

Section 33 40 00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

1.2 RELATED WORK

- A. Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing: section 31 20 00, EARTH MOVING.
- B. Concrete work, reinforcing, placement and finishing: section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Fabrication of steel ladders: section 05 50 00, METAL FABRICATIONS.
- D. Materials and testing report submittals: section 01 33 23, shop drawings, PRODUCT DATA AND SAMPLES.
- E. Erosion and sediment control: section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.3 ABBREVIATIONS

- A. HDPE: High-density polyethylene
- B. PE: Polyethylene

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Handle catch basins according to manufacturer's written rigging instructions.

1.5 QUALITY ASSURANCE

- A. Products Criteria
 - 1. 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. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.6 SUBMITTALS

- A. Manufacturers' Literature and Data shall be submitted, as one package, for pipes, fittings and appurtenances, including jointing materials, hydrants, valves and other miscellaneous items.

1.7 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):
- A185/A185M-07 Steel Welded Wire Reinforcement, Plain, for Concrete
- A242/A242M-04(2009) High-Strength Low-Alloy Structural Steel
- A536-84(2009) Ductile Iron Castings
- A615/A615M-09b Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- A760/A760M-10 Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
- A798/A798M-07 Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
- A849-10 Post-Applied Coatings, Paving, and Linings for Corrugated Steel Sewer and Drainage Pipe
- A929/A929M-01(2007) Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
- B745/B745M-97(2005) Corrugated Aluminum Pipe for Sewers and Drains
- B788/B788M-09 Installing Factory-Made Corrugated Aluminum Culverts and Storm Sewer Pipe
- C14-07 Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe
- C33/C33M-08 Concrete Aggregates
- C76-11 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- C139-10 Concrete Masonry Units for Construction of Catch Basins and Manholes
- C150/C150M-11 Portland Cement
- C443-10 Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- C478-09 Precast Reinforced Concrete Manhole Sections
- C506-10b Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
- C507-10b Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
- C655-09 Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
- C857-07 Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

C891-09	Installation of Underground Precast Concrete Utility Structures
C913-08	Precast Concrete Water and Wastewater Structures
C923-08	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
C924-02(2009)	Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
C990-09	Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
C1103-03(2009)	Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
C1173-08	Flexible Transition Couplings for Underground Piping Systems
C1433-10	Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
C1479-10	Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
D448-08	Sizes of Aggregate for Road and Bridge Construction
D698-07e1	Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft ³ (600 kN-m/m ³))
D1056-07	Flexible Cellular Materials—Sponge or Expanded Rubber
D1785-06	Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D2321-11	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D2751-05	Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
D2774-08	Underground Installation of Thermoplastic Pressure Piping
D3034-08	Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3350-10	Polyethylene Plastics Pipe and Fittings Materials
D3753-05e1	Glass-Fiber-Reinforced Polyester Manholes and Wetwells
D4101-11	Polypropylene Injection and Extrusion Materials
D5926-09	Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
F477-10	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F679-08	Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

- F714-10 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- F794-03(2009) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
- F891-10 Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core
- F894-07 Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
- F949-10 Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
- F1417-11 Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
- F1668-08 Construction Procedures for Buried Plastic Pipe
- C. American Association of State Highway and Transportation Officials (AASHTO)
 - M190-04 Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
 - M198-10 Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
 - M252-09 Corrugated Polyethylene Drainage Pipe
 - M294-10 Corrugated Polyethylene Pipe, 12 to 60 In. (300 to 1500 mm) Diameter
- D. American Concrete Institute (ACI)
 - 318-05 Structural Commentary
 - 350/350M-06 Environmental Engineering Concrete Structures and Commentary
- E. National Stone, Sand and Gravel Association (NSSGA): Quarried Stone for Erosion and Sediment Control

1.8 WARRANTY

The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized to reduce spare part requirements. The Contractor shall guarantee performance of assemblies of components, and shall repair or replace

elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 PE PIPE AND FITTINGS

- A. Corrugated PE drainage pipe and fittings, NPS 3 to NPS 10 (DN 80 to DN 250); ASTM F714, SDR 21 with smooth waterway for coupling joints.
 - 1. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.
- B. Corrugated PE pipe and fittings, NPS 12 to NPS 60 (DN 300 to DN 1500); AASHTO M294, Type S, with smooth waterway for coupling joints. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.
 - 1. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.
 - 2. Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.
- C. PVC Type PSM Sewer Piping
 - 1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends.
 - 2. Fittings: ASTM D3034, PVC with bell ends.
 - 3. Gaskets: ASTM F477, elastomeric seals.

2.3 NONPRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials
 - 1. For plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
 - 2. For dissimilar pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings: Couplings shall be an elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Shielded, flexible couplings shall be elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- E. Ring-Type, flexible couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.4 CATCH BASINS

- A. Standard Precast Concrete Catch Basins:
 - 1. Description: ASTM C478 (ASTM C478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.

2. Concrete: Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C-857.
3. Size: As noted on the plans.
4. Base Section: 6 inch (150 mm) minimum thickness for floor slab and 4-inch (102 mm) minimum thickness for walls and base riser section.
5. Riser Sections: 4 inch (102 mm) minimum thickness, and lengths to provide depth indicated.
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 M-198B.
7. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into walls, for each pipe connection.
8. Frame and Cover for Gratings:
 - a. Galvanized steel: conforming to ASTM A123.
 - b. Cast iron: conforming to ASTM A48
 - c. Weight, shape, size, and waterway openings for grates shall be as indicated on the drawings.

2.5 AREA DRAINS

A. Area Drains:

1. 6" diameter structurally foamed polyolefin or high density polyethylene round, flat grate with U.V. inhibitors. Color of drain shall be black. Directly connect to 6" riser pipe and tee connection with storm drain lateral. Open surface area shall be at least 9 square inches. Maximum flow rating shall be at least 10 gallons per minute.

2.6 SLOT DRAINS

A. General requirements: Modular system of slot drains and appurtenances; designed so slot drains fit into channel recesses without rocking or rattling. Include quantity of units required to form total lengths indicated.

B. Slot Drain:

- a. 11-gauge galvanized steel with 7/16" nominal width vertical opening and an overall nominal base width of 4.84". Slot drain shall be secured on polymer concrete channel drain with a boltless locking system, yet be able to be removed for channel drain maintenance.
- b. Install per manufacturer's recommendations.

2.7 CLEANOUTS

A. Cast-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Top-Loading Classification(s): Light Duty

2. Pipe fitting and riser to cleanout shall be same material as main pipe line.

- B. Plastic Cleanouts shall have PVC body with PVC threaded plug. Pipe fitting and riser to cleanout shall be of same material as main line pipe.

2.8 WARNING TAPE

- A. Standard, 4-Mil polyethylene 3 inch (76 mm) wide tape detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

PART 3 - EXECUTION

3.1 PIPE BEDDING

- A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material.

3.2 PIPING INSTALLATION

- A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
1. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
 2. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
 3. 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.
 4. 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.
 5. 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.
 6. Do not walk on pipe in trenches until covered by layers of shading to a depth of 12 inches (300 mm) over the crown of the pipe.
 7. Warning tape shall be continuously placed 12 inches (300 mm) above storm sewer piping.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow.
 - 2. Install PE corrugated sewer piping according to ASTM D2321 with gasketed joints.
 - 3. Install PVC sewer piping according to ASTM D2321 and ASTM F1668.

3.3 CONNECTIONS TO EXISTING VA-OWNED MANHOLES

- A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.4 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.5 CONNECTIONS

- A. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping.
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping.
 - 3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Unshielded flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

3.6 IDENTIFICATION

- A. Install green warning tape directly over piping and at outside edge of underground structures.

3.7 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred.
 1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.

3.8 TESTING OF STORM SEWERS:

- A. Submit separate report for each test.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
 4. Submit separate report for each test.
 5. Air test gravity sewers. Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
 6. Test force-main storm drainage piping. Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psi (1035 kPa).
 - a. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
- C. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

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