Knife River Indian Villages
National Historic Site

564 County Road 37, Stanton, ND 58571

REPLACEMENT OF VISITOR CENTER
SANITARY SEWER PLUMBING AND SEPTIC SYSTEM
KNRI
PMIS NO. 345002

PROJECT SPECIFICATIONS
(Construction Documents)

NATIONAL PARK SERVICE
MIDWEST REGION
April 2026

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00 01 07 - SEALS AND SIGNATURES

REGISTERED PROFESSIONAL ENGINEER CHRISTOPHER M. BAILEY PE-28356 DATE 4-17-26 NORTH DAKOTA	I hereby certify that the portion of the Specifications described below was prepared by me or under my direct supervision and that I am a duly registered Professional Engineer under the laws of the State of North Dakota. Christopher M. Bailey 04/17/2026 Pages or Specifications divisions or sections covered by this seal: Divisions: 01, 02, 10, 31, 32, 33, 40
REGISTERED PROFESSIONAL ENGINEER KYLE L. GANSKOP PE-40295 DATE 04/17/26 NORTH DAKOTA	I hereby certify that the portion of the Specifications described below was prepared by me or under my direct supervision and that I am a duly registered Professional Engineer under the laws of the State of North Dakota. Kyle L. Ganskop 04/17/2026 Pages or Specifications divisions or sections covered by this seal: Divisions: 26
REGISTERED PROFESSIONAL ENGINEER JEFFREY A. LEWIS PE-9245 DATE 4/17/2026 NORTH DAKOTA	I hereby certify that the portion of the Specifications described below was prepared by me or under my direct supervision and that I am a duly registered Professional Engineer under the laws of the State of North Dakota. Jeffrey A. Lewis 04/17/2026 Pages or Specifications divisions or sections covered by this seal: Divisions: 40

END OF SEALS AND SIGNATURE

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TABLE OF CONTENTS

DIVISION 00 — PROCUREMENT AND CONTRACTING REQUIREMENTS

00 01 07 - SEALS AND SIGNATURES .....
00 01 10 - TABLE OF CONTENTS .....

DIVISION 01 — GENERAL REQUIREMENTS

01 10 00 - DIVISION 1 SHORT FORM KNRI 345002 .....
01 73 20 - OPENINGS AND PENETRATIONS IN CONSTRUCTION .....

DIVISION 02 — EXISTING CONDITIONS

02 41 00 - DEMOLITION .....

DIVISION 10 — SPECIALTIES

10 14 00 - IDENTIFICATION DEVICES .....

DIVISION 26 — ELECTRICAL

26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL .....
26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES .....
26 05 26 - GROUNDING AND BONDING .....
26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS .....
26 05 43 - UNDERGROUND WORK FOR ELECTRICAL SYSTEMS .....

DIVISION 31 — EARTHWORK

31 10 00 - SITE CLEARING .....
31 22 19 - FINISH GRADING .....
31 23 33 - TRENCHING AND BACKFILLING.....

DIVISION 32 — EXTERIOR IMPROVEMENTS

32 92 00 - SEEDING, SODDING AND LANDSCAPING .....

DIVISION 33 — UTILITIES

33 05 33.23 - POLYETHYLENE PRESSURE PIPE AND TUBING (AWWA C901 AND AWWA C906) .....
33 05 61 - CONCRETE MANHOLES .....
33 05 63 - CONCRETE VAULTS AND CHAMBERS .....
33 32 13 - PACKAGE SEWAGE PUMPING STATION .....

DIVISION 40 — PROCESS INTERCONNECTIONS

40 05 01 - COMMON WORK RESULTS FOR PROCESS PIPING .....
40 05 07 - PIPE SUPPORT SYSTEMS .....
40 05 31 - PIPE - PLASTIC .....
40 05 51 - COMMON REQUIREMENTS FOR PROCESS AND UTILITY VALVES .....

40 05 61 - GATE VALVES .....
40 05 66 - CHECK VALVES .....

SECTION 01 10 00

DIVISION 1 SHORT FORM GENERAL REQUIREMENTS

PART 1 – GENERAL

ITEM 1 - DESCRIPTION OF WORK

1.1 Background: This project will replace all exterior sanitary plumbing infrastructure associated with the Visitor Center building and select indoor plumbing piping as shown in the drawings. This includes replacement and construction of new interior sewer piping below both floors of the building, reworked exterior lift station & valve vault with all new interior & electricalcomponents interfaced with the existing system, and a new exterior septic system including septic tank(s), cleanouts, distribution box, absorption trenches, etc. The existing sanitary system within the Visitor Center has endured issues since construction was completed back in 1992. Existing internal pipes fail to completely evacuate solids from the building, leading to backups and obstructing the system. Previous assessments identify a portion of the issue being that the pipes under the main floor level are too large (6” diameter) and at too shallow a slope (< 1.00%) to sufficiently carry solids through the building, exiting externally to the septic system. The basement sewer pipe differs from the as-built drawings, draining to the exterior lift station and is then routed back into the building at a higher elevation, connecting to the main level sewer pipe near the center of the building, finally exiting the building on the southeast side, where it makes its way to the septic tanks, dosing siphon, and filter field. There have been numerous catastrophic events involving the ejection of solids through the building’s floor drains, causing damage within the Museum Collection, Friends Group Storage, and Interpretation Storage areas. These events have led to temporary closures of the Visitor Center while maintenance staff have had to mitigate the backups and damage, leading to public health and safety concerns for both employees and visitors.

1.2 Work Covered by the Contract Documents:

A. Project Location: Knife River Indian Villages NHS Visitor Center,
564 County Road 37, Stanton, ND 58571
GPS Coordinates: N47 33' 15" W101 38' 58"
(See Construction Drawing Cover Sheet for Project Location Map)

B. Work consists of: This project will remove and replace the existing sanitary system for all exterior and interior components. Removals, at a minimum, shall include exposed and plumbing, associated pipe supports, lift station, septic tanks, dosing siphon, filter field, all applicable electrical components, and any other necessary items associated with the sanitary system improvements.

Contractor shall coordinate with the park so that construction is phased to promote minimal disruptions to the Visitor Center’s daily operations. A contractor staging and access plan shall be included to identify preferred access routes and delineate staging limits on what is a highly sensitive archeological site.

The Visitor Center building's interior plumbing shall include approximately 200 LF of new sanitary sewer piping with revised slopes and a new outlet location as shown in the plans.

The new pumped sanitary system shall, at a minimum, include the following items:
• Reworked lift station with new dual, submersible pumps inside the existing concrete lift station structure with a lockable cover and safety grate.
• Stainless steel guiderails, stainless steel hangers, lifting chains, and a davit crane base.
• Relocated & reworked Valve vault with new check valves, gate/ball/plug valves, etc.
• Automated controls including mercury free floats, conductive switches, ultrasonic sensors, audible & visual alarms, etc.
• Electrical systems including power surge protection, motor saver protection, back-up / alternative power options.
• Specifically account for minimizing the risk of developing anaerobic conditions within the wet well during the off-season (lower visitation rates), as well as addressing the risk of the septic tank being overwhelmed during peak-season (higher visitation rates).

C. All work will be performed under a single contract.

D. Period of performance: Work shall be completed within 120 calendar days of the start date provided on the Notice to Proceed. Work on site that impacts the existing system shall be completed after Labor Day.

a. Clarification: The Notice to Proceed will be issued with a period of performance that is all inclusive of supply lead times, material deliveries, decommissioning, installation, anticipated average weather days for location, final commissioning, and acceptance of completed work. The contractor will be expected to provide a project schedule with adequate critical path details to ensure all work is completed within the stated calendar days from issuance of the Notice to Proceed. If weather impacts project beyond typical average weather patterns, contractor shall provide documentation in request for additional days.

1.3 Existing Condition Protections:

A. Preservation of Historical and Archeological Fabric:

i. The Historic and Archeological Data Preservation Act of 1974 provides for the preservation of historical and archeological data that might otherwise be lost as the result of alterations to the terrain caused by a federal or federally licensed activity or program.

ii. IF, in connection with operations under this contract, the Contractor, subcontractors, or employees of any of them, discovers, encounters or becomes aware of any possible historical or archeological remains or data, objects or sites of cultural value on the project area, such as historical ruins, graves or grave markers, fossils, or artifacts not specifically noted within the contract. The Contractor shall immediately suspend all operations in the vicinity and continue work in other areas outside a 50 foot radius of discovery and notify the Contracting Officer immediately. When safe to do so, follow up in writing with photographs within 2 days, giving the location and nature of the findings. No objects of cultural resource value may be removed. Contracting Officer will contact other entities as required.

iii. Where appropriate by reason of discovery, the Contracting Officer may order delays in the time of performance and/or changes in the work. If such delays and/or changes are ordered, the time of performance and contract price shall be adjusted in accordance with Changes clause.

iv. The Contractor will be responsible for protecting the cultural resources within and adjacent to the project area from damage. In addition, the Contractor will be liable for all damage to the cultural resources caused by their actions or the actions of their agents or representatives. The Contractor shall immediately notify the Contracting Officer or their representative if any damage occurs to any cultural resource and immediately suspend work in the area in which damage has occurred until authorized to proceed.

v. The Contractor agrees to include this language within all subcontracts.

B. The structure or structures involved in this project are not historic.

C. Protection of Landscaping and Surrounding Structures: All Ground Disturbance at this project shall have oversight by an Owner provided Archeologist. Coordinate schedules as required. The Contractor shall take all necessary measures to provide protection for all trees, fencing, walks and other landscape features and surrounding structures near the work site as noted with the contract. Any such surrounding features damaged, scarred or broken as a result of the Contractor's operations at the site outside of agreed upon documented extents, shall be treated, repaired or replaced in kind to the satisfaction of the Contracting Officer at no additional expense to the Government.

ITEM 2 – PROTECTING EXISTING UTILITIES

2.1 Protecting Existing Utilities: Notify Contracting Officer (CO), Contracting Officer's Representative (COR) and utility companies as required to request location services prior to and to coordinate any excavation/digging operations, and/or for demolition if within Scope of Work.

2.2 Contractor shall be responsible for locating and preventing damage to all utilities on site or indoors. Contractor shall be aware that utility information provided in the plans is based on old as built drawings and limited locating services so contractor shall plan to locate utility lines for crossings to verify locations. 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:

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

B. Hours for Utility Shutdowns: Shutdowns 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.

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.

Superintendent's Compendium – Knife River Indian Villages National Historic Site (U.S. National Park Service)
https://www.nps.gov/knri/learn/management/lawsandpolicies.htm

A. Communications: Contractor shall provide the Contracting Officer and COR with methods of communications including land and/or cell phone numbers (note some areas of work have limited service coverage), email and in case of emergency 24-hour contact options for duration of time operations.

B. 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.

C. Smoking is not permitted within any Federal building or within 25 feet of entrances, operable windows, or outdoor air intakes.

D. Public Use of Site: Contractor shall at all times conduct operations to ensure the least inconvenience to the public. Contractor shall coordinate mobilization, construction equipment, laydown and storage areas, and construction phasing with COR to always keep park access to the public open.

3.2 On-site work hours: Work shall be generally performed during normal business working hours of 8am - 5pm, Monday through Friday, except when otherwise indicated. 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 a minimum of 72 hours in advance of the work, 14 days notice is preferred.

The following Federal holidays are observed by the National Park Service:
New Year's Day
Inauguration 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

- 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).

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. 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. A contractor staging area is shown on construction drawing C4 for reference.

C. Do Not disturb site outside of noted disturbance area, including earthwork, and clearing of vegetation, as noted on the construction drawings via the construction and grading limit lines. Contractor shall provide appropriate matts for equipment on turf areas to reduce soil compaction. Contractor shall remediate soil compaction as directed to do so by the CO/COR.

1. 10 feet beyond surface walkways, patios, surface parking, and utilities less than 12 inches in diameter
   15 feet beyond primary roadway curbs and main utility branch trenches
   25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, storm water detention facilities, and fields) that require additional staging areas to limit compaction in the constructed area.

D. Utilities

1. General: Cost or use charges for temporary facilities shall be included in the Contract Sum as required.

2. Water Service: Water from existing water system is 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.

3. Electric Power Service: Electric power from existing system is 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.

4. Sanitary Operations:

a. Toilets: Contractor must provide toilets for contractor personnel, sufficiently lighted and ventilated toilet facilities in weatherproof, sight proof, handicap accessible (if required), sturdy enclosures with privacy locks. Contractor shall supply 6 toilets, one accessible, for park staff and visitor use when service to the visitor center is interrupted. Coordinate with COR for approved location during the preconstruction meeting.

E. 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.

3. Vegetation Protection: Coordinate with COR to construct protection fence at drip line of any vegetation impacted within construction and grading limits. Any damaged vegetation is to be restored to original conditions via replacement at no additional expense to the Government. Protection fencing shall be used as a temporary barrier, meeting the following requirements:

    a. High-density plastic, extruded and stretched polyethylene fabric with 2 inch (50mm) maximum opening pattern, highly visible orange color, 48 inches (1220mm) high, supported by tubular or T-shape galvanized steel posts spaced not more than 96 inches (2440mm) apart.

Coordinate with COR prior to ANY vegetation removals. Consult with COR for any unplanned removals required for vegetation that interferes with construction. Carefully supervise excavating, grading, filling, and other construction operations near vegetation to prevent damage.

Contractor shall take care to not disturb the existing drain field until the system is switched over to the new drain field. Any damages to the existing drain field shall be immediately repaired at the contractors expense until the new drain field is operational.

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.

4. Temporary Enclosures: Provide and maintain temporary enclosures such as snow fence as required for protection of construction in progress and from access by visitors or staff, other construction operations, and similar activities.

3.4 Storage - Staging Areas:

A. Confine Storage of materials and equipment to the project staging area noted on the plans. Specific storage units shall be provided by the contractor and exact location within staging area shown in in the plans may be discussed at the preconstruction briefing. All storage units provided by the contractor shall be in a clean and acceptable condition to the COR. Security of the materials and equipment on site is the Contractor's responsibility. See construction drawing plan sheet C4 for staging plan.

3.5 Preservation of Natural Features: The existing park grounds in proximity to the Visitor Center are considered highly archaeologically sensitive assets of the park, thus the contractor shall strictly adhere to the construction and grading limit lines denoted on the plans as well as the red hatched area identified as "1988 KNRI VC Area B Mitigation Work" displayed on the MWAC map, referenced in Appendix A. It is of highest priority that all construction personnel preserve and protect the existing site assets. Reference staging plan and notes on sheet C4 for more information.

3.6 Hauling Restrictions: Contractor shall verify and be responsible for the path accessing the site and obtaining / maintaining all local, state and federal permits/licenses associated with hauling/road requirements and dumping of materials associated with the project.

3.7 Waste Removal, Recycling, and General Housekeeping:

A. Keep project site in a neat, orderly, and safe condition at all times.

1. Contractor is responsible for providing dumpsters for waste and recycling and for removing all waste created by the project. Contractor shall recycle to the highest degree possible and empty dumpsters as necessary to avoid debris on site. Coordinate with COR for approved dumpster locations prior to commencing construction, and reference contractor staging plan, construction drawing plan sheet C4.

2. Dispose of waste materials and recycling legally outside the park. The contractor shall not use park dumpsters.

3. Address Recycling: Government goal is to salvage and recycle as much nonhazardous construction waste as possible. Use sustainable methods to the extent possible during this project, recycling material as much as possible within local means. Maintain accurate documentary records for submittal of all recycled materials used including fly ash and slag cement.

4. For all waste and recycling removals offsite, contractors shall provide estimates and/or tickets to quantify material weights and report back to the park, submit to COR for review and record filing.

3.8 Occupancy Requirements for Buildings:

A. Existing Buildings:

1. Full Government Occupancy: Government will occupy buildings that will be under 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. Contractor will 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. Contractor will 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.

B. New /Existing Buildings Unoccupied:

1. N/A

3.9 Photo Documentation:

A. 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 preferably electronically by email or optional 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.

B. Existing Condition Images:

1. 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.

C. 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.

D. 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:

A. 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.

B. 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.

C. Store and handle hazardous materials in accordance with manufacturers and OSHA 29CFR1926 Subpart D requirements 1926 | Occupational Safety and Health Administration (osha.gov). Maintain readily available, on site, MSDS/Safety Data Sheets (SDS) for each chemical.

1. Immediately report all spills of hazardous materials to the CO, COR, and park.
2. Maintain a spill emergency response kit.
3. Train employees how to respond to a spill and use the emergency response kit.

3.11 Noise and Acoustics Management

A. Contractor shall not have personal radios or other media sources and they shall not be broadcast within NPS property.

B. Noise Control: Perform operations to minimize noise. Perform noise-producing work in less sensitive hours of the day or week as directed by the Contracting Officer or COR.

C. Repetitive and/or intermittent, high-level noise: Permitted only during Daytime.

1. Do not exceed the following dB(A) limitations at 50 feet: 70 dB(A) More than 12 minutes in any hour, 80 dB(A) More than 3 minutes in any hour.

2. Maximum permissible construction equipment noise levels at 50 feet: Compressors 75 dB(A), Pneumatic Tools 80 dB(A), Pumps 75 dB(A), Saws 75 dB(A), Generators 75dB(A), Vibrators 75 dB(A).

3. Ambient Noise maximum noise levels (dB) for receiving noise area at property line shall be as follows. Residential receiving area: Daytime 65 dB Nighttime 45 dB. 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 visible 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 windstorms. 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 works 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 2 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 local 911 Emergency Response, COR and or the National Park Service Emergency Dispatch.

ITEM 8 - PRECONSTRUCTION CONFERENCE

8.1 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 Contracting 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 are to be submitted prior to the Preconstruction Conference or as specified at the CO's discretion. The timeline for the documents to be submitted will be addressed at the pre-construction conference for those items that were not received and approved prior. Notice to Proceed may not be issued, and the Contracting Officer will consider other contractual remedies if not resolved as directed. 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. Contractors Commissioning Plan.
10. List of Construction Permits. Include the following information for each permit:
    a. WPPH Septic Permit.
    b. Western Plains Public Health.
    c. Contractor must be certified NDDEQ certified septic installer.

9.2 Project Submittal Process (Shop Drawings, Product Data, and Samples): Contracting Officer will provide sample cover sheet and a list of required submittals is included in each technical specification or attached at the end of this document.

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 product color selections. 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: All brand names noted are subject to 'or equal' products. 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. Contractor shall incorporate and be responsible for all collateral costs due to the or equal proposed as required to provide a complete project.

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 General Contractor:

1. Has investigated and shall provide documentation in request showing that the proposed item is equal or superior in all respects to the salient characteristics specified.
2. Will meet or exceed warranties for the proposed 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 Schedule of Values: Submit the Schedule of Values a minimum of one week prior to the Preconstruction Conference for COR review. Schedule of Values shall include defined work line items with cost break downs including labor, material, and equipment for COR approval.

9.5 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.

ITEM 12 - DEFINITION OF CONTRACT LINE ITEMS

12.1 Summary

A. The intent of this section is to explain, in general, what is and what is not included in a contract line item, and the limits or cut off points where one item ends, and another begins.

B. If no contract line item exists for a portion of the work, include the costs in a related item.

12.2 List of Contract Line Items

A. Contract Line-Item No. 1

1. This item consists of removal and replacement of the septic system on the exterior of the visitor center. This will include all removal and disposal of the existing system components, reworking of the existing lift station to fit the new layout, relocating & reworking the existing valve vault, connecting the new building service lines to the lift station, new septic tank, new piping, and new drainfield. All items shall be included in the lump sum price for Replace Septic System.

2. Payment will be made per the contract and percentage of completion level.

B. Contract Line-Item No. 2

1. This item consists of removal and replacement of the plumbing piping inside of the visitor center. This will include all removal and disposal of the existing system components, and installation of new piping per the plans and new drain line location per the plans. All items shall be included in the lump sum price for Replace Visitor Center Plumbing.

2. Payment will be made per the contract and percentage of completion level.

END OF SECTION

SECTION 01 73 20
OPENINGS AND PENETRATIONS IN CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Methods of installing and sealing openings and penetrations in construction.

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

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. ASTM International (ASTM):

a. A36, Standard Specification for Carbon Structural Steel.
b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
c. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
d. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
e. A351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
f. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
g. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
h. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
i. A995, Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts.

2. National Fire Protection Association (NFPA):

a. 70, National Electrical Code (NEC):

1) Article 501, Class 1 Locations.

b. 90A, Standard for Installation of Air Conditioning and Ventilating Systems.
c. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.3 DEFINITIONS

A. Corrosive Areas: For the purpose of this specification section, the following areas are defined as corrosive:

1. Lift Station.
2. Septic Tank

B. Hazardous Areas: Areas shown in the Contract Documents as having Class I or Class II area classifications.

C. Washdown Areas: Areas having floor drains or hose bibbs.

1.4 SUBMITTALS

A. Shop Drawings:

1. For each structure provide dimensioned or scaled (minimum 1/8 inches = 1 foot) plan view drawings containing the following information:

a. Vertical and horizontal location of all required openings and penetrations.
b. Size of all openings and penetrations.
c. Opening type.
d. Seal type.

2. Manufacturer's installation instructions for standard manufactured products.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Modular Mechanical Seals:

1. Materials:

a. Modular Links: EPDM rubber
b. Hardware: 316 Type stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Do not cut into or core drill any beams, joists, or columns.

B. Do not install sleeves in beams, joists, or columns.

C. Do not install recesses in beams, joists, columns, or slabs.

D. Field Cutting and Coring:

1. Saw or core drill with non-impact type equipment.
2. Mark opening and drill small 3/4 inches or less holes through structure following opening outline.
3. Sawcut opening outline on both surfaces.

    a. Knock out within sawcuts using impact type equipment.
    b. Do not chip or spall face of surface to remain intact.
    c. Do not allow any overcut with saw kerf.

E. Where alterations are necessary or where new and old work join, restore adjacent surfaces to their condition existing prior to start of work.

F. For interior wall applications where backer rod and sealant are specified, provide backer rod and sealant at each side of wall.

G. Do not make duct or conduit penetrations below high water levels when entering or leaving tankage, wet wells, or other water holding structures.

H. Modular Mechanical Seals:

1. Utilize one seal for concrete thickness less than 8 inches and two seals for concrete, 8 inches thick or greater.
2. Install seals such that bolt heads are located on the most accessible side of the penetration.

3.2 SCHEDULES

A. General Schedule of Penetrations through Floors, Roofs, Foundation Base Slabs, Foundation Walls, Foundation Footings, Partitions and Walls for Ductwork, Piping, and Conduit:

1. Provide the following opening and penetration types:

    a. Type A - Block out 2 inches larger than outside dimensions of duct, pipe, or conduits.
    b. Type H - Core drill.

2. Provide seals of material and method described as follows.

    a. Category 1 - Modular Mechanical Seal.
    b. Category 4 - Backer rod and sealant.
    c. Category 5 - Full depth compressible sealant with escutcheons on both sides of opening.
    d. Category 7 - Full depth compressible sealant and finish sealant or full depth expanding foam sealant depending on application.
    e. Category 8 - Banding for all grating openings and banding and cover plate of similar materials for abandoned openings.

3. Furnish openings and sealing materials through new floors, roofs, grating, partitions and walls in accordance with Schedule A, Openings and Penetrations for New Construction.
4. Furnish openings and sealing materials through existing floors, grating, roofs, partitions and walls in accordance with Schedule B, Openings and Penetrations for Existing Construction.

SCHEDULE A. OPENINGS AND PENETRATIONS SCHEDULE FOR NEW CONSTRUCTION

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

SCHEDULE B. OPENINGS AND PENETRATIONS SCHEDULE FOR EXISTING CONSTRUCTION

APPLICATIONS	DUCTS		PIPING		CONDUIT	
	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
Through floors with bottom side a hazardous location	B E	7 Not Req	B (1) E (3) H (2)	7 Not Req 7	B (1) E (3) H (2)	7 Not Req 7
Through floors on grade above water table	B	7	B	7	B	7
Through slab on grade below water table	E	Not Req	E	Not Req	E	Not Req
Through floors in washdown areas	G	3	G H (2)	3 3	G H (2)	3 3
Through walls where one side is a hazardous area	B E	7 Not Req	B (1) B (3) E H (2)	7 1 Not Req 7	B (1) (3) E H (2)	7 Not Req 7
Through exterior wall below grade above water table	B	7	B (1) B (3) H (2)	7 1 7	B (1) (3) H (2)	7 7
Through wall from tankage or wet well (above high water level) to dry well or dry area	B E	7 Not Req	B E H (2)	1 Not Req 1	B (1) (3) E H (2)	7 Not Req 7
Through wall from tankage or wet well (below high water level) to dry well or dry area	E	Not Req	E	Not Req	E	Not Req
Through exterior wall above grade	G	6	G (1) (3) H (2)	5 5	G (1) (3) H (2)	5 7
Roof penetrations	G	2	G (1) (3) H (2)	2	G	2
Through interior walls and slabs not covered by the above applications	G	4	G (1) (3) H (2)	4 4	G (1) (3) H (2)	4 4
Grating openings and penetrations	J	8	J	8	J	8

(1) Multiple piping 3 inches and smaller or multiple conduits.
(2) Single pipe 3 inches and smaller or single conduit.
(3) Single pipe or conduit larger than 3 inches.

END OF SECTION

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SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General provisions applicable to all demolition and removals.
2. Civil/site demolition and removals.
3. Architectural and structural demolition and removals.
4. Mechanical demolition and removals
5. Electrical demolition and removals.
6. Disposal of demolition debris, materials, and equipment.

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

1. Section 31 23 33 - Trenching and Backfilling.

1.2 REFERENCES

A. Reference Standards: Standards referenced in this section include, but are not necessarily limited to, the following:

1. National Fire Protection Association (NFPA):

a. 241 - Safeguarding Construction, Alteration, and Demolition Operations.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Review procedures under this and other Sections and coordinate the Work that will be performed with, or before, demolition and removals.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of authorities having jurisdiction and relevant permits, if any, required and obtained for demolition Work.

B. Qualifications:

1. Electrical Removals: Entity and personnel performing electrical removals shall be electrician(s) legally qualified to perform electrical construction and electrical work in the jurisdiction where the Site is located.
2. Plumbing Removals: Entity and personnel performing plumbing removals shall be plumber(s) legally qualified to perform plumbing construction and plumbing work in the jurisdiction where the Site is located.

1.5 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Procedure Submittals:

a. Demolition and Removal Plan: Not less than ten days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:

1) Plan for coordinating shut-offs, capping, temporary services, and continuing utility services.
2) General indication of intended approach for performing demolition Work, including how proposed demolition will affect Owner and others, including owners and occupants of properties at and adjacent to the Site and the public.
3) Disposal and recycling facilities proposed, including facility owner, facility name, location, and processes. Include copy of appropriate permits and licenses, and compliance status.
4) Planned demolition operating sequences, relative to their effect on Owner and others, including owners and occupants of properties at and adjacent to the Site and the public.
5) Detailed schedule of demolition Work in accordance with the Progress Schedule accepted by COR.
6) Copy of demolition permit (when required) obtained from authorities having jurisdiction.

2. Notification of Intended Demolition Start: Submit in accordance with Paragraph 3.1.B of this Section.
3. Qualifications Statements:

a. Name and qualifications of entity performing electrical removals, including copy of licenses required by authorities having jurisdiction.
b. Name and qualifications of entity performing plumbing removals.

1.6 FIELD CONDITIONS

A. Existing Conditions:

1. Owner and COR make no representation of condition or structural integrity of areas to be demolished or where removals are required by the Contract Documents.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Notification:

1. Not less than 48 hours prior to commencing demolition or removal, advise COR in writing of planned start of demolition Work. Do not start removals when either Owner or COR furnishes reasonable objection in a timely manner.
2. Where demolition or removal has potential to affect adjacent properties, occupants, streets, or other public thoroughfare, transportation facilities, utilities, water courses, or any combination thereof, furnish required notices to owners and occupants of properties, buildings, and structures that may be affected by the demolition or removal.
3. In accordance with Laws and Regulations, and applicable permits, furnish to authorities having jurisdiction, including emergency services as necessary, appropriate notices of planned demolition and removals.
4. Submit to COR copies of notices furnished to adjacent property owners, occupants, and authorities having jurisdiction.

B. Protection of In-Place Conditions:

1. Perform demolition and removal Work in manner that prevents damage and injury to property, structures, occupants, the public, and facilities. Do not interfere with use of, and free and safe access to and from, buildings, structures, and properties, unless allowed by the Contract Documents or otherwise allowed in writing by Owner.
2. Closing or obstructing roads, drives, sidewalks, and passageways adjacent to the Work is not allowed unless indicated otherwise in the Contract Documents. Perform the Work with minimum interference to vehicular and pedestrian traffic.
3. Provide temporary partitions between demolition work areas and (a) areas that will be occupied during demolition and removals, and (b) areas accessible to the public or visitors. Temporary partitions shall be sturdy, braced plywood in good condition, of dimensions sufficient to adequately screen demolition work from view of occupants, public, and visitors. Maintain temporary partitions in place until demolition and removal Work in the subject area is complete or until other work requires removal of temporary partitions.
4. Provide appropriate temporary barriers, lighting, sidewalk sheds, and other necessary protection.
5. Repair damage to facilities not subject to demolition or removal when such damage results from Contractor's action or inaction.

C. Existing Utilities: In addition to requirements of the General Conditions, as may be modified by the Supplementary Conditions, and other Division 01 Specifications, perform the following:

1. Should unforeseen, unknown, or incorrectly shown or indicated Underground Facilities be encountered, Contractor responsibilities shall be in accordance with the General Conditions, as may be modified by the Supplementary Conditions. Cooperate with utility owners in keeping adjacent services and facilities in operation.

2. Sanitary Sewerage: Before proceeding with demolition, locate and cap all sewer lines and service laterals discharging from the building or structure being demolished.
3. Coordinate with utility owners relative to demolition and removal Work. Where utility owner requires that only the associated utility owner modify, disconnect, cap, or any combination thereof, its associated utility service, pay the utility owner for performing such modification, disconnection, capping, or other necessary work.
4. Shutdown of utility services shall be coordinated by Contractor, assisted by Owner as required relative to contacting utility owners.

D. Remediation:

1. If unanticipated Hazardous Environmental Condition is believed to be encountered during demolition and removals, comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.

3.2 DEMOLITION - GENERAL

A. General, Common Requirements for Demolition and Removal Work:

1. Contractor shall provide all labor, materials, construction equipment and machinery, tools, services (including professional services when necessary), and incidentals as shown, specified and required for demolition, removals, and disposal Work.
2. The Work under this Section includes, but is not necessarily limited to:

   a. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of metals, masonry, attachments, appurtenances, piping, electrical systems, pavement, curbs, sidewalks, and similar existing materials, equipment, and items.

3. Demolition and removals indicated in other Sections shall comply with requirements of this Section.
4. Perform demolition Work as shown or indicated on the Drawings and as indicated elsewhere in the Contract Documents.
5. Pay for transporting and, as applicable, disposing of materials and equipment resulting from demolition and removals Work.
6. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on supporting and adjacent walls, floors, framing, facilities, and Underground Facilities.
7. Comply with NFPA 241.

B. Pollution Controls:

1. Use water sprinkling, temporary enclosures, and other suitable methods to limit emissions of dust and dirt to lowest practical level.
2. Do not use water when water may create hazardous or objectionable conditions such as icing, flooding, or pollution.
3. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work, in accordance with the General Conditions and –Division 01.

C. Explosives:

1. Explosives are not allowed at the Site. Do not use explosives for demolition and removal Work.

D. Finishing of Surfaces Exposed by Removals: Unless otherwise shown or indicated in the Contract Documents, surfaces of walls, floors, ceilings, and other areas exposed by removals, and that will remain as finished surfaces, shall be repaired and re-finished with materials that match existing adjacent surface, or as otherwise approved by COR.

3.3 STRUCTURAL REMOVALS

A. Remove structures to lines and grades shown or indicated, unless otherwise directed by COR. Where limits are not shown or indicated, limits shall be four inches outside item to be installed. Removals beyond limits shown or indicated shall be at Contractor's risk and expense and such excess removals shall be reconstructed to satisfaction of COR without additional cost to Owner.

B. Recycling and Reuse of Demolition Materials:

1. All concrete, brick, masonry, reinforcing steel, structural metals, miscellaneous metals, plaster, wire mesh, and other items contained in, or upon, building or structure to be demolished, shall be removed, transported, and disposed of away from the Site, unless otherwise approved by COR.
2. Do not use demolished materials as fill or backfill adjacent to buildings and structures, in pipeline trenches, or as subbase under buildings, structures, or pavement.

C. After removing concrete and masonry walls or portions thereof, mats, slabs, and similar construction that ties in to the Work or to existing construction, neatly repair the junction point to leave exposed only finished edges and finished surfaces.

D. Where anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the Work to existing construction, provide such materials under this Section, unless specified elsewhere in the Contract Documents.

3.4 MECHANICAL REMOVALS

A. Mechanical demolition and removal Work includes dismantling and removing existing:

1. Piping systems.
2. Mechanical removals include cutting and capping as required,.
3. Mechanical removals as required in this Section apply to systems exposed to view, hidden from view, and Underground Facilities. Mechanical removals may require working in spaces that are OSHA-classified as confined spaces.

B. Life-Safety Systems:

1. Retain existing life-safety systems, including but not limited to fire suppression systems, in place for as long as possible prior to performing associated demolition and removals.

2. Where demolishing buildings or structures equipped with life-safety systems, remove or deactivate life-safety systems only in the area where active demolition operations are in progress.

C. Demolition and Removals of Piping, Ductwork, and Similar Items:

1. Scope:

a. Safely and properly purge piping solids, liquids, and gases (as applicable) and make safe for removal and capping. Discharge contents of existing piping appropriately while avoiding damaging property; restricting access to or use of property; and creating unsafe, unsanitary, nuisances, and noisome conditions.
b. To the extent shown or indicated, remove existing piping conveying sludge, wastewater, other fluids, and process gases, and other piping.
c. Remove piping to the nearest structurally sound (or "solid") piping support, and provide caps on ends of remaining piping.
d. Where piping to be demolished passes through existing walls to remain, cut off and cap pipe on each side of wall.

2. Caps, Closures, Blind Flanges, and Plugs – General (All Piping and Ducts):

a. Provide closure pieces, such as blind flanges and caps, where shown, indicated, or necessary to complete the Work.
b. Where used in this Section, the term "cap" means the appropriate type of closure for piping being closed, including caps, blind flanges, and other closures.
c. Caps shall be compatible with the piping on which the cap is installed, fluid-tight and gastight, and appropriate for the fluid or gas conveyed in the pipe.
d. Unless otherwise shown or indicated, caps shall be mechanically fastened, fused, or welded to pipe or duct. Plug piping with means other than specified in this Section only when expressly shown or indicated in the Contract Documents or when allowed, in writing, by COR.

3. Underground Facilities:

a. When Underground Facilities are altered or removed, properly cut and cap piping left in place, unless otherwise shown or indicated.

4. Waste and Vent Piping; Ductwork:

a. Remove waste and vent piping, to extent shown and cap as required.
b. Where demolished vent piping, stacks, and ductwork passes through existing roofing, patch the roof with same or similar materials as existing, and fully compatible with existing roofing materials. Completed patch shall be watertight and comply with roofing manufacturer's written recommendations, and warranty requirements (when existing warranty remains in effect).

5. Plumbing;

a. Modifications to plumbing piping (other than soil, waste, and vent piping), shall comply with Laws and Regulations.

b. Hydrostatically test other, normally-pressurized, plumbing systems that convey fluid. Field-test piping conveying air or gas in accordance with the Contract Documents prior to returning such systems to service.

3.5 ELECTRICAL REMOVALS

A. Electrical Demolition Work Includes Performing the Following Activities and Removing Existing Electrical Items as follows:

1. Disconnecting cabling from motors, electrical sources, control panels, control stations, instrumentation and control items, and similar devices and equipment.
2. Conduits, raceways, cable trays, hangers and supports, cabling, and related items.
3. Switches, panelboards, control stations, and similar items.
4. Lighting fixtures and related items.
5. Appurtenances and miscellaneous electrical equipment, as shown, specified, or required.

B. Electrical Removals – General:

1. Comply with Laws and Regulations, including applicable electrical construction codes.
2. Lock Out and Tagging:

   a. Contractor shall lock out and tag circuit breakers and switches operated by Owner or facility manager (if other than Owner), and shall verify that affected cabling are de-energized to ground potential before commencing electrical removals Work.
   b. Upon completion of electrical removals Work, remove locks and tags and promptly advise COR and facility manager that existing facilities are available for use.

3. Remove existing electrical equipment, fixtures, and systems while avoiding damaging items required to remain. Unless shutdown is expressly allowed in Division 01, keep existing electrical systems in operation. Maintain integrity of grounding systems.
4. Disconnect and remove motors, control panels, and other electrical items where shown or indicated.
5. Store removed motors, microprocessors and electronics, and other electrical items to be reused in accordance with its manufacturer's recommendations and requirements of the Contract Documents.

C. Removal of Cabling, Conduits, Raceways and Similar Items:

1. Verify the function of each cable before disconnecting and removing.
2. Remove cabling, conduits, hangers and supports, and similar items back to the power source or control panel, unless otherwise shown or indicated.
3. Remove cabling, conduits, and similar items where shown or indicated for removal. Abandoned conduits concealed in floors, ceiling slabs, or in walls shall be cut flush with the slab or wall (as applicable) at point of entrance, suitably capped, and the area repaired in a flush, smooth manner acceptable to COR.
4. Disassemble and remove exposed conduits, junction boxes, other electrical appurtenances, and their supports.
5. Repair all areas of the Work to prevent rusting on exposed surfaces.
6. Underground Electric Demolition and Removal:

a. Conduits in Underground Facilities not scheduled for reuse shall be suitably capped watertight where each enters building or structure to remain.
b. Where shown or indicated, remove direct-burial cabling. Openings in buildings or structures for entrance of direct-burial cabling shall be patched with repair mortar or other material approved by COR for such purpose, and shall be watertight.

D. Lighting fixtures, wall switches, receptacles, starters, and other miscellaneous electrical equipment, not designated as remaining as Owner's property, shall be removed and properly disposed off-Site as required in accordance with Laws and Regulations.

3.6 DEMOLITION OF SITE IMPROVEMENTS

A. Pavement, Sidewalks, Curbs, and Gutters:

1. Demolition of asphalt or concrete pavement, sidewalks, curbs, and gutters, as applicable, shall terminate at cut edges. Edges shall be linear and have a vertical cut face.
2. To cut pavement, sidewalks, curbs, and gutters, use machinery or tools that provide a smooth-cut edge, appropriate for the required result. Where cut edges are not smooth and vertical, appropriately repair cut edge to remain, or provide new cut (in accordance with the Contract Documents) through sound material not less than six inches from original cut, providing smooth, even appearance.

B. Fencing, Guardrails, and Bollards:

1. Remove to the limits shown or indicated on the Drawings.
2. Completely remove below-grade posts and concrete.

C. Manholes, Vaults, Chambers, and Handholes:

1. Remove to the limits shown or indicated on the Drawings.
2. If not shown or indicated on the Drawings, remove to not less than three feet below finished grade indicated on the Drawings.
3. Where a portion of manhole, vault, handhole, or similar structure remains in-place, backfill portion of item that will remain with material as indicated in the "Underground Facilities Other than Manholes, Vaults, Chambers, and Handholes" provision, below, of this Article.

D. Landscaping: Comply with Section 31 10 00 - Site Clearing.

E. Other Site Improvements: When the Contract Documents require removal of other site improvements not addressed above, comply with Contract requirements for removal of buildings or structures.

3.7 DISPOSAL OF DEMOLITION DEBRIS

A. Disposal – General:

1. Promptly remove from the Site all debris, waste, rubbish, material, and equipment resulting from demolition and removal Work. Promptly upon completion of demolition and removal Work, remove from the Site construction equipment used in demolition Work.
2. Do not sell at, or adjacent to, the Site demolition materials or removed equipment and items. If materials, equipment or debris will be sold by Contractor, remove the items from the Site and adjacent areas, and perform the sale or transaction elsewhere, in accordance with Laws and Regulations.

B. Transportation and Disposal:

1. Non-Hazardous Materials, Equipment, and Debris: Properly transport and dispose of non-hazardous demolition materials, equipment, and debris at appropriate landfill or other suitable location, in accordance with Laws and Regulations. Non-hazardous material does not contain Constituents of Concern such as (but not limited to) asbestos, PCBs, petroleum, hazardous waste, radioactive material, or other material designated as hazardous in Laws or Regulations.
2. Hazardous Materials, Equipment, and Debris: When handling and disposal of items containing Constituents of Concern is included in the Work, properly transport and dispose of such items in accordance with the Contract Documents and Laws and Regulations.

C. Submit to COR information required in this Section on proposed facilities where demolition materials, equipment, and debris will be recycled. Upon request, COR or Owner, shall be allowed to visit recycling facilities to verify adequacy and compliance status. During such visits, recycling facility operator shall cooperate and assist COR and Owner.

END OF SECTION

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SECTION 10 14 00
IDENTIFICATION DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tag, tape and stenciling systems for equipment, piping, valves, pumps, ductwork and similar items.
2. Hazard and safety signs.

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

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American Society of Mechanical Engineers (ASME):

   a. A13.1, Scheme for the Identification of Piping Systems.

2. The International Society of Automation (ISA).
3. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):

   a. Z535.1, Safety Color Code.
   b. Z535.2, Environmental and Facility Safety Signs.
   c. Z535.3, Criteria for Safety Symbols.
   d. Z535.4, Product Safety Signs and Labels.

4. National Fire Protection Association (NFPA):

   a. 70, National Electrical Code (NEC).
   b. 704, Standard System for the Identification of Hazards of Materials for Emergency Response.

5. Occupational Safety and Health Administration (OSHA):

   a. 29 CFR 1910.145, Specification for Accident Prevention Signs and Tags.

1.3 SUBMITTALS

A. Shop Drawings:

1. Product technical data including:

a. Catalog information for all identification systems.
b. Acknowledgement that products submitted meet requirements of standards referenced.

2. Identification register, listing all items in PART 3 of this Specification Section to be identified, type of identification system to be used, lettering, location and color.
3. Schedule of Hazard and Safety Signage indicating text and graphics.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. W.H. Brady Co.
2. Panduit.
3. Seton.
4. National Band and Tag Co.
5. Carlton Industries, Inc.

2.2 MANUFACTURED UNITS

A. Type A1 - Round Metal Tags:

1. Materials:

a. Aluminum or stainless steel.
b. Stainless steel shall be used in corrosive environments.

2. Size:

a. Diameter: 1-1/2 inches minimum.
b. Thickness: 0.035 inches (20 GA) minimum.

3. Fabrication:

a. 3/16 inches minimum mounting hole.
b. Legend: Stamped and filled with black coloring.

4. Color: Natural.

B. Type B2 - Nonmetallic Signs:

1. Materials: Fiberglass reinforced or durable plastic.
2. Size:

a. Surface: As required by text.
b. Thickness: 60 mils minimum.

3. Fabrication:

    a. Rounded corners.
    b. Drilled holes in corners with grommets.
    c. Legend: Preprinted, permanently embedded and fade resistant for a 10 year minimum outdoor durability.

4. Color:

    a. Background: Manufacturer standard or as specified.
    b. Lettering: Black.

5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.

C. Type C - Laminated Name Plates:

1. Materials: Phenolic or DR (high impact) acrylic.
2. Size:

    a. Surface: As required by text.
    b. Thickness: 1/16 inches.

3. Fabrication:

    a. Outdoor rated and UV resistant when installed outdoors.
    b. Two layers laminated.
    c. Legend: Engraved through top lamination into bottom lamination.
    d. Two drilled side holes, for screw mounting.

4. Color: Black top surface, white core, unless otherwise indicated.

D. Type D - Self-Adhesive Tape Tags and Signs:

1. Materials: Vinyl tape or vinyl cloth.
2. Size:

    a. Surface: As required by text.
    b. Thickness: 5 mils minimum.

3. Fabrication:

    a. Indoor/Outdoor grade.
    b. Weather and UV resistant inks.
    c. Permanent adhesive.
    d. Legend: Preprinted.
    e. Wire markers to be self-laminating.

4. Color: White with black lettering or as specified.
5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.

E. Type E - Heat Shrinkable Tape Tags:

1. Materials: Polyolefin.
2. Size: As required by text.
3. Fabrication:

   a. Legend: Preprinted.

4. Color: White background, black printing.

F. Type F - Underground Warning Tape:

1. Materials: Polyethylene.
2. Size:

   a. 6 inches wide (minimum).
   b. Thickness: 3.5 mils.

3. Fabrication:

   a. Legend: Preprinted and permanently imbedded.
   b. Message continuous printed.
   c. Tensile strength: 1750 psi.

4. Color: As specified.

G. Underground Tracer Wire:

1. Materials:

   a. Wire:

      1) 12 GA AWG.
      2) Solid.

   b. Wire nuts: Waterproof type.
   c. Split bolts: Brass.

2.3 ACCESSORIES

A. Fasteners:

1. Bead chain: #6 brass, aluminum or stainless steel.
2. Plastic strap: Nylon, urethane or polypropylene.
3. Screws: Self-tapping, stainless steel.
4. Adhesive, solvent activated.

2.4 MAINTENANCE MATERIALS

A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Install identification devices at specified locations.

B. All identification devices to be printed by mechanical process, hand printing is not acceptable.

C. Attach tags to equipment with sufficient surface or body area with solvent activated adhesive applied to back of each tag.

D. Attach tags with 1/8 inches round or flat head screws to equipment without sufficient surface or body area, or porous surfaces.

1. Where attachment with screws should not or cannot penetrate substrate, attach with plastic strap.

E. Single items of equipment enclosed in a housing or compartment to be tagged on outside of housing.

1. Several items of equipment mounted in housing to be individually tagged inside the compartment.

F. Tracer Wire:

1. Attach to pipe at a maximum of 10 feet intervals with tape or tie-wraps.
2. Continuous pass from each valve box and above grade at each structure.
3. Coil enough wire at each valve box to extend wire a foot above the ground surface.
4. 1,000 feet maximum spacing between valve boxes.
5. If split bolts are used for splicing, wrap with electrical tape.
6. If wire nuts are used for splicing, knot wire at each splice point leaving 6 inches of wire for splicing.
7. Use continuous strand of wire between valve box where possible.

    a. Continuous length shall be no shorter than 100 feet.

3.2 SCHEDULES

A. Hazard and Safety Signage:

1. Permit Required Confined Space signage:

    a. Tag Type: Type B2 - Nonmetallic Signs.
    b. Fastener: Screw or adhesive.

c. Size: 10 inches x 14 inches.
d. Location: As indicated on Drawings.
e. Legend:

1) OSHA Danger sign.
2) Description of hazard: “PERMIT REQUIRED CONFINED SPACE DO NOT ENTER”.

2. Miscellaneous OSHA hazard signage:

a. Tag Type: Type B2 - Nonmetallic Signs.
b. Fastener: Screw or adhesive.
c. Size: 10 inches x 14 inches.
d. Location: As indicated on Drawings.
e. Legend:

1) Provide international graphic symbology where indicated.

B. Process Systems:

1. General:

a. Provide arrows and markers on piping.

1) At 20 feet maximum centers along continuous lines.
2) At changes in direction (route) or obstructions.
3) At valves, risers, "T" joints, machinery or equipment.
4) Where pipes pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.

b. Position markers on both sides of pipe with arrow markers pointing in flow direction.

1) If flow is in both directions use double headed arrow markers.

c. Apply tapes and stenciling in uniform manner parallel to piping.

2. Trenches with piping:

a. Tag type: Type F - Underground Warning Tape
b. Location: Halfway between top of piping and finished grade.
c. Letter height: 1-1/4 inches minimum.
d. Storm and sanitary sewer lines:

1) Color: Green with black letters.
2) Legend:

a) First line: “CAUTION CAUTION CAUTION”
b) Second line: “BURIED SEWER LINE BELOW”

e. Other piping (e.g., compressed air, irrigation, refrigerant, heating water, etc.):

1) Color: Yellow with black letters.
2) Legend:

a) First line: “CAUTION CAUTION CAUTION”
b) Second line: “BURIED PIPE LINE BELOW”

3. Valves and slide gates:

a. Tag type:

1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
2) Indoor noncorrosive:

a) Type A1 - Round Metal Tags.
b) Type B1 - Square Nonmetallic Tags.

3) Indoor corrosive:

a) Stainless steel Type A1 - Round Metal Tags.
b) Type B1 - Square Nonmetallic Tags.

b. Fastener:

1) Type A1: Chain of the same material.
2) Type B1: Stainless steel chain.

c. Color: Per ASME A13.1 corresponding to the piping system.
d. Legend:

1) Letter height: 1/4 inches minimum.
2) Valve designation as indicated on the Drawings (e.g., “V-xxx”).

4. Process equipment (e.g., pumps, pump motors, blowers, air compressors, bar screens, clarifier drive mechanism, etc.):

a. Tag type:

1) Type B2 - Nonmetallic Signs.
2) Type D - Self-Adhesive Tape Tags and Signs.
3) Type G - Stenciling System.

b. Fastener:

1) Self.
2) Screws.
3) Adhesive.

c. Legend:

1) Letter height: 1/2 inches minimum.
2) Equipment designation as indicated on the Drawings (e.g., “Primary Sludge Pump P-xxx”).

5. Piping systems:

    a. Tag type:

        1) Outdoor locations: Type G - Stenciling System.
        2) Indoor locations:

            a) Type D - Self-Adhesive Tape Tags and Signs.
            b) Type G - Stenciling System.

    b. Fastener: Self.
    c. Color: Per ASME A13.1.
    d. Legend:

        1) Letter height: Manufacturers standard for the pipe diameter.
        2) Mark piping in accordance with ASME A13.1.
        3) Use piping designation as indicated on the Drawings.
        4) Arrow: Single arrow.

6. Process tanks (over 1000 GAL) and basins, (e.g., chemical storage, clarifiers, trickling filters, digesters, etc.):

    a. Tag type:

        1) Type B2 - Nonmetallic Signs.
        2) Type G - Stenciling System.

    b. Fastener:

        1) Screw.
        2) Self.

    c. Location as directed by Owner.
    d. Legend:

        1) Letter height: 4 inches minimum.
        2) Equipment designation as indicated on the Drawings (e.g., “Clarifier CL-xxx”).

7. Equipment that starts automatically:

    a. Tag type:

        1) Type B2 - Nonmetallic Signs.
        2) Type D - Self-Adhesive Tape Tags and Signs.

    b. Fastener:

        1) Type B2 - Screw or adhesive.
        2) Type D - Self.

    c. Size: 5 inches x 7 inches

d. Location: Lift Station Pumps.
e. Legend:

1) OSHA Warning Sign.
2) Description of Warning: “THIS MACHINE STARTS AUTOMATICALLY”.

C. Electrical Systems:

1. Trenches with direct-buried conduit.

a. Tag type: Type F - Underground Warning Tape.
b. Letter height: 1-1/4 inches minimum.
c. Location:

1) Where trench is 12 inches or more below finished grade: In trench 6 inches below finished grade.
2) Where trench is less than 12 inches below finished grade: In trench 3 inches below finished grade.

d. Electrical power (e.g., low and medium voltage):

1) Color: Red with black letters.
2) Legend:

a) First line: “CAUTION CAUTION CAUTION”.
b) Second line: “BURIED ELECTRIC LINE BELOW”.

2. Enclosure for instrumentation and control equipment, (e.g., pump control panels, etc.):

a. Tag type: Type C - Phenolic Name Plates.
b. Fastener: Screws.
c. Legend:

1) Letter height: 1/2 inches minimum.
2) Equipment name (e.g., "PUMP CONTROL PANEL CPxxx").

3. Components inside equipment enclosures (e.g., circuit breakers, fuses, control power transformers, control relays, contactors, timers, etc.):

a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
b. Fastener: Self.
c. Legend:

1) Letter height: 3/16 inches minimum.
2) Description or function of component (e.g., "M-xxx”, “CR-xxx” or “TR-xxx").

4. Grounding conductors associated with grounding electrode system in accordance with the following:

a. Tag type: Type D - Self-Adhesive Tape Tags.

b. Fastener: Self.
c. Legend:

1) Letter height: 1/8 inches minimum.
2) Function of conductor (e.g., "MAIN BONDING JUMPER", "TO GROUND RING", "TO MAIN WATER PIPE").

5. Flash protection for switchboards, panelboards, industrial control panels and motor control centers:

a. Tag type: Type D - Self-Adhesive Tape Signs.
b. Fastener: Self.
c. Legend: Per NFPA 70.

END OF SECTION

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Basic requirements for electrical systems.

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

1.
2. Division 03 Specifications
3. Section 10 14 00 - Identification Devices.
4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
5. Section 26 05 33 - Raceways and Boxes for Electrical Systems.

1.2 REFERENCES

A. Definitions

1. For the purposes of providing materials and installing electrical work the following definitions shall be used.

   a. 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.
   b. Architecturally finished interior area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.
   c. Non-architecturally finished interior area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.
   d. Highly corrosive and 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.
   e. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
   f. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

B. Referenced Standards:

1. Aluminum Association (AA):

   a. ADM, Aluminum Design Manual.

2. American Institute of Steel Construction (AISC):

    a. Steel Construction Manual.

3. American National Standards Institute (ANSI).
4. 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.

5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

    a. C2, National Electrical Safety Code (NESC).

6. National Fire Protection Association (NFPA):

    a. 70, National Electrical Code (NEC).

7. National Electrical Manufacturers Association (NEMA):
8. Underwriters Laboratories, Inc. (UL).

C. 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 SUBMITTALS

A. Shop Drawings:

1. 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.

2. Fabrication and/or layout drawings:

a. Concrete and reinforcing steel, per Division 03 requirements.

B. Operation and Maintenance Manuals:

1. See Division 01 for requirements for:

a. The mechanics and administration of the submittal process.
b. The content process of Operation and Maintenance Manuals.

C. When a Specification Section includes products specified in another Specification Section, each Specification Section shall have the required Shop Drawing transmittal form and all Specification Sections shall be submitted simultaneously.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect nameplates on electrical equipment to prevent defacing.

1.5 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.

2. Indoor areas:

a. Dry.

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.
2) Stainless steel: AISI Type 316.
3) PVC coated galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 mil PVC coating.
4) Aluminum: AA Type 6063-T6.

b. Structural members (e.g., I beams, L and C channels):

1) Galvanized steel: ASTM A36/A36M steel with galvanizing per ASTM A123/A123M.
2) Aluminum: AA Type 6061-T6 or 6063-T6.

c. Mounting plates:

1) Galvanized steel: ASTM A36/A36M steel with galvanizing per ASTM A123/A123M.
2) Aluminum: AA Type 6063-T6.

d. Mounting hardware:

1) Galvanized steel.
2) Stainless steel.

e. Anchorage, Concrete and reinforcing steel: See Division 03 specifications.

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 PREPARATION

3.2 INSTALLATION

A. Install and wire all equipment, including pre-purchased 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 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 inches from process, gas, air and water piping and equipment.

H. Install equipment so it is readily accessible for operation and maintenance, is not blocked or concealed and does not interfere with normal operation and maintenance requirements of other equipment.

I. Device Mounting Schedule:

1. Unless indicated otherwise on the Drawings, mounting heights are as indicated below:

a. Separately mounted motor starter (to center of operating handle): 54 inches.
b. Pushbutton or selector switch control station (to center): 46 inches.

J. Avoid interference of electrical equipment operation and maintenance with structural members, building features and equipment of other trades.

1. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments of up to 6 inches in equipment location with the Engineer's approval.

K. Provide electrical equipment support system per the following area designations:

1. Dry areas:

a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.

2. Wet areas:

a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.

3. Corrosive areas:

a. Aluminum system consisting of aluminum channels and fittings with stainless steel nuts and hardware.

L. Provide all necessary anchoring devices and supports rated for the equipment load based on dimensions and weights verified from approved submittals, or as recommended by the manufacturer.

1. See Division 03 Specifications.
2. Do not cut, or weld to, building structural members.
3. Do not mount safety switches or other equipment to equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

M. Provide non-metallic corrosion resistant spacers to maintain 1/4 inches separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Basins, Clarifiers, Digesters, Reservoirs, etc.

N. Do not place equipment fabricated from aluminum in direct contact with earth or concrete.

O. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents and insects.

P. Do not use materials that may cause the walls or roof of a building to discolor or rust.

Q. Identify electrical equipment and components in accordance with Specification Section 10 14 00.

R. 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.

S. 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.

3.3 FIELD QUALITY CONTROL

A. Verify exact rough-in location and dimensions for connection to electrified equipment, provided by others.

1. See Specification Section 01 73 20 for openings and penetrations in structures.

B. Replace equipment and systems found inoperative or defective and re-test.

C. The protective coating integrity of support structures and equipment enclosures shall be maintained.

1. Repair galvanized components utilizing a zinc rich paint.
2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the component.
4. Repair surfaces which will be inaccessible after installation prior to installation.
5. See Specification Section 26 05 33 for requirements for conduits and associated accessories.

D. Replace nameplates damaged during installation.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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 - Common Work Results for Electrical.

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.

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 Section 26 05 00 for additional requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Building wire, power and control cable:

a. Aetna Insulated Wire.
b. Or Equal

2. Instrumentation cable:

a. Analog cable:

1) Alphawire.
2) Or Equal

3. Wire connectors:

a. Burndy Corporation.
b. Or Equal

4. Insulating and color coding tape:

a. 3M Co.
b. Or Equal

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 arch non-architectural finished areas.
    b. Building wire and power and control cable in conduit in outdoor areas and below grade.

2. 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 inches 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 inches 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 inches 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.

5. Multiple branch circuits for similar loads may be combined in a common raceway, such as multiple lighting circuits or multiple receptacle circuits or other 120Vac circuits. Do not combine lighting and receptacle circuits.

a. Do not combine control device circuits with lighting or receptacle circuits.
b. 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. 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.

b. 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.

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.

END OF SECTION

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SECTION 26 05 26
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

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

1. Section 10 14 00 - Identification Devices.
2. Section 26 05 00 - Common Work Results for Electrical.
3. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
4. Section 26 05 33 - Raceways and Boxes for Electrical Systems.

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 Section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Wire and Cable:

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

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

C. Ground Rods:

1. 3/4 inches x 10 feet.
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.

D. 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.

E. Exothermic Weld Connections:

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

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install products in accordance with manufacturer's instructions.
2. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250, except where larger sizes are indicated on the Drawings.
3. Remove paint, rust, or other non-conducting material from contact surfaces before making ground connections. After connection, apply manufacturers approved touch-up paint to protect metallic surface from corrosion.
4. Where ground conductors pass through floor slabs or building walls provide nonmetallic sleeves and install sleeve per Specification Section 01 73 20.

   a. Seal the sleeve interior to stop water penetration.

5. Do not splice grounding electrode conductors except at ground rods.
6. Install ground rods and grounding electrode conductors in undisturbed, firm soil.

   a. Provide excavation required for installation of ground rods and conductors.
   b. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
   c. Unless otherwise specified, connect conductors to ground rods with compression type connectors or exothermic weld.
   d. Provide sufficient slack in conductor to prevent conductor breakage during backfill or due to ground movement.
   e. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.

7. Do not use exothermic welding if it will damage the structure the grounding conductor is being welded to.

B. Grounding Electrode System:

1. Provide a grounding electrode system in accordance with NFPA 70, Article 250 and as indicated on the Drawings.

2. Grounding electrode conductor terminations:

a. Ground bars in electrical equipment: Use compression type conductor terminal and bolt it to the ground bar or manufacture's provided mechanical type termination device.
b. Building steel, below grade and encased in concrete: Use compression type connector or exothermic weld.
c. Building steel, above grade: Use a two-hole compression type conductor terminal and bolt to the steel with two bolts or exothermic weld.
d. Ground rod: Compression type or exothermic weld, unless otherwise specified.
e. At all above grade terminations, the conductors shall be labeled per Specification Section 10 14 00.
f. .

C. Supplemental Grounding Electrode:

1. Provide the following grounding in addition to the equipment ground conductor supplied with the feeder conductors whether or not shown on the Drawings.

a. See Grounding Electrode System paragraph for conductor termination requirements.

2. 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 FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Material and installation requirements for:

a. Conduits.
b. Conduit fittings.
c. Conduit supports.
d. Pull and junction boxes.

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

1. Section 26 05 00 - Common Work Results for Electrical.
2. Section 26 05 43 - Underground Work for Electrical Systems.

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 Section 26 05 00 for additional requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Rigid metal conduits:

a. Allied Tube and Conduit.
b. Or Equal

2. PVC coated rigid metal conduits:

a. Robroy Industries.
b. Or Equal

3. Rigid nonmetallic conduit:

a. Prime Conduit.
b. Or Equal

4. Conduit fittings and accessories:

a. Osburn Associates, Inc.
b. Or Equal

5. Or Equal Hazardous Location Conduit fittings and accessories:

a. Appleton by Emerson Electric Co.
b. Or Equal

6. Support systems:

a. Unistrut by Atkore International, Inc.
b. Or Equal

7. Outlet, pull and junction boxes:

a. Hoffman Engineering
b. Or Equal

2.2 OR EQUAL 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 inches, 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. Pass high temperature water PVC coating adhesion test and be ETL Verified PVC-001.
7. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6, NEMA RN 1.

2.3 RIGID NONMETALLIC CONDUIT

A. Schedules 40 (PVC-40):

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 degrees C wire and shall be marked "maximum 90 degrees C".
5. Standards: NFPA 70 Type PVC, NEMA TC 2, UL 651.

2.4 CONDUIT FITTINGS AND ACCESSORIES

A. Fittings for Use with RGS:

1. General:

   a. In hazardous locations listed for use in Class I, Groups C and D locations.

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. Sealing fittings:

    a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
    b. Standard and mogul size.
    c. With or without drain and breather.
    d. Fiber and sealing compound: UL listed for use with the sealing fitting.

10. Expansion couplings:

    a. 2 inches nominal straight-line conduit movement in either direction.
    b. Galvanized steel with insulated bushing.
    c. Gasketed for wet locations.
    d. Internally or externally grounded.

11. Expansion/deflection couplings:

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

12. Standards: UL 467, UL 514B, UL 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. Fittings for Use with Rigid Nonmetallic Fiberglass Conduit:

1. Coupling and adapters shall be of the same material, thickness, and construction as the conduit.
2. Epoxy adhesive for joining conduits and fittings shall be supplied by the same manufacturer as the conduit and fittings and shall provide a concrete and water tight connection.
3. Standard: NFPA 70 Type RTRC, NEMA TC14.AG, NEMA TC14.BG, UL 2420, UL 241.

E. 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.

2.5 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.

B. Cast Outlet Boxes:

1. Zinc plated cast iron or die-cast copper free aluminum with manufacturer's standard finish.
2. Threaded hubs and grounding screw.
3. Styles:

a. "FS" or "FD".
b. "Bell".
c. Single or multiple gang and tandem.
d. "EDS" or "EFS" for hazardous locations.

4. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
5. Standards: UL 514A, UL 1203.

2.6 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. NEMA 12 Rated:

1. Body and cover:

a. 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
b. Type 5052 H-32 aluminum, unpainted.

2. Seams continuously welded and ground smooth.
3. No knockouts.
4. External mounting flanges.
5. Non-hinged cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.
6. Flat door with oil resistant gasket.

C. Miscellaneous Accessories:

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

D. Standards: NEMA 250, UL 50.

2.7 SUPPORT SYSTEMS

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

1. Material requirements.

a. Galvanized steel: ASTM A123/A123M or ASTM A153/A153M.
b. Stainless steel: AISI Type 316.
c. PVC coat galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 mil PVC coating.

B. Single Conduit and Outlet Box Support Fasteners:

1. Material requirements:

a. Zinc plated steel.
b. Stainless steel.
c. Malleable iron.
d. PVC coat malleable iron or steel: 20 mil PVC coating.
e. Steel protected with zinc phosphate and oil finish.

2.8 OPENINGS AND PENETRATIONS IN WALLS AND FLOORS

A. Sleeves, smoke and fire stop fitting through walls and floors:

1. See Specification Section 01 73 20.

PART 3 - EXECUTION

3.1 RACEWAY INSTALLATION - GENERAL

A. Shall be in accordance with the requirements of:

1. NFPA 70.
2. Manufacturer instructions.

B. Size of Raceways:

1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.
2. Unless specifically indicated otherwise, the minimum raceway size shall be:

a. Conduit: 3/4 inches.
b. Wireway: 2-1/2 inches x 2-1/2 inches.

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 inches smaller than the interior of the conduit, to remove obstructions.
2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.

G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.

H. Where portions of a raceway are subject to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.

I. Fill openings in walls, floors, and ceilings and finish flush with surface.

1. See Specification Section 01 73 20.

3.2 RACEWAY ROUTING

A. Raceways shall be routed in the field unless otherwise indicated.

1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
2. Run in straight lines parallel to or at right angles to building lines.
3. Do not route conduits:

    a. Through areas of high ambient temperature or radiant heat.
    b. In 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 degrees 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. Concealed above gypsum wall board or acoustical tile suspended ceilings.
2. 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 feet:

1. Between instrumentation and 600 V and less AC power or control: 6 inches.
2. Between process, gas, air and water pipes: 6 inches.

D. Conduits shall be installed to eliminate moisture pockets.

1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.

E. Conduit shall not be routed on the exterior of structures except as specifically indicated on the Drawings.

F. Where sufficient room exists within the housing of roof-mounted equipment, the conduit shall be stubbed up inside the housing.

G. Provide all required openings in walls, floors, and ceilings for conduit penetration.

1. See Specification Section 01 73 20.

3.3 RACEWAY APPLICATIONS

A. Permitted Raceway Types Per Wire or Cable Types:

1. Power wire or cables: All raceway types.
2. Control wire or cables: All raceway types.
3. Instrumentation cables: Metallic raceway except nonmetallic may be used underground.

B. Permitted Raceway Types Per Area Designations:

1. Dry areas:

a. RGS.

2. Wet areas:

a. RGS.

3. Corrosive areas:

a. PVC-RGS.

4. NFPA 70 hazardous areas:

a. RGS.

C. Permitted Raceway Types Per Routing Locations:

1. In concrete block or brick walls:

a. PVC-40.
b. NEMA 1 rated wireway.

2. Direct buried conduits and ductbanks:

a. PVC-40.
b. 90 degrees elbows for transitions to above grade:

1) PVC-RGS.

c. Long sweeping bends greater than 15 degrees:

1) PVC-RGS.

D. Underground Conduit: See Specification Section 26 05 43.

3.4 CONDUIT FITTINGS AND ACCESSORIES

A. Conduit Seals:

1. Installed in conduit systems located in hazardous areas as required by the NFPA 70.
2. Fill plug and drain shall be accessible.
3. Pour the conduit seals in a two-step process.

a. Pour the seal and leave cover off.
b. After seal is dry, inspect for proper sealing, install cover and mark (for example, paint or permanent marker) as complete.

B. 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.

C. Install Expansion Fittings:

1. Where conduits are exposed to the sun and conduit run is greater than 200 feet.
2. Elsewhere as identified on the Drawings.

D. Install Expansion/Deflection Fittings:

1. Where conduits enter a structure.

    a. Except electrical manholes and handholes.
    b. Except where the ductbank is tied to the structure with rebar.

2. Where conduits span structural expansions joints.
3. Elsewhere as identified on the Drawings.

E. Threaded connections shall be made wrench-tight.

F. Conduit joints shall be watertight:

1. Where subjected to possible submersion.
2. In areas classified as wet.
3. Underground.

G. 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 12 rated enclosures:

    a. Watertight, insulated and gasketed hub and locknut.
    b. Use grounding type locknut or bushing when required by NFPA 70.

3. In NEMA 4 rated enclosures:

    a. Watertight, insulated and gasketed hub and locknut.

4. When stubbed up through the floor into floor mount equipment:

    a. With an insulated grounding bushing on metallic conduits.
    b. With end bells on nonmetallic conduits.

H. 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. Dry or wet areas:

a. Galvanized system consisting of: Galvanized steel channels and fittings, nuts and hardware and conduit clamps.

2. Corrosive areas:

a. PVC coated steel system consisting of: PVC coated galvanized steel channels and fittings and conduit clamps with stainless steel nuts and hardware.

3. Conduit type shall be compatible with the support system material.

a. Galvanized steel system may be used with RGS.
b. Stainless steel system may be used with RGS and PVC-RGS.
c. PVC coated galvanized steel system may be used with PVC-RGS and PVC-40.

B. Permitted single conduit support fasteners per area designations and conduit types:

1. Architecturally finished areas:

a. Material: Zinc plated steel, or steel protected with zinc phosphate and oil finish.
b. Types of fasteners: Spring type hangers and clips, straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
c. Provide anti-rattle conduit supports when conduits are routed through metal studs.

2. Dry or wet areas:

a. Material: Zinc plated steel, stainless steel and malleable iron.
b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.

3. Corrosive areas:

a. Material: Stainless steel and PVC coat malleable iron or steel.
b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.

4. Conduit type shall be compatible with the support fastener material.

a. Zinc plated steel, steel protected with zinc phosphate and oil finish and malleable iron fasteners may be used with RGS.
b. Stainless steel system may be used with RGS and PVC-RGS.
c. PVC coated fasteners may be used with PVC-RGSand PVC-40.
d. Nonmetallic fasteners may be used with PVC-40.

C. Conduit Support General Requirements:

1. Maximum spacing between conduit supports per NFPA 70.
2. Support conduit from the building structure.
3. Do not support conduit from process, gas, air or water piping; or from other conduits.
4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 LBS or to the maximum uniform load recommended by the manufacturer if the support is rated less than 25 pounds.

a. Do not exceed maximum concentrated load recommended by the manufacturer on any support.
b. Conduit hangers:

1) Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire.

c. Do not use suspended ceiling support systems to support raceways.
d. Hangers in metal roof decks:

1) Utilize fender washers.
2) Not extend above top of ribs.
3) Not interfere with vapor barrier, insulation, or roofing.

5. Conduit support system fasteners:

a. Use sleeve-type expansion anchors as fasteners in masonry wall construction.
b. Do not use concrete nails and powder-driven fasteners.

3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION

A. General:

1. Install products in accordance with manufacturer's instructions.
2. See 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:

C. Housing of wiring devices surface mounted in non-architecturally finished dry andwet areasPull 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.

3. Permitted uses of NEMA 12 enclosure:

a. Pull or junction box surface mounted in areas designated as dry.

END OF SECTION

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SECTION 26 05 43
UNDERGROUND WORK FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Material and installation requirements for:

a. Underground conduits and ductbanks.

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

1. Section 10 14 00 - Identification Devices.
2. Section 26 05 26 - Grounding.
3. Section 26 05 33 - Raceways and Boxes for Electrical Systems.
4. Section 31 23 33 - Trenching and Backfilling.

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 UNDERGROUND CONDUIT AND ACCESSORIES

A. Concrete and reinforcing steel: See Division 03 Specifications.

B. Conduit: See Specification Section 26 05 33.

C. Duct Spacers/Supports:

1. High density polyethylene or high impact polystyrene.
2. Interlocking web or mesh design.
3. Provide 3 inches minimum spacing between conduits.
4. Accessories, as required:

a. Hold down bars.
b. Ductbank strapping.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERGROUND ELECTRICAL SYSTEMS - GENERAL

A. Drawings indicate the intended location of direct buried conduit.

1. Field conditions may affect actual routing.

B. Install products in accordance with manufacturer's instructions.

C. Install manholes and handholes in conduit runs where indicated or as required to facilitate pulling of wires or making connections.

D. Comply with Specification Section 31 23 33 - Trenching and Backfilling

3.2 UNDERGROUND CONDUITS

A. General Installation Requirements:

1. Ductbank types per location:

a. Direct-buried conduit(s):

1) All areas unless indicated otherwise.

2. Do not place concrete or other required fill materials until conduits have been observed by Engineer.
3. Ductbanks shall be sloped a minimum of 4 inches per 100 feet or as detailed on the Drawings.
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 inches and less: 3 feet.
2) 1-1/4 to 3 inches: 5 feet.
3) 3-1/2 to 6 inches: 7 feet.

b. Place supports and spacers for rigid steel conduit on maximum centers as indicated for the following trade sizes:

1) 1 inches and less: 10 feet.
2) 1-1/4 to 2-1/2 inches: 14 feet.
3) 3 inches and larger: 20 feet.

c. Securely anchor conduits to supports and spacers to prevent movement during placement of concrete or other required fill materials.

6. Stagger conduit joints at intervals of 6 inches 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 degrees by long sweep bends having a minimum radius of 10 feet.

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 inches for conduits less than 3 inches trade size and 36 inches for conduits 3 inches 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 inches.
b) Diameter: Approximately 1/4 inches 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 feet 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 ductbanks, direct-buried conduit, and direct-buried wire and cable in accordance with Specification Section 10 14 00.
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 inches below grade.
b. Is below pavement sub-grading.

2. Provide a uniform minimum clearance of 3 inches 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) Provide multilevel conduits with conduit supports and separators to maintain required separations, and backfill with flowable fill in accordance with Section 31 23 33 – Trenching and Backfilling.
2) Install multilevel conduits one level at a time.

a) Each level shall be backfilled with required materials and compacted in accordance with Section 31 23 33 – Trenching and Backfilling, while maintaining required separations.

END OF SECTION

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SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Site clearing Work, including:

a. General provisions for site clearing Work.
b. Preparation for site clearing Work.
c. Clearing and grubbing.
d. Tree protection, selective removals, and selective trimming.
e. Disposal and cleaning.
f. Stripping and stockpiling of topsoil.

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

1.2 REFERENCES

A. Terminology:

1. Terms indicated below are not defined terms indicated with initial capital letters but, when used in this Section, have the meanings indicated below:

a. "Arborist" means Subcontractor retained to perform Work requiring a specialist in trees, shrubs, brush, other vegetation of the types existing at the Site, and possessing not less than the required qualifications indicated in this Section.
b. "Clearing and grubbing" means removing and disposing of all: (1) trees, brush, and other vegetation, logs, and similar items ("clearing"); and (2) stumps, roots, logs, rubbish, and debris on or in the soil ("grubbing") after Clearing. Clearing and grubbing includes grinding and removing of stumps. When clearing and grubbing, topsoil stripping and stockpiling, and required demolition Work is complete, the Site will be ready for grading and other new construction.
c. "Demolition" means removal, whether in whole or in part, of existing human-made construction, such as removal of buildings, structures, and building systems; site work (such as pavement, curbs, sidewalks, gutters) and the like; Underground Facilities; and other existing construction.
d. "Selective removal" means removal of specific trees, shrubs, brush, and other vegetation, whether as shown or indicated in the Contract Documents or as directed at the Site by COR.

e. “Selective trimming” means removal of selected parts of trees, shrubs, brush, and other vegetation, performed by arborist, for the purpose of either: (1) allowing installation of new construction adjacent to or through the tree, shrub, brush, or vegetation, or)2) removing damaged or unhealthy growth, to allow balance of the subject tree, shrub, brush, or vegetation to continue normal, healthy growth.
f. “Site clearing” means all the Work required by this Section and related Drawings.
g. “Topsoil” means existing material at the Site, visible after clearing and grubbing, to be stripped, when such material is friable, clay loam, surface soil present in depth of not less than four inches. Topsoil shall be free of subsoil, clay lumps, stones, and other objects over two-inch diameter and other objectionable material. Topsoil required for planting and landscaping Work in the Specifications of Division 32 may differ from the meaning indicated in this Section.

B. Reference Standards:

1. ASTM International (ASTM):

a. C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
b. D448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.

2. American National Standards Institute (ANSI):.

a. A300, Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices.

3. International Society of Arboriculture (ISA):

a. Container Rootball Shaving.
b. Crown Correction.
c. Balled and Burlapped Root Correction.
d. Container Root Correction.
e. High Branched Crown Observation.
f. Low Branched Crown Observation.
g. Multiple Low Branches Crown Observation.
h. Balled and Burlapped Root Observation.
i. Container Root Observation - Tree.
j. Protection Maintenance.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Limits of Site Clearing Work: When limits of site clearing Work are not expressly shown on the Drawings, or where Contractor proposes alternative limits of site clearing Work, submit drawings, developed from the Drawings, clearly indicating proposed limits of site clearing Work, with dimensions indicated where appropriate.
b. Where proposed limits of clearing and grubbing, selective removals, and topsoil stripping are not identical with each other, clearly and expressly indicate limits of each on the Shop Drawings.

B. Informational Submittals: Submit the following:

PART 2 - PRODUCTS

2.1 MATERIALS

A. Tree Wound Dressing:

1. Provide tree wound dressing, waterproof, adhesive and elastic with an antiseptic, free from kerosene, coal tar, creosote, and other material injurious to life of tree or other plant.

B. Drain Tile:

1. Provide four-inch diameter, standard strength, perforated wall, bell-and- spigot clay pipe, in accordance with ASTM C700.

C. Filter Fabric:

1. In accordance with requirements for temporary erosion and sediment controls indicated in the plans.

D. Drainage Fill:

1. Selected crushed stone, or crushed or uncrushed gravel, washed.
2. Size 24 (in accordance with ASTM D448), with 90 to 100 percent passing 2.5-inch sieve and not more than 10 percent passing 3/4-inch sieve.

E. Burlap:

1. Jute, not less than 7.2 ounces per square yard.

F. For other materials needed for site clearing Work, such as stone, topsoil, or other, comply with requirements of the Contract Documents.

PART 3 - EXECUTION

3.1 SITE CLEARING – GENERAL

A. Limits of Site Clearing Work:

1. Limits of site clearing Work are shown and indicated on the Drawings.

B. General Provisions for Site Clearing:

1. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals necessary and required to perform site clearing Work in accordance with the Contract Documents.
2. Perform site clearing Work to avoid creating nuisances, pollution, and preventable adverse effects on the environment.
3. Excavation required for site clearing shall comply with Section 31 23 33 - Trenching and Backfilling.
4. Requirements of Authorities Having Jurisdiction:

    a. Perform site clearing Work in accordance with Laws and Regulations.
    b. Obtain, pay for, and comply with permits required for site clearing Work. Obtain from authorities having jurisdiction and furnish copy of each permit as a Submittal.

5. Traffic Control:

    a. Where site clearing Work is along or adjacent to travelled ways subject to public traffic, comply with plans.
    b. Establish such controls prior to and maintain in place throughout site clearing Work that has potential to affect traffic.

6. Site clearing Work shall comply with ANSI A300 and applicable ISA standards indicated in this Section's "References" Article, unless the Contract Documents indicate more-stringent requirements.
7. Demolition Work is indicated in Section 02 41 00 - Demolition, including removal of site improvements and Underground Facilities.

3.2 PREPARATION

A. Permits and Approvals:

1. Do not commence site clearing Work until necessary permits and approvals are obtained and copies furnished to COR as Submittals.

B. Delineation of Limits of Site Clearing Work Areas:

1. Locate and clearly flag at the Site:

    a. Limits of site clearing Work.
    b. Trees, shrubs, vegetation, and other materials to remain within limits of site clearing Work.
    c. Trees, shrubs, and other vegetation to be selectively trimmed.
    d. Trees, shrubs, and vegetation to be selectively removed.
    e. Salvageable trees, shrubs, and vegetation (to be relocated) within limits of site clearing Work.

2. Flagging:

a. Flagging shall be high-visibility type. Where necessary, provide lath or stakes driven into the ground, with flagging, to clearly delineate limits.
b. Provide different-colored flagging for each type of delineation required by this Article.
c. Promptly replace lost, moved, or destroyed flagging until COR concurs that flagging is no longer needed.

3. Review with COR:

a. Before starting site clearing Work, other than flagging, review at the Site with COR.
b. Make corrections as necessary.
c. Review all trees, to be removed or selectively trimmed.
d. Review with COR at the Site trees and shrubs to be selectively trimmed, to reach mutual agreement on extent of selective trimming required.

C. Protection: Establish protection of trees, shrubs, and vegetation to remain, in accordance with this Section's Article, "Tree Protection, Selective Removals, and Selective Trimming", and other applicable provisions of the Contract Documents.

D. Temporary Erosion and Sediment Controls:

1. Provide applicable temporary erosion and sediment controls before commencing clearing and grubbing and topsoil stripping Work.
2. Comply with temporary erosion and sediment control requirements of the plans.
3. Continue providing temporary erosion and sediment controls as clearing and grubbing and topsoil stripping and stockpiling Work progresses into previously uncleared, ungrubbed areas of the Site.

3.3 CLEARING AND GRUBBING

A. Clearing and Grubbing – General:

1. Remove and dispose of all materials constituting clearing and grubbing Work within limits shown and indicated in the Contract Documents.
2. After grubbing Work is complete, properly fill holes resulting from grubbing before commencing site grading Work.

B. Trees and Shrubs Improperly Destroyed or Damaged:

1. Refer to this Section's Article, "Tree Protection, Selective Removals, and Selective Trimming".

C. Trees and Shrubs to Remain:

1. Trees and shrubs to remain shall be protected, and trimmed where necessary or required, in accordance with this Section's Article, "Tree Protection, Selective Removals, and Selective Trimming".

3.4 TREE PROTECTION, SELECTIVE REMOVALS, AND SELECTIVE TRIMMING

A. General Provisions for Tree Protection, Selective Removals, and Selective Trimming:

1. Provide temporary fencing, barricades, or guarding measures, as recommended by arborist, outside drip line of trees and shrubs to remain.
2. Protect root systems from damage caused by noxious materials, storm water runoff, site clearing, planting and landscaping, other Work, and storage of materials and equipment. Protect root systems from flooding, erosion, and excessive wetting resulting from dewatering of excavations, drainage of tanks, and other construction activities.
3. Fires are not allowed under or adjacent to trees, shrubs, and other vegetation to remain.
4. Do not store matter resulting from site clearing or demolition, topsoil, or other excavated material within drip line of trees and shrubs to remain. Vehicles are not allowed within drip line. Restrict foot, vehicle and equipment traffic to prevent compaction of soil over root systems. Where such activities are unavoidable, and only as acceptable to COR, provide temporary, continuous, heavy-duty wood planking effectively fastened together and capable of distributing loads from such activities. Temporary planking shall be underlaid by layer of filter fabric covered with two-inch layer of gravel.
5. Cut branches and roots, when necessary, with sharp pruning instruments; do not break or chop. Fully paint cuts 1/2-inch and larger in size with tree wound dressing.

B. Excavation and Protection of Trees and Shrubs:

1. Excavate within drip line of trees only where shown.
2. Where trenching for utilities is required within drip line, tunnel under or around main lateral feeder roots by drilling, auger boring, pipe jacking, or digging by hand under supervision of arborist. Do not cut main lateral roots or tap roots; cut smaller roots, which interfere with installation of the Work.
3. Where excavation for the Work is required within drip line of trees or shrubs, hand excavate to minimize damage to root systems. Perform excavation under supervision of arborist. Provide temporary shoring or other protective support systems at excavations, to minimize sloping and benching of excavations. Use narrow tine spading forks and comb excavated material to expose roots.
4. Relocate roots in backfill areas wherever possible. If large, main lateral roots are encountered, expose beyond excavation limits as required to bend and relocate without breaking. If encountered immediately adjacent to location of construction and relocation is not practical, cut roots approximately three inches back from construction.
5. Do not allow exposed roots to dry out before permanent backfill is provided; provide temporary earth cover. Water and maintain in moist condition and temporarily support and protect from damage until permanently relocated and covered with earth.

C. Grade Adjustments and Tree Protection:

1. Maintain existing grade within drip line of trees, unless otherwise shown or indicated.
2. Lowering of Preconstruction Grade:

    a. Where required finish grade is below preconstruction grade around trees and shrubs, grade beyond drip line. Maintain preconstruction grade within drip line of trees and shrubs.

b. Prune tree and shrub roots exposed during grade lowering, or provide permanent protections as recommended by arborist. Do not cut main or lateral roots or tap-roots; cut only smaller roots.
c. Compensate for loss of roots and prune branches to stimulate root growth.
d. Provide extended service through completion of the Contract correction period as recommended by arborist.

3. Minor Fills:

a. Where preconstruction grade is six inches or less below elevation of finish grade shown, fill with topsoil complying with quality requirements of Specifications for finish grading and landscaping.
b. Place in single layer and do not compact.
c. Hand-grade to required finish elevations.

D. Tree and Shrub Pruning (Selective Trimming):

1. Perform pruning and selective trimming under the supervision of arborist.
2. Remove branches from trees and shrubs to remain only after COR's concurrence, only to extent necessary to clear location of permanent construction, using branch removal methods in accordance with ANSI A300 and applicable ISA standards indicated in this Section's "References" Article.
3. Extend pruning operation to restore natural shape of entire tree or shrub where pruning is approved by COR and as recommended by arborist.
4. Prune branches to balance loss to root system caused by damage or cutting of root system.
5. Chip branches removed from trees and shrubs. Stockpile and spread chips as directed by COR, with arborist's recommendation.

E. Selective Trimming:

1. In addition to pruning (as required above), perform other selective trimming under direction of arborist.
2. Comply with ANSI A300 and applicable ISA standards indicated in this Section's "References" Article.
3. Where shown or indicated, and as directed by COR with arborist's recommendation, carefully remove larger branches, when necessary, using appropriate methods.
4. Repair cut branches in accordance with this Section.
5. During selective trimming, avoid damaging healthy (to remain) elements of trees and shrubs.
6. Dispose of trimmings as indicated in this Section's "Disposal and Cleaning" Article.

F. Selective Removals:

1. Perform selective removals under direction of arborist.
2. Comply with ANSI A300 and applicable ISA standards indicated in this Section's "References" Article.
3. Fully remove trees and shrubs shown or indicated for selective removal.
4. Remove stumps to not less than one feet below preconstruction ground surface.
5. During selective removals, avoid damaging adjacent trees and shrubs to remain, and other property.

6. Remove larger branches before cutting the trunk of tree or shrub being selectively removed.
7. Dispose of trees and shrubs selectively removed as indicated in this Section's "Disposal and Cleaning" Article.

G. Repair and Replacement of Trees and Shrubs:

1. Perform tree and shrub repair under direction of arborist.
2. Cavity Repair:

   a. Remove decayed areas to depth that exposes healthy tissue.
   b. Shape cavities to provide drainage.
   c. Paint inside of cavity with antiseptic tree wound dressing material.
   d. Do not fill cavities.
   e. When cavity's cross-section exceeds 60 percent of cross-section of tree or shrub branch, selectively trim subject branch. When cavity's cross-section exceeds 60 percent of cross-section of trunk of tree or shrub, remove tree or shrub upon COR's authorization. COR will consider arborist's recommendation. Comply with this Section's requirements for selective trimming and selective removals.

3. Repair trees and shrubs damaged by construction operations, or selectively trimmed, within 24 hours of occurrence of such damage or selective trimming. Treat damaged trunks, branches, and roots according to written instructions of arborist, in accordance with ANSI A300 and applicable ISA standards indicated in this Section's "References" Article.
4. Remove and replace trees and shrubs that are (1) dead or destroyed due to construction operations, or (2) damaged beyond reasonable hope of recovery (as determined by arborist) following repairs, or (3) damaged and determined by arborist to be incapable of resuming normal growth pattern after repairs.,
5. Obtain opinion from arborist regarding whether damaged trees, shrubs, and other vegetation is repairable with reasonable chance of success. Submit arborist's certification required in this Section's "Submittals" Article.
6. For each tree or shrub to remain but is destroyed or damaged (beyond repair) by Contractor:

   a. For trees 8 inches or more in diameter (measured one foot above preconstruction ground surface), provide two replacements of the same species. Each replacement shall be four inches diameter (measured one foot above top of root ball).
   b. For trees smaller than 8 inches diameter, and for shrubs, provide one replacement for each, of same species. Replacements shall be equal in size to original, up to maximum of four inches (measured one foot above root ball).
   c. Provide replacement at locations at the Site as directed by COR.
   d. Provide replacements in accordance with the Contract Documents, including Specifications on planting and landscaping.

3.5 DISPOSAL AND CLEANING

A. Disposal – General:

1. Dispose of matter resulting from clearing and grubbing, selective removals, and selective trimming, at appropriate offsite location, unless otherwise expressly allowed by the Contract Documents or mutual agreement of Owner and Contractor.
2. Do not use cleared, grubbed, or trimmed material as fill, backfill, or in embankments.
3. Dispose of cleared, grubbed, and trimmed material, and other materials, rubbish, and debris, in accordance with Laws and Regulations.
4. Pay all costs associated with transporting and disposing of materials and debris resulting from site clearing Work.
5. Cleared lumber and trimmings from trees are Contractor's property and, at Contractor's option, may be sold or salvaged offsite.

B. Burning:

1. Burning of trees, shrubs, brush, other vegetation, and other materials at, or adjacent to, the Site, whether in-place or cut, is prohibited .

3.6 TOPSOIL STRIPPING AND STOCKPILING

A. Stripping:

1. Before commencing topsoil stripping:

   a. Perform clearing and grubbing and selective removals.
   b. Remove grass and other vegetation that may remain following clearing and grubbing.
   c. Provide necessary and required temporary erosion and sediment controls.

2. Strip topsoil to depths encountered, in manner that prevents intermingling of topsoil with underlying subsoil and other objectionable material. Remove heavy growths of grass and vegetation and material below topsoil.
3. Before stockpiling, separate objectionable material from topsoil.
4. Do not strip topsoil from within drip line of trees and shrubs to remain as part of the completed Project.

B. Stockpiling:

1. Construct and maintain topsoil stockpiles in accordance with the plans.

C. Reuse of Stripped Topsoil:

1. Reuse in the finish grading and landscaping Work topsoil that complies with the Contract Documents for such Work.
2. Where topsoil stripped from the Site does not comply with the Contract Documents relative to quality required for use in finish grading and landscaping Work, provide appropriate soil amendment material, properly and fully mixed into topsoil stripped from the Site, so that amended material complies with quality requirements for topsoil required for finish grading and landscaping Work.

D. Disposal of Excess Topsoil:

1. Topsoil in excess of quantity required for the finished Project is Owner's property and shall be stockpiled onsite at location designated by Owner.

END OF SECTION

SECTION 31 22 19
FINISH GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Topsoil quality and placing.
2. Finish grading.

B. Related Requirements: Include, but are not necessarily limited to, the following:

1. Section 32 92 00 - Seeding, Sodding and Landscaping.

1.2 REFERENCES

A. Reference Standards:

1. American Association of State Highway and Transportation Officials (AASHTO):

a. T194, Standard Method of Test for Determination of Organic Content of Soils by Loss on Ignition.

2. ASTM International (ASTM):

a. D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
b. D4221, Standard Test Method for Dispersive Characteristics of Clay Soil by Double Hydrometer.
c. D4972, Standard Test Methods for pH of Soils.
d. D5268, Standard Specification for Topsoil Used for Landscaping and Construction Purposes.
e. D6913, Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
f. D7928, Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis.
g. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Contractor's Testing Laboratory:

a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of materials specified in this Section.
b. When Contractor is expressly required, by this Section's "Quality Assurance" Article, "Source Quality Control" Article or elsewhere in the Contract Documents, to retain testing laboratory for tests required under this Section's "Quality Assurance" Article or "Source Quality Control" Article, retain one testing laboratory for quality assurance testing and field quality control testing.
c. Testing laboratory shall comply with ASTM E329.
d. Testing laboratory shall be experienced in the types of testing required.
e. Selection of testing laboratory is subject to COR's acceptance. Upon COR's request, submit qualifications statement for testing laboratory, including name of entity, location, copies of applicable certifications, summary of entity's experience, and names and qualifications of personnel who will perform the subject sampling and testing.

B. Quality Assurance Testing:

1. Quality assurance testing, which may also be regarded as source quality control testing when topsoil to be installed will be topsoil originally stripped from the Site, is in addition to field quality control activities required by this Section's "Field Quality Control" Article.
2. Allow free access to material stockpiles and borrow areas at all times. Tests shall be at Contractor's cost.
3. Contractor's Testing Laboratory Scope:

a. Obtain samples and perform testing of proposed topsoil materials, whether obtained from offsite borrow sources or stockpiled topsoil originally stripped from the Site, to provide assurance that the Work will comply with the Contract Documents.

4. Required Quality Assurance Material Testing by Contractor's Testing Laboratory:

a. Perform the following quality assurance tests for every 500 cubic yards of topsoil, or part thereof, to be incorporated into the Work. Submit results of such tests to COR and obtain COR's acceptance thereof prior to incorporating the subject topsoil into the Work.

1) Gradation in accordance with ASTM D6913 and D7928.
2) Clay content in accordance with ASTM D4221.
3) pH in accordance with ASTM D4972.
4) Organic content in accordance with ASTM D2974 or AASHTO T194.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:

a. Borrow Soil Materials: Name and address of Supplier of borrow soil materials, gradation, and Supplier's certification that materials are sufficiently free of Constituents of Concern so that a Hazardous Environmental Condition will not be created or exacerbated.
b. If no soil materials will be obtained from any borrow location, expressly so indicate to COR in writing.

B. Informational Submittals: Submit the following:

1. Quality Assurance Test Results Submittals:

a. Submit results of quality assurance testing performed in accordance with this Section's "Quality Assurance" Article, unless included as part of another submittal under this Section.

1) Tests on materials from onsite and borrow sources.

2. Qualifications Statements:

a. Quality assurance testing laboratory, when requested by COR.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. All soil accepted as topsoil, whether obtained from onsite or offsite sources, shall comply with requirements of this Section.
2. Topsoil Source: Reuse surface soil stockpiled on Site, where possible. Verify suitability of stockpiled surface soil to produce topsoil, as specified. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

a. Supplement acceptable onsite soil with manufactured topsoil from offsite sources, when quantities available on-Site are insufficient to complete the Work.
b. When existing soil material stripped from the Site and stockpiled does not comply with requirements of this Section, such soil may be provided as topsoil when addition of amendments and fertilizers will bring such soil material into compliance with this Section's topsoil requirements. Furnish to COR written advisory of Contractor's intent to amend existing soil materials to be compliant with topsoil requirements.

3. Provide fertile, friable, natural loam, surface soil, capable of sustaining vigorous plant growth; free of any admixture of subsoil, clods of hard earth, plants or roots, sticks, stones larger than one inch diameter, or other extraneous material harmful to plant growth, in compliance with ASTM D5268.
4. Provide topsoil of the following characteristics:

a. Required gradation:

Sieve Size	Percent Passing
3/4 inch mesh	100
No. 4-sieve	90 to 100
No. 200-sieve	0 to 10

b. Clay content of material passing No. 200-sieve shall be not greater than 60 percent, as determined by hydrometer tests.
c. pH-adjusted with ferrous sulphate or ground limestone to provide pH 5.5 to 7.0 at time of installation of lawns and meadow areas, unless particular species of planting requires a different pH for optimal growth.
d. Electrical conductivity of a 1:2 soil-water suspension shall not exceed 1.0 milliohm per centimeter and with less than 200 parts per million of extractable aluminum.
e. Cation Exchange Capacity: 5, minimum.
f. Organic content not less than five percent, as determined by ignition loss of oven-dried samples passing No. 10-sieve (Muffle Furnace Temperature: 110 plus or minus five degrees C for eight hours).
g. Free of pests and pest larvae.
h. Relative to Constituents of Concern, topsoil shall be in accordance with Laws and Regulations. Constituents of Concern, if any, in topsoil furnished shall not constitute or result in a Hazardous Environmental Condition.

B. Topsoil Amendments and Fertilizer

1. Requirements for topsoil amendments and fertilizer, together with other planting materials, are in Section 32 92 00 - Seeding, Sodding, and Landscaping.
2. Provide planting soil by adding amendments, fertilizer, and other materials to topsoil and other suitable soil materials in accordance with Section 32 92 00 - Seeding, Sodding, and Landscaping, as necessary to support vigorous growth of required plantings.

2.2 SOURCE QUALITY CONTROL

A. Tests and Inspections at Source of Supply:

1. Perform quality assurance testing, and submit results to COR, in accordance with the "Quality Assurance" Article in Part 1 of this Section.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-place Conditions:

1. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing plants from damage caused by finish grading.

B. Preparation – General:

1. In accordance with plans, provide temporary measures for controlling erosion and sedimentation, airborne dust, and fugitive dust emissions from the Site.
2. Topsoil stripping and stockpiling requirements are indicated in Section 31 10 00 - Site Clearing.
3. Adjust rough grading to within 0.1 foot of required elevations. Properly compact sub-grades. Rough grading shall provide for appropriate drainage in accordance with the Contract Documents.
4. Before applying topsoil:

   a. Remove from exposed subgrade all stones and debris over one inches in any dimension and properly dispose of such items at an appropriate, offsite location.
   b. Loosen sub-grade surface to depth of not less than two inches.

3.2 INSTALLATION

A. Installation Requirements:

1. Required Depth of Topsoil:

   a. For areas of gardens, shrubs and similar plantings, provide finished, lightly compacted, topsoil depth of not less than 6 inches.
   b. For all other areas requiring topsoil, including lawns and meadows, provide finished, lightly compacted, topsoil depth of not less than 4 inches.

2. Do not place topsoil when subgrade is muddy, wet or frozen enough to cause clodding.
3. Provide finished surface smooth and true to required grades, in accordance with this Article's "Installation Tolerances" provision. Provide finished surface of topsoil equal to required finished elevations after light rolling and natural settlement.
4. Grade topsoil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to provide required finish grades.
5. Restore topsoil if eroded or otherwise disturbed after finish grading and before planting.
6. Topsoil Quantity Differentials:

   a. If quantity of required topsoil exceeds the quantity, if any, of topsoil stockpiled at the Site and available for use by Contractor, provide the additional required quantity from appropriate offsite borrow sources at no additional cost to Owner.
   b. When quantity of topsoil obtained from offsite borrow sources exceeds the required quantity of topsoil, remove excess from the Site, unless Owner allows such excess to be stockpiled at an appropriate location at the Site.
   c. When quantity of required topsoil is less than quantity of onsite stockpiles, following installation of topsoil, properly grade remaining stockpile for appropriate drainage without undue erosion and seed stockpile as required for other areas of lawn restoration in accordance with the Contract Documents.

B. Installation Tolerances:

1. Finish Grading Tolerance: ±0.1 foot from finish elevation required by the Contract Documents. Ensure adequate drainage.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Upon completion of topsoil installation, obtain COR's concurrence regarding grades and drainage.
2. Where directed by COR, provide test holes to demonstrate that required depth of topsoil was provided. After observation and measurement by COR, properly refill test holes.
3. Where insufficient depth of topsoil is revealed, remedy by providing required depth and quantity in accordance with the Contract Documents. When additional topsoil is added after initial establishment of plant growth, re-establish required plantings to provide compliance with the Contract Documents.

3.4 PROTECTION

A. Commencing immediately after topsoil installation, protect installed topsoil from erosion and damage from other causes, including personnel, vehicles, and equipment. Promptly perform measures to permanently stabilize soils and prevent erosion, in accordance with Section 32 92 00 - Seeding, Sodding, and Landscaping.

END OF SECTION

SECTION 31 23 33
TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Requirements for excavating, filling, and other earth Work for linear, buried utility projects, including:

   a. Field conditions.
   b. Soil and aggregate materials.
   c. Excavation.
   d. Preparation of subgrades.
   e. Filling and compacting.
   f. Rough grading.
   g. Disposal of excavated spoil materials.

B. Related Requirements Include, but are not necessarily limited to, the following:

1. Section 31 10 00 - Site Clearing.
2. Section 31 22 19 - Finish Grading.

1.2 REFERENCES

A. Terminology:

1. The following terms are not defined and are not indicated with initial capital letters but, when used in this Section, have the following meaning:

   a. “Borrow” means material required for trenching, backfilling, and related earth Work in excess of quantity of suitable material available from required grading, cuts, and excavations at the Site. Borrow may be necessary even though not otherwise expressly required by the Contract Documents.
   b. “Cohesive soil” means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical or near-vertical sideslopes, and is plastic when moist. Cohesive soil is difficult to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.
   c. “Cohesionless soil” means fill material that does not clump together; its grains remain separate and apart from each other. Cohesionless soils typically have a low proportion of fine (no. 200 mesh size and less) particles and may be soil material or granular material. The terms “cohesionless soils”, “cohesionless materials”, “non-cohesive soils”, and the like have the same meaning.

d. “Fill” means soil material, granular material, or other material indicated in this Section required for backfilling excavations or as material for achieving required rough grading. Unless indicated otherwise in the context of a specific provision, the terms “fill” and “backfill” have the same meaning, as do derivative terms such as, “filling” and “backfilling”. When used by itself, the term “backfill” means material required for refilling an excavation.

e. “Foundations” means bottoms of manholes, chambers, vaults, and similar structures; base slabs (slabs-on-grade); bearing directly on soil, granular material, or rock.

f. “Granular material” means gravel, sand, or silt, (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry. The terms “granular material”, “aggregate material”, and “granular soil” have the same meaning. Detailed requirements for specific types of granular material are indicated in Article 2.1 of this Section.

g. “Rock” means: igneous, metamorphic, or sedimentary rock or stone; boulders over two cubic yards in volume in open areas and boulders over one cubic yard in volume in trenches; and mass concrete; that cannot be removed using rippers and therefore requires drilling and blasting or use of large excavator-mounted pneumatic breakers. If rock is encountered during the Work, promptly furnish notice of differing subsurface condition in accordance with the General Conditions (as may be modified by the Supplementary Conditions); when necessary, COR will furnish requirements for rock removal via appropriate Contract modification. The following do not qualify as rock:

1) Soft, weathered or disintegrated rock that can be removed by normal excavating equipment, including bulldozers with rippers and large trackhoes with rock teeth or rock buckets.
2) Loose or previously blasted rock.
3) Broken stone in rock fills.
4) Rock or stone that falls into the excavation from outside limits of excavation shown or indicated in the Contract Documents.
5) Boulders that can be removed without drilling, blasting, or pneumatic breakers.
6) Pavements, sidewalks, and gutters of concrete, asphalt, or masonry.

h. “Subgrade” means the uppermost surface of native soil material unmoved from cuts; the bottom of excavation.

i. “Trenching” means excavating for buried utilities, other Underground Facilities, and related excavation Work. In this Section, the words, “trenching” and “excavating” have the same meaning. In this Section, the word “excavation”, whether singular or plural, is general and includes trenching.

j. “Unauthorized excavation” means removing materials beyond limits shown or indicated in the Contract Documents or otherwise directed by COR.

k. “Unclassified”, when used in referring to trenching, excavating, or excavations, means excavation and disposal of all materials, of any description whatsoever, encountered in performing the Work, unless otherwise shown or indicated in the Contract Documents.

l. “Unsuitable soil materials” means soil or other materials encountered at or below subgrade elevation of insufficient strength, stiffness, or characteristics to support the Work in accordance with the Contract Documents or as determined by COR. The terms “unsuitable soil material”, “unsuitable soil”, and “unsuitable material” have the same meaning.

B. Reference Standards: Standards referenced in this section include, but are not necessarily limited to, the following:

1. American Association of State Highway and Transportation Officials (AASHTO):

a. AMRL R18 - AASHTO Accreditation Procedure Manual.

2. ASTM International (ASTM):

a. C33/C33M - Standard Specification for Concrete Aggregates.
b. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
c. D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
d. D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
e. D2166 - Standard Test Method for Unconfined Compressive Strength of Cohesive Soil.
f. D2216 - Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
g. D2434 - Standard Test Methods for Measurement of Hydraulic Conductivity of Coarse-Grained Soils.
h. D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
i. D2850 - Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils.
j. D3740 - Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
k. D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
l. D4254 - Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
m. D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
n. D6913 - Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
o. D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
p. D7928 - Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis.
q. E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Contractor's Testing Laboratory:

   a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of materials specified in this Section.
   b. When Contractor is expressly required, by this Section's "Field Quality Control" Article or elsewhere in the Contract Documents, to retain testing laboratory for tests required under this Section's "Field Quality Control" Article, retain one testing laboratory for quality assurance testing and field quality control testing.
   c. Testing laboratory shall possess current, valid accreditation from the AASHTO Materials Reference Laboratory (AMRL), in accordance with AASHTO AMRL R18, for ASTM D3740, for tests required for quality assurance testing indicated in this Article and field quality control testing indicated to be Contractor's responsibility.
   d. Testing laboratory shall be experienced in the types of testing required.
   e. Selection of testing laboratory is subject to COR's acceptance. Upon COR's request, submit qualifications statement for testing laboratory, including name of entity, location, copies of applicable certifications, summary of entity's experience, and names and qualifications of personnel who will perform the subject sampling and testing.

B. Quality Assurance Testing:

1. Quality assurance testing, which may also be regarded as source quality control testing, is in addition to field quality control testing required by this Section's "Field Quality Control" Article.
2. Materials used in the Work may require testing and retesting, as directed by COR, during the Project. Allow free access to onsite material stockpiles, borrow sources, and other sources of aggregate and soil materials at all times. Tests not specifically indicated to be performed at Owner's expense (if any), including retesting of defective materials and defective Work, shall be at Contractor's cost.
3. Contractor's Testing Laboratory Scope for Quality Assurance Sampling and Testing:

   a. Obtain samples and perform testing of proposed fill materials in the laboratory, at the Site, and at borrow locations (if any) to provide assurance that the Work will comply with the Contract Documents.
   b. Testing laboratory shall perform testing required to obtain data for selecting moisture content for placing and compacting fill materials.
   c. Submit to COR, via Contractor, written results of each test.

4. Required Quality Assurance Material Testing by Contractor's Testing Laboratory:

   a. Perform the following quality assurance tests on materials to be incorporated into the Work. Submit results of such tests to COR and obtain COR's acceptance thereof prior to incorporating the subject materials into the Work.
   b. Gradation in accordance with ASTM D6913 and ASTM D7928. Perform one test for every 500 cubic yards of each material to be incorporated into the Work.

c. Atterberg limits in accordance with ASTM D4318. Perform one test for every 500 cubic yards of the following types of materials to be incorporated into the Work: suitable soil material, and soil structural fill.
d. Moisture/density relations for fill in accordance with ASTM D698, ASTM D1557, ASTM D4253, or ASTM D4254, as applicable. Perform one test for every 500 cubic yards of each material to be incorporated into the Work.
e. Moisture content of stockpiled or borrow material in accordance with ASTM D2216. Perform one test for every 500 cubic yards of each material to be incorporated into the Work.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Schedule (table or written narrative) indicating, for each specific area of the Work, type of fill materials proposed, together with indication of whether source of materials is onsite or borrow source. Identification of each type of material shall employ material names/designations identical to those in the Contract Documents.

2. Product Data:

a. Borrow Soil Materials: Name and address of Supplier of borrow soil materials, gradation, and Supplier's certification that materials are sufficiently free of Constituents of Concern so that a Hazardous Environmental Condition will not be created or exacerbated. If no soil materials will be obtained from any borrow location, expressly so indicate to COR in writing.
b. Aggregate: Supplier's published description of aggregate materials, including name and address of Supplier, certification of material's compliance with AASHTO and state department of transportation standards, and gradation.

B. Informational Submittals: Submit the following:

1. CORCORQuality Assurance Test Results Submittals:

a. Submit results of quality assurance testing performed in accordance with this Section's "Quality Assurance" Article, unless included as part of another submittal under this Section. Submit results for the following quality assurance testing:

1) Tests on materials from onsite and borrow sources.
2) Optimum moisture – maximum dry density curve for each type of fill material.

2. Field Quality Control Submittals:

a. Submit results of testing and inspection performed in accordance with the field quality control Article in Part 3 of this Section, including:

1) Indication of soil classification in accordance with ASTM D2487.

2) Field density testing.
3) Proctor Compaction Test to determine optimum moisture for soil and maximum dry density.

1.5 CORFIELD CONDITIONS

A. Existing Conditions:

1. Subsurface Conditions:

a. Subsurface Information: The Supplementary Conditions indicate information (if any) that is Technical Data on subsurface conditions at the Site. Such information and data are not intended as a representation or warranty of continuity of conditions between soil borings or test pits, nor of groundwater levels at dates and times other than date and time when measured, nor that purpose of obtaining the information and data were appropriate for use by Contractor. Owner and COR are not responsible for interpretations or conclusions drawn therefrom by Contractor.
b. Contractor's Explorations: Soil borings and other exploratory operations may be made by Contractor, at no additional cost to Owner. Coordinate Contractor-performed test borings and other exploratory operations with Owner, utility owners, and owners of transportation facilities as appropriate. Perform such explorations without disrupting or otherwise adversely affecting operations of Owner and others.

2. Where subsurface conditions or locations of Underground Facilities and structures are unforeseen or differ substantively from that shown or indicated in the Contract Documents, comply with Contract requirements for giving notice and other actions.
3. Existing Structures and Underground Facilities:

a. The Contract Documents show or indicate certain structures and Underground Facilities adjacent to the Work. Such information was obtained from existing records and is not guaranteed to be correct or complete. Contractor shall explore ahead of the excavation to determine the exact location of all existing structures and Underground Facilities. Existing structures and Underground Facilities shall be supported and protected from damage by Contractor. Immediately repair and restore existing structures and Underground Facilities damaged by Contractor without additional cost to Owner.
b. Movement or operation of construction equipment and machinery over Underground Facilities shall be at Contractor's sole risk. When required by owner of the Underground Facility, prepare and submit to owner of such Underground Facility, and obtain their acceptance, of Contractor's plan presenting Contractor's analysis of the loads to be imparted during construction (including transient loading by construction equipment, machinery, and vehicles) and Contractor's proposed measures to protect structures and Underground Facilities during the Work.
c. Acceptance of or approval by utility owner or COR of Contractor's proposed evaluation and method(s) for protecting Underground Facilities in no way modifies or reduces Contractor's sole responsibility for complying with the Contract Documents, means, methods, procedures, techniques, and sequences of construction, and the safety and protection measures incident thereto.

d. Coordinate with utility owners for shut off of services in active piping and conduits. When required by utility owner, Owner will assist Contractor with utility owner notifications. Completely remove buried piping and conduits indicated for removal and not otherwise indicated as being abandoned or to remain in place.
e. In general, service lines and laterals to individual residences, businesses, buildings, and structures, are not shown; however, Contractor shall assume that a service exists for each utility owner to each residence, business, building, structure, and property.
f. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when such interruption is indicated in the Contract Documents or when allowed in writing by COR after acceptable temporary utility services are provided by Contractor for the affected structure or property.

PART 2 - PRODUCTS

2.1 MATERIALS

1. Provide granular under-slab fill under foundations, manholes, chambers, vaults, handholes, and similar Work unless other under-slab material is required by the Contract Documents.
2. ASTM C33/C33M gradation size no. 67, or other material acceptable to COR.
3. Material shall be uniformly-graded, washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, free of organic and deleterious material, complying with the following:

   a. 100 percent passing a 1.5-inch sieve.
   b. Not more than five percent passing a no. 4 sieve.

B. Granular Structural Fill:

1. Granular structural fill, sometimes called “select granular fill”, is required for improving subgrade (after removal of unsuitable material), as backfill for excavations in areas that, after restoration, will be subject to vehicular traffic, and at other locations shown or indicated for such material in the Contract Documents.
2. Material shall be well-graded, crushed aggregate, free of organic and deleterious material, with Proctor density of not less than 120 pounds per cubic foot, complying with the following:

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
1.25-inch	100
No. 4	38 to 65
No. 8	25 to 60
No. 30	10 to 40
No. 200	3 to 12

C. Soil Structural Fill:

1. At Contractor's option, soil structural fill may be low-volume change cohesive soil material or granular soil material.
2. Free of organic and deleterious matter, frozen material and debris.
3. Low-volume change cohesive soil material:

    a. ASTM D2487 classification: CL-ML or CL.
    b. Liquid limit: Less than 45.
    c. Maximum plasticity index: 20.

4. Granular soil material:

    a. ASTM D2487 classification: GW, GP, GM, GC, SW, SP, SM or SC.

5. Previously excavated materials complying with the Contract Documents requirements for soil structural fill may be used for soil structural fill.
6. When onsite materials are unsuitable for use as soil structural fill, provide granular structural fill or approved borrow material as soil structural fill. Prior to using borrow material as soil structural fill, furnish product data Submittal and quality assurance Submittal for proposed material and obtain COR's approval and acceptance (as applicable) of the proposed material.

D. Suitable Soil Material as Non-Structural Fill:

1. Provide suitable soil material as fill for the Work, unless other material is required.
2. Material shall be:

    a. Free of rock larger than three inches in any dimension, debris, waste, frozen materials, organic material, and other deleterious material.
    b. ASTM D2487 classification: GW, GP, GM, GC, SC, SW, SP, SM, CL-ML or CL.
    c. Liquid limit: Not greater than 45.
    d. Plasticity index: not greater than 20.

3. Previously-excavated materials complying with the Contract Documents requirements for suitable soil material may be used for suitable soil material.
4. When onsite materials are unsuitable for use as suitable soil material, provide soil structural fill or approved borrow material as suitable soil material. Prior to using borrow material as suitable soil material, furnish product data Submittal and quality assurance Submittal for proposed material and obtain COR's approval and acceptance (as applicable) of the proposed material.

E. Subbase Material:

1. Subbase material is granular material underlying pavement, sidewalks, and other surfaces expressly indicated in the Contract Documents.
2. Material shall be naturally- or artificially-graded mixture of natural or crushed gravel, crushed stone, or natural or crushed sand. Slag is unacceptable.
3. Material shall comply with the following gradation requirements:

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve.
2-inch	100
1-inch	70 to 100
3/4-inch	50 to 90
No. 4	30 to 60
No. 40	5 to 40
No. 200	0 to 15

F. Pipe Bedding Material:

1. Materials: Unless otherwise expressly required in the Contract Documents, pipe bedding material shall be crushed stone and gravel, free of: rock or gravel larger than one-inch in any dimension, debris, waste, frozen materials, organic material and other deleterious matter.

   a. Pipe bedding material shall be crushed stone and gravel, free of rock or gravel larger than 0.5-inch in any dimension.

G. Flowable Fill, also known as Controlled Low Strength Material (CLSM):

1. Unless expressly required otherwise by the Contract Documents, flowable fill may be used, at Contractor's option (following COR's approval), for backfilling in lieu of the following materials: granular structural fill, pipe bedding material, soil structural fill, suitable soil material used as non-structural fill, and subbase material.
2. Material provided shall be excavatable by ordinary mechanical excavation equipment, such as backhoes.

2.2 SOURCE QUALITY CONTROL

A. Tests and Inspections at Source of Supply:

1. Perform quality assurance testing, and submit results to COR, in accordance with the "Quality Assurance" Article in Part 1 of this Section.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Provide COR with sufficient notice and with means to examine areas and conditions under which trenching, backfilling, other related earth Work, and grading will be performed. COR will advise Contractor in writing when COR is aware of conditions that may be detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
2. This Article, however, in no way modifies or reduces Contractor's sole responsibility for complying with the Contract Documents, for construction means, methods, procedures, techniques, and sequences, and for the safety and protection measures incident thereto.
3. Nothing in this Article, including action by COR or Resident Project Representative (if any), is for benefit of Contractor.

B. Installing the Work constitutes Contractor's approval of underlying work, subgrades, and field conditions prevailing at the time of the Work.

3.2 PREPARATION

A. Site Preparation:

1. Comply with Section 31 10 00 - Site Clearing.
2. Comply with this Section's "Erosion and Sediment Control During Construction" Article.

3.3 EROSION AND SEDIMENT CONTROLS DURING CONSTRUCTION

A. Temporary Erosion and Sediment Controls – General:

1. Provide temporary erosion and sediment controls in accordance with plans, and other requirements of the Contract Documents.
2. When applicable, also comply with requirements of the erosion and sediment control plan approved by authorities having jurisdiction and the Project's storm water pollution prevention plan and permit, if any.

3.4 EXCAVATION

A. Excavation – General:

1. Perform all excavation Work, including trenching and backfilling, required to complete the Work as shown, specified, and required. Excavating Work includes removing, handling, and proper disposal of earth, sand, clay, expansive-type soils, other unsuitable soil materials, gravel, hardpan, soft, weathered or decomposed rock, concrete and masonry (reinforced or unreinforced), pavements, rubbish, debris, stumps, and other materials, regardless of moisture content, within the excavation limits.
2. Trenching and backfilling Work shall comply with the Contract Documents, including required grades, elevations, general dimensions, and alignment shown or indicated on the Drawings including cuts and fills, as applicable.
3. Protect existing buildings and structures against undermining and destabilization. If adjacent trenching affects foundations of one or more buildings or structures, promptly advise COR in writing.

4. If unsuitable material and obstructions are encountered during excavation, remove material and replace as directed by COR.

B. Excavation Methods:

1. Traditional Excavation Methods: Excavation via traditional methods, such as backhoe, bulldozer, other earth moving construction equipment or machinery, or excavation using hand tools, is acceptable for all excavating Work.
2. Use of Explosives:

   a. Use of explosives is not allowed.

3. Micro-trenching: Installation of buried utilities using micro-trenching equipment and techniques is acceptable when the associated Underground Facility is of a size and depth appropriate for such construction method. Submit to COR request for interpretation or clarification for requirements for resin backfilling of micro-trenches. COR will issue such requirements via Field Order.
4. Trenchless: Where Contractor proposes trenchless construction techniques, such as directional drilling, micro-tunneling, or others, comply with the Contract Documents regarding such construction methods. When the Contract Documents do not include requirements for the proposed trenchless construction method, submit to COR request for interpretation or clarification to obtain appropriate requirements, which will be issued via appropriate Contract modification.

C. Excavation Protection:

1. Provide excavation protection system(s) in accordance with Laws and Regulations to prevent injury to persons and property, including Underground Facilities.
2. Provide safe access to excavations, including emergency exit, and safe access for construction equipment and machinery, where applicable, in accordance with laws and Regulations.

D. Excavations for Manholes, Chambers, and Vaults:

1. Refer to this Section and applicable details (if any) on the Drawings for requirements on excavation pay limits for manholes, chambers, vaults, and similar items.
2. Elevation of bottom of manholes, chambers, and vaults may be changed only via duly issued Contract modification. Such modifications may be directed by COR to ensure a stable bearing surface. Elevations of piping, conduit, and similar other Underground Facilities shall be as shown or indicated on the Contract Documents.
3. Extend excavations sufficiently on each side of manholes, chambers, vaults, or similar construction only as necessary for installing precast concrete structures and appurtenances, including temporary supports of excavations, observation and inspection of the Work, and safe sloping of sides of excavations, as necessary.

E. Subgrades – General:

1. Provide firm, dense, thoroughly compacted, consolidated subgrades, free of mud, muck, and other soft and unsuitable materials. Subgrades shall remain firm and intact under all construction operations. Reinforce subgrade by providing granular structural fill on subgrades that are otherwise solid but become soft or muddy on top due to construction operations. Finished elevation of stabilized subgrades shall not be above subgrade elevations shown on the Drawings, unless bottom of trench is rock below required bottom elevation of pipe, manhole, chamber, or vault, and above required bottom of excavation elevation.
2. If, in COR's opinion, subgrade becomes soft, muddy, or both, because of construction delays, failure to dewater properly, or other cause within Contractor's control, excavate subgrade to firm material, trim the subgrade, and backfill with granular structural fill material at Contractor's cost.
3. Remove unsuitable subgrade materials below foundations. Limits of required removal of unsuitable material, when not otherwise expressly shown or indicated in the Contract Documents, shall be outside exterior limits of foundations around perimeter of manhole, chamber, vault, or similar item, by not less than the greater of the following horizontal distances:

    a. Distance equal to depth of required removal of unsuitable material, below bottom of foundations.
    b. Three feet.
    c. As directed by COR

4. Preparation of Subgrades for Subsequent Work:

    a. Level off subgrades to receive foundations or compacted fill.
    b. Where subgrades are to receive subsequent fill or manholes, chambers, vaults, or similar items, remove loose materials and bring subgrades into compliance with the Contract Documents.
    c. Where compacted fill material is required to bring subgrade up to underside of construction, scarify existing subgrade upon which fill material will be placed to depth of six inches and then compact to density required in this Section before fill material is placed thereon.
    d. Do not excavate lower than required for buried piping or foundations, unless directed otherwise by COR.
    e. Where excavation extends below required elevation without authorization, promptly advise COR and remedy unauthorized excavation in accordance with the Contract Documents. Corrections may include:

        1) Under soil-supported foundations or soil-supported retaining walls:

            a) Filling entire vertical distance between excavated subgrade and material required under foundation or other structure with compacted granular structural fill.
            b) Concrete fill is acceptable for bringing elevations to proper position.

        2) For locations other than those indicated above including slabs-on-grade:

            a) Backfill and compact unauthorized excavations as indicated for authorized excavations of same classification, unless otherwise directed by COR.

3) Contractor is not eligible for change in Contract Price or Contract Times for remedying unauthorized excavations.

5. Evaluation and Protection of Subgrade:

a. Advise COR as soon as excavation is completed for COR's observation of subgrades and, where necessary or required, inspection and testing of subgrades.
b. If COR determines that bearing materials at required subgrade elevations are unsuitable, provide subgrade stabilization as indicated in this Article.
c. Do not commence further construction until subgrade under compacted fill material, under foundations and retaining walls is acceptable (in accordance with the Contract Documents) to COR, who may consider results of required testing, and who may elect to consult with geotechnical consultant (if any).
d. COR shall have sufficient opportunity to observe subgrade, after successful completion of tests and inspections required by the Contract Documents.
e. Place fill material and perform subsequent construction after subgrade is acceptable in accordance with the Contract Documents.
f. Protect subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.

6. Subgrade stabilization:

a. If subgrade under foundations or fill material, is frozen, loose, wet, or soft before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by COR, who may consult with geotechnical consultant.
b. Loose, wet, or soft materials, when approved by COR, may be stabilized by a compacted working mat of well graded crushed stone.
c. Stabilization shall be in accordance with the Contract Documents. Where the Contract Documents do not address subgrade stabilization, promptly submit to COR written request for clarification or interpretation, or other written instrument in accordance with the Contract Documents. In such event, do not proceed until response is obtained from COR.

F. Pipe Trench Preparation:

1. Not more than 50 feet of trench may be opened in advance of installing pipe in trench.
2. Trench width shall be minimized to greatest extent practical, and shall comply with the following:

a. Trench width shall be sufficient to provide space for installing, jointing and inspecting piping. The Drawings show additional requirements for trenches. In no case shall trench be wider at top of pipe than pipe barrel's outside diameter (OD) plus two feet, unless otherwise shown or indicated.
b. Enlargement of trench width at pipe joints may be made when required and approved by COR.
c. For excavating and backfilling for manholes, chambers, and vaults associated with buried piping, excavation at widest point of manhole, chamber, or vault shall be not wider than two feet greater than widest outside dimension (including bottom footings or flanges, if any, of precast concrete structures) of the associated manhole, chamber, or vault.

d. Trench width shall be sufficient for Contractor's means of temporarily supporting the excavation and dewatering.
e. Trench width shall be sufficient to allow thorough compaction of fill adjacent to bottom half of pipe.
f. Do not use construction equipment or machinery that necessitates trench to be excavated to excessive width.

3. Depth of trench shall be as shown or indicated in the Contract Documents. If required and approved by COR in writing (such as a duly issued Contract modification), depths may be revised.
4. Where COR considers existing subgrade (beneath intended bedding material) unsuitable, remove and replace such unsuitable material with granular structural fill material for full width of trench, down to suitable material.

G. Freeze Protection:

1. Do not place foundations or fill material on frozen subgrade.
2. When freezing temperatures are expected, based on widely recognized, reputable source for weather forecasts at or near the Site, do not excavate to full depth indicated, unless foundations or fill material can be placed immediately after excavation has been completed and is acceptable in accordance with the Contract Documents.
3. Protect from freezing excavation, subgrade, and fill materials when subsequent Work thereon is delayed.

H. Construction Traffic on Soils:

1. Furnish and use appropriate backhoe or other low-contact pressure equipment to remove existing materials.
2. Minimize construction traffic on existing materials and saturated soils and avoid soil disturbance.
3. Repair disturbed subgrade materials prior to performing subsequent Work. Remedial work shall be in accordance with the Contract Documents. When not addressed in the Contract Documents, remedial Work shall be as directed by COR via appropriate Contract modification.
4. Allow only minimal foot traffic on bearing soils prepared for subsequent installation of fill or foundations.

3.5 FILLING AND COMPACTING

A. Filling and Compacting – General:

1. Provide and compact all fill required for the finished grades as shown and as indicated in this Section.

B. Place fill as promptly as progress of the Work allows, but not until completing the following:

1. Obtaining COR's concurrence, after observation by COR or Resident Project Representative (if any) of construction below finish grade, including removal of trash and debris from excavations, waterproofing (where required), and related Work.

2. Successful completion of required field quality control activities for Work that will be covered or concealed by filling, including field quality control testing of buried piping, conduits that will convey fluid or gas, and exfiltration testing (where performed or required) of manholes, chambers, vaults, and similar items. For manholes, chambers, and vaults, where infiltration testing or vacuum testing is performed or required, such testing may be performed following backfilling.
3. Completion of proper documentation of as-constructed conditions and existing conditions (such as locations of Underground Facilities) in accordance with Division 01.
4. Removal of temporary supports of excavations.
5. Remove fill that includes organic materials or other unacceptable material and replace with fill material complying with the Contract Documents.

C. Placement – General:

1. Place fill to the grades shown or indicated. Bring up evenly on all sides fill around manholes, chambers, vaults, and similar items, and Underground Facilities.
2. Management of Moisture Content:

   a. Place fill materials at moisture content and density as indicated in this Article's requirements on compaction density. Prior to placing fill material, optimum moisture and maximum density properties for proposed material shall be obtained from COR, who may consult with geotechnical consultant, if any. Furnish and use construction equipment and machinery capable of adding measured amounts of water to fill materials to bring fill materials to a condition within required moisture content range. Control moisture for each lift necessary for required compaction.
   b. Furnish and use construction equipment and machinery capable of discing, aerating, and mixing fill materials to ensure reasonable uniformity of moisture content throughout fill materials, and to reduce moisture content of borrow materials by air drying, when necessary.
   c. When subgrade or fill materials requires moisture-conditioning before compaction, fill material shall be sufficiently mixed or worked on the subgrade to ensure uniform moisture content throughout the lift of material to be compacted.
   d. Materials at moisture content in excess of specified limit shall be dried by appropriate means, such as aeration or stockpiling for gravity drainage and air drying.

3. Compaction:

   a. Compaction Equipment:

      1) Perform compaction with construction equipment and machinery suitable for the type of fill material placed. Unless otherwise required, compact cohesive soils using sheepsfoot compactor, and compact granular materials using pneumatic rollers, vibrators, or other construction equipment or machinery to obtain required density.
      2) Select and use equipment capable of providing the minimum density required in the Contract Documents.

3) Use light compaction equipment and machinery, with equipment or machinery gross weight not exceeding 7,000 pounds within horizontal distance of 10 feet from the wall of completed, below-grade manholes, chambers, vaults, and similar items, and walls of adjacent buildings or structures.
4) Furnish and use construction equipment and machinery capable of compacting in restricted areas next to structures and around piping and Underground Facilities.

b. Compaction Test Area:

1) Effectiveness of construction equipment and machinery selected by Contractor for compacting, shall be tested at start of compacted fill Work by constructing a small section of fill within the area where fill will be placed.
2) If tests on the test section of fill indicate that required compaction is not obtained, do one or more of the following: increase the quantity of coverages, decrease the lift thicknesses, or use different compactor equipment or machinery.

4. Placement of Lifts and Compaction:

a. Place fill materials in horizontal, loose lifts, not exceeding specified thickness prior to compacting.
b. Place fill in manner ensuring uniform lift thickness after placing.
c. Preparation of surfaces for placement of fill:

1) Before commencing placing of fill, scarify underlying material to depth of six inches.
2) Where ground surface is steeper than one vertical to four horizontal ("1V:4H"), plow surface to bench and break up surface so that fill material will bind with existing surface. For slopes steeper than 1V:4H and less than 1V:1.5H, bench shall be six feet wide. For slopes steeper than or equal to 1V:1.5H and less than 1V:0.5H, bench shall be four feet wide.

d. Mechanically compact each lift, by not less than two complete coverages of compactor. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of compactor's compacting surface.
e. Compaction of fill materials by inundation with water is unacceptable.

5. Restrictions:

a. Do not place fill materials when standing water is present on surface of area where fill will be placed.
b. Do not compact fill when standing water is present on the fill to be compacted.
c. Do not place or compact fill in frozen condition or on top of frozen material.
d. Fill containing organic or deleterious materials or other unacceptable material previously described shall be removed and replaced prior to compaction.

6. If required densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly functioning compaction equipment or machinery, perform all work necessary to provide required densities. Such work shall include, at no additional cost to Owner, complete removal of unacceptable fill areas and replacement and re-compaction until acceptable fill is provided.
7. Repair, at Contractor's cost, observed or measured settlement. Make repairs and replacements as necessary and required within 30 days after being so advised by COR, unless more-timely action is necessary to avoid or reduce the potential for safety hazards or damage to property.

D. Fill Placed in Pipe Trenches:

1. Piping trenches may be backfilled prior to testing of piping, unless nature of test requires observation of pipe or manholes, chambers, vaults, or similar items during testing. Do not construct building or structure over piping until piping has been successfully tested and passed.
2. Pipe Bedding: Pipe bedding material shall be as follows:

   a. Unless otherwise shown or indicated, install buried piping on not less than six-inch layer of aggregate pipe bedding material underneath piping.
   b. Pipe bedding material shall extend upward from elevation required immediately above to 6 inches above crown of associated buried piping.
   c. Pipe bedding material shall be spread and the surface graded to provide a uniform and continuous support beneath piping at all points between bell holes or pipe joints.
   d. Install initial layer of pipe bedding material on prepared subgrade and compact as required. Provide appropriate divot in the bedding material to accommodate each pipe bell or joint. Install piping so that pipe barrel carries the weight of each pipe segment, rather than pipe bells or joints bearing the pipe's weight.
   e. Slight disturbance of installed pipe bedding material surface during withdrawal of pipe slings or other lifting tackle is acceptable.
   f. After each pipe's bedding material has been graded, and the piping has been aligned, joined in accordance with the Contract Documents, and placed in final position on bedding material, provide and compact sufficient pipe trench fill material under and around each side of pipe and back of bell or end thereof to hold piping in proper position and maintain alignment during subsequent pipe jointing and embedment operations.
   g. Subsequent to forming pipe joint, place additional pipe bedding material, in required lifts, to required top elevation of pipe bedding material. Ensure bedding material is properly and fully placed under pipe "haunches" for proper support of piping. Compact lifts of pipe bedding material in accordance with this Article prior to placing subsequent backfill material.

3. Placing and Compacting Pipe Trench Fill: Unless otherwise shown, placing and compacting of pipe trench fill materials shall comply with the following:

   a. Deposit and compact pipe trench fill material uniformly and simultaneously on each side of piping to prevent lateral displacement of piping.
   b. Each layer of pipe trench fill material shall be compacted by not less than two complete coverages of all portions of surface of each lift using appropriate compaction equipment or machinery.

c. Method of compaction and compaction equipment and machinery used shall be appropriate for material to be compacted and shall not transmit damaging shocks to piping.

E. Installation of Flowable Fill, also known as Controlled Low Strength Material (CLSM):

1. Discharge flowable fill from ready-mix delivery vehicle into excavation, or other space to be backfilled with such material, via chutes, pumping, or hand-carried in buckets, in accordance with the Contract Documents and requirements of flowable fill ready-mix Supplier.
2. Subgrade on which flowable fill is placed shall be free of disturbed or softened material and water.
3. Place flowable fill in lifts not greater than four feet depth.
4. Placing of each lift of flowable fill shall be a continuous operation, to the extent practicable.
5. Place flowable fill in manner that prevents flotation of piping or other damage to the Work, other Underground Facilities, and adjacent property.
6. Cold Weather Placing:

   a. Do not place flowable fill on frozen subgrade.
   b. Flowable fill batching, mixing, and placing may be performed when weather conditions are favorable, and ambient air temperature is 34 degrees F and rising.
   c. At the time of placing, flowable fill must have a temperature of not less than 40 degrees F.
   d. Discontinue placing flowable fill when ambient air temperature is 38 degrees F or less and falling.

7. After placing flowable fill, allow not less than 12 hours before placing subsequent lift or approved otherwise by COR.
8. Prevent contact with flowable fill by construction vehicles and equipment, or other traffic, for not less than 24 hours after placing, or until flowable fill is sufficiently hard to prevent rutting or other damage by vehicles and construction equipment.

F. Fill Required Under Subbase for Pavement and Other Traveled Ways:

1. Where bottom of pavement or surfacing of other traveled way will be at elevation equal to or less than preconstruction ground surface, after required excavation and preparation of subgrade, provide required subbase material to required depth. At underside of pavement or other surfacing of traveled way, subbase material shall extend horizontally six inches beyond edges of pavement or other surfacing. Exterior edges of subbase material shall be placed and compacted at uniform slope of one foot vertical-to-one foot horizontal away from top edge of subbase down to subgrade.
2. Where bottom of pavement or surfacing of other traveled way will be at elevation greater than preconstruction ground surface, after required preparation of subgrade, provide required fill material and subbase material to required depth. At underside of pavement or other surfacing of traveled way, subbase material shall extend horizontally six inches beyond edges of pavement or other surfacing. Exterior edges of subbase material and fill material shall be placed and compacted at uniform slope of one foot vertical-to-one foot horizontal away from top edge of subbase down to subgrade.

G. Compaction Density Requirements:

1. Compaction Requirements for Sitework (including civil, grading, and Underground Facilities):

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Under Pavement, Other Traveled Ways, Curbs, Gutters, Sidewalks, and Buried Utilities (including manholes, chambers, vaults, and similar items):		
Cohesive soils	95% per ASTM D698	-2 to +3% of optimum
Cohesionless soils	75% relative density per ASTM D4253 and ASTM D4254	
Sitework Not Covered by the Above Category or Classification:		
Cohesive soils	90% of ASTM D698	-2 to +3% of optimum
Cohesionless soils	65% relative density per ASTM D4253 and ASTM D4254	

2. Compaction Requirements for Materials Supporting Foundations and Adjacent to Buildings and Structures:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Fill supporting foundations and fill adjacent to exterior of buildings and structures, adjacent to walls, piers, and columns	95% per ASTM D698	-2 to +3% of optimum

3. Compaction Density and Moisture Requirements for Specific Areas:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Outside buildings and structures, under slabs-on-grade	95% per ASTM D698	-2 to +3% of optimum

4. Fill Lift Thickness:

   a. Unless expressly shown or indicated otherwise, place fill in trenches, below piping, below foundations, or under paved areas in horizontal uncompacted layers not exceeding eight inches deep, and thoroughly compact each before next layer is placed.
   b. In pipe trenches, above elevation of bottom of pipe, horizontal uncompacted layers shall be six inches deep.

5. Fill Moisture Content: Fill shall be wetted and thoroughly mixed to achieve moisture content to within the required range indicated in the applicable table, above, with the following exception(s):

   a. On-site clayey soils: Optimum to plus three percent (moisture less than optimum is unacceptable).

6. Replace natural, undisturbed soils or compacted soil subsequently disturbed or removed by construction operations with materials compacted as indicated.
7. Field quality control testing for density; to verify that specified density was obtained, will be performed during each day of compaction Work. Responsibility for field quality control testing is indicated in this Section's "Field Quality Control" Article.
8. When field quality control testing indicates unsatisfactory compaction, provide additional compaction necessary to obtain the required compaction. Perform additional compaction Work at no additional cost to Owner until required compaction is achieved. Such work includes complete removal of unacceptable (as determined by COR) fill areas and replacement and re-compaction until acceptable fill is provided in accordance with the Contract Documents.

H. Replacement of Unacceptable Excavated Materials: In cases where over-excavation to replace unacceptable soil materials is required, backfill the excavation to required subgrade with granular structural fill material and thoroughly compact in accordance with applicable table in this provision. Slope the sides of excavation in accordance with the maximum allowable inclinations specified for each element of the Work.

3.6 UNAUTHORIZED EXCAVATION

A. Unauthorized Excavation – General:

1. Excavations outside lines and grades shown or indicated and that are not approved by COR (including excavations below required subgrade elevation, unless COR directs removal of unsuitable subgrade material), together with removing and disposing of the associated material, shall be at Contractor's cost and risk.
2. Fill unauthorized excavations with properly compacted granular structural fill material at Contractor's cost.

3.7 PAVEMENT SUBBASE COURSE

A. Pavement Subbase – General:

1. Place subbase material, in layers of specified thickness, over subgrade to support pavement base course.
2. Prepare subgrade underlying subbase course in accordance with this Section's general requirements for subgrades.

B. Grade Control:

1. During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Placing of Pavement Subbase Course:

1. Provide subbase material where required to the limits shown or indicated.

2. Place subbase course material on prepared subgrade in layers of uniform thickness, in accordance with indicated cross-section and thickness. If the Contract Documents do not show or indicate required section of replacement paving, replacement subbase course shall be of thickness equal to existing subbase course.
3. Maintain optimum moisture content for compacting subbase material during placing operations.
4. After completing compaction, other than that necessary for bringing material for the next course, do not haul or drive over compacted subbase.
5. To prevent softening of subgrade, do not install pavement subbase in excess of 100 feet in length without compacting.
6. If subgrade material becomes churned up into or mixed with subbase material, remove the mixed material and replace with clean, compacted subbase material.

3.8 GRADING

A. Grading – General:

1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.
2. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Building Lines:

1. Grade areas adjacent to building lines to drain away from buildings and structures.
2. Grade to prevent ponding of water. Provide grades and slopes as shown on the Drawings and to allow effective drainage to proper drainage routes, such as catch basins, ditches or swales intended to convey storm water, and other storm water drainage routes. Where intended grade for effective drainage is unclear, promptly submit to COR request for interpretation and obtain COR's interpretation or clarification before proceeding,
3. Provide final surfaces free of irregular surface changes, in accordance with the following:

    a. Grassed Areas and Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than one inch above or below required subgrade elevations. Requirements for topsoil and finish grading are in Section 31 22 19 - Finish Grading.
    b. Sidewalks: Shape surface of areas under sidewalks to line, grade, and cross section, with finish surface not more than one inch above or below required subgrade elevation.
    c. Pavement (including hard-surfaced pavement and areas with stone surfacing): Shape surface of areas under pavement to line, grade, and cross section, with finish surface not more than 0.5-inch above or below required subgrade elevation.

C. Grading Surface of Fill Under Concrete Slabs-on-Grade:

1. Grade smooth and even, free of voids, compacted as specified, and to required elevation.
2. Provide final grades within tolerance of 0.5-inch when tested with a ten-foot straight edge.

3.9 DISPOSAL OF EXCAVATED SPOIL MATERIALS

A. Spoil Disposal - General:

1. Contractor shall haul away excavated material that does not comply with requirements for fill, or is in excess of quantity required for fill.
2. Disposal of materials shall comply with Laws and Regulations, at no additional cost to Owner.

3.10 FIELD QUALITY CONTROL

A. Site Tests and Inspections:

1. Testing Laboratory:

a. Employ a testing laboratory to perform field quality control testing.
b. Testing Laboratory Scope:

1) Perform field moisture content tests (in accordance with ASTM D2216 or ASTM D6938) and density tests (in accordance with ASTM D1556 or ASTM D6938) to verify that required compaction of fill materials was provided.
2) Tests of actual unconfined compressive strength or bearing tests (in accordance with ASTM D2850 or ASTM D2166) on each stratum.
3) Furnish to COR and Contractor written results of each test.

c. Authority and Duties of Testing Laboratory:

1) Testing laboratory representatives ("technician") shall inspect the materials in the field, perform testing, and report findings to COR and Contractor. When the Work is defective, technician will direct attention of COR and Contractor to such defective Work.
2) Technician shall not supervise performance of any of Contractor's Work. Technician shall not perform other duties for Contractor.
3) Work will be tested and inspected by testing laboratory as the Work progresses, but failure to detect defective Work (including defective materials) shall not, in any way, prevent later rejection when defect is discovered, nor shall it obligate COR for Substantial Completion or final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release requirements of the Contract Documents, or to approve or accept any portion of the Work.

2. Responsibilities and Duties of Contractor:

a. Use of testing laboratory in no way relieves Contractor of responsibility to provide Work in compliance with the Contract Documents.

b. When Owner furnishes services of testing laboratory, geotechnical consultant, or any combination thereof, for trenching, backfilling, and related earth Work, Owner and COR do not represent that the sampling and testing performed by Owner-hired testing laboratory or observations by Owner-hired geotechnical consultants, is sufficient for Contractor's purposes, or to monitor all aspects of the trenching, backfilling, and related earth Work. If additional quality control is needed to verify that the Work performed and materials delivered to the Site are in accordance with the Contract Documents, Contractor may retain its own, independent testing laboratory to perform additional sampling and testing for Contractor's purposes.

c. To facilitate testing laboratory and geotechnical consultant, Contractor shall advise testing laboratory not less than two days in advance of filling operations to allow for completion of field quality control testing and for assignment of personnel.

d. Contractor shall be responsible for providing required compaction for fill and other earthwork. Contractor shall control construction operations by performing confirming tests to verify that Contractor has complied with the Contract Documents relative to compaction and moisture content.

e. Contractor shall demonstrate adequacy of compaction equipment and procedures before exceeding one or more of the following quantities of earthwork. Each test location shall include tests for each layer, type, or class of fill to finish grade.

1) 200 linear feet of trench fill.
2) 10 cubic yards of granular structural fill.
3) 100 cubic yards of suitable soil material.
4) 50 cubic yards of subbase material.

3. Testing laboratory will inspect and indicate acceptable subgrades and fill layers before construction work is performed thereon. Testing of subgrades and fill layers shall be as follows:

a. Trenches for Underground Facilities (including buried ductbanks):

1) In Open Fields: Two locations every 100 linear feet.
2) Along Dirt or Gravel Roads or Off Traveled Right-of-Way: Two locations every 100 linear feet.
3) Crossing Paved Roads: Two locations along each crossing.
4) Under Pavement Cuts or Within Two Feet of Pavement Edges: One location every 100 linear feet.

b. For granular structural fill: Once per lift for each 1,000 square feet placed and compacted.

c. For soil structural fill:

1) For backfilling trenches directly adjacent to buildings or structures, on 30-foot intervals on all sides of the building or structure for every compacted lift, but not less than one per lift on each side of the building or structure for buildings or structures less than 60 feet long on a side.
2) For material not used as fill against buildings or structures, once per lift for each 1,000 square feet placed and compacted.

d. For Suitable Soil Material: One per 1,000 square feet on every compacted lift.

e. Subbase Material: One per 1,000 square feet on every compacted lift.

4. Periodic compliance tests will be made by COR to verify that compaction is in accordance with the Contract Documents, at no cost to Contractor. Contractor shall remove overburden above the level at which COR wishes to test and shall fill and re-compact the material after testing is complete.

B. Defective Work:

1. If testing laboratory reports or inspections indicate subgrade, fill, or bedding compaction less than specified density, Contractor shall remove unacceptable materials as necessary and replace with specified materials and provide additional compaction at Contractor's cost until subgrades, bedding, and fill are acceptable.
2. Costs for retesting of subgrade, fill, or bedding materials that did not originally comply with the Contract Documents, including required density, shall be paid by Contractor.

3.11 RESTORATION

A. Restoration – General:

1. Perform finish grading, including providing topsoil, in accordance with Section 31 22 19 - Finish Grading.
2. Provide replacement paving, sidewalks, curbs, gutters, and similar items in accordance with the Contract Documents including the Specifications of Division 32 - Exterior Improvements.
3. Restore landscaping including lawn and meadow areas, in accordance with the Contract Documents including the Specifications of Division 32 - Exterior Improvements.

END OF SECTION

SECTION 32 92 00
SEEDING, SODDING AND LANDSCAPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seedingprepartion and landscaping:

a. Soil preparation.

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

1. Section 31 22 19 - Finish 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. D2397, Standard Specification for Cationic Emulsified Asphalt.
b. D2974 – Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
c. D5268, Standard Specification for Topsoil Used for Landscaping and Construction Purposes.

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.

B. Samples:

1. Metal edge.

1.4 SEQUENCING AND SCHEDULING

A. Installation Schedule:

1. Indicate anticipated dates COR will be required to review finished grade for initial acceptance and final acceptance.

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

2.3 ACCESSORIES

A. Wrapping Material:

1. Two-ply asphalt cemented Kraft crepe paper in strips or burlap in strips.
2. Secure to tree with good quality six-ply cotton twine or binder twine.

B. Tree Stakes: Furnish as detailed or in full accordance with State Specifications.

C. Staking Wire: 12 GA galvanized.

D. Reinforced Rubber Hose: 5/8 or 3/4 inches diameter.

E. Rock: Round, washed river rock, minimum 1/2 to 1 inch size.

F. Weed Barrier: 5 oz woven weed barrier.

G. Metal Edging: Steel edging, 1/8 x 4 inches, 16 inches tapered steel stakes, painted black; or Aluminum edging, 1/8 x 4 inches with line and splicing stake.

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 inches.
2. Remove stones over 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter.
3. Prior to advising COR area is ready for seed, 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. Remove stones or other substances from surface which will interfere with turf development or subsequent mowing operations.
6. 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.

7. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and before planting.

3.2 INSTALLATION

A. Landscape Materials:

1. Edging: Install edging in accordance with manufacturer's recommendations in locations shown on Drawings.
2. Rock areas:

    a. Compact subgrade to limits of installation of rock layer.
    b. Spread herbicide at rate of 100-120 pounds per acre in accordance with manufacturer's recommendations.
    c. Cover area with weed barrier fabric and overlap edge 6 inches minimum.
    d. Install 3 inch layer of rock as detailed.

B. Pruning and Repairing Existing Trees:

1. Remove dead or dying limbs, repair and treat wounds, remove limbs that interfere with construction or with vehicular traffic and repair, rotted or decayed areas specifically noted on Drawings.
2. Procedure:

    a. To prevent stripping the bark, stub cut branches that are too large to be supported by hand.
    b. Coat branch cuts over 1 inch in diameter with an asphaltic varnish containing an antiseptic.
    c. Where existing trees interfere with construction, prune the limb back flush to the main trunk.

        1) Maintain 7 feet vertical clearance where evergreens overhang new sidewalks.

    d. Provide 10 feet vertical clearance along the main access road where the existing trees are subjected to vehicular traffic.
    e. Repair bark wounds by removing injured bark, shaping the wound to an elongated ellipse, disinfecting it and applying antiseptic paint.

        1) Repair all rotten areas.

3.3 MAINTENANCE AND REPLACEMENT

A. General:

1. 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.

2. Replace unacceptable materials with materials and methods identical to the original specifications unless otherwise approved by the COR.

END OF SECTION

SECTION 33 05 33.23
POLYETHYLENE PRESSURE PIPE AND TUBING (AWWA C901 AND AWWA C906)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyethylene (PE) pipe, fittings, and appurtenances.

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

1. Section 31 23 33 - Trenching and Backfilling.
2. Section 40 05 01 - Common Work Results for Process Piping.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American National Standards Institute (ANSI):

a. B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
b. B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
c. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.

2. ASTM International (ASTM):

a. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
b. A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
c. A194, Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
d. A536, Standard Specification for Ductile Iron Castings.
e. B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
f. D638, Standard Test Method for Tensile Properties of Plastics.
g. D1248, Specification for Polyethylene Plastics Molding and Extrusion Materials.
h. D1505, Test Method for Density of Plastics by the Density-Gradient Technique.
i. D1598, Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure.
j. D1599, Test Method for Short-Time Hydraulic Failure Pressure of Plastics Pipe, Tubing and Fittings.
k. D2239, Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.

l. D2290, Test Method for Apparent Tensile Strength of Ring or Tubular Plastics and Reinforced Plastics by Split Disk Method.
m. D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
n. D2737, Standard Specification for Polyethylene (PE) Plastic Tubing.
o. D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
p. D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
q. D3261, Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
r. D3350, Standard Specification for Polyethylene (PE) Plastics Pipe and Fittings Materials.
s. F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
t. F1055, Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
u. F2620, Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

3. American Water Works Association (AWWA).

a. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. through 144 In.
b. C901, Polyethylene (PE) Pressure Pipe and Tubing, ¾ In. through 3 In. for Water Service.
c. C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 In. through 65 In. for Waterworks.

4. Plastic Pipe Institute (PPI):

a. TR-3, Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Material.
b. PPI TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds.

5. Military Specification (Mil Spec):

a. QQ-P-416F, Plating, Cadmium Electro Deposited.

6. National Sanitation Foundation International (NSF):

a. 14, Plastic Piping Components and Related Materials.
b. 61, Drinking Water System Components – Health Effects.

1.3 DEFINITIONS

A. DIOD: Ductile Iron Outside Diameter.

B. CTS: Copper Tube Size.

C. DR: Dimension Ratio, Outside Diameter/Minimum Wall Thickness, both in inches.

D. Diametral Deflection: reduction in diameter caused by earth and surcharge loads acting on the installed pipe.

E. ESCR: Environmental Stress Crack Resistance.

F. HDB: Hydrostatic Design Basis per ASTM D2837.

G. IPS: Iron Pipe Size.

H. SDR: Standard Dimension Ratio.

I. SIDR: Standard Inside Diameter Ratio.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

   a. Dimensioned, scaled drawings showing Contractor's proposed deviations from piping alignment shown on the Drawings.
   b. Where necessary, include both plans and profiles and section views in Shop Drawings.

2. Product Data:

   a. Manufacturer's published catalog information and specifications for each size and type of PE piping required, including pipe, fittings, and jointing materials.
   b. Clearly indicate in product data submittal the reference standards with which pipe and appurtenances comply.
   c. Where couplings are required, submit coupling manufacturer's catalog literature and specifications for the specific couplings proposed.

B. Informational Submittals; Submit the following:

1. Supplier Instructions:

   a. Submit manufacturer's written instructions for handling, storing, and installing piping furnished.

2. Source Quality Control:

   a. Submit documentation from manufacturer that piping materials furnished were inspected at the production facility and successfully passed manufacturer's quality control procedures.
   b. Manufacturer's affidavit certifying piping materials furnished comply with AWWA standard C906.

3. Fusion machines proposed for joining pipe/fittings.

4. Field Quality Control:

    a. Documentation of temperature and pressure profiles from data logger for each butt fusion joint.
    b. Results of field quality control testing and inspections required in this Section.
    c. Documentation of temperature and pressure profiles from data logger for each butt fusion joint.

1.5 DELIVERY, HANDLING, AND STORAGE

A. In addition to requirements elsewhere in the Contract Documents, also comply with the following:

    1. During handling and installation avoid conditions where pipe bends excessively and avoid imparting kinks in the pipe.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe:

    1. AWWA C906.

        a. PE 4710 polyethylene material.
        b. ASTM D3350 cell classification 445574C.
        c. Minimum Hydrostatic Design Basis (HDB) of 1600 psi at 73 degF when tested in accordance with PPI TR-3.

B. Fittings:

    1. Same material and thickness as adjoining pipe.

        a. Fittings may be one DR lower (thicker) than the adjoining pipe.

    2. Molded fittings:

        a. Butt fused: ASTM D3261.
        b. Socket: ASTM D2683.
        c. Electrofusion: ASTM F1055.

    3. Fabricated fittings: Fabricate from same material as pipe.

C. Back-up flanges:

    1. Stainless steel: ASTM A182, dimensions per AWWA C207, Class 150.
    2. Ductile iron: ASTM A536 Grade 70-50-5, dimensions per ANSI B16.1, Class 150.

D. Nuts and Bolts:

1. Buried:

    a. Tee-Head bolts for mechanical joints: Per AWWA/ANSI C111/A21.11.
    b. Other bolts and nuts: ASTM A307
    c. Wax Tape Coatings per AWWA C217.

2. Exposed: Mechanical galvanized ASTM B695, Class40.
3. Heads and dimensions per ASME B1.1.
4. Threaded per ASME B1.1.
5. Project ends 1/4 to 1/2 inches beyond nuts.

E. Gaskets:

1. Comply with piping system schedules in Section 40 05 01 - Common Work Results for Process Piping, and other relevant requirements of the Contract Documents.
2. When gaskets are provided for flanged connections, elastomeric gaskets shall have serrated faces and appropriate penetrations for bolts.

2.2 MANUFACTURED UNITS

A. Adaptor Fittings:

1. Mechanical joint: Adaptor fitting butt fused to pipe.

    a. Capable of developing same pressure rating as specified for pipe.
    b. Restrained.
    c. Central Plastics MJ Adaptor or equal.

B. Restrained Adapter Fitting:

1. Restrained coupling for pipe material transition.
2. Multi/Joint 3000 Plus, Type 3000

C. Butt Fusion Equipment:

1. Designed to create a joint at least as strong as the adjacent pipe.
2. Equipment to contain stops to prevent excessive pressure on pipe ends during fusion process.
3. Equipment to plane pipe ends prior to fusion process.
4. Provide a data logger to document temperatures and pressures for each butt fusion joint.

2.3 DESIGN CRITERIA

A. DR: DR 11, See Drawings.

B. Pipe Outside Diameter (OD) :

1. Minimum allowable pipe outside diameter: In accordance with AWWA C906, Table 4 (DIOD sizing).

C. Stub flanges: Design to develop full pressure specified for pipe with blind flange connected to back up flange.

2.4 FABRICATION

A. Pipe:

1. Clearly mark pipe and fittings per AWWA C906 AWWA C901.
2. Service Indication:

   a. Provide integral color or longitudinal color banding at 180 degrees apart.

      1) Sewer: Green.

B. Stub flanges:

1. Design for use with backing flange.
2. Fabricate per manufacturers recommendations to develop full pressure specified for pipe with blind flange attached.

2.5 SOURCE QUALITY CONTROL

A. Materials:

1. Incoming polyethylene materials:

   a. Inspect for density per ASTM D1505, melt rate per ASTM D1248, and carbon and color containment.
   b. Provide certification from material supplier for a minimum of 30% of all incoming polyethylene materials.
   c. PE pipe manufacturer shall verify certifications prior to processing into finished pipe or fittings.

2. Outgoing materials:

   a. Manufacturer to inspect for diameter, wall thickness, length, straightness, out-of-roundness, concentricity, toe-in, inside and outside surface finish, markings, and end cut.
   b. Perform tests to determine density, melt flow rate, carbon content, and carbon dispersion.
   c. Test representative samples of the pipe provided to determine hoop tensile strength and ductility by either quick burst per ASTM D1599 or ring tensile per ASTM D2290.

B. Equipment:

1. Qualify each extrusion line and molding machine to produce pressure rated products by taking representative production samples and performing sustained pressure tests in accordance with ASTM D1598.

C. Quality Control Program:

1. Pipe and fitting manufacturer shall maintain permanent Quality Control (QC) and Quality Assurance (QA) records.
2. Certified copies of the quality control data taken during product manufacture shall be supplied to the Owner upon request.

D. Factory Inspection:

1. PE pipe manufacturer's production and quality assurance facilities shall be open and available for inspection by Owner and its authorized representatives.

PART 3 - EXECUTION

3.1 GENERAL

1. Locations: Provide PE piping at the locations shown on the Drawings or as otherwise shown and indicated in the Contract Documents.
2. Install PE piping in accordance with:

   a. Section 31 23 33 - Trenching and Backfilling.
   b. Other provisions of the Contract Documents.
   c. Laws and Regulations.

3.2 INSTALLATION

A. General:

1. Locations: Provide PE piping at the locations shown on the Drawings or as otherwise shown and indicated in the Contract Documents.
2. Install PE piping in accordance with:

   a. Manufacturer's recommendations.
   b. Section 31 23 33 - Trenching and Backfilling.
   c. Other provisions of the Contract Documents.
   d. Laws and Regulations.

3. Field repairs of pipe and fittings are not permitted, with the exception that portions of straight pipe which are damaged may be cut off provided this alteration is in accordance with the manufacturer's established procedures.

B. Joining method - Fusion Joints:

1. Joint Fusing – General:

a. Comply with ASTM F2620, the Contract Documents, pipe manufacturer's written instructions, and fusion machine manufacturer's written recommendations. Where any of the foregoing are inconsistent, comply with the more-stringent requirement. When unclear, request and obtain from Engineer written interpretation or clarification.
b. Fusion joiner shall be appropriately qualified and experienced in making the type of fusion joint required (butt fusion, socket fusion or sidewall fusion). Fusion joiner shall perform fusion jointing only for the types of joints for which such person possesses appropriate qualifications and experience.
c. Cost of certifying its workers and performing testing required for fused joints is Contractor's responsibility.
d. Plane ends of joints in fusion machine prior to heating.
e. Push pipe ends together in fusion machine and visually inspect compatibility and alignment of the two ends.
f. Comply with pipe manufacturer's written procedures and recommended heating time for pipe ends based upon pipe diameter and ambient temperature.
g. Visually inspect joint immediately upon removal of heating element to verify blistering of pipe has not occurred. Blistering of pipe is unacceptable.
h. Do not remove pipe from fusion machine until pipe has cooled in accordance with the pipe manufacturer's written instructions.

2. PE pipe 1 inch diameter and smaller shall be socket fused.
3. PE pipe joints 1.5 inch diameter and larger shall be butt fused.
4. Electro-Fusion Fittings:

a. Comply with pipe fitting manufacturer's written instructions.
b. Ensure ends of connecting pipe are round when fusing.
c. Couplings: Provide means to place pipe ends in compression when fusion coupler is heated/cooled until connection process is complete.

C. Joining method – Flanged Joints:

1. Slide back up flange on PE pipe.
2. Install stub flange on end of pipe with butt fusion.
3. Make flange faces flat and perpendicular to pipe centerline.
4. Allow one flange free movement in any direction while bolts are being tightened.
5. Do not assemble adjoining flexible joints until flanged joints in piping system have been tightened.
6. Using torque wrench, gradually and uniformly tighten flange bolts to provide even compression of gaskets.
7. Check bolt torque after 24 hours to ensure that stress relief has not occurred.

D. Joining method – Mechanical Joint:

1. Use only for joining PE pipe to DIP or PVC (AWWA C900).
2. Install MJ adapter on end of PE pipe with butt fusion.
3. Clean components before installation.

a. Clean bolts and nuts by wire brushing.
b. Lubricate bolts with vegetable-based oil only.

4. Insert nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
5. Using torque wrench, gradually and uniformly tighten fastening hardware and prevent undue strain on connected piping.
6. Test joint for leakage.

    a. If joint leaks under pressure testing, loosen or remove nuts and bolts, reset, or replace the gasket, reinstall or retighten bolts and nuts, and retest the joints.
    b. Completed joints shall be watertight.

7. Check bolt torque after 24 hours to ensure that stress relief has not occurred.

E. Install buried pipe per Section 40 05 01 and per details shown on Drawings.

1. Allow pipe to stabilize to trench bottom or casing temperature before final tie-in or backfilling.
2. For field sweeps, the minimum cold bending allowable radius:

DR	Minimum Radius
≤9	20 times pipe OD
>9 - 13.5	25 times pipe OD
>13.5 - 21	27 times pipe OD
>21	30 times pipe OD
With flange or fitting inside sweep	100 times pipe OD

3.3 FIELD QUALITY CONTROL

A. Use only fusion machine operators who have been trained by machine manufacturer no more than 12 months prior to installation of first fused joint.

B. Visually inspect all pipe for gouges.

1. Gouges in excess of 10% of the pipe wall thickness are not acceptable.
2. In area where excessive gouges are present, cut out affected pipe section and butt fused to remaining pipe to make a continuous section.

C. Check integrity of the heating plate in the fusion equipment a minimum of twice per each 8-hour work shift for temperature uniformity.

D. Butt-fused specimen joint inspection and testing per ASTM F2620, Appendix X4.

1. Visually inspect all joints during and after joining to ensure that the joint meets the requirements of the butt fusion welding procedure.
2. On every day that butt fusions are to be made, prepare a trial butt-fused joint specimen.

3. Allow specimen to cool completely and cut into test straps.
4. Test straps:

    a. Length: 12 inches (min) or 30 times the wall thickness.
    b. Location of fusion: Center of strap.
    c. Width: 1 inch (min) or 1.5 times the wall thickness.

5. Visually examine the straps for voids or discontinuities.
6. Deform the straps by bending, torque, or impact.
7. If failure of the joint occurs outside of the joint area, the test is acceptable.

E. Diametral Deflection:

1. After backfilling, check each section of pipe for deflection by pulling a mandrel through the pipe.
2. Pipe with deflection exceeding 5% of the inside diameter: remove backfill and replace to provide a deflection of less than 5%.
3. Retest any repaired pipe.

F. Hydrostatically test installed pipe and fittings in accordance with Section 40 05 01.

1. Provide butt fused stub flanges, back up flanges and blind flanges on both ends of each pipe string for hydrostatic testing prior to and following installation.

END OF SECTION

SECTION 33 05 61
CONCRETE MANHOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast concrete manholes, for sanitarysewerage.
2. Seals between adjacent precast concrete manhole sections.
3. Manhole rungs, where required.
4. Manhole benches.
5. Piping connections to manholes.
6. Grade rings and similar materials for adjusting manhole frames and covers to grade.

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

1. Section 02 41 00 - Demolition.
2. Section 31 23 33 - Trenching and Backfilling.
3. Section 40 05 01 - Common Work Results for Process Piping.

1.2 REFERENCES

A. Terminology:

1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this section have the meaning indicated below:

a. “Frame and cover” means a circular metallic frame, installed on, or mechanically attached to, the top of a manhole, vault, chamber, or other construction, into which a round, metallic cover is installed. In this Section, the terms, “frame and cover”, “cover and frame”, and derivative terms, have the same meaning.
b. “Sanitary sewer piping” means buried piping conveying wastewater by gravity to an appropriate disposal location. Sanitary sewer piping systems typically include manholes for cleaning and maintenance access to the buried piping. In this Section, the terms “sanitary sewer piping”, “combined sewer piping”, “wastewater piping”, and derivative terms have the same meaning.

B. Reference Standards: Standards referenced in this section include, but are not necessarily limited to, the following:

1. American Association of State Highway and Transportation Officials (AASHTO):

a. LRFD Bridge Design Specifications.

2. ASTM International (ASTM):

a. C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
b. C478, Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
c. C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
d. C990, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
e. C969, Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
f. C1244, Title: Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
g. C1478, Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes, and Laterals.
h. C1619, Standard Specification for Elastomeric Seals for Joining Concrete Structures.
i. C1821, Standard Practice for Installation of Underground Circular Precast Concrete Manhole Structures.
j. D1227, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
k. D3575, Standard Test Methods for Flexible Cellular Materials Made from Olefin Polymers.
l. D4101, Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials.
m. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free.
n. D4819, Standard Specification for Flexible Cellular Materials Made From Polyolefin Plastics.
o. D4976, Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
p. F2510, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Corrugated Dual- and Triple-Wall Polyethylene and Polypropylene Pipes.

3. Prestressed Concrete Institute (PCI):

a. MNL 135, Tolerance Manual for Precast and Prestressed Concrete Construction.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Schedule (in tabular or narrative format), of concrete manholes proposed, apportioned by concrete manholes location within the Work, indicating, for each: Project-specific location, size and depth, whether flat top section or conical top section will be provided, whether flat transition section or eccentric conical section will be provided, whether manhole will be precast concrete or otherwise (when allowed), live load rating, manufacturer and model number or item designation, materials for connecting buried piping to concrete manhole, material proposed for adjusting frames and covers to required rim elevation, specific types of concrete manhole accessories proposed (if any), whether manhole interior and exterior will be coated and generic type of coating (if any), and other pertinent information.
b. Schedule listing each, individual manhole, indicating sectional breakdown with all concrete components and sections for each, with express cross-reference of each concrete component and section to manhole manufacturers standardized or customized design drawings and data. Indicate elevation of each pipe penetration in each manhole, as well as location of each pipe penetration into manhole.
c. Reinforcing steel Shop Drawings for cast-in-place concrete base sections, or elements thereof, when not furnished as part of reinforcing steel Submittals.
d. Concrete mix design for concrete manholes.
e. Detailed, scale drawings for specialized or custom concrete manholes required, indicating dimensions, weights, materials, layout, and other pertinent information.

2. Product Data:

a. Submit manufacturer's published information, including catalog excerpts, specifications, and indication of specific reference standards with which materials comply, for each item specified in this Section. Furnish such information for each size and type of item required.
b. Manufacturer's detailed drawings for standardized concrete manholes commonly furnished by manufacturer, as relevant to the Work.
c. Manufacturer's published catalog information and specifications for each size and type of concrete manhole, and materials for connecting buried piping to concrete manhole, manhole rungs, and concrete manhole accessories required in this Section.
d. Clearly mark on product data Submittals proposed items and features, and clearly indicate, via cross-outs or other method, items and features not proposed for the Work.

B. Informational Submittals: Submit the following:

1. Manufacturer Instructions:

a. Instructions for handling, storing, and installing, items furnished under this Section.

2. Field Quality Control Submittals:

a. Written results of field tests and inspections required by this Section, including clear indication whether such results comply with criteria for acceptance indicated in the Contract Documents.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packing and Transportation:

1. Advise COR of scheduled date of delivery of precast concrete items to the Site approximately 24-hours in advance.
2. Do not ship precast concrete items without COR's prior approval of associated Shop Drawings and product data Submittals.
3. Comply with Laws and Regulations regarding transporting materials.
4. Provide temporary supports, bracing, and shipping methods that dampen vibration during shipping and handling.
5. Provide adequate padding material between tie chains or cables to prevent concrete chipping, scoring, and other damage during shipping and handling.

B. Delivery:

1. Comply with ASTM C1821 relative to delivery and inspection of precast concrete items upon delivery to the Site.

C. Storage and Handling:

1. Comply with ASTM C1821, relative to handling and storage, unless otherwise required in the Contract Documents.
2. Lift concrete manholes, and separate elements thereof, only at lifting points designated by manufacturer.
3. Clearly indicate, whether by obvious marking on exterior of each precast concrete item (at location that will not be exposed-to-view) or on delivery documents, weight of each precast concrete item.
4. Clearly indicate by obvious marking on exterior of precast concrete items (at locations that will not be exposed to view) sections that, together, are intended to comprise a single manhole, when shipped as separate components.

PART 2 - PRODUCTS

2.1 MANHOLE STRUCTURES

A. Description:

1. Provide all labor, materials, construction equipment and machinery, tools, services (including professional services), and appurtenances necessary, required, or both, to furnish and install precast, reinforced concrete manholes.
2. Locations of required precast concrete manholes are shown or indicated on the Drawings.
3. Existing manholes requiring new piping connections as part of the Work are shown on the Drawings. Requirements for such connections are in this Section.
4. Locations of existing concrete manholes requiring repair or rehabilitation as part of the Work are shown or indicated on the Drawings. Requirements for repair and rehabilitation of existing manholes are in other Specifications in Division 33 - Utilities.

B. Materials: Provide materials as indicated below, to comply with relevant requirements of the Contract Documents:

1. Reinforced Concrete: Comply with ASTM C478, unless otherwise required by the Contract Documents.
2. Seals for Watertight Joints Between Precast Concrete Elements: Provide the following where watertight joints are required, between separate, precast concrete elements, such as bases, transition sections, riser sections, eccentric cone top sections, flat top sections, and others, of size appropriate for concrete manhole sections.

    a. Elastomeric Gaskets: ASTM C443 and ASTM C1619, EPDM or natural rubber.
    b. Cold-applied Asphalt Joint Compound:

        1) Material required in this provision may be furnished in lieu of gaskets required above in this provision or preformed flexible joint sealing compound required below in this provision.
        2) ASTM C990, cold applied mastic, forming pliable, durable, continuous, moisture proof joints, conforming to movement of surfaces to which it is applied. Comprised of special blended asphalts, refined oils, mineral stabilizers, and asbestos-free fibers. Suitable for forming watertight seal on concrete.

    c. Preformed Flexible Joint Sealing Compound:

        1) Material required in this provision may be furnished in lieu of gaskets or cold-applied asphalt joint compound required above in this provision.
        2) ASTM C990, butyl rubber joint sealant, furnished as preformed “rope”, with easily removable backing paper. Material shall be specifically intended for sealing joints of concrete pipe and concrete manhole sections.

3. Elastomeric Connectors Between Buried Pipe and Concrete Manholes: Provide the following where watertight, rubber boot connector is required, of size appropriate for opening in concrete manhole and outside diameter of pipe.

    a. EPDM or natural rubber.
    b. Bands for connecting boot to pipe, regardless of pipe material: Type 316 stainless steel.
    c. Corrugated polyethylene, corrugated polypropylene, ribbed PVC, or ribbed or corrugated ABS thermoplastic single-, double-, or triple-wall pipe: ASTM F2510.
    d. Smooth exterior wall polyethylene pipe: ASTM C923.
    e. Concrete pipe: ASTM C1478.
    f. Corrugated metal pipe: ASTM C923 connector to concrete manhole, with ASTM C1478 resilient connector used as adapter on pipe exterior where ASTM C923 rubber boot connects to pipe.
    g. PVC and ABS thermoplastic pipe with smooth external wall: ASTM C923.
    h. Ductile iron pipe: ASTM C923.

4. Polymer Grade Rings: Provide required quantity of one of the following:

a. Expanded, polypropylene, black, complying with ASTM D3575 and ASTM D4819.
b. High density polyethylene, ASTM D4976.

5. Manhole Rungs:

a. Copolymer Material Surrounding Steel Reinforcing Bar: ASTM D4101 and ASTM D3575.

C. Mixes:

1. Comply with ASTM C478, unless otherwise required by the Contract Documents.
2. Provide normal weight concrete for precast concrete applications.

D. Fabrication: Provide fabrication as indicated below, or, other, relevant provisions, elsewhere in the Contract Documents:

a. Fabricate concrete manholes in accordance with ASTM C478, unless otherwise required by the Contract Documents. Provide concrete manholes suitable for loading requirements set forth in the Contract Documents.

2. Precast Concrete Manholes:

a. Provide concrete manholes each comprised of the fewest sections reasonably possible.
b. Where precast concrete manholes will be comprised of separate, precast concrete components, such as base sections, transition sections, riser sections, conical top sections, or flat top sections, as necessary for installation at the Site, provide tongue and groove type joint between sections.
c. Dimensions:

1) Diameter and height (depth) of concrete manholes shall comply with the Drawings. Provide each concrete manhole with "sump", approximately two to three inches deep, below lowest required pipe invert elevation. Sump planar dimensions shall equal diameter required for concrete manhole's base section.
2) Flat Top Sections: Top slab thickness shall be not less than eight inches.
3) Access opening in top section of manhole shall be not less than required clear opening dimensions for associated cover.
4) Wall Thickness (applicable to conical top sections, riser sections, conical transition sections, and base sections): Not less than 1/12 of inside diameter of associated concrete section, and in no event less than five inches.
5) Riser Sections: Not less than four feet diameter.
6) Flat Transition Sections: Slab thickness shall be not less than eight inches.
7) Monolithic Base Sections:

a) Base slab thickness shall be not less than eight inches.

b) For straight-through channels, provide not less than 0.1 foot vertical differential between inverts of two lowest pipe penetrations in base section. Where channel in manhole will change direction by 70 to 135 degrees, provide not less than 0.1 foot vertical differential between inverts of two lowest pipe penetrations in base section.
c) Required dimensions of "sump", below lowest pipe invert elevation, are indicated above in this provision.
d) When required in the Contract Documents, provide precast concrete "flange" around entire circumference of base section, equal in thickness to base slab, extending not less than six inches out from exterior surface of base section wall.

d. Top Sections:

1) Provide eccentric, conical top section for each concrete manhole, unless expressly required otherwise in the Contract Documents, or when approved by COR.
2) Provide flat top section for manholes where required by the Contract Documents. Provide access hole through each flat top section against wall of associated riser section.

e. Riser Sections:

1) Fabricate concrete riser sections with vertical walls that will be perpendicular to bottom slab of associated base section.
2) Minimum Acceptable Vertical Height of Riser Sections: One foot.

f. Base Sections:

1) Fabricate concrete base sections with vertical walls perpendicular to base slab, with right angles between base slab and walls.
2) Provide monolithic precast concrete base sections.
3) Cast-in-place concrete base section is unacceptable, unless expressly required by the Contract Documents.
4) When manhole bench will be factory-fabricated, whether as part of base sections initial casting or following initial casting of base section, bench shall comply with requirements for manhole benches in this Section's "Installation" Article.

g. Marking:

1) Provide markings of precast concrete items in accordance with ASTM C478, and this Section.
2) Using a permanent marking system, mark manufacturer's name or trademark and date of manufacture on one side of each precast concrete item as soon as possible after stripping forms.
3) When precast concrete items comply with state department of transportation standard specifications, or other, similar, widely-used construction specifications, also permanently mark on each precast concrete item the type or specifications reference with which precast concrete item complies.

4) Additional requirements on markings are in this Section's "Delivery, Storage, and Handling" Article.

h. Storage and Curing:

1) Maintain precast concrete items, after stripping forms and during secondary curing, in temperature- and humidity-controlled environment at approximately 50 degrees F until items have attained 80 percent of required 28-day compressive strength.
2) Do not place precast concrete items in environment less than 32 degrees F after secondary cure, unless temperature differential between precast concrete items and ambient air temperature is less than 30 degrees F.
3) Store precast concrete items until required 28-day compressive strength is achieved.

3. Fabrication of Rubber Boot Connections:

a. Fabricate rubber boots, where required, in accordance with the reference standards indicated for each in the "Materials" provision of this Article.

4. Grade Adjustment Items:

a. Precast Concrete Grade Rings:

1) Comply with requirements for precast concrete grade rings in ASTM C478, unless required otherwise in this Section or elsewhere in the Contract Documents.
2) When provided, grade rings shall be of appropriate planar dimensions that do not reduce required manhole cover clear opening diameter. Provide circular grade rings for circular frames and covers.
3) Width: Not less than width of flange of concrete manhole frame.
4) Height of each grade ring shall not exceed 12 inches.
5) Manufacture grade rings level and true, except where top of grade ring is expressly intended to accommodate frames and covers on sloping surfaces.

b. Polymer Grade Rings:

1) High-compression, molded polypropylene with finished density of not less than 7.5 pounds per cubic foot, or molded polyethylene with finished density of not less than 58.7 pounds per cubic foot.
2) When provided, grade rings shall be of appropriate planar dimensions that do not reduce required manhole cover clear opening diameter. Provide circular grade rings for circular frames and covers.
3) Tongue-and-groove keyways for vertical alignment.
4) Adhesive trench on underside for watertight seal.
5) Width: Not less than width of flange of concrete manhole frame.
6) Height of each grade ring shall not exceed 12 inches.
7) Manufacture grade rings level and true, except where top of grade ring is expressly intended to accommodate frames and covers on sloping surfaces.
8) Adhesives as recommended by polymer grade ring manufacturer for securing polymer grade rings together.

5. Manhole Rungs:

a. Comply with ASTM C478 unless required otherwise in this Section.
b. Install manhole rungs at the precast concrete manufacturing facility.
c. Rung Type: drop rung type.
d. Rung Width: 13 inches.
e. Non-skid, slip-resistant surface on top of each rung..
f. Install manhole rungs in accordance with Laws and Regulations.
g. Provide manhole rungs in single, vertical, linear line in each manhole, with tolerance of not more than 0.25 inch.
h. Vertically space manhole rungs in accordance with Laws and Regulations and, in no event, greater than 12 inches on centers.

E. Fabrication Tolerances:

1. Comply with tolerances set forth in ASTM C478 and PCI MNL 135, except as follows:

a. Length of Member: variation of not more than 1/8-inch per 10 feet of length. In no event shall overall dimension of item vary by -0.25-inch and +0.5-inch.
b. Cross-Sectional Dimensions (meaning, cross-section of planar view of installed concrete manhole): tolerance of up to 3/8-inch is acceptable.

2.2 SOURCE QUALITY CONTROL

A. Tests and Inspections:

1. Comply with ASTM C478, including criteria for acceptance.
2. In addition, perform manufacturer's standard shop tests and inspections.
3. Promptly upon COR's request, furnish as Submittal, documentation of performance and successfully complying with criteria for acceptance of required tests and inspections.

B. Defective Work:

1. Reasons for rejecting, as defective Work, concrete manholes delivered to the Site, or upon observation or inspection at the place of fabrication, are indicated in ASTM C478.
2. Remedy defective concrete manhole Work in accordance with ASTM C478, unless required otherwise in the Contract Documents.
3. In event COR marks concrete manhole sections as acceptable, such marking does not constitute acceptance of such Work, which is furnished only prior to final payment, in accordance with the Contract Documents, nor does such marking reduce or mitigate, in any way, Contractor's sole responsibility for construction means, methods, techniques, procedures, and sequences, and associated safety and protection measures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspection:

1. Inspect precast concrete items delivered to the Site prior to installation, in accordance with ASTM C1821. Do not install defective precast concrete items.
2. Inspect surfaces on which each precast concrete item will be installed, in accordance with ASTM C1821.

B. Installing the Work constitutes Contractor's approval of underlying work, substrates, subgrades, and field conditions prevailing at the time of the Work.

3.2 PREPARATION

A. Excavation and Related Work:

1. Perform excavating and filling Work, including preparation of subgrades, in accordance with Section 31 23 33 - Trenching and Backfilling.
2. Prior to installing each concrete manhole, provide base of required thickness of granular under-slab fill. Where required thickness of such material is not otherwise shown or indicated in the Contract Documents, provide six-inch thick base of such material under concrete manholes, extending outward by six inches from exterior edge of base section flange of concrete manhole.
3. Provide level, true, top surface of aggregate base.

3.3 INSTALLATION

A. Installation Requirements:

1. Installation – General:

a. Install items in accordance with the Contract Documents, manufacturer's written instructions, applicable permits issued by authorities having jurisdiction, and Laws and Regulations. Where such requirements conflict, obtain interpretation or clarification from COR prior to commencing the associated Work.
b. Unless otherwise required by the Contract Documents, install precast concrete manholes in accordance with ASTM C1821.

2. Installing Concrete Manholes:

a. Install concrete manholes at appropriate elevation, in accordance with the Contract Documents, for positive flow of wastewater or stormwater (as applicable) as intended. Properly align concrete manholes and install level.
b. Coordinate final location of each concrete manhole with adjacent Work and existing facilities, including buried piping, curbing, pavement, paved gutters, sidewalks, and other, similar items.
c. Joints Between Manhole Sections:

1) Joints Between Manhole Sections – General:

a) Provide joints between concrete manhole sections in accordance with ASTM C1821 and additional, applicable requirements, below, for type of joint seal provided.

b) Provide joint seal around entire circumference of each joint between adjacent concrete manhole sections.

c) Completed joints required as watertight shall be free of visible or apparent leakage. Manholes indicated as "sanitary sewer" shall be watertight. In addition, manholes indicated in the Contract Documents as requiring field-testing for watertightness (for example, where the Contract Documents require performing vacuum testing or exfiltration testing on such manhole) shall be watertight. "Watertight", as related to manholes, means manholes that successfully pass required field testing, such as vacuum testing and exfiltration testing, as applicable.

2) Elastomeric Gasketed Joints:

a) Provide elastomeric gaskets for joints between concrete manhole sections in accordance with ASTM C443.

3) Cold-applied Asphalt Joint Compound:

a) Provide cold-applied asphalt joint compound for joints between concrete manhole sections in accordance with ASTM C990.

4) Preformed Flexible Joint Sealing Compound:

a) Provide preformed flexible joint sealing compound for joints between concrete manhole sections in accordance with ASTM C990.

d. Manhole Rungs:

1) Where manholes include manhole rungs, install precast concrete sections to provide continuous, well-aligned manhole rungs for entire depth of manhole, with required spacing between adjacent rungs. When precast concrete sections are installed so that manhole rungs are not aligned within tolerance indicated in Article 2.1 of this Section, re-position precast concrete sections to provide manhole rungs aligned in accordance with required tolerance.

2) Following installation of all manhole sections and materials provided to adjust manhole rims to required elevation, vertical distance between manhole rim and first rung shall not exceed two feet.

3) Vertical distance between bottom manhole rung and top surface of adjacent concrete bench shall be not more than 12 inches.

e. Transition Sections and Top Sections:

1) Install transition sections and top sections with openings properly aligned for maintenance personnel accessing manhole.

2) Where manhole rungs are provided, install transition sections and top sections properly oriented on manhole rungs for convenient personnel access.

f. Seal lifting holes tight with solid rubber plugs driven into holes from outside. Fill remaining void with non-shrink grout.

3. Connecting Buried Piping to Concrete Manholes:

a. Connect buried piping to concrete manholes only at specifically intended locations, such as where piping connections were intentionally provided cast into concrete manhole, unless otherwise required by the Contract Documents or approved by COR.
b. Comply with ASTM C1821, unless otherwise required by the Contract Documents.
c. Connecting to concrete manhole at cast-in penetration with rubber boot:

1) Provide additional adapter gasket as necessary when connecting piping with external ribs or corrugations, creating smooth sealing surface on pipe exterior. Gasket shall be compatible with boot and pipe material.
2) Ensure pipe is properly aligned and centered. Push pipe into boot until pipe end is flush with inside wall of manhole. Secure with stainless steel bands in accordance with boot manufacturer's written instructions.
3) Ensure rubber boot connector is fully seated and compressed, forming watertight seal.

4. Manhole Benches:

a. Bench Material:

1) Provide field-constructed benches in manholes, of non-shrink grout, following completion of piping connections to manhole base, including drop pipes, if any.
2) Provide factory-constructed benches in manholes, provided by precast concrete manufacturer, of normal weight concrete.

b. Provide benches in accordance with requirements of this provision and other, applicable requirements of the Contract Documents.
c. Trim pipe ends flush with interior surface of manhole wall.
d. Clean with high-pressure water (greater than or equal to 3,500 psig), concrete surfaces to which manhole bench will adhere, to remove dirt, grease, laitance, loose concrete, and other deleterious matter. Dampen concrete to which bench will adhere before applying bench material. Standing water is unacceptable.
e. Use stainless steel trowel for compacting and smoothing bench surfaces.
f. Bench Configuration:

1) Provide benches with channels, with U-shaped cross-section, with channel depth equal to diameter of associated pipe. Provide semicircular channel bottoms.
2) Where manhole bench will accommodate connected piping of different diameters, provide smooth transitions across manhole bench.
3) Provide smooth transitions between connected piping and channels in manhole benches, including channel inverts.
4) Provide smooth surfaces in channels. Irregularities where solids may collect are unacceptable.

5) Where connected piping requires change in flow direction in manhole bench, provide smooth transitions with longest feasible radius.
6) Sharp edges or corners in bench channels are unacceptable.
7) Between top of channels in manhole invert and manhole wall, provide bench surface at slope between 0.5-inch to one-inch vertical per one foot horizontal, to provide drainage back into channels in event of manhole flooding.

g. Service laterals and drop pipes discharging onto bench surface are unacceptable. Provide appropriate channels for such connections to manhole.
h. Where feasible, provide bench surface of sufficient size for maintenance personnel access to manhole, underneath manhole's frame and cover.

5. Installing Frames and Covers:

a. Grade Rings:

1) Provide grade rings necessary or required to achieve required rim elevation of frames and covers.
2) Install grade rings atop concrete manhole top sections, as required, on which frames will be installed.
3) Total height of grade rings, shall not exceed 12 inches vertical.
4) Fully secure polymer grade rings to each other and to concrete manhole by providing adhesives as recommended by polymer grade ring manufacturer. Joints between adjacent polymer grade rings, and between polymer grade rings and concrete manhole, shall be watertight.
5) Fully secure precast concrete grade rings to each other and to concrete manhole by providing non-shrink grout. Joints between adjacent precast concrete grade rings, and between precast concrete grade rings and concrete manhole, shall be watertight. Remove excess non-shrink grout to provide smooth, clean surfaces.

6. Cleanliness of Concrete manholes:

a. Continuously maintain interior of concrete manholes and related piping and appurtenances, free of dirt, foreign material, and other deleterious matter.
b. If, in COR's opinion, concrete manholes, appurtenances, or any combination thereof, contain dirt, foreign material, or other deleterious matter that cannot be removed manually or by flushing, remove such matter by other means.
c. At end of each workday, and when Contractor's workers are absent from the Site, plug, cap or otherwise provide watertight covering over open tops of, and empty pipe penetrations into, concrete manholes to prevent ingress of foreign material, humans, animals, and insects.

7. Clean surfaces of joints and accessory items, such as gaskets, couplings, fastening hardware, and similar items, prior to performing jointing of concrete manhole components, grade rings, frames and covers, pipe sections, and similar items.
8. Backfilling:

a. Comply with Section 31 23 33 - Trenching and Backfilling.

B. Installation Tolerances:

1. Tolerances for earth work are indicated in Section 31 23 33 - Trenching and Backfilling.
2. Planar locations of concrete manholes shall be not more than three inches (in any horizontal direction) different from location shown or indicated in the Contract Documents.
3. Pipe invert elevations at connections to concrete manholes shall be not more than 0.5-inch (vertical) different from invert elevations shown or indicated in the Contract Documents. In no event shall deviations in pipe invert elevations at concrete manholes result in sanitary sewer or storm sewer piping without required downward slope, unless otherwise directed by COR.

3.4 FIELD QUALITY CONTROL

A. Field Tests and Inspections:

1. Compliance with Indicated Tolerances:

   a. Perform field measurements, to determine compliance with installation tolerances in this Section and required invert elevations. Record results for each concrete manhole and buried piping connected thereto, clearly indicating the concrete manhole designation, concrete manhole locations, and invert elevations based on Project datum.

2. Field Testing for Manhole Joint Integrity Where Watertightness is Required: Perform the following field tests and inspections when manholes are required to be watertight. Such manholes include all sanitary sewer manholes.

   a. Where watertightness of manholes is not determined, in accordance with the Contract Documents concurrently with field tests of associated buried piping, perform field tests of individual manholes in presence of COR, in accordance with ASTM C1244 or ASTM C969. When field testing is performed in accordance with ASTM C969, required test is exfiltration test. Criteria for acceptance shall be as indicated in the associated reference standard specified in this paragraph.
   b. Comply with Section 40 05 01 - Common Work Results for Process Piping, and piping schedules included in the Contract Documents, relative to required field tests and inspections of buried sanitary sewer or storm sewer piping, as applicable, connected to concrete manholes.
   c. Apparent leakage at joints of concrete manhole sections, connections between concrete manholes and connected buried piping, concrete manholes and grade-adjustment items, at joints between adjacent grade adjustment items, and between grade adjustment items and concrete manhole frames, is unacceptable.

3. Submit written results of required tests and inspections and obtain COR's acceptance prior to requesting inspection for Substantial Completion.

B. Defective Work:

1. The following constitute basis for COR rejecting concrete manhole Work as defective:

a. Reasons for rejection or non-acceptance indicated in ASTM C478 and ASTM C1821.
b. Precast concrete manholes, or components thereof, damaged during shipping, handling, storage, installation, and otherwise damaged when in Contractor's care, custody, or control.
c. Where manhole rungs are required, rungs without required spacing, or that do not comply with indicated tolerance for vertical linearity, or that do not extend sufficient distance from manhole wall, or that are of insufficient size.
d. Concrete manholes that exhibit motion after installation or appear, in any way, unstable or installed on improper bedding or improperly-prepared subgrade.
e. Where manholes are required to be watertight, visible or apparent discharge of groundwater:

    1) between frame and grade adjustment items, and between grade adjustment items and associated concrete manhole.
    2) at joints between concrete manhole sections.
    3) at points of concrete manhole connection to associated, buried piping.

f. Manholes installed in manner restricting ease of access by maintenance personnel, or that are otherwise unsafe.
g. Concrete manhole inverts and benches without smooth transitions, or without required slopes, or that result in collection of debris, sediment, or other matter.
h. Concrete manhole inverts and benches containing refuse, debris, sediment, or other foreign matter.
i. Other non-compliance with the Contract Documents.

2. Promptly upon Contractor becoming aware of defective concrete manhole Work, remedy such defect so that associated concrete manhole complies with the Contract Documents.

END OF SECTION

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SECTION 33 05 63
CONCRETE VAULTS AND CHAMBERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast concrete utility structures, non-circular in plan, and appurtenant items.

   a. Valve and meter vaults.

2. Design and fabrication of precast concrete utility structures.

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

1. Section 31 23 33 - Trenching and Backfilling.
2. Section 33 05 61 - Concrete Manholes.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. ASTM International (ASTM):

   a. C857, Standard Practice for Minimum Design Loading for Underground Precast Concrete Utility Structures.
   b. C858, Standard Specification for Underground Precast Concrete Utility Structures.
   c. C890, Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
   d. C990, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
   e. D1227, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.

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):

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 COR 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.

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 PRECAST UTILITY 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.

2. Manhole frames and covers:

a. Furnish and install in accordance with Specification Section 33 05 61.
b. Cast frames into top slab.

D. Concrete:

1. Conform to requirements of ASTM C858.

a. Minimum 28-day compressive strength 4500 psi.
b. All portions of precast utility structure are considered to be exposed to freeze-thaw cycles.

E. Joints:

1. Joints of precast riser and top sections:

a. Preformed flexible joint sealants: ASTM C990.
b. Exterior joint wrap.

2. Pipe and conduit entry for utility structures.

2.2 DESIGN

A. General Design Requirements:

1. Design precast units and appurtenances in accordance with ASTM C858.

a. Notify COR and furnish cast-in-place structures if sizes of precast utility structures shown on Drawings can not be designed or fabricated.

B. Specific Design Requirements:

1. Design precast units taking into account reduced cross section at openings and penetrations.
2. Structure shall be checked for buoyancy.

a. The minimum factor of safety for uplift with the design groundwater elevation shall be 1.25, unless a larger factor of safety is required by the local governing body or building code.

PART 3 - EXECUTION

3.1 PRECAST UTILITY STRUCTURE CONSTRUCTION

A. General:

1. Prepare subgrade for base as required by Specification Section 31 23 33.

   a. For precast base slabs, place and compact 6 inches of Granular Fill or Bedding Material as shown on Drawings.
   b. Confirm that base is level and fully supported by stable material.

2. For structures with open pipe flow, make inverts in accordance with Section 33 05 61.
3. Ensure accurate vertical placement and leveling prior to placement of interior grout.

   a. Provide vertical alignment tolerance of maximum 1 inch horizontal to 10 feet vertical.

B. Build each structure to dimensions shown on plans and at such elevation that pipe sections built into wall of structure will be true line of pipe extensions.

C. For all horizontal mating surfaces between precast concrete units, apply premolded flexible joint sealant to clean mating surfaces in accordance with sealant manufacturer's written instructions. Apply sufficient pressure to each concrete unit to seat unit in sealant.

D. Seal all pipe penetrations in manhole.

1. Where post-installed seals are permitted, form pipe openings smooth and well shaped.
2. After installation, seal exterior of penetration 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 inches to ensure complete seal.

E. Set top slab level to elevation shown on Drawings.

3.2 FIELD QUALITY CONTROL

A. Any proposed repairs of precast components or structures shall be submitted to COR for approval.

B. Structures shall be observed for signs of leakage during periods of high groundwater.

C. No leakage that includes visible flow through joints between precast concrete sections or through pipe penetrations shall be permitted.

D. Damp spots on interior wall surfaces shall be considered leakage and shall not be permitted.

1. Damp spots shall be defined as spots where moisture from a source outside the structure can be picked up on a dry hand.
2. Locate the source of water movement through the wall and permanently seal.

E. Dampness on the top of the base slab will not be construed as leakage.

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, pumping equipment, piping, valves, electrical and control components, davit crane, and appurtenant items.

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

1. Section 40 05 01 - Common Work Results for Process Piping.
2. Section 40 05 51 - Common Requirements for Process and Utility Valves.
3. Section 40 05 61 - Gate Valves.
4. Section 40 05 66 - Check Valves.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. National Electrical Manufacturers Association (NEMA):

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
b. ICS 6, Industrial Control and Systems Enclosures.

2. National Fire Protection Association (NFPA):

a. 70, National Electrical Code (NEC).
b. 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

3. Occupational Safety and Health Administration (OSHA).
4. 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.

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. Retrofit existing precast concrete wetwell and valve vault.

   a. Demolish existing system and prepare structure to receive new equipment.
   b. Provide new seals at penetrations.
   c. Provide new davit crane.

2. Process equipment:

   a. Duplex Submersible grinder pump(s).
   b. Quick disconnect pump bases with guide rails and lifting chain.

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, lighting, electrical distribution within station and single point exterior power connection for pump station.
   c. Manufacturer's standard submersible wiring between grinder pump station and junction box.

1.4 SUBMITTALS

A. Shop Drawings:

1. Fabrication and/or layout drawings (plan(s) and Specification Section(s)) showing all equipment piping, mechanical and electrical components.
2. Information as required by other related narrow-scope Specification Sections.
3. 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.

4. 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. Contract Closeout Information: Operation and Maintenance Data:

1. See Division 01 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 Owner acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Submersible grinder sewage pumps:

a. ABS Pirahna S10/4W.
b. Or Equal.

2. Pump Controller:

a. ABS PC211
b. Or Equal.

3. Control panel enclosure:

a. Hoffman.
b. Or Equal.

4. Davit Crane

a. Thern Ensign 500 5PT5-M1
b. Or Equal.

5. Level Control & switches:

a. FOGRod Level 7.5-100 with Barrier.
b. Or Equal.

B. See referenced Specification Sections for acceptable manufacturers for other pump station components.

2.2 MATERIALS OF CONSTRUCTION

A. See referenced Specification Sections for materials of construction for station components not defined in this Specification Section.

B. Anchor Bolts, Nuts and Washers: 304 stainless steel.

C. Float Switches and Switch Support:

1. Floats: Polypropylene or Teflon coated 316 stainless steel.
2. Cable jacket: PVC or neoprene.
3. Cable clamp: Polypropylene or 316 stainless steel.
4. Support: 304 stainless steel pipe and anchor hardware.

D. Conduits: Stainless Steel.

E. Davit Crane:

1. Boom, Mast, & Base: Steel.
2. Manual Winch.
3. Base: Pedestal with Quick Disconnect.

2.3 PUMP STATION COMPONENTS

A. Underground Chamber and valve vault:

1. Retrofit to house new duplex submersible pumps.
2. Quick disconnects on discharge piping between pump and connection to force main to allow ease of pump removal.
3. Stainless steel pump discharge piping with transition fittings to connect to forcemain pipe materials.
4. All hardware of 300 Series stainless steel.

B. Process Equipment:

1. See Division 40 for basic equipment requirements.
2. Submersible Grinder Pumps:

a. Operating Conditions:

1) 25 GPM at 20 FT TDH.
2) 30 GPM at 13 FT TDH.

b. Centrifugal grinder pump with cutter ring and rotor.
c. Mechanical seal.
d. Pump castings shall be cast iron, fully epoxy coated 8-10 mils nominal dry thickness.
e. Motor:

1) Maximum driver horsepower: 0.5.
2) Power: 240 V, 60 Hz, Single Phase.
3) Explosion proof, Class 1 Division 1 Locations.
4) Speed (nominal): 3,400 rpm.
5) Thermally protected.

f. Grinder:

1) Locate directly below the pumping elements and direct-driven by a single, one piece motor shaft.

2) Position the grinder such that the solids are fed in an upward flow direction.

C. Interior Piping, Valving and Pipe Supports:

1. Piping:

a. See Section 40 05 01 for piping basic requirements.
b. 304 stainless steel pump discharge piping

2. Valving:

a. See Section 40 05 51 for basic valve requirements.
b. Check valve

1) Equip each pump discharge with a brass swing check valve.
2) The check valve will provide a full-ported passageway when open.
3) Size: 2 IN.
4) Body, Disc, Cap, and Hinge Pin: Brass.
5) Rating: 200 psi.

c. Gate valve:

1) Equip each pump discharge with a brass gate valve.
2) Body, Bonnet, Stem, Packing Nut, and Disc: Brass.
3) Hand wheel: Cast Iron.
4) Packing: Asbestos free graphite.
5) Rating: 200 psi.

D. Electrical and Control Systems:

1. 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 NFPA 70.
d. Install wiring in accordance with NFPA 70, NEMA and applicable local codes.
e. Provide selectively polarized, grounded convenience outlets located close to equipment having plug-in power connection.
f. Provide short conduit leads of flexible, liquid-tight polyvinyl covered steel with compatible grounding fittings between the fixed conduit and mechanical equipment requiring power.
g. Provide duplex safety grounding receptacle on side of pump control panel.
h. Install all wiring outside of control panels in conduit except for 115 V items which are provided with power cords for receptacle power.
i. 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.

2. Control components:

a. Pump control panel:

1) Provide panel with NEMA 4X rating (either Stainless Steel or polycarbonate).
2) Lockable.
3) High level alarm with alarm horn and alarm light.
4) Phenolic nameplate for each panel face component.
5) Operator devices to be heavy duty oil tight design.
6) Push buttons and selector switches to have NEMA A600 rated contacts.
7) Indicating lights to be push-to-test type.

a) Provide green lens for on or running, red for off or stopped and blue for alarm.

8) Utilize plastic sleeve type wire markers to identify all wires.

a) Identify circuit number, function and polarity.

9) Panel face mounted components:

a) HAND/OFF/AUTO switch for each wastewater pump.
b) Status indicating light for each pump.
c) Alarm status lights for high and low wet well.
d) Alarm condition of each grinder.
e) Six-digit non-resettable running time indicator for each wastewater pump.
f) Pump alternator ON/OFF switch.
g) High Level indicator light and alarm reset switch.

10) Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes. See specifications for information on how to determine the available fault current, such that, the SCCR rating meets or exceeds the available fault current.

b. Float control system:

1) Provide four field adjustable floats in wet well for wastewater pump control.
2) See Drawing for float function and respective elevation.
3) Level switches:

a) Tilt type.
b) Sealed mercury switch in float.
c) Provided complete with flexible electrical cable length required for application.
d) Contact rated at 4.5 A at 120 VAC.

4) 1 inch diameter stainless steel support pipe connected to wet well wall using stainless steel mounting brackets and hardware.

2.4 SOURCE QUALITY CONTROL

A. 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. Adjust automatic control to start and stop pumps at approximate levels required by job conditions.

2.5 MAINTENANCE MATERIALS/SPARE PARTS

A. See individual equipment Specification Sections.

B. Provide one complete spare grinder pump.

C. Two spare capacitors for each installed capacitor.

D. Two spare fuses & circuit breakers for each installed fuse & circuit breaker.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Per Manufacturer Recommendations.

B. Excavate an adequate area to provide space for the basin and piping and to allow proper compaction of backfill.

C. Properly backfill basin with suitable materials. Backfill with clean well graded material free of ice, snow, debris, rock or organic materials. Approved backfill materials include:

1. Pea gravel – 3/4 to 1/8 inch.
2. Crushed rock – 1/2 to 1/8 inch.

D. Seal annular space between wall sleeves and piping/conduit with modular mechanical seals for watertight seal.

E. Seal all conduits between classified and unclassified areas in accordance with NFPA 70.

F. Terminate level switch cables in common junction box located in pump chamber.

G. Install floats at elevations shown on Drawing.

H. Make main power connection to station in accordance with NFPA 70.

3.2 FIELD QUALITY CONTROL

A. Coordinate and pay for the services of a factory trained representative for a maximum period of 8 hours 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

SECTION 40 05 01
COMMON WORK RESULTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Common work results for buried and exposed process piping, including:

a. Insulating unions.
b. Dirt strainers (Y type).
c. Dry disconnect couplings.
d. Dielectric flange kits.
e. Pipe saddles (for gage installation).
f. Dismantling Joints.
g. Water for testing.
h. General procedures for installing buried piping.
i. General procedures for installing non-buried piping.
j. Connections to existing piping
k. Field testing of piping.
l. Cleaning of piping.
m. Piping System Schedules.

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

1. Section 10 14 00 - Identification Devices.
1. Section 31 23 33 - Trenching and Backfilling.
2. Section 40 05 07 - Pipe Support Systems.
3. Section 40 05 51 - Common Requirements for Process and Utility Valves.

1.2 REFERENCES

A. Terminology:

1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this section have the meaning indicated below:

a. “Hazardous gas systems” means digester gas, chlorine gas, sulfur dioxide gas, carbon dioxide gas, lab gases.
b. “HPC” means high performance coating.
c. “PVDF” means polyvinylidene fluoride.

B. Reference Standards:

1. American Association of State Highway and Transportation Officials (AASHTO):

a. M36, Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains (Equivalent ASTM A760).
b. M190, Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
c. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing.
d. M294, Interim Specification for Corrugated Polyethylene Pipe 12 to 24 Inch Diameter.

2. American Iron and Steel Institute (AISI).
3. American Public Health Association (APHA), American Waterworks Association (AWWA), Water Environment Federation (WEF):

   a. APHA/AWWA/WEF - Standard Methods for Examination of Water and Wastewater.

4. American Society of Mechanical Engineers (ASME):

   a. B16.3, Malleable Iron Threaded Fittings.
   b. B16.5, Pipe Flanges and Flanged Fittings.
   c. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
   d. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
   e. B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
   f. B36.19, Stainless Steel Pipe.
   g. B40.100, Pressure Gauges and Gauge Attachments.

5. Association of Materials Protection and Performance (AMPP) (National Association of Corrosion Engineers (NACE)):

   a. NACE SP0286, Electrical Isolation of Cathodically Protected Pipelines.

6. 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. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
   d. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   e. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
   f. A197, Standard Specification for Cupola Malleable Iron.
   g. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
   h. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   i. A518, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
   j. A536, Standard Specification for Ductile Iron Castings.
   k. A760, Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
   l. B88, Standard Specification for Seamless Copper Water Tube.

m. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
n. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
o. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
p. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
q. F1417, Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air.

7. Chlorine Institute, Inc. (CI):

a. Pamphlet 6, Piping Systems for Dry Chlorine.

8. 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.

9. National Fire Protection Association (NFPA):

a. 54, National Fuel Gas Code.
b. 69, Standard on Explosion Prevention Systems.

10. Underwriters Laboratories, Inc. (UL).

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate flange dimensions and drilling between piping, valves, and equipment.
2. Completion of the Work of this Section and COR's acceptance of associated field testing and inspection results is required prior to Contractor requesting inspection for Substantial Completion of the associated Work.

B. Scheduling and Sequencing:

1. Perform required testing prior to installing required coatings, and insulation, unless otherwise indicated or acceptable to COR.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Schedule (in tabular format or narrative format)indicating each required piping system, indicating system location, service, pipe material, joint types, pipe lining (if any), pipe coating (if any), and other pertinent data.

b. Fabrication and Layout Drawings:

1) Exterior yard piping drawings (minimum scale 1 inch equals 10 feet) with information including:

a) Dimensions of piping lengths.
b) Invert or centerline elevations of piping crossings.
c) Acknowledgement of bury depth requirements.
d) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
e) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.
f) Line slopes and vents.

2) Interior piping drawings (minimum scale 1/8 inches equals 1 foot) with information including:

a) Dimensions of piping from column lines or wall surfaces.
b) Invert dimensions of piping.
c) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination.
d) Location and type of pipe supports and anchors.
e) Locations of valves and valve actuator type.
f) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
g) Acknowledgement of valve, equipment and instrument tag numbers.
h) Provisions for expansion and contraction.
i) Line slopes and air release vents.
j) Rough-in data for plumbing fixtures.

3) Schedule of interconnections to existing piping and method of connection.

2. Product Data:

a. Submit manufacturer's published information, including catalog excerpts, specifications, and indication of specific reference standards with which materials comply, for each item specified in this Section, unless such information is furnished as part of a Submittal under another Specifications section. Furnish such information for each size and type of item required.
b. Clearly mark on product data Submittals proposed items and clearly indicate, via cross-outs or other method, items not proposed for the Work.

B. Informational Submittals:

1. Supplier Instructions:

a. Instructions for handling, storing, installing, and placing into operation materials specified in this Section.

2. Field Quality Control Submittals:

a. Results of tests, inspections, and other quality control activities required by the Contract Documents and performed at the Site.

C. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data:

a. Submit for pipe and piping system components in accordance with Division 01.

2. Record Documentation:

a. Submit record documents of piping layout Shop Drawings showing and indicating changes made during fabrication and installation, in accordance with Contract Modifications, allowance authorizations (if any), and field conditions encountered. Such Submittal is in addition to record documents required under Division 01.

PART 2 - PRODUCTS

2.1 PIPING SYSTEMS SCHEDULE

A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping systems schedule at the end of "Part 3 – Execution" of this Section.

B. Description:

1. Piping Systems Organization and Definition:

a. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid or slurry conveyed, system pressure, piping size and materials of construction.
b. Comply with the Piping Systems Schedule in "Part 3 – Execution" of this 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. Underground Warning Tape:

1. See Section 10 14 00 - Indentification Devices.

C. Valves:

1. See schematics and details for definition of manual valves used in each system under 4 inches in size.

    a. See Drawingsschedule for valve types 4 inches and above and for automatic valves used in each system.

2. See Section 40 05 51 - Common Requirements for Process and Utility Valves.

PART 3 - EXECUTION

3.1 BURIED PIPING INSTALLATION

A. Unless otherwise shown on the Drawings, provide a minimum of 6 feet and maximum of 8 feet 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 Section 01 73 20 and as shown on Drawings.

C. When entering or leaving structures with buried mechanical joint piping, install joint within 2 feet of point where pipe enters or leaves structure.

    1. Install second joint not more than 6 feet nor less than 4 feet from first joint.

D. Install expansion devices as necessary to allow expansion and contraction movement.

E. Laying Pipe In Trench:

    1. Perform excavation and backfilling in accordance with Section 31 23 33 - Trenching and Backfilling
    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 COR.

    7. Seal open end of line with watertight plug if pipe laying stopped.
    8. Remove water in trench before removal of plug.

F. Lining Up Push-On Joint Piping:

    1. Lay piping on route lines shown on Drawings.
    2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
    3. Observe maximum deflection values stated in manufacturer's written literature.

4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.

G. Anchorage and Blocking:

1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.
2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall.

    a. Concrete blocks shall not cover pipe joints.

3. Provide bearing area of concrete in accordance with drawing detail.

H. Install underground hazard warning tape per Section 10 14 00 - Identification Devices.

I. Install insulating components where dissimilar metals are joined together.

3.2 NON-BURIED PIPING INSTALLATION

A. Install piping in vertical and horizontal alignment as shown on Drawings.

B. Alignment of piping smaller than 4 inches may not be shown; however, install according to Drawing intent and with clearance and allowance for:

1. Expansion and contraction.
2. Operation and access to equipment, doors, windows, hoists, moving equipment.
3. Headroom and walking space for working areas and aisles.
4. System drainage and air removal.

C. Enter and exit through structure walls, floor and ceilings using penetrations and seals specified in Section 01 73 20 and as shown on the Drawings.

D. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.

E. Pipe Support:

1. Use methods of piping support as shown on Drawings and as required in Section 40 05 07 - Pipe Support Systems.
2. Where pipes run parallel and at same elevation or grade, they may be grouped and supported from common trapeze-type hanger, provided hanger rods are increased in size as specified for total supported weight.

    a. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.

3. Size pipe supports with consideration to specific gravity of liquid being piped.

F. Locate and size sleeves and castings required for piping system.

1. Arrange for chases, recesses, inserts or anchors at proper elevation and location.

G. Use reducing fittings throughout piping systems.

1. Bushings will not be allowed unless specifically approved.

H. Equipment Drainage and Miscellaneous Piping:

1. Provide drip pans and piping at equipment where condensation may occur.
2. Hard pipe stuffing box leakage to nearest floor drain.
3. Avoid piping over electrical components such as motor control centers, panelboards, etc.

    a. If piping must be so routed, utilize 16 GA, 316 stainless steel drip pan under piping and over full length of electrical equipment.
    b. Hard pipe drainage to nearest floor drain.

4. Collect system condensate at drip pockets, traps and blowoff valves.
5. Provide drainage for process piping at locations shown on Drawings in accordance with Drawing details.
6. For applications defined above and for other miscellaneous piping which is not addressed by a specific piping service category in PART 1, provide 304 stainless steel piping and fittings.

    a. Size to handle application with 3/4 inches being minimum size provided.

I. Unions:

1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.
2. Mechanical type couplings may serve as unions.
3. Additional flange unions are not required at flanged connections.

J. Install expansion devices as necessary to allow expansion/contraction movement.

K. Provide full face gaskets on all systems.

L. Anchorage and Blocking:

1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.

M. Equipment Pipe Connections:

1. Equipment - General:

    a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of pipe or fitting which would prevent uniform gasket pressure at connection or would cause unnecessary stresses to be transmitted to equipment flanges.
    b. Where push-on joints are used in conjunction with flanged joints, final positioning of push-on joints shall not be made until flange joints have been tightened without strain.

c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint.

1) Provide tightening torque in accordance with manufacturer's recommendations.

d. Support and match flange faces to uniform contact over their entire face area prior to installation of any bolt between the piping flange and equipment connecting flange.
e. Permit piping connected to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
f. Align, level, and wedge equipment into place during fitting and alignment of connecting piping.
g. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
h. To provide maximum flexibility and ease of alignment, assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.

1) Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
2) Realign as necessary, install flange bolts and make equipment connection.

i. Provide utility connections to equipment shown on Drawings, scheduled or specified.

2. Plumbing and HVAC equipment:

a. Make piping connections to plumbing and HVAC equipment, including but not limited to installation of fittings, strainers, pressure reducing valves, flow control valves and relief valves provided with or as integral part of equipment.
b. Furnish and install sinks, fittings, strainers, pressure reducing valves, flow control valves, pressure relief valves, and shock absorbers which are not specified to be provided with or as integral part of equipment.
c. For each water supply piping connection to equipment, furnish and install union and gate or angle valve.

1) Provide wheel handle stop valve at each laboratory sink water supply.
2) Minimum size: 1/2 inches.

d. Furnish and install "P" trap for each waste piping connection to equipment if waste is connected directly to building sewer system.

1) Size trap as required by IPC.

e. Stub piping for equipment, sinks, lavatories, supply and drain fittings, key stops, "P" traps, miscellaneous traps and miscellaneous brass through wall or floor and cap and protect until such time when later installation is performed.

N. Provide insulating components where dissimilar metals are joined together.

O. Instrument Connections:

1. See drawing details.

3.3 CONNECTIONS WITH EXISTING PIPING

A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.

B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.

C. Undertake connections in fashion which will disturb system as little as possible.

D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.

E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.

F. Where connection involves potable water systems, provide disinfection methods as prescribed in this Section.

G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

3.4 FACILITIES FOR ACCESSING CONCEALED PIPING

A. Provide access doors or panels in walls, floors, and ceilings to permit access to valves, piping and piping appurtenances requiring service.

B. Size of access panels to allow inspection and removal of items served, minimum 10 x 14 inches size.

3.5 CATHODIC PROTECTION

A. Isolate, dielectrically, all piping from all other metals including reinforcing bars in concrete slabs, other pipe lines, and miscellaneous metal.

B. Provide connections from wire or cable by Thermit Cadwelding accomplished by operators experienced in this process.

C. Install cabling with loop and overhead knot around each pipe and slack equal to at least 50 percent of straight line length.

D. After cadwelding, coat exposed metallic surfaces with hot applied tape.

3.6 FIELD QUALITY CONTROL

A. Field Testing of Piping - General:

1. Test at the Site, following piping installation, all piping, except as expressly indicated otherwise elsewhere in the Contract Documents.
2. When authorities having jurisdiction require that their delegate or representative witness field testing of piping, advise COR in writing and authorities having jurisdiction not less than 48 hours prior to the associated testing.
3. Perform testing of piping in presence of COR.
4. Temporarily remove or protect piping-mounted devices, and devices installed on, in, or inline with piping and piping system appurtenances, such as manholes or chambers subjected to piping system testing, that could be damaged by testing. Upon successful completion of field testing of piping, reinstall devices temporarily removed and remove temporary protections provided for such devices, and verify such devices are in proper operating condition.
5. Provide construction equipment and machinery, apparatus, and services necessary, required, or both, for field testing of piping, including:

    a. Test pumps, compressors, hoses, temporary piping, calibrated monitoring and indicating devices, meters, test containers, valves, fittings, and temporary pumping systems required to maintain facility and system operations.
    b. Temporary bulkheads, bracing, blocking, and thrust restraints.

6. Remedy observed and apparent leaks and remedy piping failing to comply with required acceptance criteria. Retest after implementing remedies until acceptable test results are obtained.
7. Unless otherwise shown or indicated, field testing of piping shall include existing piping systems connecting to new piping being tested. Test existing piping to nearest operable valve. Piping not installed by Contractor failing testing shall be remedied upon issuance of appropriate Contract Modification or allowance authorization (if any).
8. Testing Schedules:

    a. Type of testing required, and test pressure (when applicable), are indicated in piping schedules in the Contract Documents, including this Section.
    b. Unless otherwise indicated, required test pressures are at lowest elevation of piping segment being tested.
    c. For piping not indicated in piping schedules in the Contract Documents:

        1) Hydrostatically test piping that will convey liquid or slurry at pressure greater than five psig. Provide process air piping test for piping that will convey air or gas under pressure or vacuum, except chlorine gas, which requires separate testing.
        2) Use exfiltration testing, low-pressure air testing, or vacuum testing for other piping.
        3) Water quality testing (including bacteriological testing) of piping that will convey potable water or water that will be treated to become potable is required promptly following disinfection of such piping.

    d. Test Pressure:

1) Where piping is required to be field tested under pressure, provide test pressure in accordance with piping schedules included in the Contract Documents.
2) If test pressure is not indicated in piping schedule in the Contract Documents, or if test is required for piping not indicated in piping schedule in the Contract Documents, obtain interpretation or clarification from COR before proceeding. Test pressure will be determined by COR based on maximum anticipated sustained operating pressure and methods described in AWWA manual or reference standard applicable to such piping system.

9. Scheduling and Sequencing of Field Testing of Piping:

a. Test exposed, non-insulated piping, and obtain COR's acceptance of results, as condition precedent to requesting Substantial Completion of such piping..
b. Test exposed, insulated piping following installation of such piping and prior to insulation installation.
c. Test concealed interior piping prior to concealment and, if piping is insulated, prior to insulation installation.
d. Test buried piping (insulated and non-insulated) prior to backfilling and, if insulated, prior to insulation installation.

10. Instrumentation Used for Field Testing of Piping:

a. Perform field testing of piping systems that will operate under pressure or vacuum using calibrated pressure or vacuum measuring equipment, as applicable, and calibrated volumetric measuring equipment. Such calibrations shall have been issued not more than 12 months prior to the testing for which they are used.
b. Required value of parameter to be measured shall be in upper half of range of the associated item of pressure-, vacuum-, volume-measurement, and other measuring instrumentation used in field testing of piping.

B. Hydrostatic Testing of Piping:

1. Preparation for Testing:

a. For thermoplastic pipe and fiberglass pipe, comply with procedures in Sections 7, 8, 9.1, and 9.2 of AWWA C605, and the Contract Documents.
b. For polyethylene pipe, comply with procedures in ASTM F2164, and the Contract Documents. Test duration, including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize, shall not exceed eight hours. If re-testing of a test section or pipeline is required, not less than eight hours shall elapse between tests.
c. For steel pipe, comply with procedures in AWWA Manual M11, and the Contract Documents. Wetting period is not required for pipe without cement-lining.
d. For other piping, comply with procedures in AWWA Manual M9, and the Contract Documents, except minimum wetting period required immediately prior to testing for asbestos cement pipe shall be 24 hours rather than 48 hours prescribed for concrete pipe. Wetting period is not required for pipe without cement mortar- or concrete-lining.
e. Prior to testing, provide adequate thrust restraint and verify joints are properly installed.

2. Test Procedure:

   a. Fill piping slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in pipe being tested.
   b. Expel air from piping as necessary. Obtain COR's approval prior to tapping pipe for expelling air.
   c. Examine exposed joints and valves and remedy to eliminate visible or otherwise apparent leakage.
   d. After required wetting period (if any), add water as necessary to pressurize piping to required test pressure. Maintain test pressure for stabilization period of ten minutes before beginning testing.
   e. Polyethylene Pipe: After filling piping, gradually pressurize pipe to test pressure and maintain required test pressure for three hours for pipe to expand. During expansion, add water to maintain required test pressure. Begin timed test period after expansion period and complying with other requirements.
   f. Timed test period shall not begin until after piping is filled, exposed to required wetting period (if any), air is expelled, and pressure stabilized.
   g. Timed Test Period: After stabilization period, maintain test pressure for not less than two hours. During timed testing period, add water as necessary to maintain pressure within five psig of required test pressure. For polyethylene pipe, after three-hour expansion period, reduce test pressure by ten psig and do not add water. Test pressure shall remain steady for one hour, indicating no leakage.
   h. Pump from test container to maintain test pressure. Measure volume of water pumped from test container and record on test report. Record pressure at test pump at 15-minute intervals for duration of test.

3. Allowable Leakage Rates: Leakage is defined as the quantity of water supplied to pipe segment being tested to maintain pressure within five psig of test pressure during timed test period. Allowable leakage rates for piping are:

   a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.
   b. Rates based on formula or table in AWWA Manual M41:

      1) Metal and fiberglass pipe joined with rubber gaskets as sealing members, including the following joint types:

         a) Bell and spigot and push-on joints.
         b) Mechanical joints.
         c) Bolted sleeve type couplings.
         d) Grooved or shouldered couplings.

   c. Rates based on make-up allowance in AWWA Manual M9:

      1) Prestressed concrete cylinder pipe (AWWA C301), other types of concrete pressure pipe (AWWA C300, AWWA C302, and AWWA C303), and other types of concrete pipe joined with O-ring rubber gasket sealing members.

   d. Rates based on formula or table in AWWA C605:

      1) Plastic pipe joined with O-ring gasket sealing members.

4. Record date, time, and location of each test, indicating piping segment tested, general description of apparatus used, pressure and leakage measurements obtained, remarks concerning conditions encountered during testing of each pipe segment, whether each pipe segment successfully passed the test, and names and employers of individuals performing and witnessing such testing. Furnish such results as Submittal.

C. Process Air Testing of Piping:

1. Process Air Testing of Piping - General:

   a. Required test pressure is indicated in the piping schedules included in the Contract Documents.

2. Preparation for Testing:

   a. Provide temporary restraints, such as tie rods, at expansion joints as necessary.
   b. Verify that pipe supports, where present, are secure.
   c. Test one pipe segment at a time. Use temporary blind flanges and isolators as necessary.
   d. Provide corporation stops, or similar, appropriate type of temporary valves, for filling and relieving air for testing. Provide temporary automatic pressure relief valves and pressure gages with range suitable for test pressure.

3. Test Procedure:

   a. Pressurize pipe segment being tested with air to required test pressure. Maintain pressure for not less than two hours.
   b. Apply soapy water solution to piping joints being tested to check for leakage, indicated by presence of bubbles, while test pressure is maintained.
   c. Allowable Leakage: Zero.

4. Remedy and retest piping that fail testing until acceptable results are obtained.
5. After completing testing, remove temporary measures provided for testing and provide Type 304 stainless steel threaded plugs at taps used for testing.
6. Record date, time, and location of each test, indicating piping segment tested, general description of apparatus used, pressure measurements obtained, remarks concerning conditions encountered during testing of each pipe segment, whether each pipe segment successfully passed the test, and names and employers of individuals performing and witnessing such testing. Furnish such results as Submittal.

D. Exfiltration Testing of Gravity Sewers:

1. Plug and bulkhead ends and lateral connections of each pipe segment to be tested and admit clean water until piping is full. Admit clean water slowly to minimize air entrapment. Groundwater surface elevation shall be less than pipe invert during exfiltration testing.
2. Immediately prior to performing exfiltration testing, verify groundwater surface elevation adjacent to piping segment being tested.
3. Length of piping segment being tested shall not exceed 700 feet. Piping segment being tested may include one or more manholes.
4. Before measuring leakage, allow water to wet pipe interior for the following period:

a. Concrete Pipe: 48 hours.
b. Cement Mortar-lined Pipe: 24 hours.
c. Asbestos-cement Pipe: 24 hours.
d. Other Pipe: Wetting period not required.

5. Maintain hydrostatic head during test equal to elevation two feet above present and future maximum groundwater elevation at pipe segment tested. COR will determine test water surface elevation for each pipe segment. COR's determination will be indicated in COR's response to required testing plan Submittal.
6. Add water from test container or from metered supply as required to maintain test water level within three inches of test head throughout testing.
7. Test duration shall be not less than two hours.
8. Allowable Leakage Rates:

   a. Leakage is defined as quantity of water that must be supplied to pipe segment tested to maintain hydrostatic head within three inches of required test head during testing after pipe is filled and required wetting period has elapsed, plus quantity required to refill to original head at completion of test.
   b. Leakage shall not exceed 100 gallons per inch-diameter per mile per day.

9. Record date, time, and location of each test, indicating piping segment tested, general description of apparatus used, leakage measurements obtained, remarks concerning conditions encountered during testing of each pipe segment, whether each pipe segment successfully passed the test, and names and employers of individuals performing and witnessing such testing. Furnish such results as Submittal.

E. Low Pressure Air Testing of Gravity Sewers:

1. Plug and bulkhead ends and lateral connections of piping segment to be tested.
2. Length of piping segment being tested shall not exceed 700 feet. Piping segment being tested may include one or more manholes.
3. Required test pressure shall be increased by number of feet of equal to groundwater surface elevation above invert of lowest point of piping segment being tested.
4. Test in accordance with requirements of authority having jurisdiction.
5. When laws, rules, regulations, codes, ordinances, or lawful orders of authorities having jurisdiction are not in effect at the Site at the time the Work is performed, comply with testing procedures indicated in the applicable reference standard, indicated below:

   a. Thermoplastic and Polyethylene Pipe: ASTM F1417.

6. Record date, time, and location of each test, indicating piping segment tested, general description of apparatus used, pressure measurements obtained, remarks concerning conditions encountered during testing of each pipe segment, whether each pipe segment successfully passed the test, and names and employers of individuals performing and witnessing such testing. Furnish such results as Submittal.

F. Vacuum Testing of Gravity Sewers:

1. Plug and bulkhead ends and lateral connections of pipe segment or manhole to be tested.
2. Length of piping segment being tested shall not exceed 700 feet. Piping segment being tested may include one or more manholes.

3. Following set-up of test apparatus, draw vacuum of ten inches of mercury on pipe segment or manhole being tested.
4. Start test upon reaching specified test vacuum. Test duration shall be 15 minutes.
5. Record vacuum drop at end of test. If vacuum drop is greater than one inch of mercury, pipe segment or manhole fails the test and shall be remedied and retested until acceptable results are obtained. If vacuum drop is less than one inch of mercury, pipe segment or manhole passes the test.
6. Record date, time, and location of each test, indicating piping segment tested, general description of apparatus used, vacuum measurements obtained, remarks concerning conditions encountered during testing of each pipe segment, whether each pipe segment successfully passed the test, and names and employers of individuals performing and witnessing such testing. Furnish such results as Submittal.

3.7 CLEANING

A. Cleaning of Piping:

1. Cleaning of Piping – General:

a. Clean interior of piping systems thoroughly before installing.
b. Before jointing piping, thoroughly clean and wipe joint contact surfaces and properly dress and make joints.
c. For piping requiring disinfection that has not been kept clean during storage and handling, swab interior of each section and contact surfaces of joints, before installation, with five percent sodium hypochlorite solution.
d. Maintain pipe in clean condition during installation.
e. Cap or plug openings in pipe at end of each workday. Prevent entry of dirt, dust, particulates, water, humans, animals, and insects.

3.8 LOCATION OF BURIED OBSTACLES

A. Furnish exact location and description of buried utilities encountered and thrust block placement.

B. Reference items to definitive reference point locations such as found property corners, entrances to buildings, existing structure lines, fire hydrants and related fixed structures.

C. Include such information as location, elevation, coverage, supports and additional pertinent information.

D. Incorporate such information on Record Drawings.

3.9 PIPING SYSTEM SCHEDULES

A. Piping System 16 – Buried Pipe for Sanitary Sewerage and Combined Sewerage Service:

1. General:

a. Piping symbol and service:

1) SAN – Sanitary Sewer.
2) FM – Force Main Sewer (conveying either sanitary sewage or combined sewage).

b. Field Tests and Inspections:

1) Gravity Sewers:

a) Low-pressure air testing of gravity sewers (thermoplastic and polyethylene pipe up to 36-inch, vitrified clay pipe up to 24-inch, concrete pipe up to 24-inch.
b) Test procedures are indicated in this Section's "Field Quality Control" Article.

2) Force Main Sewers:

a) Hydrostatic testing of piping that will operate under pressure 200 psig.
b) Test procedures are indicated in this Section's "Field Quality Control" Article.

c. Gaskets:

1) As indicated in the Specifications for required pipe material.

2. System components:

a. Comply with the Specifications for the required pipe material in Division 33 - Utilities and Division 40 - Process Interconnections.

B. Piping System 21 – Buried and Exposed Building Stormwater, Waste, and Vent Piping:

a. Piping symbol and service:

1) VT - Vent.
2) WST - Waste.

b. Field Tests and Inspections:

1) Test either entire system as a whole, or successive portions of system.
2) Tightly and temporarily close openings, except highest opening of system being tested.
3) Fill system being tested with water to overflow elevation.
4) Test with head of not less than ten feet of water, except for uppermost ten feet of system.
5) Allow water to stand in system for not less than 15 minutes before inspecting.
6) Inspect system being tested for apparent leakage, and remedy apparent leaks.

c. Gaskets: Rubber, ASTM C564.

2. System components:

a. Pipe size 1.25inches and 1.5inches:

1) Exposed service.

a) Material: Galvanized steel, Schedule 40.
b) Reference: ASTM A53.
c) Lining: Galvanized.
d) Coating: HPC;
e) Fittings: Cast iron drainage.

(1) ASTM A126, Class B.

f) Joints: Threaded.

b. Pipe size 2 inches and larger:

1) Exposed service.

a) Material: Cast iron soil pipe.
b) Reference: ASTM A74, CISPI 301.
c) Lining: None.
d) Coating: None
e) Fittings: ASTM A74.
f) Joints: No-hub with elastomeric sealing sleeve and stainless steel clamp assembly conforming to CISPI 301.

2) Buried service (to five feet outside limits of building or structure):

a) Material: Cast-iron soil pipe.
b) Reference: ASTM A74.
c) Lining: None.
d) Coating: Bituminous.
e) Fittings: ASTM A74.
f) Joints: Hub and spigot.

3. Stormwater and Waste Piping Installation:

a. Install horizontal stormwater or waste piping less than 4 inch diameter with slope of not less than 1/4 inch per foot, or two percent, toward discharge location.
b. Install 4 inch and larger piping at 1/8 inch per foot.
c. Install as close to construction as possible to maintain maximum head room.
d. Make changes of direction with 1/8 bends and junctions with wye fittings.
e. Provide short wye fittings in vertical pipe only.
f. Provide handhole test tee at base of each stack.
g. Provide cleanouts at dead ends, at changes of direction, and at 50-foot intervals on horizontal runs. Where cleanouts occur in concealed spaces, provide with extensions to floors above or to walls as necessary.
h. Install piping true to grade and alignment. Begin installing at system low point.

i. Provide vertical extensions of underground piping below partition walls for concealment in wall. Where hubs are wider than partition, install hubs one- inch below final floor.
j. Install piping in concealed locations within finished structures such as administration and office facilities, and at locations shown on the Drawings.
k. For hub and spigot joints, install hub facing flow.

4. Vent Piping Installation:

a. Provide each vent stack parallel to each stormwater or waste stack to receive branch vents from fixtures.
b. Originate each vent stack from base of associated stormwater piping or waste piping.
c. Where possible, combine stormwater, waste, or vent stacks before passing through roofing to minimize quantity of roof penetrations.
d. Offset pipes running close to exterior walls away from such walls before passing through roof to allow proper flashing.
e. Provide pipes passing through roofing with cast iron enlargers not less than 12 inches below underside of roof decking, one size larger than pipe and not less than four inch diameter.
f. Terminate each vent with frostproof jacket.
g. For vent stacks four inches and larger, extend vent stack piping through roofing by vertical distance not less than 12 inches.
h. Provide vent piping serving pressure regulating devices in compliance with Laws and Regulations, including applicable plumbing codes.
i. Provide stormwater, waste, and vent piping, serving finished buildings and structures such as administration and office facilities, in appropriately concealed locations, as shown or indicated on the Drawings.

3.10 SERVICE SYSTEM SUMMARY

A. Service Systems as defined in the Drawings.

END OF SECTION

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SECTION 40 05 07
PIPE SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe support and anchor systems.
2. Design of Pipe Support Systems as specified.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American Society of Mechanical Engineers (ASME):

   a. B31.3, Process Piping.

2. ASTM International (ASTM):

   a. A36, Standard Specification for Carbon Structural Steel.
   b. A123/123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   c. A153/153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   d. A276, Standard Specification for Stainless Steel Bars and Shapes.
   e. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
   f. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
   g. A917, Standard Specification for Steel Sheet, Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface (General Requirements).
   h. A918, Standard Specification for Steel Sheet, Zinc-Nickel Alloy Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
   i. B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

3. American Welding Society (AWS):

   a. D1.1, Structural Welding Code - Steel.
   b. D1.6, Structural Welding Code - Stainless Steel.

4. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):

a. SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

B. Responsibility:

1. Support systems for piping greater than 12 inches diameter, or with internal pressure over 100 psi, or piping with product temperatures over 200 degrees F, are shown on the Drawings and are not to be designed by Contractor unless indicated in Contract Documents.
2. Design complete support systems for piping 12 inches and smaller where supports are not shown on the Drawings.
3. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to design, furnish and install the system of hangers, supports, guidance, anchorage and appurtenances.
4. General piping support details may be indicated on the Drawings in certain locations for pipe 12 inches diameter and smaller.
5. Incorporate those details with requirements of this Specification Section to provide the piping support system.

C. Each type of pipe hanger or support shall be the product of one manufacturer.

D. Qualifications:

1. Pipe support designer:

a. Licensed Professional Engineer registered in the state the project is located in.
b. Minimum of five years experience designing pipe supports for projects of similar size and complexity.

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:

a. Scaled drawings showing location, installation, material, loads and forces, and deflection of all hangers and supports.
b. Analyze each pipe system for all loads and forces on hangers and supports and their reaction forces to the structure to which they are fastened.
c. Where Contract Documents indicate contractor is to design pipe support systems, submit detail design calculations and scaled drawings signed by Pipe support designer.

2. Product data:

a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
c. Itemized list of wall sleeves, anchors, support devices and all other items related to pipe support system.

B. Informational Submittals:

1. Certifications.

a. Pipe support designer qualifications

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. General:

1. Galvanized components:

a. Hot-dip galvanized components:

1) General: ASTM 123/123M.
2) Fasteners and hardware: ASTM 153/153M.

2. Dissimilar metals protection:

a. Galvanized-to-galvanized and galvanized-to-aluminum: No protection required.
b. All other galvanized-to-dissimilar metal connections: Neoprene or nylon pads, shims, grommets, etc.

B. Hanger Rods:

1. Material:

a. ASTM A36.
b. ASTM A575, Grade M1020.
c. ASTM A576, Grade 1020.
d. Minimum allowable tensile stress of 12,000 psi at 650 degrees F per MSS SP-58.

2. Continuously threaded.
3. For galvanized rod: Hot-dip galvanized after threads are cut.
4. Load limit:

NOMINAL ROD DIAMETER	MAXIMUM SAFE LOAD, (LBS)
3/8 inches diameter (min)	610
1/2 inches diameter	1,130
5/8 inches diameter	1,810
3/4 inches diameter	2,710
7/8 inches diameter	3,770
1 inches diameter	4,960

C. Hangers:

1. Hangers for use directly on copper pipe: Copper plated or PVC coated.
2. Hangers for use other than directly on copper pipe: Hot-dip galvanized.
3. Hanger type schedule:

APPLICATION	PIPE SIZE	HANGER TYPE
All except noted	4 inches and less	MSS Type 1 or 12 Similar to Empire Figure 41.
All except noted	Over 4 inches	MSS Type 1 Similar to Empire Figure 11.
Steam, condensate, and hot water	All	MSS Type 43 Similar to Empire Figure 272 w/ spring hanger.
Service in chemical storage areas and as indicated on drawings for corrosion resistance	All	FRP trapeze hangers or clevis hangers as specified below.

D. Concrete Inserts for Hanger Rods:

1. Continuous slots: Unistrut #P1000.
2. Individual inserts: Similar to ANVIL Figure 281.

E. Beam Clamps for Hanger Rods:

1. MSS SP-58, Type 21.
2. Material:

   a. Corrosive areas: 304 stainless steel.
   b. Highly corrosive areas: 316 stainless steel.
   c. All other areas: Hot-dip galvanized steel.

3. Standard duty.

F. Trapeze Hangers for Suspended Piping:

1. General:

   a. Material:

      1) Corrosive areas: 304 stainless steel.
      2) Highly corrosive areas: 316 stainless steel.
      3) All other areas: Hot-dip galvanized steel.

   b. Angles, channels, or other structural shapes.
   c. Curved roller surfaces at support point corresponding with type of hanger required.

2. In chemical storage and feed areas and as indicated on the drawings:

a. Materials: FRP.
b. Aikinstrut fiberglass channel or equal.

G. Vertical Pipe Supports:

1. At base of riser.

a. Material:

1) Corrosive areas: 304 stainless steel.
2) Highly corrosive areas: 316 stainless steel.
3) All other areas: Hot-dip galvanized steel.

2. Lateral movement:

a. Clamps or brackets:

1) MSS SP-58, Type 8 or 42.
2) Similar to Empire Industries Figure 50.

H. Expanding Pipe Supports:

1. Spring hanger type.
2. MSS SP-58, Type 51.

I. Pipe Support Saddle:

1. General:

a. Minimum contact area:

1) 120 Degrees minimum.
2) 180 Degrees for PVC/PE greater than 12 inches

2. For pipe located 3 feet or less from floor elevation, except as otherwise indicated on Drawings.

a. MSS SP-58 Type 38.
b. Material:

1) Corrosive areas: 304 stainless steel.
2) Highly corrosive areas: 316 stainless steel.
3) All other areas: Hot-dip galvanized steel.

c. Similar to Empire Industries Figure 426.

J. Pipe Support Risers/Stanchions:

1. Schedule 40 pipe.
2. Material: match pipe support saddle.
3. Size: As recommended by saddle manufacturer.

K. Pipe Support Base Plate:

1. 4 inches larger than support.
2. Collar 3/16 inches thickness, circular in shape, and sleeve type connection to pipe.
3. Collar fitted over outside of support pipe and extended 2 inches from floor plate.
4. Collar welded to floor plate.
5. Edges ground smooth.
6. Material: match pipe support saddle.
7. Assembly hot-dip galvanized after fabrication.
8. Provide low carbon stainless steel for welded fabrications.

L. Pipe Covering Protection Saddle:

1. For insulated pipe at point of support.
2. MSS SP-58 Type 40.
3. Material:

   a. Corrosive areas: 304 stainless steel.
   b. Highly corrosive areas: 316 stainless steel.
   c. All other areas: Hot-dip galvanized steel] .

4. Stainless steel: Similar to Empire Industries Figure 167.

M. Wall Brackets:

1. For pipe located near walls and 8 feet or more above floor elevation or as otherwise indicated on the Drawings.
2. MSS SP-58, Type 33.
3. Material:

   a. Corrosive areas: 304 stainless steel.
   b. Highly corrosive areas: 316 stainless steel.
   c. All other areas: Hot-dip galvanized steel.

4. Similar to Empire Industries Figure 802.

N. Pipe Anchors:

1. For locations shown on the Drawings.
2. 1/4 inches steel plate construction.
3. Hot-dip galvanized after fabrication.
4. Designed to prevent movement of pipe at point of attachment.

2.2 DESIGN REQUIREMENTS

A. Supports capable of supporting the pipe for all service and testing conditions.

1. Provide 5 to 1 safety factor.

B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.

C. Design supports and hangers to allow for proper pitch of pipes.

D. For chemical and waste piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:

1. ASME B31.3.
2. MSS SP-58.
3. Except where modified by this Specification.

E. For steam and hot and cold water process piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:

1. ASME B31.1.
2. MSS SP-58.

F. Check all physical clearances between piping, support system and structure.

1. Provide for vertical adjustment after erection.

G. Support vertical pipe runs in pipe chases at base of riser.

1. Support pipes for lateral movement with clamps or brackets.

H. Place hangers are to be installed on outside of pipe insulation.

1. Use a pipe covering protection saddle for insulated pipe at support point.
2. Insulated piping 1-1/2 inches and less:

a. Provide a 9 inches length of high density perlite or high density calcium silicate at saddle.

3. Insulated piping over 1-1/2 inches: Provide a 12 inches length of high density perlite or high density calcium silicate at saddle.

I. Provide 20 GA pipe saddle for fiberglass and plastic pipe support points to ensure minimum contact width of 4 inches.

1. Material: match support.

J. Pipe Support Spacing:

1. General:

a. Factor loads by specific weight of liquid conveyed if specific weight is greater than water.
b. Locate pipe supports at maximum spacing scheduled unless indicated otherwise on the Drawings.
c. Provide at least one support for each length of pipe at each change of direction and at each valve.

2. Steel, stainless steel, cast-iron, and ductile iron pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/2 and less	5
2 thru 4	10
5 thru 8	15
10 and greater	20

3. Copper pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
2-1/2 and less	5
3 thru 6	10
8 and greater	15

4. PVC pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/4 and less	3
1-1/2 thru 3	4
4 and greater	5

* Maximum fluid temperature of 120 degrees F.

5. Support each length and every fitting:

   a. Bell and spigot piping:

      1) At least one hanger.
      2) Applied at bell.

   b. Mechanical coupling joints:

      1) Place hanger within 2 feet of each side of fittings to keep pipes in alignment.

6. Space supports for soil and waste pipe and other piping systems not included above every 5 feet.
7. Provide continuous support for nylon tubing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide piping systems exhibiting pulsation, vibration, swaying, or impact with suitable constraints to correct the condition.

1. Included in this requirement are movements from:

a. Trap discharge.
b. Water hammer.
c. Similar internal forces.

B. Weld Supports:

1. AWS D1.1.
2. Weld anchors to pipe in accordance with ASME B31.3.
3. AWS D1.6 for stainless steel supports.

C. Locate piping and pipe supports as to not interfere with open accesses, walkways, platforms, and with maintenance or disassembly of equipment.

D. Inspect hangers for:

1. Design offset.
2. Adequacy of clearance for piping and supports in the hot and cold positions.
3. Guides to permit movement without binding.
4. Adequacy of anchors.

E. Inspect hangers after erection of piping systems and prior to pipe testing and flushing.

F. Install individual or continuous slot concrete inserts for use with hangers for piping and equipment.

1. Install concrete inserts as concrete forms are installed.

G. Welding:

1. Welding rods: ASTM and AWS standards.
2. Integral attachments:

a. Include welded-on ears, shoes, plates and angle clips.
b. Ensure material for integral attachments is of good weldable quality.

3. Preheating, welding and postheat treating: ASME B31.3, Chapter V.

END OF SECTION

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SECTION 40 05 31
PIPE - PLASTIC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic pipe.

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

1. Section 40 05 01 - Common Work Results for Process Piping.

1.2 QUALITY ASSURANCE

A. See Specification Section 40 05 01.

B. Referenced Standards:

1. ASTM International (ASTM):

a. PVC (polyvinyl chloride) materials:

1) D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
2) D1785, Standard Specification for Poly(Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80 and 120.
3) D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
4) D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
5) D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
6) F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
7) F949, Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.

b. Installation:

1) D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

2. American Water Works Association (AWWA):

a. PVC (polyvinyl chloride) materials:

1) C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In.

3. NSF International (NSF).

1.3 SUBMITTALS

A. See Specification Section 40 05 01.

PART 2 - PRODUCTS

2.1 PVC DRAINAGE, SEWER PIPING

A. Materials:

1. Furnish materials in full compliance to the following material specification.
2. PVC pipe shall be rigid, unplasticized polyvinyl chloride (PVC) made of PVC plastic having a cell classification of 12454-B or 12454-C as described in specification ASTM D1784.
3. The requirements of this Specification are intended to provide for pipe and fittings suitable for non-pressure drainage of wastewater and surface water.
4. Joining systems shall consist of an elastomeric gasket joint meeting requirements of ASTM D3212.
5. Supply to the COR all information and sample of joining method for his evaluation.

   a. Only jointing methods acceptable to the COR will be permitted.

6. Provide pipe and fittings meeting or exceeding the following requirements:

   a. 4-27 inches diameter: ASTM D3034 and ASTM F679, SDR 35.
   b. 8-30 inches diameter: ASTM F794.

7. Ensure impact strengths and pipe stiffnesses in full compliance to these Specifications.

B. Installation: Install pipe and fittings in accordance with ASTM D2321 and as recommended by the manufacturer.

1. Provide for a maximum deflection of not more than 5%.

PART 3 - EXECUTION

3.1 IDENTIFICATION

A. Identify each length of pipe clearly at intervals of 5 feet 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 PVC DRAINAGE, SEWER PIPING

A. Installation: Install pipe and fittings in accordance with ASTM D2321 and as recommended by the manufacturer.

1. Provide for a maximum deflection of not more than 5%.

B. Infiltration and Exfiltration:

1. The maximum allowable infiltration measured by test shall not exceed 100 GAL per inch of pipe diameter per mile per 24 hours.
2. For exfiltration, all the pipe and fittings shall exceed performance requirements by the test procedure as specified in Section 40 05 01.
3. Observe full instructions of the COR for carrying of testing procedures.

a. Perform tests only during presence of the COR or his authorized representative.

4. Should any test on any section of pipe line disclose either infiltration rates greater than allowed or disclose air loss rate greater than that permitted, locate and repair the defective joints or pipes at no cost to Owner and retest until requirements stated are met.

C. Deflection:

1. After backfilling, each section of pipe shall be checked for deflection by pulling a mandrel through the pipe.
2. Pipe with deflection exceeding 5% of the inside diameter shall have backfill removed and replaced to provide a deflection of less than 5%.
3. Any repaired pipe shall be retested.

3.3 PVC TUBING

A. Fittings:

1. Install tubing with nylon fittings and connectors.
2. Use barbed type adapters with stainless steel clamps.
3. Provide fittings capable of withstanding temperatures from a -70 to 250 degrees F.
4. Ensure fittings have the same pressure and temperature rating as the tubing.

B. Trays:

1. Flat smoothed bottom tray for supporting flexible hoses when there is a chance that the hoses may pulse or move.

END OF SECTION

SECTION 40 05 51
COMMON REQUIREMENTS FOR PROCESS AND UTILITY VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Valving and valving appurtenances.

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

1. Section 40 05 01 - Common Work Results for Process Piping.
2. Section 40 05 61 - Gate Valves.

1.2 REFERENCES

A. Definitions:

1. The following are definitions of abbreviations used in this Specification Section or one of the individual valve sections:

a. CWP: Cold water working pressure.
b. SWP: Steam working pressure.
c. WOG: Water, oil, gas working pressure.
d. WWP: Water working pressure.

B. 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 inches through 144 inches.
   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 inches through 48 inches (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 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
2. Product technical data including:

   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions.
   c. Valve pressure and temperature rating.
   d. Valve material of construction.
   e. Special linings.
   f. Valve dimensions and weight.
   g. Valve flow coefficient.

B. Informational Submittals:

1. Test reports if required in the individual valve specification.

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 FABRICATION

A. End Connections:

1. Provide the type of end connections for valves as required in the Piping Schedules presented in Section 40 05 01 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.

2. Buried:

    a. Tee-Head bolts for mechanical joints: Per AWWA/ANSI C111/A21.11.
    b. Other bolts and nuts: ASTM A307.

3. Exposed: Mechanical galvanized ASTM B695, Class 40.
4. Heads and dimensions per ASME B1.1.
5. Threaded per ASME B1.1.
6. Project ends 1/4 to 1/2 inches beyond nuts.

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 feet on each side of box.

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

D. For grooved coupling valves, install rigid type couplings or provide separate support to prevent rotation of valve from installed position.

E. Wax Tape Coating System:

1. After installation, coat all buried nuts and bolts with a wax tape coating system in accordance with:

   a. AWWA C217.
   b. Manufacturer’s printed instructions.

2. Cut strips of wax tape and apply them around all bolts and nuts so that there are no voids or spaces under the tape.
3. Apply a sufficient amount of tape to completely encapsulate all bare metal.

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

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

3.2 FIELD QUALITY CONTROL

A. Wax Tape Coating Testing:

1. Inspect each wax tape-wrapped component.

   a. Verify primer was applied to substrate surfaces.
   b. Ensure the wax tape has fully encapsulated all portions of the substrate.
   c. Ensure that the wax tape is in intimate contact with the substrate.
   d. Verify that the wax tape has been applied to the specified thickness.

2. Do not backfill until this inspection is complete and the wax tape application is approved by the Engineer.

END OF SECTION

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SECTION 40 05 61
GATE VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gate valves.

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

1. Section 40 05 51 - Common Requirements for Process and Utility Valves.

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.

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 inches (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. Ethylene Propylene Diene Monomer (EPDM).

3. Design requirements:

a. Minimum 150 PSIG working pressure.
b. Buried: NRS, O-ring stem seal, 2 inches square operating nut.
c. Exposed: NRS, O-ring, stem seal, handwheel.
d. Counter clockwise open rotation.
e. Fusion bonded epoxy coating interior and exterior except stainless steel and bearing surfaces.

1) Comply with AWWA C550.
2) Wetted bronze parts in low zinc bronze.
3) Aluminum bronze components: Heat treated per AWWA C504.

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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 40 05 51.

B. Where larger buried valves utilize smaller bypass valves, provide a second valve box installed over the bypass valve operating nut.

C. Do not install gate valves inverted or with the stems sloped more than 45 degrees from the upright unless the valve was ordered and manufactured specifically for this orientation.

END OF SECTION

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SECTION 40 05 66
CHECK VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Check valves 2.5-inch diameter and smaller.
2. Swing check valves, three-inch to 24-inch diameter.
3. Cushioned swing check valves, three-inch to 24-inch diameter.
4. Double door check valves.
5. Silent check valves.
6. Rubber flapper swing check valves, two-inch to 24-inch diameter.
7. Ball check valves, 0.5-inch to four-inch diameter.
8. Duckbill check valves.

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

1. Section 40 05 51 - Common Requirements for Process and Utility Valves.

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, Gray 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.

B. Informational Submittals: Submit the following:

1. In accordance with Section 40 05 51.
2. Manufacturer's Instructions:

a. Manufacturer's written instructions for delivery, handling, storage, installation, and startup.

PART 2 - PRODUCTS

2.1 CHECK VALVES: 2.5 INCHES AND SMALLER

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

1. Comply with MSS SP-80.
2. Materials:

a. Body, bonnet, disc: Bronze.

3. 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 SWING CHECK VALVES: 3 INCHES TO 24 INCHES

A. Swing Check Valves (Water, Wastewater, Sludge):

1. Comply with AWWA C508.
2. Materials:

a. Body and cover: Cast iron.
b. Seat ring, hinge: Bronze.
c. Disc:

1) 3 to 4 inches: Bronze.
2) 6 to 24 inches: Cast iron with rubber face.

d. Hinge shaft: Stainless steel.
e. Bearings, connecting hardware: Bronze.

3. Design requirements:

a. 175 psi working pressure (3 to 12 inches).
b. 150 psi working pressure (14 to 24 inches).
c. Furnish with outside weight and lever or lever and spring.

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 01 - Common Work Results for Process Piping.
b. Section 40 05 51 - Common Requirements for Process and Utility Valves.

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