

SECTION 33 34 00
SANITARY UTILITY SEWERAGE FORCE MAINS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Force mains.
 - 2. Bedding materials.

- B. Related Sections:
 - 1. Section 31 23 17 - Trenching: Excavation and backfill requirements.
 - 2. Section 33 05 14 - Utility Manholes and Structures: Manholes vaults.
 - 3. Section 33 05 19 - Pressure Piping Tied Joint Restraint Systems.
 - 4. Section 33 05 23 - Trenchless Utility Installation: Pipe installation under roadways and other obstructions.
 - 5. Section 33 01 32 - Sewer and Manhole Testing.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 2. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - 3. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 - 4. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

- B. American Water Works Association:
 - 1. AWWA C104 - ANSI Standard for Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - 2. AWWA C105 - ANSI Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 3. AWWA C110 - ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1,219 mm), for Water.
 - 4. AWWA C111 - ANSI Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 5. AWWA C151 - ANSI Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
 - 6. AWWA C153 - ANSI Standard for Ductile-Iron Compact Fittings for Water Service.
 - 7. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - 8. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings.
 - 9. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm through 300 mm), for Water Distribution.
 - 10. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 36 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution.

- C. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, 2007, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate piping layout, including piping specialties.
- C. Product Data: Submit data on pipe materials, pipe fittings, valves, and accessories.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record location of pipe runs, connections, and invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with SCDOT Standard Specifications except as modified herein.
- B. Perform work in accordance with utility company standards.
- C. Maintain one copy of each document on site.

1.6 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this Section.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements and elevations are as indicated on Drawings.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Do not place materials on private property without written permission of property owner.
- C. During loading, transporting and unloading, exercise care to prevent damage to materials.
- D. Do not drop pipe or fittings.
- E. Avoid shock or damage to pipe.
- F. Take measures to prevent damage to exterior surface or internal lining of pipe.
- G. Do not stack pipe higher than recommended by pipe manufacturer.

- H. Store gaskets for mechanical and push-on joints in cool, dry location out of direct sunlight and not in contact with petroleum products.

1.9 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate the Work with connection to existing municipal sewer utility service and trenching.

PART 2 PRODUCTS

2.1 FORCE MAIN PIPING

- A. Ductile Iron Pipe: AWWA C151. Bituminous outside coating: AWWA C151. Cement Mortar Lining: AWWA C104.
 - 1. Pipe Thickness Class: 50
 - 2. Pipe Pressure Rating: 350 psi minimum for 8" through 12", 250 psi minimum for 14" and larger.
 - 3. Fittings: Ductile iron, standard size, AWWA C110; compact size, AWWA C153.
 - a. Coating: Bituminous Coating, AWWA C110.
 - b. Lining: Cement Mortar Lining, AWWA C104
 - 4. Joints:
 - a. Mechanical Joints: AWWA C111.
 - b. Push-On Joints: AWWA C111.
 - c. Flanged Joints inside structures: AWWA C115.
 - d. Boltless Restrained Joints: Boltless, push-on type, joint restraint independent of joint seal. Conform to pipe manufacturers specifications.
 - e. Tied Restrained Joints: Per Section 33 05 19.
- B. Polyvinyl Chloride (PVC): AWWA C900 and AWWA C905, marked for Sanitary Service, colored green.
 - 1. Pipe Class: DR 18, 150 psi.
 - 2. Fittings:
 - a. Ductile Iron, standard size, AWWA C110; compact size, AWWA C153.
 - 3. Joints:
 - a. Ductile Iron, Mechanical Joint, AWWA C111.
 - b. Boltless Restrained Joints: Boltless, push-on type, joint restraint independent of joint seal. Conform to pipe manufacturers specifications.

2.2 AIR RELEASE VALVES

- A. Manufacturers:
 - 1. Val-Matic.
 - 2. Apco Valve and Primer Co.
 - 3. Crispin Valve Co.
 - 4. Valmatic Valve and Manufacturing Corp.
 - 5. Substitutions: Equal per Section 01 60 00 - Product Requirements.
- B. Furnish materials in accordance with utility company or governing agency requirements.

2.3 UNDERGROUND PIPE MARKERS

- A. Plastic Ribbon and Trace Wire Tape: Brightly colored green continuously printed with "SEWER FORCE MAIN" in large letters, minimum 6 inches wide by 4 mils thick, with magnetic detectable conductor manufactured for direct burial service.

2.4 DOUBLE-DISC GATE VALVES

- A. Manufacturers:
 - 1. American Flow Control.
 - 2. Clow Valve Company.
 - 3. Mueller Company.
 - 4. Substitutions: Equal per Section 01 60 00 - Product Requirements.
- B. Furnish materials in accordance with utility company or governing agency requirements.
- C. Double-Disc Gate Valves: AWWA C500, NSF 61; iron body, bronze trim.
 - 1. Gate: Double disc parallel seat gate.
 - 2. Stem: Non-rising stem.
 - 3. Seals: O-ring stem seals.
 - 4. Operating Nut: Square; open counterclockwise unless otherwise indicated.
 - 5. Ends: Flanged, mechanical joint or bell end connections.
 - 6. Coating: AWWA C550; interior and exterior.
 - 7. Provide valves 16 inch diameter and larger with bypass valves and gear operators.
 - 8. Sizes 12-Inch Diameter and Smaller: 200 psig.
 - 9. Sizes 14-Inch Diameter and Larger: 150 psig.

2.5 RESILIENT WEDGE GATE VALVES

- A. Manufacturers:
 - 1. American Flow Control.
 - 2. Clow Valve Company.
 - 3. Mueller Company.
 - 4. Substitutions: Equal per Section 01 60 00 - Product Requirements.
- B. Furnish materials in accordance with utility company or governing agency requirements.
- C. Resilient Wedge Gate Valves: AWWA C509; iron body, bronze or ductile iron.
 - 1. Resilient seats.
 - 2. Stem: Non-rising bronze stem.
 - 3. Operating Nut: Square; open counterclockwise unless otherwise indicated.
 - 4. Ends: Flanged, mechanical joint or bell end connections.
 - 5. Coating: AWWA C550; interior/exterior.
 - 6. Sizes 12-Inch Diameter and Smaller: 200 psig.
 - 7. Sizes 16-Inch Diameter and Larger: 150 psig.

2.6 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. American Flow Control.
 - 2. Clow Valve Company.
 - 3. Mueller Company.
 - 4. Substitutions: Equal per Section 01 60 00 - Product Requirements.
- B. Size 12 Inch to 24 Inch: AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, ten infinite position lever handle.

- C. Furnish materials in accordance with utility company or governing agency requirements.

2.7 VALVE BOXES

- A. Valves 12-Inch Diameter and Smaller: Cast iron, two-piece, screw type.
- B. Valves Larger Than 12-Inch Diameter: Cast iron, three-piece, screw type; round base.
- C. Cast iron lid marked "SEWER".

2.8 PRECAST CONCRETE VALVE VAULTS

- A. Conform to Section 33 05 14 - Utility Manholes and Structures.
- B. Provide size and type as indicated on Drawings.

2.9 CONCRETE FOR THRUST RESTRAINT AND COLLARS

- A. Concrete: Class A Concrete conforming to Divisions 500 and 700 of the SCDOT Standard Specifications.
 1. Compressive strength of 3,000 psi at 28 days.
 2. Air entrained.
 3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
 4. Maximum slump of 3.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
 5. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

2.10 BEDDING AND COVER MATERIALS

- A. Bedding for Rigid Pipe (DIP, PVC C900, and PVC C905): Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SP, SP-SM or SP-SC.
- B. Backfill around Pipe and Above Pipe: As specified in Section 31 23 17 -Trenching.

2.11 ACCESSORIES

- A. Polyethylene Jackets: AWWA C105 polyethylene jacket. Single layer, lapped over pipe joint 1 foot minimum, and secured with 10-mil polyethylene tape.
- B. Steel Rods, Bolt, Lugs, and Brackets: ASTM A36/A36M or ASTM A307 carbon steel.

PART 3 EXECUTION

3.1 PREPARATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify existing sewer connection, size, location, and inverts are as indicated on Drawings.

3.2 EXCAVATION

- A. Excavate pipe trench in accordance with Section 31 23 17 for Work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated on Drawings.
- B. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.
- C. Provide sheeting and shoring as required.
- D. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8 inches in compacted depth; compact to 95 percent.

3.3 INSTALLATION – PIPE

- A. Install ductile iron pipe and fittings in accordance with AWWA C600 and manufactures' instructions.
- B. Install PVC pipe in accordance with AWWA C605 and manufactures' instructions.
- C. Handle and assemble pipe in accordance with manufacturer's instructions and as indicated on Drawings.
- D. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.
- E. Maintain minimum 10-foot horizontal separation and 18-inch vertical separation of water main from sewer piping or as required by local code.
- F. Install pipe to indicated elevation to within tolerance of 1/2 inch.
- G. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.
- H. Remove scale and dirt on inside and outside before assembly.
- I. Route pipe in straight line. Relay pipe that is out of alignment or grade.
- J. Install pipe with no high points unless indicated on Drawings. If unforeseen field conditions arise which necessitate high points, install air release valves as directed by Architect/Engineer.
- K. Install pipe to have bearing along entire length of pipe. Excavate bell holes to permit proper joint installation. Do not lay pipe in wet or frozen trench.
- L. Prevent foreign material from entering pipe during placement.
- M. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- N. Close pipe openings with watertight plugs during work stoppages.
- O. Install access fittings to permit disinfection of water system performed under Section 33 13 00.
- P. Install underground marking tape continuously 18 to 24 inches below finished grade

- Q. Establish elevations of buried piping with not less than 3 feet of cover. Measure depth of cover from final surface grade to top of pipe barrel.

3.4 POLYETHYLENE ENCASEMENT

- A. Encase Ductile Iron piping in polyethylene where indicated on Drawings to prevent contact with surrounding backfill material.
- B. Install in accordance with AWWA C105, Method A.
- C. Terminate encasement 3 to 6 inches above ground where pipe is exposed.

3.5 CONCRETE THRUST RESTRAINT

- A. Provide valves, tees, bends, caps, plugs, and dead ends with concrete thrust blocks as indicated on Drawings.
- B. Pour concrete thrust blocks against undisturbed earth. Locate thrust blocks at each elbow or change of pipe direction to resist resultant force and so pipe and fitting joints will be accessible for repair.
- C. Do not encase fitting joints and flanges.

3.6 TIED JOINT RESTRAINT

- A. Install tied joint restraint systems in accordance with Section 33 05 19.

3.7 BACKFILLING

- A. Backfill and compact around sides and to top of pipe in accordance with Section 31 23 17.
- B. Maintain optimum moisture content of material to attain required compaction density.

3.8 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform soil compaction tests in accordance with Section 31 23 17.
- C. Perform pressure test on sanitary sewer force mains in accordance with AWWA C600.
 - 1. Notify Engineer and Owner 72 hours in advance of test and have witness test.
 - 2. After completion of pipeline installation, including backfill, but prior to final connection to existing system, conduct concurrent hydrostatic pressure and leakage tests in accordance with AWWA C600.
 - 3. Provide equipment required to perform leakage and hydrostatic pressure tests.
 - 4. Test Pressure: Not less than 200 psi or 50 psi in excess of maximum static pressure, whichever is greater.
 - 5. Conduct hydrostatic test for at least a two-hour duration.
 - 6. No pipeline installation will be approved when pressure varies by more than 5 psi at completion of hydrostatic pressure test.
 - 7. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, close corporation cocks and apply test

pressure. At conclusion of tests, remove corporation cocks removed and plug resulting piping openings.

8. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.
9. Examine exposed piping, fittings, valves, and joints carefully during hydrostatic pressure test. Repair or replace damage or defective pipe, fittings, valves, or joints discovered, following pressure test.
10. No pipeline installation will be approved when leakage is greater than that determined by the following formula:

$L = (SDV \sqrt{P})/133,200$
L = allowable, in gallons per hour
S = length of pipe tested, in inches
D = nominal diameter of pipe, in inches
P = average test pressure during leakage test, in pounds per square inch (gauge)

11. When leakage exceeds specified acceptable rate, locate source and make repairs. Repeat test until specified leakage requirements are met.

END OF SECTION