. Pull-back: That part of the guided boring and reaming operations of the horizontal directional drilling process in which the drill string is pulled back through the bore to the launch pit, in some cases simultaneously installing the carrier pipe to its final position.
46. Pull Back Force: The tensile load applied to a drill string during the pull-back operation. Guided boring and directional drilling rigs are generally rated by their maximum pull-back force.
47. Restoration: Overall site improvements that are done at the conclusion of the project to return the work areas to their original (or better) condition, including backfilling, compacting and re-surfacing any excavations at the entry and exit pits.
48. Roller Cone Bit or Reamer: A bit or reamer in which the teeth rotate on separate, internal shafts that are usually aligned perpendicular to line to develop a bore diameter larger than the pilot bore diameter; used for boring rock.
49. Sonde Housing: Integral unit in the directional drill head that also houses the sonde radio sending unit.
50. Slurry: Same as drilling fluid and mud.
51. Spoil (Muck): Soil, rock and other materials displaced by a tunnel or casing, and removed as the tunnel or casing is installed.
52. Stakedown Plate: A plate staked to the ground to stabilize the forward end of the drill rack.
53. Sub saver: A replaceable sub on the carriage motor to which the drill pipe is connected.
54. Survey Tools: Downhole equipment and instruments used to determine the position of a bore in directional drilling or site investigation.
55. Swivel Pulling: Used to attach service to drill pipe and pulled into the bore.
56. Trenchless Technology: Refers to a family of methods, materials, and equipment that can be used for installation of new, or replacement or rehabilitation of existing underground utilities with minimal or no disruption to the ground surface along the utility alignment, thereby causing no disruption to traffic, commerce, and other activities, as opposed to excavating open cut pipe trenches and the associated major disruptions to surface activities.
57. Walkover System: Same as locator.
58. Washover Pipe: A rotating drill pipe of larger diameter than the pilot drill pipe and placed around it with its leading edge less advanced. Its purpose is to provide stiffness to the drilling pipe in order to maintain steering control over long bores, to reduce friction between the drill string and the soil and to facilitate mud circulation. See directional drilling.

59. Water Table: The elevation of subsurface ground water.

## 1.5 SUBMITTALS

### A. Shop Drawings:

1. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.

### B. Quality Assurance: Submit samples of the daily logs and records that will be maintained.

1. The actual daily logs and records shall be provided to the Engineer within two working days of the date to which the records pertain.
2. Refer to Quality Assurance portion of this Section.

### C. Shop Drawings:

1. See Division 01 Specifications for requirements for the mechanics and administration of the submittal process.
2. All Shop Drawings shall be reviewed and accepted by the Contracting Officer prior to Contractor's mobilization.
3. The Drawings shall include:
  - a. Planned equipment.
  - b. Equipment setup areas.
  - c. Pipe string layout areas.
  - d. Extent of proposed excavations.
  - e. Line and grade of proposed bore.
  - f. Approximate length of the bore.
  - g. Approximate length of pipe string.
  - h. Location of mud containers and other secondary containment devices such as sand bas.
  - i. All pothole data to locate all utilities, underground structure/facilities along the planned bore path.
  - j. Traffic control plans.
  - k. List of lubricants and horizontal directional drilling additives.
  - l. Location of spoil sites.
  - m. Anticipated or proposed deviations in line and grade from the design plan and profile of pipeline.
  - n. Anticipated production rate.

### D. Drilling Plan: Submit a detailed narrative description of the sequence of tasks that will be performed to install the specified pipe string using horizontal directional drilling. The plan shall include, but not be limited to:

1. A description of the proposed drilling procedures consisting of the pilot bore and reaming operations.

2. Drilling equipment including drill rig pushing and pulling capacities, and torque and mud pumping capacities.
  3. Indicate the diameters of multiple-pass pilot, intermediate and final bores, or single-pass staged bore, as applicable.
- E. Frac-out Plan: Submit a detailed narrative of a frac-out prevention and cleanup plan. The plan shall include, but not be limited to:
1. Name(s) and phone numbers of biological monitor(s) and crew supervisor(s).
  2. Site-specific resources of concern.
  3. Monitoring protocols, including biological monitoring and frac-out monitoring.
  4. Containment and cleanup plan, including staging location of vacuum trucks and equipment, equipment list, necessary hose lengths, special measures needed for steep topography, at each location.
- F. Schedule: Submit a detailed schedule with all major construction activities and durations, with beginning and completion dates shown. The schedule shall include, but not be limited to:
1. Rig mobilization and setup.
  2. Pilot bore hole drilling.
  3. Back reaming.
  4. Pullback of pipe.
  5. Cleanup and restoration.
  6. The schedule shall be subject to reasonable updating as requested by the Engineer to accommodate unforeseen work conditions affecting the progress of the project.
- G. Description of Equipment: Submit manufacturer's cut sheets or detailed descriptions of planned equipment to be used for the pipeline installation, including drill rig capacity. All texts, drawings, figures and photographs shall be clear and legible.
- H. Product Data: Submit manufacturer's published:
1. Product data including specifications describing planned materials to be used for the pipeline installation.
  2. Warranty information for materials, as applicable.
  3. Materials Safety Data Sheets (MSDS) for materials, as applicable.
  4. All texts, drawings, figures and photographs shall be clear and legible.
- I. Drilling Fluid Pressures: Submit calculations detailing the maximum and minimum drilling fluid pressures expected during the directional drilling process. These calculations shall address minimum pressures required for borehole stabilization as well as maximum pressures to prevent inadvertent drilling fluid returns.
- J. Surveying Equipment and Procedures: Submit records of equipment calibrations and certifications for all equipment used for downhole surveys and tracking of the drill head and bore path. Procedures to be used will be described in the submittal, including quality assurance measures.

- K. Calculations for Thrust, Torque, and Pullback: Submit calculations for thrust, torque, and pullback loads, for the conditions and operating practices anticipated.
- L. Pipe Material Properties:
1. Maximum Pulling Force: Submit calculations determining the maximum pulling force that may be anticipated during the pullback operation to overcome theoretical frictional forces.
    - a. The calculations shall be stamped by a professional engineer licensed in the State of Kansas accompanied by written approval from the pipe manufacturer verifying that the maximum calculated pulling force will not exceed the manufacturer's recommended yield tensile strength and factor of safety for the proposed pipe material and fused joint.
  2. Radius of Curvature: Submit the radius of curvature planned for the installation of the pipeline along with calculations showing that installation stresses do not exceed allowable stress. Use a minimum factor of safety of 2.0 to determine the allowable stress.
- M. Plans for Disposal of Spoils and Drilling Fluids: Submit plans for disposal of waste materials resulting from the horizontal directional drilling process including drilling fluids, rock cuttings, waste oil, fuel, discharge water, and other wastes.
1. Identify the disposal site and procure and submit a letter from the licensed disposal site indicating willingness and legal authority to accept the described waste products.
- N. Safety Plan: Submit a Safety Plan including the name and mobile phone number of the Contractor's Site Safety Representative, emergency telephone numbers for local medical facilities, and precautions for handling and disposal of any hazardous and flammable materials.
- O. Contingency Plans for Potential Problems: Submit contingency plans for remediation of potential problems that may be encountered during the drilling operations. The contingency plans shall address the observations that would lead to the discovery of the problem, the methods that would be used to mitigate the problem, and estimated time to mitigate the problem and resume the installation. Potential problems that shall be addressed include:
1. Obstructions encountered.
  2. Drilling fluid pressures that exceed maximum allowable pressures.
  3. Inadvertent drilling fluid returns (hydro-fracture).
  4. Loss of circulation.
  5. Deviation from planned bore path.
  6. Inability to advance drill stem or pipe.
  7. Drill stem or pipe stresses that exceed allowable values for torsion, bending, axial tension, or compression.
  8. Drill stem or pipe twisted off or broken off in borehole.
  9. Pipe collapse.

- P. The following shall be submitted as construction progresses and at the completion of construction.
1. Daily Logs and Records: Submit complete, legible, written daily logs and records as called for in Paragraph 1.06.A and as directed by the Engineer, within two working days of the date to which the records correspond.
  2. Deviations in Plan and Profile: Document all deviations of actual line and grade from design plan and profile of the bore path and submit to the Engineer immediately upon discovery.
- Q. As-Built Drawings: Submit as-built drawings showing plan and profile views of the completed installed pipeline, correctly referenced to project stationing and elevations, and major site features after the completion of the project.
- R. Drilling Fluid Weights: Submit calculations of expected weights of drilling fluid for stabilization of the bore hole.

## 1.6 QUALITY ASSURANCE

- A. Daily Logs and Records:
1. Maintain daily logs and records to document the following: Drilling lengths, location of drill head, drilling fluid pressures and flow rates, drilling fluid losses, inadvertent returns, drilling times required for each pipe joint, any instances of retraction and redrilling segments of the pilot bore, and any other relevant observations.
  2. The position of the drill head shall be continuously tracked and recorded. A plot of actual drill path relative to design line and grade shall be maintained and updated daily, or more frequently as directed by the Engineer. Any pipe sections not meeting specified tolerances will be replaced or repaired to the Engineer's satisfaction at no additional cost to the Owner.
  3. Advance Notice and Inspections: Provide at least 72 HRS advance written notice (not including holidays or weekends) to the Engineer of planned major drilling operations including pilot bore launch, reaming, and pipe pullback. Immediately notify the Engineer in writing when any significant problems are encountered or if ground conditions are construed as being materially and significantly different than the conditions presented in the geotechnical investigation report.
  4. Surveying Equipment and Procedures: Inspect and calibrate prior to use all surveying equipment to be used for down-hole surveying and tracking of the bore and drill head.
  5. Drilling Equipment: Provide written certification by the manufacturer that the drilling equipment is capable of completing the planned installation.
- B. Regulatory Requirements:
1. Be solely responsible that the work is performed in compliance with all applicable federal, state, and local permits and safety requirements.
  2. Utilize all required safety equipment and procedures at all times.

3. Drilling equipment shall be connected to a ground with a copper conductor capable of handling maximum anticipated fault current as determined by the Contractor.
  - a. The system shall be capable of sensing contact with an energized electrical cable.
  - b. The system shall incorporate an audible alarm warning system that warns workers of electrical hazards during drilling operations.
  - c. Check the system shall be checked to verify proper operation prior to initiation of drilling operations.
4. Crew members operating drilling equipment handling drill stems near the drilling equipment shall wear hot boots and hot gloves, safety glasses and hard hats, and will stand on grounded wire mesh mats. The locator operator shall wear hot boots.

#### 1.7 SITE CONDITIONS

- A. Existing utilities and buried structures and facilities have been indicated on the Plans based on a field survey and on review of available Plans. This information is not warranted to be accurate or complete. Contractor shall contact the local utility locating service company prior to beginning excavation and shall dig test pits as required to resolve conflicts with the directional drilling operation.
- B. Water for drilling and for testing is the responsibility of the Contractor.
- C. Dispose of excess drilling fluids in approved off-site locations in accordance with state and federal laws and regulations. Provide silt fencing, check dams, and straw bales as needed.
- D. Where the butt fused pipe string is laid-out within the roadway right-of-way, maintain access to public and private entrances and driveways at all times.
- E. Clean-up and restore to pre-construction condition any public or private property disturbed or damaged during construction. Restoration shall include paved and unpaved surfaces, shrubbery, landscaping, trees, structures, and all else encountered.

- 1.8 Provide copies of written and signed agreements with adjacent property owners for any arrangements made by the contractor for use of property outside of the rights-of-way and public property shown on the plans.

## PART 2 - PRODUCTS

### 2.1 DRILLING FLUIDS

- A. Drilling fluids shall be a mixture of water and bentonite, with mixture proportions selected by the Contractor to ensure borehole stability, reduce drag on the pipe, and completely fill the annular space between the bore and the pipe to control settlement. Management and disposal of drilling fluids shall be the Contractor's responsibility.
  1. Applicable MSDS shall be maintained in the Contractor's field office for the duration of the work.

### 2.2 DRILL RODS/DRILL STEM

- A. Provide high quality drill rods that have been inspected and determined to be adequate for the project requirements. Do not use bent, cracked, or fatigued drill stem. Threads shall be in good condition. Measure and record the lengths of drill rods.
  - a. Directional drilling equipment.
- B. Drill Unit: The drill unit shall be a remote-steerable boring system that is designed specifically for use in the installation of pipelines and is capable of accurately drilling (true to line and grade) through the types and hardness of soil that the Contractor expected. Where necessary, the drilling system shall utilize a high-pressure, low-volume, liquid-assisted, mechanical rock drilling technology that is capable of installing pipelines of the diameter and length required in ground conditions that the Contractor anticipated.
- C. Crew Gear: Provide all crew members with grounded safety mats, heavy gauge ground cables with connectors, and hot boots and gloves.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Install HDPE pipe by directionally controlled horizontal drilling. This process includes drilling a small diameter pilot hole in a vertical arc from the rig side to the pipe side, and then reaming out the hole until the HDPE water pipeline can be pulled through for a complete installation.

- B. Instrumentation and Documentation: Provide and maintain instrumentation which will accurately locate the pilot hole and measure drilling fluid flow discharge rate and pressure. Allow Contracting Officer access to these instruments and their readings at all times. Plot the horizontal and vertical location of the pilot bore at intervals not to exceed 25 FT.
- C. HDPE Pipe Hydrostatic Tests: The entire butt fused length of HDPE pipe shall be hydrostatically tested after installation.
  - 1. Final Hydrostatic Test and Disinfection: Conduct final hydrostatic testing and disinfection as specified under Paragraph 3.7 herein.

### 3.2 EXAMINATION

- A. Inspection of Conditions: Inspect the site prior to initiating work to be satisfied of the general conditions and requirements of the work to be performed. Do not proceed until all unsatisfactory conditions have been corrected.
- B. Preparation:
  - 1. Protect existing structures and utilities using adequate ways and means for the duration of the project.
  - 2. Provide adequate control of surface water drainage and runoff and provide adequate erosion control measures.
  - 3. Do not initiate directional drilling before all submittals are received, reviewed, and accepted by the Contracting Officer.
  - 4. Do not initiate directional drilling until all frac-out mitigation measures and sound attenuation facilities are in place.

### 3.3 CONSTRUCTION AREA

- A. Work Area: Maintain the work area in a manner that will minimize adverse impacts on facility operation. Proceed with work in a safe, orderly manner, while maintaining the work site free of debris and unnecessary equipment and materials.
- B. Spills: Take all measures necessary to minimize and control drilling fluid spillage and returns at entry and exit points, and at intermediate points, by controlling operating pressures, drilling speed, and other operational factors. Promptly clean up all inadvertent returns or spills. Mobile spoil removal equipment will be on site during all drilling, prereaming, reaming, and pullback operations and shall be capable of quickly removing spoils. Notify the Engineer immediately of any inadvertent returns and spills and immediately clean up the return and spill.
- C. Protection: The Contractor's procedures and equipment shall provide protection of workers, particularly against electrical shocks.
- D. Storage: Store combustible materials (fuel, oil, lubricants, etc.) in a well-ventilated storage facility removed from the immediate vicinity of the drilling area by at least 20 FT.

- E. Water Supply: Water supply for the project will be metered by the Owner.
  - 1. Coordinate with Owner for water used for HDD construction. Only recycled water is allowed to use.
  - 2. Be responsible for cost of any construction water.
- F. Temporary Lighting: Procure and maintain all temporary lighting needed for Contractor's operations, safety, testing, and inspection.
- G. Mobile Telephone Service: Provide mobile telephone service for all key personnel engaged in construction activities at the project site, throughout the construction period. Post emergency numbers and numbers of key site personnel for the Contractor, Engineer, and Owner shall be posted at each phone location.
- H. Removal of Temporary Facilities: Remove all temporary facilities at the completion of construction. Remove and dispose unneeded soil, aggregate, and other materials at approved sites. Restore to original condition any damage to streets, sidewalks, lawns, and common areas.

#### 3.4 MOBILIZATION

- A. Mobilize all equipment, materials, and personnel necessary to construct a new pipeline as indicated using the Horizontal Directional Drilling process.
- B. Entry Pit and Exit Pit Work Areas:
  - 1. The horizontal directional drilling pilot bore shall be launched from an at-grade entry pit.
  - 2. The horizontal directional drilling pilot bore shall terminate at an at-grade exit pit.
  - 3. Employ appropriate precautions and measures to prevent erosion, surface drainage, and spillage of drilling fluids and other materials that could adversely impact the environmental quality of the site.
  - 4. Use hay bales to line the work area to minimize erosion and runoff and protect the site. Mobile spoils removal equipment capable of quickly removing any spoils from entry and exit pits or other areas shall be present during all drilling, reaming, and pullback operations.
  - 5. Provide and use appropriate safety equipment and procedures as deemed appropriate, based on accepted standard industry practices and these Specifications.

### 3.5 DIRECTIONAL DRILLING

- A. Provide all equipment, materials, and personnel necessary for completing the pipeline installation as indicated. The equipment and materials shall include:
1. Directional drilling rig with all necessary ancillary equipment, including drill stem, cutting bits, reaming bits, swivels, expanders, motors, pumps, hoses, mixing equipment, drilling fluid processing equipment (cuttings separation equipment), downhole survey equipment, fluid pressure and flowrate monitoring equipment, spare parts, pipe handling equipment, crane, backhoe, roller, sideboom tractors, control cabin and control equipment, and office equipment.
  2. Drilling fluids, water, fuel, lubricant, polymers, or other additives.
  3. Any other expendable or reusable materials, supplies, and equipment needed for the installation.
- B. Borehole Profile: Provide a vertical profile for the borehole similar to the design profile indicated.
1. Be responsible for designing and achieving a vertical profile for the borehole based on the directional drilling rig suitable for the project.
- C. Pilot Hole: The pilot hole shall follow the Contractor's design of the vertical profile for the borehole.
1. Radius of curvature: The radius of curvature shall not be less than the calculated minimum value to maintain pipe stresses within allowable limits, including the appropriate safety factor. The radius of curvature shall be calculated over the distance of three drill stem sections.
  2. Entry and Exit Tolerances: Locations of entry and exit points indicated are approximate. Beginning and ending stationing, and pipeline bearing and distance indicated are approximate.
  3. Drill Rig Capacity: The drill rig shall have the capacity to install the specified pipeline. The system should have thrust, pullback, and torque capacities at least double, that is 100 percent greater than the required values of thrust, pullback, and torque calculated and submitted as necessary for the installation.
  4. Instrumentation and Monitoring: Provide and maintain an instrumentation and monitoring system that is capable of accurately locating the position of the drill head in the x, y, and z axes, that is capable of monitoring and recording drilling fluid pressures and flowrates, and drill stem thrust, torque, and pullback loads. These data shall be recorded at least twice per drill pipe length or every 15 FT or 15 minutes, whichever is most frequent.
    - a. Submit these data to the Engineer within one working day of the date to which the records pertain.
    - b. Allowable tolerances are:
      - 1)  $\pm 3$  IN vertical.
      - 2)  $\pm 4$  IN horizontal.

5. Position of Drill Head: Monitor and record x, y, and z coordinates relative to an established surface survey benchmark, from downhole survey data and surface survey data, using the Tru Tracker or equivalent surface survey system. The data shall be recorded at least twice per drill stem length or at 15 FT or 15 minute intervals during drilling, whichever is most frequent. Deviations between the recorded and design bore path will be calculated and reported on the daily log. If the deviations exceed tolerances specified elsewhere, such occurrences will be reported immediately to the Engineer.
6. Drill Stem Thrust and Torque: Measure and record drill stem thrust and torque at least twice per drill stem length or at 15 FT or 15 minute intervals during pilot hole drilling, whichever is most frequent. Report sudden increases in torque or thrust to the Engineer immediately. Report instances of thrust, torque, or pullback exceeding allowable limits to the Engineer immediately.
  - a. Submit prereaming, reaming, and pullback thrust and torque measurements with daily logs.
7. Drilling Fluid Pressures and Flow Rates: Monitor and record drilling fluid pressures and flowrates continuously. Monitor the pressures at the entry point, at the injection nozzle, and at two locations within 2 FT behind the drill head in the annular space between the drill stem and bore or between the pipe and bore. Take these measurements during pilot hole drilling, during reaming and pullback operations.
  - a. Submit fluid pressure and flow rate measurements with daily logs.
  - b. Disposal: Disposal of drilling fluids, at approved off site locations, shall be the responsibility of the Contractor and shall be conducted in compliance with all pertinent environmental regulations, right-of-way and workspace agreements and permit requirements. Disposal of drilling fluids into drainage courses shall not be allowed.
  - c. Inadvertent Returns: Drilling fluid returns at locations other than the entry and exit points shall be minimized. Contractor shall immediately clean-up inadvertent returns.
8. Drilling Fluid Viscosity and Density: Measure and record drilling fluid viscosity and density at least 3 times per shift with at least 2 HRS between readings, using calibrated Marsh funnel and mud balance. Include these measurements in daily logs submitted to the Engineer. Document modifications to the drilling fluids by noting the types and quantities of drilling fluid additives and the dates and times when introduced. Document and report the reason for the addition of drilling fluid additives or other modifications.
  - a. Submit these measurements and documentations in the daily logs.

9. Obstructions: In the event that any obstruction is encountered that prevents further advancement of the drill stem, or pullback of the prereamer, reamer, and/or pipe notify the Engineer immediately. Investigate the cause and determine an appropriate response. Appropriate response may include revisions to equipment or methods, retraction and redrilling of a portion of the bore, or abandonment of the hole. If abandonment is deemed necessary, recover, to the extent practically possible, any drill stem, pipe, and tools in the bore, and properly abandon the bore, unless otherwise directed in writing by the Engineer. Pressure-grout the abandoned bore with a lean cement-sand grout mixture, or other approved materials if the bore is abandoned. If the bore is abandoned, be allowed to begin a second attempt to install the pipeline at an alternate location approved in writing by the Engineer. In any case, take all reasonable actions to complete the installation with minimal delays. The extra costs and payments to the Contractor, if any, will be negotiated between the Owner and Contractor, based on the cause and reasonable time and materials. For purposes of this contract, an obstruction is defined as any hard object lying completely or partially within the design pathway of the bore and pipeline that prevents further advancement of the drill stem, reamer, and pipe.

D. Pipe Installation:

1. Install Polyethylene Pipe per ASTM F1962 - 11
2. Pipe shall be pulled into the bore hole at a controlled rate to avoid pipe buckling, abrasion damages to pipe surface, hydrofracture, etc.
3. Pipe shall be supported on rollers as recommended by the pipe manufacturer.
4. Never have the pull back force to exceed the allowable pull back force recommended by the manufacturer.
5. Never bend the pipe so that the bend radius is less than the minimum radius recommended by the manufacturer.
6. The radius of the bore shall also consider the minimum allowable bending radius for the drilling rods or pipe.

E. Joining Procedures:

1. HDPE pipe joints shall be fused on the surface prior to installation.
  - a. Alternative methods of fusing shall be approved by the Engineer.
  - b. PE pipe 1 IN and under shall be socket fused.
  - c. PE pipe joints 1-1/2 IN and over shall be butt fused.
2. Fusion joiner must be qualified by type of fusion (i.e., butt fusion, socket fusion or sidewall fusion) and fuse pipe only as qualified.
3. Each joint must be visually inspected inside and outside for damage, dirt, moisture, or any other abnormalities prior to fusing.
4. All joint fusion shall be performed in strict accordance with the manufacturer's specifications.
5. All fusion equipment must be approved by the manufacturer and operated by qualified and certified operators.
  - a. Cost for testing and certifying personnel shall be born by the Contractor.

- F. Site Restoration and Demobilization: Remove all equipment, materials, and waste or debris from the site and restore site to its original condition upon completion of the installation.

### 3.6 INTERNAL INSPECTION OF INSTALLED PIPE

- A. After installation of the HDPE forcemain, conduct an internal inspection of the pipeline, in the presence of the Engineer, using a mandrel or pipeline pig designed for that purpose to demonstrate that the pipe has not collapsed or deflected excessively.
- B. Devices pulled through the forcemain, shall be designed to prevent damage to the HDPE pipe.

### 3.7 FINAL TESTING

- A. Upon completion of installation of the directionally drilled water pipeline, perform hydrostatic and bacteriological testing in accordance state and local standards, and as specified below.
- B. Provide pumps, piping, fittings, calibrated gages, and all else required to complete the required testing.
- C. Conduct final hydrostatic tests in accordance with HDPE pipe manufacturer's written recommendations, and as follows:
  - 1. Fill the pipeline with water and bleed off trapped air.
  - 2. Subject the pipe section to 150 PSI at the highest point of the line for a 4 HR period. Sufficient water shall be added at the end of each hour to maintain 150 PSI.
  - 3. At the conclusion of the fourth hour, water shall be added to reestablish the 150 PSI test pressure and the actual test will begin. The pipe shall then be maintained between 145 PSI and 150 PSI over the next 3 HRS by adding measured amounts of water with a small volume, high pressure pump.
  - 4. Record the volume of make-up water added to maintain the specified pressure. The total amount of water added over the 3 HR period shall not exceed 3.4 GAL per 100 FT of pipe tested.
  - 5. The total duration of the testing procedure shall not exceed 8 HRS.
  - 6. A minimum of 16 HRS is required between the conclusion of one hydrostatic test and the commencement of another test. During this 16 HR period between tests, the pipe must be depressurized, but is not required to be drained.
  - 7. Allowable starting times for the hydrostatic tests shall be between 8:00 AM and 10:00 AM, Monday through Thursday, exclusive of Contracting Officer observed holidays.
- D. Pneumatic testing will not be allowed at any time.
- E. Upon acceptance of final hydrostatic testing, reduce the pressure to zero gauge and leave with the blind flanges in place until connection with the adjacent forcemain commences.

3.8 DISPOSAL

- A. Drilling Mud: Dispose drilling mud waste, in a legal manner, to an off-site waste disposal facility that can readily accept such waste.

END OF SECTION

## SECTION 33 05 16 - PRECAST CONCRETE MANHOLE STRUCTURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Precast concrete structures and appurtenant items.
  - a. Sanitary sewer manholes, septic tanks, and appurtenances.

##### B. Related Specification Sections include but are not necessarily limited to:

1. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.

#### 1.2 QUALITY ASSURANCE

##### A. Referenced Standards:

1. ASTM International (ASTM):
  - a. A48/A48M, Standard Specification for Gray Iron Castings.
  - b. A536, Standard Specification for Ductile Iron Castings.
  - c. C150/C150M, Standard Specification for Portland Cement.
  - d. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
  - e. C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
  - f. D1227, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
  - g. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free.

#### 1.3 SUBMITTALS

##### A. Shop Drawings:

1. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.
2. Concrete mix design(s):
  - a. Submit detailed mix design.
  - b. Certification in accordance with ASTM C858, Section 12.

3. Fabrication and/or Layout Drawings:
    - a. Include detailed diagrams of utility structures showing typical components and dimensions, reinforcement, and other details.
    - b. Itemize, on separate schedule, elevations or sectional breakdown of each utility structure with all components and refer to drawing identification number or notation.
    - c. Indicate required penetration details for all piping entering each structure.
  4. Drawings and calculations: All Drawings, including Layout Drawings, certifications and calculations shall be sealed by a Professional Engineer registered in the state where the project is located.
    - a. Provide certification stating that calculations provided have been prepared specifically for this Project and that they match and pertain to the Shop Drawings provided.
    - b. Provide a summary document as part of the above certification listing the design criteria used for precast design including:
      - 1) Codes and standards.
      - 2) Soil load.
      - 3) Exterior groundwater load.
      - 4) Live loads.
      - 5) Other loads.
  5. Test Reports:
    - a. Copies of source quality control tests, including compressive strength and air content, for units provided.
  6. Buoyancy uplift and structural calculations.
- B. Unless approved prior to submittal, submit all products from this Specification Section in one complete submittal package. Include all products and accessories together.
1. Certifications.
  2. Test reports.

#### 1.4 SITE CONDITIONS

- A. Design groundwater elevation for precast structure design shall be the 100-year flood elevation shown on the Contract Documents.
1. If the 100-year flood elevation is not shown on the Contract Documents, the design groundwater elevation shall be equal to the ground surface elevation at the structure.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Access doors: Per Drawing details.
2. Manhole rings, covers and frames:
  - a. Neenah Foundry and Neenah Enterprises, Inc.
  - b. Deeter Foundry.
3. Premolded joint sealant:
  - a. NPC Bidco, Inc., C-56.
  - b. Ram-Nek, Henry Co.
  - c. EZ-Stik, Press-Seal Gasket Corp.
  - d. CS-102, Conseal.
4. Elastomeric joint seals:
  - a. Kent Seal.
5. External joint wrap.
  - a. NPC, Bidco, Inc.
  - b. EZ-Wrap, Press-Seal Gasket Corp.
  - c. RUBR-Nek, Henry Co.
6. Emulsified fibrated asphalt compound:
  - a. Sonneborn Hydrocide 700B Semi-Mastic.

### 2.2 SANITARY SEWER, MANHOLE STRUCTURE COMPONENTS

A. Provide utility structures with interior dimensions as shown on the Drawings.

B. Provide the following components for each utility structure:

1. Precast base section with integral or cast in place base slab.
2. Precast wall section(s).
3. Precast flat top.
  - a. Where reinforcement is shown for top slab, furnish slab with reinforcing as designed, but not less than reinforcing shown on Drawings.

- C. Provide openings and appurtenances as shown on Drawings.
  - 1. Access doors:
    - a. Cast access doors into top slab.
    - b. Where access door frames have drainage channels, cast PVC drain lines in top slab to drain location shown on Drawings. If no drain location is shown, drain frames to outer edge of top slab.
    - c. Protect doors and frames from damage during concrete placement and shipping.
    - d. See Specification Section 08 31 00.
  - 2. Manhole frames and covers:
    - a. Furnish and install in accordance with Specification Section 33 05 16.
    - b. Cast frames into top slab.
- D. Special Coatings and Joint Treatment:
  - 1. Joints of precast sections:
    - a. Black mastic compound: ASTM D4586.
  - 2. Vertical wall surfaces:
    - a. Emulsified fibrated asphalt compound meeting ASTM D1227 Type II for all exterior and interior vertical wall surfaces.
- E. Sanitary Sewer Manhole Concrete:
  - 1. Provide all sanitary manholes constructed with Portland ASTM C150/C150M, Type I or II cement with a tricalcium aluminate content not to exceed 8%.
  - 2. Mix aggregate shall be a minimum of 50% crushed limestone.
  - 3. Provide 3000 PSI non-shrink grout.

## PART 3 - EXECUTION

### 3.1 MANHOLE CONSTRUCTION

- A. General:
  - 1. Construct cast-in-place concrete base slabs.
  - 2. Make inverts with a semi-circular bottom conforming to the inside contour of the adjacent sewer sections.
  - 3. On all straight runs, lay pipe through manhole and cut out top half of pipe.
    - a. See detail on Drawings.
    - b. If pipes deflect at manhole, shape as specified in Paragraphs 2 and 4 IN this General Paragraph.

4. Shape inverts accurately and steel trowel finish.
  - a. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert using as large a radius as manhole inside diameter will permit.
  - b. Pour base slab integral with bottom barrel section.
- B. Build each manhole to dimensions shown on plans and at such elevation that pipe sections built into wall of manhole will be true extensions of line of pipe.
- C. For all horizontal mating surfaces between concrete and concrete or concrete and metal, above established high groundwater elevation shown trowel apply to clean surface black mastic joint compound to a minimum wet thickness of 1/4 IN immediately prior to mating the surfaces.
- D. For all horizontal mating surfaces between concrete to concrete and concrete to metal, install resilient O-ring type gaskets.
- E. For horizontal joints that fall below established high groundwater elevation shown, install a resilient O-ring type gasket or pre-molded joint compound.
- F. If PVC pipe is specified, pipe manufacturer shall install resilient O-ring gaskets centered in wall of manhole.
- G. Seal all pipe penetrations in manhole.
  1. Form pipe openings smooth and well shaped.
  2. After installation, seal cracks with, non-shrink grout.
  3. After grout cures, wire brush smooth and apply two coats emulsified fibrated asphalt compound to minimum wet thickness of 1/8 IN to ensure complete seal.
- H. Set and adjust frame and cover final 6 IN (minimum) to 18 IN (maximum) to match finished pavement or finished grade elevation using precast adjuster rings.

END OF SECTION

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## SECTION 33 05 33 - POLYETHYLENE UTILITY PIPE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Polyethylene pipe.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

#### 1.2 QUALITY ASSURANCE

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - b. A197, Standard Specification for Cupola Malleable Iron.
    - c. D638, Standard Test Method for Tensile Properties of Plastics.
    - d. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
    - e. D1693, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
    - f. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
    - g. D2513, Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
    - h. D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
    - i. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
    - j. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
  - 2. Society for Protective Coatings (SSPC):
    - a. SP 3, Power Tool Cleaning.

#### 1.3 DEFINITIONS

- A. SDR: Standard Dimension Ratio.
- B. IPS: Iron Pipe Size.
- C. CTS: Copper Tube Size.

D. ESCR: Environmental Stress Crack Resistance.

#### 1.4 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 40 05 00.
2. Certifications: Installer certification.
3. Field quality control documents.
4. Test reports.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers of PE pipe are acceptable:

1. Phillips Driscopipe.
2. Plexco.
3. Polypipe.

B. See Specification Section 40 05 00.

#### 2.2 PE 4710 PIPING

A. General:

1. Provide PE 4710 piping with fittings and appurtenances to locations shown on Drawings.
2. Furnish materials in accordance with ASTM D2513 and in full compliance to the following material specifications:
  - a. Material description: ASTM D1248, Type III, Class C, Category 5, Grade P34.
  - b. Cell classification: ASTM D3350, PE 445574C.
  - c. ESCR: ASTM D1693, condition C,  $F_0 > 5,000$  HRS.
3. Modulus of elasticity: ASTM D638, 130,000 PSI.
4. Hardness: ASTM D2240, 65 Shore D.
5. SDR: 9.0.
6. IPS for line size greater than 1 IN.
7. CTS for line size less than or equal to 1 IN.

B. Fittings:

1. ASTM D2513.
2. SDR: 9.0.

3. 1/2 to 3 IN: ASTM D2683.
  4. 4 to 10 IN: ASTM D3261.
  5. End connections:
    - a. Socket fused ends for fittings 1 IN and under.
    - b. Butt-fused ends for fitting 1-1/2 IN and greater.
  6. Use IPS reducers on the service mains.
  7. Use tapping tees or straight outlet service saddles to join service lines to the main.
  8. Mitered or field fabricated fittings are not allowed.
- C. Installation: Install pipe and fittings in accordance with ASTM F1962 and as recommended by the manufacturer.
1. Provide for a maximum deflection of not more than 5 PCT.
  2. PE 4710 shall not be field threaded and such threaded joints shall not be used in gas distribution systems.
- D. Deflection:
1. After backfilling, each section of pipe shall be checked for deflection by pulling a mandrel through the pipe.
  2. Pipe with deflection exceeding 5 PCT of the inside diameter shall have backfill removed and replaced to provide a deflection of less than 5 PCT.
  3. Any repaired pipe shall be retested.
- E. PE 4710 to Steel Transition Fittings:
1. When connecting plastic to steel use either Universal Maxi-Grip Coupling or weld-in transition fitting.
  2. Universal Maxi-Grip Coupling:
    - a. Match coupling size with pipe size.
    - b. For 1-1/4 IN IPS and 2 IN IPS Maxi-Grip provide sheer sleeve protector.
  3. Install according to Maxi-Grip Fitting Installation Procedures.
    - a. Construction:
      - 1) 12 IN long steel nipple, swaged at one end and weld bevel of 37-1/2 on the other.
        - a) Closed grooves machined on inside of diameter of the swaged section.
        - b) Plastic pipe with a steel insert pushed into the swaged end shall form a joint stronger than the yield strength of the plastic pipe.
        - c) Steel nipple shall be coated with heat fused epoxy.

- 2) Firmly pack and bed the sleeve to its final grade with sand or sand/clay mixture.
    - a) Manually backfill and tamp the bellhole to ensure the sleeve is centered around the pipe and the pipe and transition fitting are well supported.
  - b. Installation:
    - 1) Connect the steel side of the transition fitting to steel pipe by welding.
      - a) During installation, prevent plastic pipe portion of fitting from being overheated by wrapping wet cloths around plastic pipe portion of fitting before welding.
      - b) After second weld pass, stop and allow joint to cool for at least 5 minutes then continue with final pass.
    - 2) During welding process, keep the cloths wet.
      - a) Do not remove wet cloths until you can put your hand on the weld area.
    - 3) Before fusion of the plastic, place a protective sleeve over the steel section of the fitting.
      - a) See the following table for protective sleeve size.
    - 4) Join the plastic side of the transmission fitting to the plastic pipe by heat fusion.
      - a) Position protective sleeve to proper cantilever length as indicated on the following table.
    - 5) Firmly pack and bed the sleeve to its final grade with sand or sand/clay mixture.
      - a) Manually backfill and tamp the bellhole to ensure the sleeve is centered around the pipe and the pipe and transmission fitting are well supported.
4. Transition fitting and protective sleeve sizes:

TRANSITION FITTING	PROTECTIVE SLEEVE SIZES			
1 IN CTS	1-1/4 IN	1.8 IN	13.8 IN	10.8 IN
2 IN IPS	2 IN	4.7 IN	23 IN	19 IN
3 IN IPS	3 IN	6.0 IN	28 IN	23 IN
4 IN IPS	4 IN	7.0 IN	34 IN	29 IN

## PART 3 - EXECUTION

### 3.1 IDENTIFICATION

- A. Identify each length of pipe clearly at intervals of 5 FT or less.
  - 1. Include manufacturer's name and trademark.
  - 2. Nominal size of pipe, appurtenant information regarding polymer cell classification and critical identifications regarding performance specifications, and "NSF" approvals when applicable.

### 3.2 INSTALLATION

- A. See Specification Section 33 05 07 and Section 40 05 00.
- B. General:
  - 1. Install buried pipe as indicated on Drawings.
  - 2. Insure that kinking or excessive bend diameters of the pipe do not occur during the installation process.
  - 3. Insure that the pipe installed in the trench is firmly supported.
  - 4. Cap all open pipe ends at the end of the work day.
  - 5. All installed valves shall be tested in the presence of the Engineer.
    - a. All repairs deemed necessary by the Engineer shall be made by the Contractor.
  - 6. Remove any cave-in portions of the trench prior to placing sand bagging around the pipe.
  - 7. HDPE pipe and fittings shall be by the same manufacturer.
    - a. The minimum strength of the fittings shall not be less than that of the pipe.
  - 8. Service taps shall be installed as shown on the Drawings.
  - 9. Changes in direction of PE Pipe:
    - a. Pipe may be cold-bent to minimum radius of 20 times the pipe diameter as it is installed.
    - b. If fittings or fusions are present in the bend, the minimum recommended cold bending radius is 125 times the outside diameter of the pipe.
  - 10. Remove cutting and threading burrs.
- C. Joining Procedures:
  - 1. HDPE pipe joints shall be fused on the surface prior to installation into the trench.
    - a. Alternative methods of fusing shall be approved by the Engineer.
    - b. PE pipe 1 IN and under shall be socket fused.

- c. PE pipe joints 1-1/2 IN and over shall be buttfused.
- 2. Fusion joiner must be qualified by type of fusion (i.e., butt fusion, socket fusion or sidewall fusion) and fuse pipe only as qualified.
- 3. Each joint must be visually inspected inside and outside for damage, dirt, moisture, or any other abnormalities prior to fusing.
- 4. All joint fusion shall be performed in strict accordance with the manufacturer's specifications.
- 5. All fusion equipment must be approved by the manufacturer and operated by qualified and certified operators.
- a. Cost for testing and certifying personnel shall be born by the Contractor.

END OF SECTION

## SECTION 33 31 11 - GRAVITY SEWER PIPELINE AND MANHOLE CONSTRUCTION

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Installation and testing of sewer pipes, manholes, structures and appurtenances.
2. Connections to existing sewers.
3. Coordination and interface with existing facilities and utilities.

##### B. Related Specification Sections include but are not necessarily limited to:

1. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
2. Section 32 91 13 - Topsoiling and Finished Grading.
3. Section 33 05 16 - Precast Concrete Manhole Structures.
4. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
5. Section 33 05 33 - Polyethylene Utility Pipe.

#### 1.2 QUALITY ASSURANCE

##### A. Referenced Standards:

1. ASTM International (ASTM):
  - a. C1244, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
  - b. F1417, Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air.
2. Occupational Safety and Health Administration (OSHA).

#### 1.3 SUBMITTALS

##### A. Shop Drawings:

1. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Catalog data sheets for all materials.
  - c. Details of all piping system components confirming that the pipe, fittings, and appurtenances conform to the specified requirements.
  - d. Manufacturers' written recommendations for material handling, delivery, storage, installation, and minor repair of materials damaged in shipping.

- e. Recommended details for buoyancy restraint and for manhole/pipe connections.
  - f. Fabrication and/or layout drawings as specified in individual pipe material specifications.
- 2. See individual pipe material specifications for additional required submittals.
- B. Test Reports:
  - 1. Submit results of leakage tests including the following:
    - a. Test procedure.
    - b. Pipeline segment tested.
    - c. Length of pipe tested.
    - d. Test pressure.
    - e. Test duration.
    - f. Amount of leakage.
    - g. Corrective action, if any.
- C. Contract Closeout Information: Operation and Maintenance Data.

#### 1.4 DELIVERY, STORAGE, AND HANDLING OF PRODUCTS

- A. In addition to the requirements specified in this section, see related paragraphs in individual pipe specifications.
- B. Deliver, handle and store products in accordance with manufacturer's instructions.
- C. Protect pipeline sections stored at the site from damage.
- D. Store all products above the ground upon platforms, pallets, skids, or other supports supplied by the Contractor.
  - 1. Store in a way to permit ready access for identification and inspection by the Engineer.
- E. Keep products free from dirt and other foreign matter.
- F. Provide suitable quantities of all lifting equipment to handle the pipe.
  - 1. Do not utilize any equipment that is not rated to handle the intended loading or conditions of use to which it will be subjected, or which will damage or gouge the pipe.
  - 2. Do not drag or drop pipe.
- G. Place pipe lain directly on the ground prior to placement on an area free of loose stones or sharp objects.

- H. Repair or replace any new pipe and fittings damaged before or during installation at Contractor's expense, before proceeding further.
  - 1. Utilize repairs methods as recommended by the manufacturer.
  - 2. Replace damaged materials as directed by Owner's project representative.
- I. Protect PVC pipe from UV degradation if stored outside for more than 30 days.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Pipe:
  - 1. See individual pipe material specifications listed in Paragraph 1.1 B above.
- B. Manholes: See Specification Section 33 05 16.
- C. Fill and Backfill at manholes: See Specification Section 31 23 33.
- D. Embedment and Bedding Materials for pipelines: See Section Specification 31 23 33.
- E. Size mandrels to meet deflection requirements specified herein or in the individual pipe material specifications.
- F. Pipe Joint Testing Equipment:
  - 1. Utilize joint testing equipment capable of providing sufficient sealing pressure for air bladder to prevent leakage through bladder seals.
  - 2. Include pressure gage to aid in verification of adequate applied pressure and joints ability to withstand the applied pressure without leaking.
  - 3. Utilize joint testing equipment that encapsulates the full 360 DEG circumference of the joint and at least 6 IN each side of the joint.
  - 4. Pipes furnished with an integral "testable" joint, consisting of two gaskets with fittings to pressure test between the two gaskets, will be tested using the test equipment and fittings recommended by the pipe manufacturer.

## PART 3 - EXECUTION

### 3.1 GENERAL REQUIREMENTS

- A. Furnish all construction materials and equipment required for installation and backfill.
- B. Install the pipeline complete, including bends, stop logs, and other associated work and appurtenances, as shown on the Drawings or as herein specified.
- C. Make all necessary connections to sewer lines shown on the Drawings and in accordance with the Specifications.

- D. Construct all sewer piping, manholes, and structures to be free of visible ground water inflow.
  - 1. Install sanitary sewer manholes and structures that are watertight.
    - a. Repair or replace any manhole or structure showing infiltration of ground water through joined surfaces, pipe to manhole/structure connections or manhole/structure wall.
  - 2. Install pipe with watertight pipe joints.
    - a. Repair or replace any joint showing infiltration of ground water through pipe joints or pipe to manhole connections.
- E. Alignment: Lay gravity sewer lines in straight alignment and uniform grade between manholes.
  - 1. Install at grade as shown on Drawings.
- F. Brace and protect pipe sections to prevent deformation during installation and backfill.
- G. Deflection: Pipe deflection after final backfill shall not exceed the specified limits detailed in the individual pipe specifications.
  - 1. Remove and replace any pipe observed to be deflecting in excess of the specified limits.
- H. Perform testing in accordance with requirements of this Section.
- I. Provide Engineer with free access to work for inspection.
  - 1. Such inspection shall not relieve the Contractor of his responsibility for performing Work in accordance with the Contract Documents.

### 3.2 PIPELINE INSTALLATION

- A. Lateral shoring of the trench walls or other similar construction methods may be required.
  - 1. Design and implement all such methods.
  - 2. When required, install shoring in accordance with all applicable local, State and OSHA regulations.
  - 3. Remove shoring prior to backfilling.
- B. Grade bottoms of trenches such that when bedding is placed between the trench bottom and the pipe, each section of pipe is installed to the specified depth or elevation with uniform support.
- C. Determine and fix alignment and grade or elevation of each pipeline from offset stakes or calibrated laser instruments.

- D. Install pipelines on the line and grade shown on the Drawings.
  - 1. Calculate required elevation of each pipe joint and survey installed elevation at each joint prior to stabbing the next joint to verify grade.
  - 2. Relay pipe to proper grade if any joint elevation deviates from the calculation by more than 0.01 FT.
- E. Remove material at the bottom of the trench if determined to be unsuitable by the Engineer.
  - 1. Backfill trench with approved subgrade material or bedding material to the specified depth or elevation as described in Specification Section 31 23 33.
- F. Install only clean pipe and fittings.
  - 1. Provide physical barriers to protect open ends of sections of pipe in place from the entrance of trench water, mud, dirt, or other foreign substances with when pipe installation is not in progress.
- G. Begin pipe laying at the lowest elevation with bell ends facing the direction of laying, except when reverse laying is permitted by Engineer.
- H. Where the drawings require concrete encasement or flowable fill embedment and backfill, anchor pipe as required to prevent floatation.
  - 1. Alternatively, Contractor may place concrete or flow fill materials in staged lifts allowing each lift to reach initial set prior to placing the subsequent lift to limit buoyancy effects and prevent floatation of the pipeline.
- I. Pipeline may be backfilled as it is installed, provided all inspection and testing requirements are met.
- J. Pipe, fittings, and special pieces will be subject to inspection by Engineer, prior to installation.
  - 1. Report all damages not detected by Engineer but discovered by Contractor during installation to Engineer for corrective action or replacement.
- K. Repair of pipe damaged during installation shall conform to the manufacturer's repair procedures; with the concurrence of Engineer.

### 3.3 RESTORATION

- A. Restore all existing structures or services damaged by Contractor's operations at no cost to Owner.
  - 1. Repair or replace culverts that are damaged, removed or interfere with the work as part of restoration at no additional cost to Owner.

- B. Restore all area disturbed by installation of the pipelined in accordance with the Specifications, the Drawings:
  - 1. Provide slope protection, re-vegetation, and road restoration as necessary.
- C. Gravel Surfaced Drives and Roadways:
  - 1. Restore all damaged gravel surfaced drives and roadways to a condition equal to or better than original.
- D. Trees:
  - 1. Do not remove trees without written instructions from the Engineer unless tree removal is shown on Drawings.
  - 2. No separate payment will be made for tree removal and the cost shall be included in the bid unit price sewer pipe.
- E. Fences, Signs, Mailboxes, etc.:
  - 1. Restore all damaged fences, signs, mailboxes, etc., to their original conditions.
    - a. No separate payment will be made for these items.

#### 3.4 PROTECTION OF EXISTING UTILITIES

- A. Verify the location of all underground utilities.
  - 1. Omission from, or the inclusion of utility locations on the plans is not to be considered as the nonexistence of or a definite location of existing underground utilities.
- B. Notify utility representative prior to construction to obtain available information on location of existing utilities.
  - 1. Contractor shall be responsible for locating all utilities.
- C. Notify representative of the underground utilities 24 HRS in advance of crossings.
- D. Existing water services and sewer services:
  - 1. Repair damage to existing water service using copper pipe and union the same size as existing service.
  - 2. Repair damage to existing sewer laterals with pipe of same size and material as damaged pipe.

### 3.5 FIELD QUALITY CONTROL

#### A. General Testing Requirements:

1. Furnish necessary personnel, materials, and equipment, including bulkheads, restraints, anchors, temporary connections, pumps, water, pressure gauges, and other means and facilities required to perform tests.
2. Obtain Engineer's approval of methods and the equipment used for the tests prior to testing.
3. Provide reasonable facilities and access for Engineer to inspect, test and obtain such information as required with respect to the materials used and the progress and condition of the Work and the results obtained.
  - a. Work that is not performed in accordance with the procedure or does not comply with the requirements of the Specifications will be rejected.
4. Coordinate testing schedules with Engineer.
  - a. Perform all specified tests under observation of Engineer.
  - b. Provide a minimum of 48 HRS advance notice prior to commencing any testing.
5. Perform testing as work progresses and as required to facilitate connections with existing sewers.
6. Obtain water for testing and cleaning at no additional cost to the Owner.
7. Test only those portions of pipes that have been installed as part of this Contract.
  - a. Test new pipe sections prior to making final connections to existing piping.
  - b. Furnish and install plugs, bulkheads, and restraints required to isolate new pipe sections.
8. Unsuccessful Tests:
  - a. Where tests are not successful, correct defects or remove defective piping and appurtenances and install piping and appurtenances that comply with the specified requirements.
  - b. Repeat testing until tests are successful at no additional cost to Owner.
9. Deflection:
  - a. Check each section of pipe after backfilling for deflection by pulling a mandrel through the pipe.
  - b. Conduct test after the final backfill has been in place at least 30 days.
  - c. Maximum long term deflection: less than 5% of the initial diameter.

#### B. Low Pressure Air Testing:

1. Test all gravity sewer pipes with a low pressure air test.
  - a. Comply with ASTM F1417.

- b. Time elapsed for a 1 PSI drop in air pressure: Per ASTM F1417.
    - c. Maximum air loss: Per ASTM F1417.
  - 2. Submit schedule to Engineer for approval prior to starting the tests.
  - 3. Conduct air test after the final backfill has been in place for a minimum of 30 days.
  - 4. Correct pipes failing air test and conduct second test after final backfill has been in place an additional 30 days.
  - 5. If the length of sewer to be tested is fully or partially submerged in groundwater, increase test pressure as necessary to overcome the actual static pressure exerted by the groundwater.
    - a. If a test pressure greater than 8 psi results, utilize water infiltration testing in lieu of air testing.
  - 6. Locate leaks by testing short sections of pipe.
    - a. Repair leaks and retest affected reach of sewer.
- C. Deflection Testing: Test all flexible sewer pipes for deflection.
- 1. Perform the mandrel test with the Engineer in observance for all pipe sizes.
  - 2. Deflection limits: as indicated in the individual pipe sections or as specified in article titled "General Testing Requirements" above, whichever is more stringent.
  - 3. Conduct test after the final backfill has been in place at least 30 days.
  - 4. Correct pipes failing deflection test and conduct second test after final backfill has been in place an additional 30 days.
- D. Joint Testing:
- 1. Test all sewer pipe joints
  - 2. Conduct test after final backfill has been in place for at least 30 days.
  - 3. Supply pressure gages of type, calibration, accuracy acceptable to the Engineer.
    - a. Engineer may request certification of the gages by a reliable testing firm and may compare these gages with an Owner's gage at any time.
  - 4. Repair or replace pipe joints that do not pass joint test and retest.
    - a. Conduct retests after repairs have been made and final backfill has been in place for 30 days.
  - 5. Test procedure:
    - a. Center joint tester over joint to be tested and inflate seals.
    - b. Apply 3.5 PSIG pressure to joint and allow pressure to stabilize.
    - c. If the pressure holds or drops less than 1 PSI in 30 SEC, joint is acceptable.

6. When pipe materials are provided with a “testable joint”, cap testing tube securely with a plug at testing port following successful completion of joint test and acceptance by Engineer.

E. Manhole Testing:

1. Vacuum test all manholes per ASTM C1244 for leakage after installation, before epoxy lining is placed, and prior to being backfilled.
2. Visually inspect all manholes for leaks and defects prior to vacuum testing.
3. Repair all leaks, defects or cracks discovered by visual inspection prior to vacuum testing.
4. Seal all pipes entering manholes at a point outside the manhole walls so as to include testing of the pipe/manhole joints.
5. Make all necessary repairs and retest the manhole.
  - a. Inspect exterior of the manhole during this period for visible evidence of leakage.
  - b. All repairs will be subject to acceptance by the Engineer.

END OF SECTION

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## SECTION 33 32 13 - PACKAGE SEWAGE PUMPING STATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Package sewage pumping station, structural components, process equipment, piping, valves, HVAC, electrical and control components, and appurtenant items.

##### B. Related Sections include but are not necessarily limited to:

1. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
2. Section 40 05 51 - Valves - Basic Requirements.
3. Section 40 05 61 - Gate Valves.
4. Section 40 05 66 - Check Valves.

#### 1.2 QUALITY ASSURANCE

##### A. Referenced Standards:

1. ASTM International (ASTM):
  - a. A36, Standard Specification for Carbon Structural Steel.
2. American Welding Society (AWS):
  - a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
  - b. D1.1, Structural Welding Code - Steel.
3. National Electrical Manufacturers Association (NEMA):
  - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - b. ICS 6, Industrial Control and Systems Enclosures.
4. National Fire Protection Association (NFPA):
  - a. 70, National Electrical Code (NEC).
  - b. 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
5. Occupational Safety and Health Administration (OSHA).
6. Underwriters Laboratories, Inc. (UL).

B. Qualifications:

1. Manufacturer shall be regularly engaged in the manufacture of packaged sewage pumping stations for not less than five years.
2. Structural design of the pumping station shall be accomplished by a structural engineer registered in the state where the Project is located.

C. Single Source Responsibility:

1. Provide single source responsibility for all station components and systems through supplier of package pump station.

### 1.3 SYSTEM DESCRIPTION

A. The package sewage pumping station shall consist of the following major components:

1. Underground wet well with separate valve pit.
2. Process equipment: Duplex submersible grinder pumps.
3. Interior piping, valving and pipe supports.
4. Electrical and control systems:
  - a. Wastewater pump control system and control panel with surge protection.
  - b. Motor starters, circuit breakers, panelboards, electrical distribution, and single point exterior power connection for pump station.
  - c. Manufacturer's standard submersible wiring between grinder pump station and first junction box.

### 1.4 SUBMITTALS

A. Shop Drawings:

1. See Division 01 Specification.
2. Scaled (1/4 IN = 1 FT minimum) fabrication and/or Layout Drawings (Plan(s) and Specification Section(s)) showing all equipment piping, mechanical and electrical components.
3. Information as required by other related narrow-scope Specification Sections.
4. Submit Shop Drawing for station and all mechanical, electrical, and instrumentation components, complete, in single, coordinated submittal.
  - a. Provide separate tabs for each major section of work being provided.
  - b. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations.
5. Wet well uplift calculations showing wet well ballast provided to resist flotation, as required.
  - a. Use the top of structure as the high groundwater elevation and use a factor of safety of 1.5 (minimum).

6. Certifications:
  - a. Provide Owner with a written certification that station has been installed properly and started up and is ready for operation by Owner's personnel.
  - b. Factory checkout certification for all systems in pump station.

B. Contract Closeout Information:

1. Operation and Maintenance Data:
  - a. See Division 01 Specification for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

## 1.5 WARRANTY

- A. Provide Owner with manufacturer's warranty guaranteeing pumping station to be free from defects for 2 year(s) from date of Contracting Officer acceptance.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Package pump station:
    - a. Topp Industries, Duplex Fiberglass Lift Station.
    - b. Environment One, W Series Fiberglass Lift Station.
    - c. Barnes (Crane Pumps & Systems), Omni Grind Plus.
- B. Submit request for substitution in accordance with Division 01 Specification.
- C. See referenced Specification Sections for acceptable manufacturers for other pump station components.

### 2.2 EQUIPMENT

- A. Submersible Grinder Pumps: Hydromatic HVS200 Submersible Sewage Grinder Pump or approved equal.
  1. Operating conditions:
    - a. 15 GPM at 0 FT TDH.
    - b. 11 GPM at 92 FT TDH.
    - c. 7.8 GPM at 185 FT TDH.

2. Drive horsepower: 2 HP minimum, 5 HP maximum.
3. Progressive cavity or recessed impeller with grinder head.
4. Silicon carbide single mechanical seals.
5. Pump castings shall be cast iron, fully epoxy coated 8-10 MILS nominal dry thickness.
6. 60 Hz.
7. 208V, 3-phase.
8. Explosion proof, approved for Class 1 Division 1 Locations.

B. Grinder:

1. Locate directly below the pumping elements and direct-driven by a single, one piece motor shaft.
2. Provide cutter teeth and shredder ring of hardened 4140 steel Rockwell 50-60 C.
3. Position grinder such that solids are fed in an upward flow direction.
4. Maximum velocity through cutting mechanism: 4 FT/second.
5. The grinder shall be capable of reducing all components in normal domestic sewage, and a reasonable amount of foreign objects such as paper, wood, plastic, glass, wipes, rugger, and similar materials into finely divided particles which will pass freely through the passages of the pump and the discharge piping.

C. Check Valve:

1. Provide each pump with a gravity operated, flapper type check valve.
  - a. The resilient seat flapper check valve shall provide a full ported passageway when open.
  - b. Working parts will be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength.
  - c. A non-metallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back pressure.
  - d. Construct the valve body of Class 30 cast iron, powder coated.
  - e. Locate check valve in valve pit.

D. Gate Valve:

1. Provide a gate valve for each pump discharge located in the valve pit.
2. Stainless steel, pressure rating 235 PSI.

E. Underground Wetwell Chamber and Valve Pit:

1. Construct the wetwell and valve pit of fiberglass with a ballast support flange and provide a minimum storage of 150 GAL between the tank bottom elevation and the inlet pipe elevation. Reinforced as required for loadings.
2. House duplex submersible pumps.
3. Quick disconnects on discharge piping between pump and connection to force main to allow ease of pump removal.

4. Cover:
  - a. HDPE with 150 LBS/SF minimum, lockable.
  - b. Or a lockable, aluminum, non-slip lid with lifting handle, powder coated aluminum fall protection grating, and stainless steel hinges and hardware. Lid shall have a service rating of 150 LBS/SF.
5. Provide inlet flanges for sanitary lines as shown on Drawings.
6. Stainless steel pump discharge piping with transition fittings to connect to 2 IN HDPE pipe materials.
7. A 2 IN NPT vent with screen that penetrates the top of the wetwell.
8. Concrete ballast for wetwell as necessary. Include ballast requirements in pump station submittals.
9. All hardware of 300 Series stainless steel.

F. Accessories:

1. Serviceability:
  - a. The grinder pumps shall be equipped with two lifting hooks complete with lift out harness or guide rails to facilitate pump removal.
  - b. All mechanical and electrical connection shall be provided with easy disconnect capability to facilitate removal.
  - c. All maintenance tasks for the grinder pump station must be possible without entry into the grinder pump station.
2. Controls:
  - a. Use control floats or pressure switches as level controls for controlling pump operation.
  - b. Provide Off, On, and Alarm level controls.
  - c. For duplex systems an alarm will require both pumps to run simultaneously.
3. Control Panel:
  - a. Install remotely mounted automatic control panel.
  - b. Provide the following:
    - 1) High level alarm with alarm horn, and alarm light.
    - 2) NEMA 4, UL listed for wall or pole mounting with mounting hardware.
    - 3) Panel face mounted components:
      - a) Hand/Off/Auto switch for each pump.
      - b) Status indicating light for each pump.
      - c) Alarm status light for high level.
      - d) Non-resettable running time indicator for each pump.
      - e) Pump alternator On/Off switch.
    - 4) Entry hub for wiring at bottom of panel.

- 5) Conduit necessary for wiring from panel to pump station.
  - 6) Lockable.
  - 7) Provide Short Circuit Current (SCCR) labelling as required by NFPA 70 and other applicable codes.
- c. Coordinate the cable connecting the pump unit to the control panel with the control panel location requirements.
- 1) Splicing of this cable is allowed.
  - 2) Provide manufacture's standard submersible wiring for connection between grinder pump station and first junction box handhole.
4. Power Distribution:
- a. Wiring: Copper conductor with type XHHW insulation.
  - b. Starters: Combination magnetic type with MCP type circuit breaker disconnect, NEMA full size rated with ambient compensated thermal type overload relay with external reset button and oversized control power transformer.
  - c. Service disconnect for station: Thermal magnetic circuit breaker sized and located per NEC.
  - d. Install wiring in accordance with NEC, NEMA and applicable local codes.
  - e. Provide short conduit leads of flexible, liquid-tight polyvinyl covered steel with compatible grounding fittings between the fixed conduit and mechanical equipment requiring power.
  - f. Provide duplex safety grounding receptacle on side of pump control panel.
  - g. Install all wiring outside of control panels in conduit according to Division 26 Specifications.
  - h. Furnish thermal magnetic circuit breakers for branch disconnect service, over current protection of all motor controls and all auxiliary circuits.
- 1) Label switches using phenolic nameplates.
5. Pump Lifting Device:
- a. One (1) davit cranes shall be supplied to assist in removing pumps from the wetwell.
  - b. Lifting device shall be a crane with hand winch and will include an adjustable boom to ensure adequate reach and height.
  - c. Lifting device to include a swivel handle for rotation and positioning.
  - d. Crane Capacity: 400 LBS.
  - e. Materials of construction: Stainless Steel, Type 304 minimum (davit crane, winch, mounting hardware and accessories).
  - f. Crane and base will be supplied by the pumps station supplier and the structure designed to accommodate the crane, with the crane being integral to the structure or mounted to a separate concrete base. If a separate concrete base is proposed, the location is to be shown by the pump station manufacturer to allow for removal of either pump without relocating the crane. If this option is used the base must extend below the frost line and use appropriate anchorage and reinforcing as approved by the Engineer.

6. Spare Parts:
  - a. Furnish the minimum spare parts in accordance with the requirements of these Specifications:
    - 1) One (1) spare grinder pump.
  - b. Spare parts shall be properly bound and labeled for easy identification without opening the packaging and suitably protected for long term storage in a humid environment.

### 2.3 SOURCE QUALITY CONTROL

- A. Secure from the pump manufacturer the following inspections and tests on each pump before shipment from factory:
  1. Check impeller, motor rating and electrical connections for compliance with this Specification Section.
  2. Test motor and cable insulation for moisture content or insulation defects.
  3. Prior to submergence, run pump dry to establish correct rotation and mechanical integrity.
  4. Run pump submerged for 30 minutes.
- B. Testing:
  1. All components of pump station shall be given an operational test at factory to check for excessive vibration, for leaks in piping or seals, and for correct operation of automatic control system and auxiliary equipment.
    - a. Correct all deficiencies.
  2. Couple pump suction and discharge lines to a reservoir and have the pumps recirculate water for at least 1 HR under simulated service conditions.
  3. Adjust automatic control to start and stop pumps at approximate levels required by job conditions.

### 2.4 MAINTENANCE MATERIALS

- A. See individual equipment Specification Sections.
- B. Touch up kit for coating field welds and for repair of scratches.

## PART 3 - EXECUTION

- A. Procedures for the installation of the submersible grinder pump station and control panel are as follows:
  1. Install the pump station at the locations shown on the Drawings.

2. Install piping in wet well and valve vault and connect the discharge line to the force main.
3. Contractor to construct a control panel mounting surface as specified in the Drawings.
4. Install the control panel on the surface at a height of 5 FT above finished grade.
  - a. Coordinate location of panel with Contracting Officer and Architect/Engineer.
5. Install a conduit from the control panel to the pump station.
  - a. Locate the pump station and the control panel in close proximity to each other.
6. Install the cable, provided by the pump manufacturer, into the conduit from the control panel to the pump station and connect the cable wiring to the pump station.
7. Install the pumps per manufacturer's recommendations.
  - a. Provide a written statement from manufacturer's qualified representative that the installation was performed properly and is ready for operation by Contracting Officer's personnel.
8. Test the pumps.
  - a. Contractor to obtain potable water, ground water or lake water for testing. Testing with wastewater is not acceptable.
  - b. Contractor to abide by all Contracting Officer requirements for metering and cross connection protection.
    - 1) It is the Contractor's responsibility to transport the water to the pump station for testing.
  - c. Contracting Officer personnel are to witness the testing of the unit.
  - d. Provide 4 HRS for manufacturer's qualified representative to instruct Contracting Officer's personnel on operations and maintenance of the pumping station.
9. Install the pump station top and leave secured.

### 3.2 FIELD QUALITY CONTROL

- A. Coordinate and pay for the services of a factory trained representative for a maximum period of 16 HRS to perform the initial start-up of the lift station and instruct personnel who will be operating the lift station in the required maintenance and service procedures.

END OF SECTION



# DIVISION 40

## PROCESS INTERCONNECTIONS



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## SECTION 40 05 00 - PIPE AND PIPE FITTINGS - BASIC REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Process piping systems.
2. Utility piping systems.

##### B. Related Specification Sections include but are not necessarily limited to:

1. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
2. Section 40 05 51 - Valves - Basic Requirements.

#### 1.2 QUALITY ASSURANCE

##### A. Referenced Standards:

1. ASTM International (ASTM):
  - a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - b. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
  - c. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - d. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
  - e. A518, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
  - f. A536, Standard Specification for Ductile Iron Castings.
  - g. A774, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
  - h. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
  - i. C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
  - j. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
  - k. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
  - l. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
  - m. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

- n. D4101, Standard Specification for Polypropylene Plastic Injection and Extrusion Materials.
  - o. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
  - p. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
- 2. American Water Works Association (AWWA):
    - a. C800, Standard for Underground Service Line Valves and Fittings.
  - 3. American Water Works Association/American National Standards Institute (AWWA/ANSI):
    - a. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
    - b. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
    - c. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
    - d. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
  - 4. Cast Iron Soil Pipe Institute (CISPI):
    - a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
  - 5. International Plumbing Code (IPC).
  - 6. Underwriters Laboratories, Inc. (UL).
- B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

### 1.3 SYSTEM DESCRIPTION

- A. Piping Systems Organization and Definition:
  - 1. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid conveyed, system pressure, piping size and system materials of construction.
  - 2. See PIPING SYSTEMS SCHEDULE in PART 3.

### 1.4 SUBMITTALS

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.

- b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
- c. Separate schedule sheet for each piping system scheduled in this Specification Section showing compliance of all system components.
  - 1) Attach technical product data on gaskets, pipe, fittings, and other components.

B. Informational Submittals:

- 1. Test reports:
  - a. Copies of pressure test results on all piping systems.
  - b. Reports defining results of dielectric testing and corrective action taken.
  - c. Notification of time and date of piping pressure tests.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe coating during handling using methods recommended by manufacturer.
  - 1. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.
- B. Prevent damage to pipe during transit.
  - 1. Repair abrasions, scars, and blemishes.
  - 2. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

PART 2 - PRODUCTS

2.1 PIPING SYSTEMS SCHEDULE

- A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping systems schedule located at the end of PART 3 of this Specification Section.

2.2 COMPONENTS AND ACCESSORIES

- A. Reducers:
  - 1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment connections.
  - 2. Connection size requirements may change from those shown on Drawings depending on equipment furnished.

- B. Protective Coating and Lining:
  - 1. Include pipe, fittings, and appurtenances where coatings, linings, coating, tests and other items are specified.
- C. Valves:
  - 1. See schematics and details for definition of manual valves used in each system under 4 IN in size.
    - a. See Drawings for valve types 4 IN and above and for automatic valves used in each system.
  - 2. See Specification Section 40 05 51.

### PART 3 - EXECUTION

#### 3.1 EXTERIOR BURIED PIPING INSTALLATION

- A. Unless otherwise shown on the Drawings, provide a minimum of 4 FT and maximum of 8 FT earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing.
- B. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals specified in Specifications and as shown on Drawings.
- C. Laying Pipe In Trench:
  - 1. Excavate and backfill trench in accordance with Specification Section 31 23 33.
  - 2. Clean each pipe length thoroughly and inspect for compliance to specifications.
  - 3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
  - 4. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
  - 5. Except for first two joints, before making final connections of joints, install two full sections of pipe with earth tamped alongside of pipe or final with bedding material placed.
  - 6. Lay pipe in only suitable weather with good trench conditions.
    - a. Never lay pipe in water except where approved by Engineer.
  - 7. Seal open end of line with watertight plug if pipe laying stopped.
  - 8. Remove water in trench before removal of plug.
- D. Lining Up Push-On Joint Piping:
  - 1. Lay piping on route lines shown on Drawings.
  - 2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
  - 3. Observe maximum deflection values stated in manufacturer's written literature.

4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
  5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.
- E. Anchorage and Blocking:
1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.
  2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall.
    - a. Concrete blocks shall not cover pipe joints.
  3. Provide bearing area of concrete in accordance with drawing detail.

### 3.2 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION

- A. Install piping in vertical and horizontal alignment as shown on Drawings.
- B. Alignment of piping smaller than 4 IN may not be shown; however, install according to Drawing intent and with clearance and allowance for:
1. Expansion and contraction.
  2. Operation and access to equipment, doors, windows, hoists, moving equipment.
  3. Headroom and walking space for working areas and aisles.
  4. System drainage and air removal.
- C. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.
- D. Locate and size sleeves and castings required for piping system.
1. Arrange for chases, recesses, inserts or anchors at proper elevation and location.
- E. Use reducing fittings throughout piping systems.
1. Bushings will not be allowed unless specifically approved.

### 3.3 CONNECTIONS WITH EXISTING PIPING

- A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.
- B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.
- C. Undertake connections in fashion which will disturb system as little as possible.

- D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.
- E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.
- F. Where connection involves potable water systems, provide disinfection methods as prescribed in this Specification Section.
- G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

### 3.4 FIELD QUALITY CONTROL

- A. Pipe Testing - General:
  - 1. Test piping systems as follows:
    - a. Test buried piping (insulated and non-insulated) prior to backfilling and, if insulated, prior to application of insulation.
    - b. Test buried piping after backfilling has been complete.
    - c. Provide complete retesting of buried systems after backfilling has been completed.
  - 2. Isolate equipment which may be damaged by the specified pressure test conditions.
  - 3. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring equipment to determine leakage rates.
    - a. Select each gage so that the specified test pressure falls within the upper half of the gage's range.
    - b. Notify the Engineer 24 HRS prior to each test.
  - 4. Completely assemble and test new piping systems prior to connection to existing pipe systems.
  - 5. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
  - 6. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.

B. Pressure Testing:

1. Testing medium: Unless otherwise specified in the PIPING SYSTEMS SCHEDULE, utilize the following test media.

a. Liquid systems:

PIPE LINE SIZE (DIA)	GRAVITY OR PUMPED	SPECIFIED TEST PRESSURE	TESTING MEDIUM
Up to and including 48 IN	Gravity	25 PSIG or less	Water
Above 48 IN	Gravity	25 PSIG or less	Water
All sizes	Pumped	250 PSIG or less	Water

2. Allowable leakage rates:

a. All pressure piping systems and all buried, insulated piping systems which are hydrostatically pressure tested shall have zero leakage goal at the specified test pressure throughout the duration of the test.

b. Hydrostatic exfiltration and infiltration for sanitary and stormwater sewers (groundwater level is below the top of pipe):

- 1) Leakage rate: 200 GAL per inch diameter per mile of pipe per day at average head on test section of 3 FT.
- 2) Average head is defined from groundwater elevation to average pipe crown.
- 3) Acceptable test head leakage rate for heads greater than 3 FT: Acceptable leakage rate (gallons per inch diameter per mile per day) equals 115 by (actual test head to the 1/2 power).

c. Hydrostatic infiltration test for sanitary and stormwater sewers (groundwater level is above the top of pipe):

- 1) Allowable leakage rate: 200 GAL per inch diameter per mile of pipe per day when depth of groundwater over top of pipe is 2 to 6 FT.
- 2) Leakage rate at heads greater than 6 FT: Allowable leakage rate (gallons per inch diameter per mile of pipe per day) equals 82 by (actual head to the 1/2 power).

- d. For low pressure (less than 25 PSIG) air testing, the acceptable time for loss of 1 PSIG of air pressure shall be:

PIPE SIZE (IN DIA)	TIME, MINUTES/100 FT
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8

3. Hydrostatic pressure testing methodology:

a. General:

- 1) All joints, including welds, are to be left exposed for examination during the test.
- 2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
- 3) Provide temporary restraints for expansion joints for additional pressure load under test.
- 4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
- 5) Do not coat or insulate exposed piping until successful performance of pressure test.

4. Air testing methodology:

a. General:

- 1) Assure air is ambient temperature.

b. Low pressure air testing:

- 1) Place plugs in line and inflate to manufacturer's designated seal pressure.
- 2) Check plugs for proper sealing.
- 3) Introduce low pressure air into sealed line segment until air pressure reaches 4 PSIG greater than ground water or allowable limits of ASTM F1417.
  - a) Use test gage conforming to ASME B40.100 with 0 to 15 PSI scale and accuracy of 1% of full range.
- 4) Allow 2 minutes for air pressure to stabilize.
- 5) After stabilization period (3.5 PSIG minimum pressure in pipe) discontinue air supply to line segment.
- 6) Record pressure at beginning and end of test.

### 3.5 CLEANING, DISINFECTION AND PURGING

#### A. Cleaning:

1. Clean interior of piping systems thoroughly before installing.
2. Maintain pipe in clean condition during installation.
3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
4. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications.
  - a. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes.
  - b. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner.

### 3.6 LOCATION OF BURIED OBSTACLES

- A. Furnish exact location and description of buried utilities encountered and thrust block placement.
- B. Reference items to definitive reference point locations such as found property corners, entrances to buildings, existing structure lines, fire hydrants and related fixed structures.
- C. Include such information as location, elevation, coverage, supports and additional pertinent information.
- D. Incorporate information on "As-Recorded" Drawings.

### 3.7 PIPING SYSTEM SCHEDULES

#### A. Piping System 1 – Buried, HDPE Sanitary Sewer

1. General:
  - a. Piping symbol and service:
    - 1) Gravity Sanitary Sewer Pipe.
  - b. Test requirements:
    - 1) Test medium: Low pressure air.
    - 2) Pressure: See the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
    - 3) Duration: See the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.

- 2. System components:
  - a. Pipe size 6 IN:
    - 1) Buried service:
      - a) Materials: HDPE.
      - b) Lining: None.
      - c) Coating: None.
      - d) Joints: Butt fused joints per specifications.
      - e) Pipe connections to sanitary manholes: Where pipe enters a new precast concrete manhole, a watertight flexible connection meeting the requirements of ASTM C923 to be used. Connection cast in the base. Rubber boot with stainless steel clamps. Press-Seal Gasket Corp or equal.

- 3. Piping System 2 – HDPE Lift Station and Force Main Piping. General:
  - a. Piping symbol and service: Lift Station and Forcemain Piping.
  - b. Test requirements: Test Forcemain piping according to Section 33 05 07.

- 4. System components:
  - a. Pipe size 1-1/2 - 2 IN:
    - 1) Buried service (Directional Controlled Horizontal Drilled):
      - a) Material: HDPE, SDR 9, (250 PSI), Iron Pipe Size (IPS).
      - b) Reference: AWWA C901, ASTM D3035, PE4710, ASTM D3350 Cell Classification 445574.
      - c) Lining: None.
      - d) Coating: None.
      - e) Fittings: Butt Fusion Fittings. Manufacturing per ASTM D3261.
      - f) Transition Connections: Provide HDPE transition fittings where necessary.
      - g) Joints: Butt Fusion Joining.
      - h) Tracer wire: Size #10AWG; Green; Jacket Coating; 45 MIL.

### 3.8 SERVICE SYSTEM SUMMARY

- A. Service Systems as defined in the Drawings.

END OF SECTION

## SECTION 40 05 51 - VALVES - BASIC REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Valving, actuators, and valving appurtenances.
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

#### 1.2 QUALITY ASSURANCE

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. B1.20.1, Pipe Threads, General Purpose.
    - b. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
    - c. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
  - 2. ASTM International (ASTM):
    - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    - b. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
    - c. D638, Standard Test Method for Tensile Properties of Plastics.
    - d. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
    - e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
    - f. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
  - 3. American Water Works Association (AWWA):
    - a. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
    - b. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
    - c. C504, Standard for Rubber-Seated Butterfly Valves.
    - d. C507, Standard for Ball Valves, 6 IN through 48 IN (150 MM through 1200 MM).
    - e. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
    - f. C550, Standard for Protective Coatings for Valves and Hydrants.
    - g. C606, Standard for Grooved and Shouldered Joints.

4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
  - a. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. National Electrical Manufacturers Association (NEMA):
  - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - b. MG 1, Motors and Generators.
6. National Fire Protection Association (NFPA):
  - a. 70, National Electrical Code (NEC).

### 1.3 DEFINITIONS

- A. The following are definitions of abbreviations used in this Specification Section or one of the individual valve sections:
  1. CWP: Cold water working pressure.
  2. SWP: Steam working pressure.
  3. WOG: Water, oil, gas working pressure.
  4. WWP: Water working pressure.

### 1.4 SUBMITTALS

- A. Shop Drawings:
  1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Valve pressure and temperature rating.
    - d. Valve material of construction.
    - e. Special linings.
    - f. Valve dimensions and weight.
    - g. Valve flow coefficient.
    - h. Wiring and control diagrams for electric or cylinder actuators.
    - i. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations.
  2. Test reports.
- B. Contract Closeout Information:
  1. Operation and Maintenance Data:

- a. See Division 01 Specification for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
- 1. Verification from valve actuator manufacturer that actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted, and that the valve actuator responds correctly to the valve position command.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, refer to individual valve Specification Sections for acceptable manufacturers.

### 2.2 MATERIALS

- A. Refer to individual valve Specification Sections.

### 2.3 VALVE ACTUATORS

- A. Valve Actuators - General:
  - 1. Provide actuators as shown on Drawings or specified.
  - 2. Counter clockwise opening as viewed from the top.
  - 3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
  - 4. Size actuator to produce required torque with a maximum pull of 80 LB at the maximum pressure rating of the valve provided and withstand without damage a pull of 200 LB on handwheel or chainwheel or 300 FT-pounds torque on the operating nut.
  - 5. Unless otherwise specified, actuators for valves to be buried, submerged or installed in vaults or manholes shall be sealed to withstand at least 20 FT of submergence.
  - 6. Extension stem:
    - a. Install where shown or specified.
    - b. Solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.
    - c. Pin all stem connections.
    - d. Center in valve box or grating opening band with guide bushing.
- B. Buried Valve Actuators:

1. Provide screw or slide type adjustable cast iron valve box, 5 IN minimum diameter, 3/16 IN minimum thickness, and identifying cast iron cover rated for traffic load.
  2. Box base to enclose buried valve gear box or bonnet.
  3. Provide 2 IN standard actuator nuts complying with AWWA C500, Section 3.16.
  4. Provide at least two tee handle keys for actuator nuts, with 5 FT extension between key and handle.
  5. Extension stem:
    - a. Provide for buried valves greater than 4 FT below finish grade.
    - b. Extend to within 6 IN of finish grade.
  6. Provide concrete pad encasement of valve box as shown for all buried valves unless shown otherwise.
- C. Plastic Valve Vault:
1. Provide in non-traffic areas only on valve applications 3-1/2 IN and less.
  2. Nominal 7-1/2 IN DIA top section.
  3. Design unit for screw type extension section having nominal 9 IN DIA bell.
  4. Cast iron ring and lid.
  5. Constructed of injection molded polyolefin compound with fibrous inorganic component reinforcing and UV stabilization.
  6. Armor Access Boxes.
- D. Exposed Valve Manual Actuators:
1. Provide for all exposed valves not having electric or cylinder actuators.
  2. Provide handwheels for gate and globe valves.
    - a. Size handwheels for valves in accordance with AWWA C500.
  3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 IN DIA and smaller.
    - a. Lever actuators for butterfly valves shall have a minimum of five intermediate lock positions between full open and full close.
    - b. Provide at least two levers for each type and size of valve furnished.
  4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 IN DIA and larger.
  5. Provide gearing for gate valves 20 IN and larger in accordance with AWWA C500.
  6. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.
  7. Provide chain actuators for valves 6 FT or higher from finish floor to valve centerline.
    - a. Cadmium-plated chain looped to within 3 FT of finish floor.
    - b. Equip chain wheels with chain guides to permit rapid operation with reasonable side pull without "gagging" the wheel.

- c. For smaller valves with lever or handle operators, provide offset tee handles with attached chain for operation from the operating floor.
- 8. Provide cast iron floor stands where shown on Drawings.
  - a. Stands to be furnished by valve manufacturer with actuator.
  - b. Stands or actuator to include thrust bearings for valve operation and weight of accessories.
- E. Valve Lockout Devices:
  - 1. Device manufactured from same material as valve operator, preventing access to valve operator, to accept lock shackle.

## 2.4 FABRICATION

- A. End Connections:
  - 1. Provide the type of end connections for valves as required in the Piping Schedules presented in Section 40 05 00 or as shown on the Drawings.
  - 2. Comply with the following standards:
    - a. Threaded: ASME B1.20.1.
    - b. Flanged: ASME B16.1, Class 125 unless otherwise noted or AWWA C207.
    - c. Bell and spigot or mechanical (gland) type: AWWA/ANSI C111/A21.11.
    - d. Soldered: ASME B16.18.
    - e. Grooved: Rigid joints per Table 5 of AWWA C606.
- B. Refer to individual valve Specification Sections for specifications of each type of valve used on Project.
- C. Nuts, Bolts, and Washers:
  - 1. Wetted or internal to be bronze or stainless steel.
    - a. Exposed to be zinc or cadmium plated.
- D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application without interference from handle.
- E. Epoxy Interior Coating: Provide epoxy interior coating for all ferrous surfaces in accordance with AWWA C550.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

B. Setting Buried Valves:

1. Locate valves installed in pipe trenches where buried pipe indicated on Drawings.
2. Set valves and valve boxes plumb.
3. Place valve boxes directly over valves with top of box being brought to surface of finished grade.
4. Install in closed position.
5. Place valve on firm footing in trench to prevent settling and excessive strain on connection to pipe.
6. After installation, backfill up to top of box for a minimum distance of 4 FT on each side of box.

C. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.

D. Install electric or cylinder actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external handwheel.

E. For threaded valves, provide union on one side within 2 FT of valve to allow valve removal.

F. Install valves accessible for operation, inspection, and maintenance.

3.2 ADJUSTMENT

A. Adjust valves, actuators and appurtenant equipment to comply with the specifications.

1. Operate valve, open and close at system pressures.

B. Refer to Drawings for valve callouts.

1. Valves are not scheduled but type and size are defined on Drawings in plan, section, or schematic.

END OF SECTION

## SECTION 40 05 61 - GATE VALVES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Gate valves.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 40 05 51 - Valves - Basic Requirements.

#### 1.2 QUALITY ASSURANCE

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - 2. American Water Works Association (AWWA):
    - a. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
    - b. C504, Standard for Rubber-Seated Butterfly Valves.
    - c. C550, Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.
  - 3. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
    - a. SP-9, Spot Facing for Bronze, Iron and Steel Flanges.
    - b. SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
    - c. SP-80, Bronze Gate, Globe, Angle and Check Valves.

#### 1.3 DEFINITIONS

- A. OS&Y: Outside Screw and Yoke.
- B. NRS: Non-rising Stem.
- C. RS: Rising Stem.

#### 1.4 SUBMITTALS

- A. Shop Drawings:

1. See Specification Section 40 05 51.
- B. Contract Closeout Information:
  1. Operation and Maintenance Data:
    - a. See Division 01 Specification for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

### 2.2 VALVES: WATER (HOT, COLD, HEATING, COOLING, SERVICE, PROCESS, POTABLE, NON-POTABLE, AND WASTEWATER)

- A. Resilient Wedge Gate Valves, 2 to 48 IN (Water, Wastewater Application):
  1. Comply with AWWA C509 AWWA C515.
  2. Materials:
    - a. Stem and stem nut: Bronze.
      - 1) Wetted bronze parts in low zinc bronze.
      - 2) Aluminum bronze components: Heat treated per AWWA C504.
    - b. Body, gate: Ductile iron.
    - c. Resilient wedge: Fully encapsulated rubber wedge. Styrene Butadiene Rubber (SBR) or Ethylene Propylene Diene Monomer (EPDM).
  3. Design requirements:
    - a. Minimum 150 PSIG working pressure.
    - b. Buried: NRS, O-ring stem seal, 2 IN square operating nut.
    - c. Exposed: OS&Y, stuffing box stem seal, handwheel NRS, O-ring, stem seal, handwheel.
    - d. Counter clockwise open rotation.
    - e. Fusion bonded epoxy coating interior and exterior except stainless steel and bearing surfaces.
      - 1) Comply with AWWA C550.
      - 2) Wetted bronze parts in low zinc bronze.
      - 3) Aluminum bronze components: Heat treated per AWWA C504.
  4. Manufacturers:

- a. Clow.
- b. Mueller.
- c. American Flow Control.
- d. M & H.

## 2.3 ACCESSORIES

- A. Refer to Drawings and valve schedule for type of actuators.
  - 1. Furnish actuator integral with valve.
- B. Refer to Specification Section 40 05 51 for actuator requirements.

## 2.4 FABRICATION

- A. General:
  - 1. Provide valves with clear waterways the full diameter of the valve.
- B. Spot valves in accordance with MSS SP-9.

## 2.5 SOURCE QUALITY CONTROL

- A. Perform following tests, in accordance with AWWA C500, on valves constructed in accordance with AWWA C500:
  - 1. Operation test.
  - 2. Hydrostatic test.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. See Specification Section 40 05 51.
- B. Where larger buried valves utilize smaller bypass valves, provide a second valve box installed over the bypass valve operating nut.
- C. Do not install gate valves inverted or with the stems sloped more than 45 DEG from the upright unless the valve was ordered and manufactured specifically for this orientation.

END OF SECTION

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## SECTION 40 05 66 - CHECK VALVES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Check valves 2.5 IN DIA and smaller.
2. Ball check valves, 0.5 to 4 IN DIA.

##### B. Related Requirements: Include but are not necessarily limited to:

1. Section 40 05 51 - Valves - Basic Requirements.

#### 1.2 REFERENCES

##### A. Referenced Standards:

1. American Society of Mechanical Engineers (ASME):
  - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
2. American Water Works Association (AWWA):
  - a. C508, Standard for Swing-Check Valves for Waterworks Service, 2 IN through 24 IN NPS.
3. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
  - a. SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
  - b. SP-80, Bronze Gate, Globe, Angle and Check Valves.

#### 1.3 QUALITY ASSURANCE

##### A. Qualifications:

1. Valve Manufacturers:
  - a. Manufacturer shall be a business regularly engaged in manufacturing and furnishing check valves of the type required and similar equipment.
  - b. Manufacturer shall be able to document having furnished not less than 50 check valves, of the type required, of size equal to or larger than those required for the Work, during the past five years.

- c. When requested by Engineer, submit qualifications statement indicating manufacturer's record of manufacturing and furnishing check valves of the types and sizes required and furnish documentation of compliance with qualifications requirements of this Article.

#### 1.4 SUBMITTALS

A. Action Submittals: Submit the following:

- 1. In accordance with Section 40 05 51 - Valves Basic Requirements.

B. Informational Submittals: Submit the following:

- 1. In accordance with Section 40 05 51 - Valves Basic Requirements.
- 2. Manufacturer's Instructions:
  - a. Manufacturer's written instructions for delivery, handling, storage, installation, and startup.

C. Closeout Submittals: Submit the following:

- 1. Operation and Maintenance Data:
  - a. Submit in accordance with Division 01 Specification.

#### PART 2 - PRODUCTS

##### 2.1 CHECK VALVES: 2.5 IN AND SMALLER

A. Class 125 Bronze Swing Check Valves (Fuel Oil, Compressed Air, Water, Wastewater):

- 1. Comply with MSS SP-80.
- 2. Manufacturers:
  - a. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    - 1) Nibco T413-V.
    - 2) Stockham B-319Y.
- 3. Materials:
  - a. Body, bonnet, disc: Bronze.
- 4. Design requirements:
  - a. Horizontal swing, renewable disc.

- b. Unless otherwise shown on the Drawings, use for water, wastewater, condensate, steam to 125 PSI.

## 2.2 BALL CHECK VALVES: 1/2 IN TO 4 IN

### A. Manufacturers:

- 1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - a. R&G Sloane.
  - b. Corr Tech.

### B. Performance Criteria:

- 1. Pressure Rating: 150 PSI at 73 DEGF.

### C. Materials:

- 1. Body: Cast Iron.
- 2. Ball: Glass filled or polypropylene.
- 3. Seals: Viton or EPDM.

### D. Design Requirements:

- 1. Connectors: Double union.

## 2.3 SOURCE QUALITY CONTROL

### A. Factory Tests and Inspections:

- 1. Perform manufacturer's standard factory tests and inspections on materials and equipment furnished. Correct defects prior to shipment to the Site.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. Installation – General:

- 1. Provide check valves at locations shown and indicated in the Contract Documents.
- 2. Install in accordance with the Contract Documents and manufacturer's written instructions. In event of conflict between the Contract Documents and manufacturer's written instructions, obtain written interpretation or clarification from Engineer.
- 3. Comply with:

- a. Section 40 05 51 - Valves - Basic Requirements.
  - b. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
4. Before installing, ensure each check valve is clean and free of dirt and debris.

### 3.2 FIELD QUALITY CONTROL

#### A. Field Tests and Inspections:

1. Promptly after installing, before installing connecting pipe, verify proper and free operation of check valve.
2. Hydrostatically test check valves together with associated piping.
3. To extent practical, prior to Substantial Completion, verify proper operation of each installed check valve.

END OF SECTION