

SECTION 33 30 00**SANITARY SEWERAGE UTILITIES****PART 1 - GENERAL****1.1 DESCRIPTION:**

Outside, underground sanitary sewer system, complete, ready for operation, including all gravity flow lines, pressure (force) lines manholes, cleanouts, frames, covers, structures, appurtenances, and connections to new building and structure, service lines, existing sanitary sewer lines, and existing sanitary structures, and all other incidentals.

1.2 RELATED WORK:

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING. Dewatering: Section 31 23 19, DEWATERING.
- C. Concrete Work Reinforcing, Placement and Finishing; Section 03 30 00, CAST-IN-PLACE CONCRETE. Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- D. Protection of Materials and Equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- E. Sanitary Sewer Pumping Facilities: Section 22 13 29, SANITARY SEWERAGE PUMPS.
- F. Pipeline Directional Drilling Methods: Section 33 05 23, UTILITY HORIZONTAL DIRECTIONAL DRILLING.

1.3 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, including model number, securely affixed in a conspicuous

place on equipment, or name or trademark, including model number cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

1.4 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers' Literature and Data: Submit the following as one package:
 - 1. Pipe, Fittings, and, Appurtenances.
 - 2. Jointing Material.
 - 3. Manhole and Structure Material.
 - 4. Frames and Covers.
 - 5. Steps and Ladders.
 - 6. Gate Valves.
 - 7. Check Valves.
 - 8. Cleanout Tees.

1.5 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - A48/A48M-03.....Gray Iron Castings
 - A536-84(2004).....Ductile Iron Castings
 - A615/A615M-06.....Deformed and Plain Carbon-Steel Bars for
Concrete Reinforcement
 - A625/A625M-03.....Tin Mill Products, Black Plate, Single Reduced
 - C139-05.....Concrete Masonry Units for Construction of Catch
Basins and Manholes
 - C150-05.....Portland Cement

- C478-06a/C478M-06a.....Precast Reinforced Concrete Manhole Sections
- C857-95(2001).....Minimum Structural Design Loading for
Underground Precast Concrete Utility Structures
- D698-00ae1.....Laboratory Compaction Characteristics of Soil
Using Standard Effort (12,400 ft-lbf/ft³ (600
kN-m/m³))
- D2321-05.....Underground Installation of Thermoplastic Pipes
for Sewers and Other Gravity-Flow Applications
- D2412-02.....Determination of External Loading
Characteristics of Plastic Pipe by Parallel-
Plate Loading
- D2992-01.....Practice for Obtaining Hydrostatic or Pressure
Design Basis for Fiberglass (Glass-Fiber-
Reinforced Thermosetting-Resin) Pipe and
Fittings
- D3034-04a.....Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe
and Fittings
- D3212-96a (2003) e1.....Joints for Drain and Sewer Plastic Pipes Using
Flexible Elastomeric Seals
- D3261-03.....Butt Heat Fusion Polyethylene (PE) Plastic
Fittings for Polyethylene (PE) Plastic Pipe and
Tubing
- D3350-05.....Polyethylene Plastics Pipe and Fittings
Materials
- F477-02e1.....Elastomeric Seals (Gaskets) for Joining Plastic
Pipe
- F714-05.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based on
Outside Diameter
- C. American Water Works Association (AWWA):
 - C110/A21.10-03.....Ductile Iron and Gray Iron Fittings for Water
 - C115-99.....Flanged Ductile-Iron Pipe with Threaded Flanges
 - C800-01.....Underground Service Line Valves and Fittings
 - C508-01.....Swing Check Valves for Waterworks, 2 inches (50
mm) Through 24 inches (600 mm) NPS

- C550-05.....Protective Epoxy Interior Coatings for Valves and Hydrants
- C605-94.....Underground Installation of Polyvinyl (PVC) Pressure Pipe and Fittings for Water
- C800-01.....Underground Service Line Valves and Fittings
- C900-97Polyvinyl Chloride (PVC) Pressure Pipe, 100 mm (4 inches) Through 300 mm (12 inches) for Water Distribution
- C905-97.....Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 350 mm through 1,200 mm (14 Inches through 48 Inches), for Water Transmission and Distribution
- C906-99.....Polyethylene (PE) Pressure Pipes and Fittings, 100 mm through 1575 mm (4 Inches through 63 Inches), for Water Distribution

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

- M198-05.....Joints for Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealants

E. Uni-Bell PVC Pipe Association:

- Uni-B-6-98.....Recommended Practice Low Pressure Air Testing of Installed Sewer Pipe

PART 2 - PRODUCTS

2.1 PIPING:

A. Gravity Flow Lines (Pipe and Fittings):

1. Polyvinyl Chloride (PVC):

- a. Pipe and Fittings, 100 to 375 mm (4 to 15 inches) in diameter, shall conform to ASTM D3034, Type PSM, SDR 35. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D3212. Gaskets shall conform to ASTM F477. Solvent welded joints shall not be permitted.

B. Pressure (Force) Lines (Pipe and Fittings):

1. All pipe and fittings used in the construction of force mains shall be rated for a minimum of 1035 kPa (150 psi).
2. Polyvinyl Chloride (PVC): PVC pipe 100 mm to 300 mm (4 to 12 inches) shall conform to AWWA C900, Class 150 (DR 18). PVC pipe larger than 300 mm (12 inches) shall conform to AWWA C905, Class 165 (DR 25). Fittings for PVC pipe shall be ductile iron.
3. High Density Polyethylene (HDPE) pipe and fittings shall be manufactured from PE 3408, high density, extra high molecular weight polyethylene meeting the requirements of ASTM D3350. Pipe shall be manufactured in accordance with ASTM F714, and shall be Class 160 (DR 11). Molded fittings shall be manufactured in accordance with ASTM D3261 and subject to the test required under ASTM D3261. Fabricated fittings shall be made by heat fusion jointing of machined shapes cut from pipe, sheet stock, or molded fittings. Molded and fabricated fittings shall be rated for a minimum working pressure equivalent to the pipe. Joints shall be heat fusion butt joints, flange adapters, or mechanical couplings.
 - a. Flange adapters shall have adequate through-bore length to be clamped in a butt fusion jointing machine without the use of a stub-end holder. The sealing surface of the flanged shall be machined with a series of V-shaped grooves to restrain the gasket against blow out. Back-up rings and flange bolts shall be rated equal to or greater than the mating pipe. All flange adapters shall be equipped with a stainless steel internal pipe stiffener.
 - b. Mechanical couplings shall be sleeve style, restrained coupling. The sleeve and gland shall be epoxy coated and lined and rated for the pressure of the mating pipe. Coupling shall be supplied with stainless steel pipe stiffeners to be installed within the pipe.

2.2 JOINTING MATERIAL:**A. Gravity Flow Lines:**

1. Polyvinyl Chloride (PVC) Pipe (Gravity Use): Joints, ASTM D3212. Elastomeric gasket, ASTM F477.

B. Pressure (Force) Main:

1. All joints indicated on the drawings as being "restrained" shall be fully restrained and capable of restraining 50 percent above all loads acting on the joint, but not less than 1035 kPa (150 psi). Thrust blocks shall not be permitted.
2. Polyvinyl Chloride (PVC) Pipe (Pressure Use):
 - a. Push-on joints shall conform to AWWA C900, C905.
 - b. Push-on gaskets for pipe, ASTM F477.
 - c. Restrained joints shall comply with one of the following:
 - 1) Joints to mechanical ductile iron fittings shall comply with the requirements for ductile iron pipe, except the mechanical joint restraint gland shall be specifically designed for use with PVC pipe.
 - 2) Push-on bell and spigot joints shall be retained with retaining rings and thrust rods. The rings shall be ductile iron conforming to ASTM A536. The rings shall be split style with serrated inside face which grips the pipe when the halves of the ring is assembled together. The ring shall not bear directly on the back of the bell. The rods shall be of adequate size and number to resist all axial movement of the joint.
3. High Density Polyethylene (HDPE) pipe and fittings shall be fusion butt welded, flanged, or mechanical couplings as recommended by the manufacturer. Restrained joints shall be limited to fusion welded and flanged.

2.3 MANHOLES AND VAULTS:

- A. Manholes and vaults shall be constructed of precast reinforced sections, with precast concrete segmental blocks or rings as needed for final adjustment. The manholes and vaults shall be in accordance with the details in the plan set, and the following:
 1. Precast Concrete Segmental Blocks: Blocks shall conform to ASTM C139 and shall not be less than 150 mm (6 inches) thick for manholes to a depth of 3.6m (12 feet); not less than 200 mm (8 inches) thick for manholes deeper than 3.6m (12 feet) deep. Blocks shall be not less than 200 mm (8 inches) in length. Blocks shall be shaped so that joints seal and bond effectively with cement mortar. Parge structure

- interior and exterior with 15 mm (1/2 inch) of cement mortar applied with a trowel and finished to an even glazed surface.
2. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type.
 3. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 4. Flat top manhole tops shall be reinforced concrete as detailed on the drawings, and in compliance with ASTM C478.
 5. Mortar:
 - a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, 1/4 part lime hydrate, and 3 parts sand.
 - b. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 21 L (5-1/2 gallons) per sack of cement.
 6. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M198.
 7. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover, and the words "sanitary sewer". The studs and the lettering shall be raised 8 mm (5/16 inch). The cover shall be a minimum of 600 mm (24 inches) in diameter and shall have two 25 mm (1 inch) vent holes located diametrically opposite, 100 mm (4 in) in from the edge of the rim. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.

2.4 CONCRETE:

Concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Division 03 of these specifications.

2.5 REINFORCING STEEL:

Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

2.6 VALVES:

- A. AWWA C800, corporation stop valves rated for 1360 kPa (200 psi) WSP. The interior and exterior of the valve shall be epoxy-coated for AWWA C550.
- B. Operation:
 - 1. Shall turn counterclockwise to open.
 - 2. 50 mm (2 inch) nut for socket wrench operation.
- C. Joints: End of valve shall accommodate, or be adapted to, pipe furnished.

2.7 WARNING TAPE:

- A. To be located at all open-cut pipe section: Standard, .1mm (4Mil) polyethylene 76 mm (3 inch) wide tape detectable type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

PART 3 - EXECUTION**3.1 BUILDING SERVICE LINES:**

- A. Install sanitary sewer service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.
- B. Connections of service line to building piping shall be made after the new sanitary sewer system has been constructed, tested, and accepted for operation by the VA. The Contractor shall install all temporary caps or plugs required for testing.
- C. When building services have not been installed at the time when the sanitary sewer system is complete, provide temporary plugs or caps at the ends of all service lines. Mark the location and depth of the

service lines with continuous warning tape placed 300 mm (12 inches) above service lines.

3.2 ABANDONED MANHOLES STRUCTURES AND PIPING:

- A. Manholes and Structures Outside of Building Areas: Remove frame and cover, cut and remove the top of an elevation of 600 mm (2 feet) below finished grade. Fill the remaining portion with compacted gravel or crushed rock or concrete.
- C. Piping under and within 1500 mm (5 feet) of building areas shall be completely removed.
- D. Piping outside of building areas shall have all ends of the piping at the limit of the abandonment and within structures and manholes, plugged with concrete, and abandoned in-place.
- E. The Contractor shall comply with all OSHA confined space requirements while working within existing manholes and structures.
- F. When the limit of the abandonment terminates in an existing manhole to remain, the flow line in the bench of the manhole to the abandoned line shall be filled with concrete and shaped to maintain the flowline of the lines to remain.

3.3 CONNECTIONS TO EXISTING PUBLIC UTILITY COMPANY MANHOLES:

- A. Comply with all rules and regulations of the public utility.
- B. The connection to the existing utility shall comply with the standard details and specifications of the public utility company, except as specifically modified on the plans and specifications.

3.4 PIPE SEPARATION:

- A. Horizontal Separation - Water Mains and Sewers:
 - 1. Existing and proposed water mains shall be at least 3 meters (10 feet) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
 - 2. Gravity flow mains and pressure (force) mains may be located closer than 3 meters (10 feet) but not closer than 1.8 m (6 feet) to a water main when:
 - a. Local conditions prevent a lateral separation of ten feet; and

- b. The water main invert is at least 450 mm (18 inches) above the crown of the gravity sewer or 600 mm (24 inches) above the crown of the pressure (force) main; and
 - c. The water main is in a separate trench separated by undisturbed earth.
3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe. The pipe for the sanitary sewer main shall comply with the specifications for pressure (force) mains, and the water main material shall comply with Section 33 10 00, WATER UTILITIES. The sewer shall be pressure tested as specified for pressure (force) mains before backfilling.

B. Vertical Separation - Water Mains and Sewers at Crossings:

1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 450 mm (18 inches) above the crown of gravity flow sewer or 1200 mm (48 inches) above the crown of pressure (force) mains. The vertical separation shall be maintained within 3 meters (10 feet) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.
2. In no case shall pressure (force) sanitary main cross above, or within 450 mm (18 inches) of water lines.
3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 450 mm (18 inches) above or 300 mm (12 inches) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 450 mm (18 inches) below the water line provided both the water line and sewer line are constructed of ductile iron pipe. The pipe for the sewer shall conform to the requirements for pressure sewers specified herein. Piping for the water main shall conform to Section 33 10 00, WATER UTILITIES.
4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 3 meters (10 feet).

3.5 GENERAL PIPING INSTALLATION:

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade. Pressure (force) mains shall have the bells facing the direction of flow.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not lay sewer pipe in same trench with another pipe or other utility. Sanitary sewers shall cross at least 450 mm (18 inches) below water lines.
- H. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 300 mm (12 inches) over the crown of the pipe.
- I. Warning tape shall be continuously placed 300 mm (12 inches) above sewer pipe in all open-cut areas.
- J. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
 - 1. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
 - 1. High Density Polyethylene (HDPE) Piping: Comply with manufacturer's recommendations with gaskets with fused joints.
- K. Installation of Pressure (Force) Mains:
 - 1. Sections of piping listed on the drawings shall be fully restrained using approved joint restraint devices. Joint restraint devices shall be installed in accordance with the manufacturer's recommendations.

For devices with twist of nuts, the twist of nuts shall be placed on top of the fitting for the Engineer's inspection. The Contractor shall torque test all bolts, set screws, identified by the VA.

2. Thrust blocks shall not be permitted.
3. Install pressure (force) mains in accordance with the provisions of these specifications and the following standards:
 - a. Polyvinyl Chloride (PVC) Piping: AWWA C605.
 - b. High Density Polyethylene (HDPE) Piping: Per manufacturer's recommendations.

3.6 MANHOLES AND VAULTS:

A. General:

1. Circular Structures:
 - a. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.
 - b. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top, shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
 - c. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.
2. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
3. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
 - a. Forming directly in concrete base of structure.

- b. Building up with brick and mortar.
- 4. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (1-inch per foot) nor more than 1:6 (2 inches per foot). Bottom slab and benches shall be concrete.
- 5. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inches) thick, by 300 mm (12 inches) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.7 SETTING OF VALVES:

- A. Avoid setting corporation valves under pavement except where shown on the drawings.
- B. Clean valve interior before installation.
- C. Set valve plumb, restrain ends of valves when indicated on the drawing.

3.8 INSPECTION OF SEWERS:

Inspect and obtain the VA's approval. Thoroughly flush out before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lip at joints on the inside of gravity sewer lines are not acceptable.

3.9 TESTING OF SANITARY SEWERS:

- A. Gravity Sewers and Manholes:
 - 1. Exfiltration Test:
 - a. Subject pipe to hydrostatic pressure produced by head of water at depth of 900 mm (3 feet) above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 900 mm (3 feet) above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During one hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 11 L (3.0 gallons) per hour per 30 m (100 feet).

- b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.
- 3. Infiltration Test: If ground water level is greater than 900 mm (3 feet) above invert of the upper manhole, infiltration tests are acceptable. Allowable leakage for this test will be the same as for the exfiltration test.
- B. Pressure (Force) Mains: Test at 690 kPa (100 psi) for two hours. Leakage shall be per the following:

$$L=J*D*\sqrt{P}/4500$$

Where:

- L = Maximum Allowable Leakage in Gallons per Hour
- J = Number of Joints in Test Area
- D = Diameter of Pipe in Inches
- P = Average Test Pressure (Psi)

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