

SECTION 33 40 00 STORM SEWER UTILITIES

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. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- 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 DEFINITIONS

- A. ABBREVIATIONS
 - 1. HDPE: High-density polyethylene
 - 2. PE: Polyethylene
- B. DELIVERY, STORAGE, AND HANDLING
 - 1. Do not store plastic manholes, pipe, and fittings in direct sunlight.
 - 2. Handle manholes and catch basins according to manufacturer's written rigging instructions.
- C. COORDINATION
 - 1. Coordinate connection to storm sewer main with the Public Agency providing storm sewer off-site drainage.
 - 2. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.
- D. QUALITY ASSURANCE:
 - 1. Products Criteria:

- a. 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.
- b. 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.

1.4 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.

1.5 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):
 - A185/A185M-07Steel 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-07Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
 - A849-10Post-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
 - C14-07Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe
 - C33/C33M-08Concrete Aggregates

- C76-11Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- C139-10Concrete Masonry Units for Construction of Catch Basins and Manholes
- C150/C150M-11Portland Cement
- C443-10Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- C478-09Precast Reinforced Concrete Manhole Sections
- C506-10bReinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
- C507-10bReinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
- C655-09Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
- C857-07Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
- C891-09Installation of Underground Precast Concrete Utility Structures
- C913-08Precast Concrete Water and Wastewater Structures
- C923-08Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
- C924-02(2009).....Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
- C990-09Joints 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
- C1173-08Flexible Transition Couplings for Underground Piping Systems
- C1433-10Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
- C1479-10Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
- D448-08Sizes of Aggregate for Road and Bridge Construction
- D698-07e1Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))
- D1056-07Flexible Cellular Materials—Sponge or Expanded Rubber

- D1785-06Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2321-11Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- D2751-05Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
- D2774-08Underground Installation of Thermoplastic Pressure Piping
- D3034-08Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- D3350-10Polyethylene Plastics Pipe and Fittings Materials
- D3753-05e1Glass-Fiber-Reinforced Polyester Manholes and Wetwells
- D4101-11Polypropylene Injection and Extrusion Materials
- D5926-09Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
- F477-10Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F679-08Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- F714-10Polyethylene (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
- F891-10Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core
- F894-07Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
- F949-10Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
- F1417-11Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
- F1668-08Construction 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 Water Works Association(AWWA):

- C105/A21.5-10.....Polyethylene Encasement for Ductile iron Pipe Systems
- C110-08Ductile-Iron and Gray-Iron Fittings
- C219-11Bolted, Sleeve-Type Couplings for Plain-End Pipe
- C600-10Installation of Ductile iron Mains and Their Appurtenances
- C900-07Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
- M23-2nd ed.....PVC Pipe "Design And Installation"

E. American Society of Mechanical Engineers (ASME):

- A112.6.3-2001Floor and Trench Drains
- A112.14.1-2003Backwater Valves
- A112.36.2M-1991 ...Cleanouts

F. American Concrete Institute (ACI):

- 318-05.....Structural Commentary and Commentary
- 350/350M-06.....Environmental Engineering Concrete Structures and Commentary
- 1. National Stone, Sand and Gravel Association (NSSGA): Quarried Stone for Erosion and Sediment Control

1.6 WARRANTY

- A. 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 // two years // from final acceptance. Further, the Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

1.7 PRODUCTS

A. FACTORY-ASSEMBLED PRODUCTS

- 1. 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.

B. PE PIPE AND FITTINGS

1. 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.
 - a. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.
2. 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.
 - a. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.
 - b. 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.
3. PVC Profile Sewer Piping
 - a. Pipe: ASTM F794, PVC profile, gravity sewer pipe with bell-and-spigot ends.
 - b. Fittings: ASTM D3034, PVC with bell ends.
 - c. Gaskets: ASTM F477, elastomeric seals.
4. PVC Type PSM Sewer Piping
 - a. Pipe: ASTM D3034, SDR 35 , PVC Type PSM sewer pipe with bell-and-spigot ends.
 - b. Fittings: ASTM D3034, PVC with bell ends.
 - c. Gaskets: ASTM F477, elastomeric seals.
5. PVC Gravity Sewer Piping
 - a. Pipe and fittings shall be ASTM F679, , PVC gravity sewer pipe with bell-and-spigot ends.
 - b. Gaskets: ASTM F477, elastomeric seals for gasketed joints.

C. CONCRETE PIPE AND FITTINGS

1. Reinforced-Concrete sewer pipe and fittings shall be ASTM C76 or ASTM C655.

- a. Bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM C443, rubber gaskets.

D. CLASS IIINONPRESSURE TRANSITION COUPLINGS

1. 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.
2. Sleeve Materials
 - a. For concrete pipes: ASTM C443, rubber.
 - b. For plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
 - c. For dissimilar pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
3. 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.
4. 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.
5. 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.

E. CLEANOUTS

1. 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.
 - a. Top-Loading Classification(s): Heavy Duty Pipe fitting and riser to cleanout shall be same material as main pipe line.
2. 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.

F. DRAINS

1. Cast-Iron Area Drains: ASME A112.6.3, gray-iron round body with anchor flange and round secured grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.
 - a. Top-Loading Classification(s): Medium and Heavy Duty

G. MANHOLES AND CATCH BASINS

1. Standard Precast Concrete Manholes:
 - a. Description: ASTM C478 (ASTM C478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - b. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
 - c. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
 - d. Base Section: 6 inch (150 mm) minimum thickness for floor slab and 4-inch (102 mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
 - e. Riser Sections: 4 inch (102 mm) minimum thickness, and lengths to provide depth indicated.
 - f. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
 - g. Joint Sealant: ASTM C990 (ASTM C990M), bitumen or butyl rubber.
 - h. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into manhole walls, for each pipe connection.
 - i. Steps: If total depth from floor of manhole to finished grade is greater than 60 inches (1500 mm). Individual FRP steps, width of 16 inches (400 mm) minimum, spaced at 12 to 16 inch (300 to 400 mm) intervals.
 - j. Adjusting Rings: Reinforced-concrete rings, 6 to 9 inch (150 to 225 mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.
2. Manhole Frames and Covers:
 - a. Description: Ferrous; 24 inch (610 mm) ID by 7 to 9 inch (175 to 225 mm) riser with 4 inch (102 mm) minimum width flange and 26-inch (600 mm) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
 - b. Material: ASTM A48/A48M, Class 35 gray iron unless otherwise indicated.

H. CONCRETE FOR MANHOLES AND CATCH BASINS

1. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:
 - a. Cement: ASTM C150, Type II.
 - b. Fine Aggregate: ASTM C33, sand.
 - c. Coarse Aggregate: ASTM C33, crushed gravel.
 - d. Water: Potable.
2. Concrete Design Mix: 4000 psi (27.6 MPa) minimum, compressive strength in 28 days.
 - a. Reinforcing Fabric: ASTM A185, steel, welded wire fabric, plain.
 - b. Reinforcing Bars: ASTM A615, Grade 60 (420 MPa) deformed steel.
3. Manhole Channels and Benches: Channels shall be the main line pipe material. Include benches in all manholes and catch basins.
 - a. Channels: Main line pipe material or concrete invert. Height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: Same slope as the main line pipe. Bench to be concrete, sloped to drain into channel. Minimum of 6 inch slope from main line pipe to wall sides.

I. STORMWATER DISPOSAL SYSTEMS

J. RESILIENT CONNECTORS AND DOWNSPOUT BOOTS FOR BUILDING ROOF DRAINS

1. Resilient connectors and downspout boots: Flexible, watertight connectors used for connecting pipe to manholes and inlets, and shall conform to ASTM C923.

K. WARNING TAPE

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

1.8 EXECUTION

A. PIPE BEDDING

1. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular 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. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

B. PIPING INSTALLATION

1. 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.
2. 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.
 - a. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
 - b. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
 - c. 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.
 - d. 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.
 - e. 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.
 - f. 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.
 - g. Warning tape shall be continuously placed 12 inches (300 mm) above storm sewer piping.
3. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

4. 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.
5. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
6. Install gravity-flow, nonpressure drainage piping according to the following:
 - a. Install piping pitched down in direction of flow.
 - b.
 - c. Install PE corrugated sewer piping according to ASTM D2321 with gasketed joints.
 - d. Install PVC cellular-core piping, and PVC sewer piping, according to ASTM D2321 and ASTM F1668.
 - e. Install reinforced concrete sewer piping according to ASTM C1479.

C. REGRADING

1. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
2. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

D. CONNECTIONS TO EXISTING VA-OWNED MANHOLES

1. 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.

E. CONNECTIONS TO EXISTING PUBLIC UTILITY MANHOLES

1. Comply with all rules and regulations of the public utility.

F. DRAIN INSTALLATION

1. Install type of drains in locations indicated.

- a. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - b. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 - c. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - d. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads
2. Set drain frames and covers with tops flush with pavement surface.

G. MANHOLE INSTALLATION

1. Install manholes, complete with appurtenances and accessories indicated. Install precast concrete manhole sections with sealants according to ASTM C891.
2. Set tops of frames and covers flush with finished surface of manholes. 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 1/2 inch (15 mm) 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.
3. Rectangular Structures:
 - a. Precast concrete structures shall be placed on a 8 inch (200 mm) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on an 8 inch (200 mm) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
 - b. Do not build structures when air temperature is 32 deg F (0 deg C), or below.

- c. 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:
 - 1.) Forming directly in concrete base of structure.
 - 2.) Building up with brick and mortar.
 - d. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1 to 12 or more than 1 to 6. Bottom slab and benches shall be concrete.
 - e. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.
 - f. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
 - g. 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 2 inches (50 mm) above the adjacent finish grade. Install an 8 inch (203 mm) thick, by 12 inch (300 mm) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.
- H. CATCH BASIN INSTALLATION
- 1. Construct catch basins to sizes and shapes indicated.
 - 2. Set frames and grates to elevations indicated.
- I. CONNECTIONS
- 1. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section FACILITY STORM DRAINAGE PIPING.
 - 2. Encase entire connection fitting, plus 6 inch (150 mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 3. Make connections to existing piping and underground manholes.
 - a. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping.

- b. 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.
 - c. 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.
 - d. 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.
4. 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.
- a. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - 1.) // Unshielded // Shielded // flexible couplings for same or minor difference OD pipes.

J. IDENTIFICATION

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

K. FIELD QUALITY CONTROL

- 1. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
 - a. Submit separate reports for each system inspection.
 - b. Defects requiring correction include the following:
 - 1.) Alignment: Less than full diameter of inside of pipe is visible between structures.
 - 2.) Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.

- 3.) Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - 4.) Infiltration: Water leakage into piping.
 - 5.) Exfiltration: Water leakage from or around piping.
 - c. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - d. Reinspect and repeat procedure until results are satisfactory.
- L. TESTING OF STORM SEWERS:
 1. Submit separate report for each test.
 2. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - a. Do not enclose, cover, or put into service before inspection and approval.
 - b. Test completed piping systems according to requirements of authorities having jurisdiction.
 - c. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
 - d. Submit separate report for each test.
 - e. 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.
 3. 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.
- M. CLEANING
 1. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 33 40 00