

Section 02509

THERMOPLASTIC PIPE CULVERTS
AND DRAINS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Corrugated High-Density Polyethylene (HDPE) pipe for culverts, including fittings.
- B. Polypropylene (PP) pipe for storm sewers.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No separate payment will be made for HDPE or PP pipe under this Section. Include cost in unit prices for work, as specified in following sections:
 - a. Section 02631 - Storm Sewers.
 - 2. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

- A. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Pipe, 300 mm to 1500 mm (12 in. to 60 in.) Diameter
- B. AASHTO M 330 - Standard Specification for Polypropylene Pipe, 300 mm to 15000 mm (12 in. to 60 in.) Diameter
- C. AASHTO Standard Specifications for Highway Bridges
- D. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- E. ASTM D 3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

- F. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- G. Plastic Pipe Institute Drainage Handbook

1.04 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. The Contractor shall submit a certificate of compliance of the pipe product that is manufactured in accordance with AASHTO M330. Supplying manufacturing facilities shall be in compliance with AASHTO's National Transportation Product Evaluation Program (NTPEP) for the specified pipe product.
- C. Submit manufacturer's installation specifications before beginning work. Maximum fill depth and backfill requirements shall be included in the manufacturer's installation specifications.

1.05 QUALITY CONTROL

- A. Provide manufacturer's certificate of conformance to Specifications.
- B. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.
- C. Engineer reserves right to inspect pipes or witness pipe manufacturing. Inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Specifications.
 - 1. Manufacturer's Notification: Should City Engineer wish to witness manufacture of specific pipes, manufacturer shall provide City Engineer with minimum three weeks notice of when and where production of those specific pipes will take place.
 - 2. Failure to Inspect. Approval of products or tests is not implied by City Engineer's decision not to inspect manufacturing, testing, or finished pipes.

PART 2 PRODUCTS

2.01 PIPE DESIGN

- A. A “Thermoplastic Pipe Installation” detail sheet must be signed and sealed by a registered Professional Engineer licenses to practice in the State of Texas and be included in the Contract Documents when thermoplastic pipe is specified. The specifying Professional Engineer is required to confirm the conditions for the project and structural adequacy of the pipe system.

The Plastic Pipe Institute publishes an online design manual that contains information related to all aspects of design and construction of thermoplastic pipe. For structural design of plastic pipe systems see the Plastic Pipe Institute Handbook, Chapter 7 “Structural Design” (www.plasticpipe.org). Additionally, thermoplastic pipe suppliers also have information on the use of their products.

When specifying plastic pipe on a project, the specifying Design Engineer must be aware of minimum depth of fill required and how these are measured for different pipe and pavement types.

1. Corrugated High Density Polyethylene (HDPE) Pipe

The specifying Design Engineer is responsible for ensuring that depth of fill is not less than 18 inches for pipe diameters up to 36 inches or 24 inches for pipe diameters over 36 inches. The depth of fill is measured as the distance from the top of pipe to the bottom of the flexible pavement, or from the top of the pipe to the top of rigid pavement.

2. Polypropylene Pipe

The specifying Design Engineer is responsible for ensuring that depth of fill is not less than 12 inches for pipe diameters up to 48 inches or 24 inches for pipe diameters over 60 inches. The depth of fill is measured as the distance from the top of pipe to the bottom of the flexible pavement, or from the top of the pipe to the top of rigid pavement.

Polypropylene pipes are stiffer than corrugated high-density polyethylene (HDPE) pipes which provide for more resilience against installation related deflection and is preferred for use over HDPE on transportation projects.

2.02 CORRUGATED HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

- A. Corrugated high-density polyethylene pipe and fittings shall meet the requirements of AASHTO M 294.
- B. Raw Materials: Corrugated high-density polyethylene pipe and fittings manufactured from virgin polyethylene (PE) compounds shall meet the requirements of cell class 435400C as defined and described in ASTM D3350, except that the maximum allowable carbon black content is 4 percent. The PE compound used shall meet the environmental stress crack resistance according to the NCLS test set forth in AASHTO M 294.
- C. Designation Type: For corrugated high-density polyethylene pipes used in gravity flow drainage applications, use Type S (outer corrugated wall with smooth inner liner).
- D. Section Properties: The minimum wall thickness of the inner walls of Type S pipe shall meet the requirements of AASHTO M 294, Section 7.2.2. The pipe stiffness requirement of 5 percent deflection shall conform to AASHTO M 294, Section 7.4.

2.03 POLYPROPYLENE (PP) PIPE

- A. Polypropylene pipe and fittings shall meet the requirements of AASHTO M 330.
- B. Raw Materials: Polypropylene compounds used to manufacture the pipe and fittings shall meet the minimum properties of AASHTO M 330, Section 6.1.1.
- C. Designation Type: Polypropylene pipes used in gravity flow drainage applications shall be Type S (outer corrugated wall with smooth inner liner).
- D. Section Properties: The minimum wall thickness of the inner walls for Type S pipe shall meet the requirements of AASHTO M 330, Section 7.2.2. The pipe stiffness at 5 percent deflection will meet the requirements in Section 7.4 of AASHTO M 330.

2.04 PIPE TESTING

- A. The manufacturer shall perform the appropriate test procedures on representative samples of each type of pipe furnished and shall verify that the pipe complies with the specifications. A certificate of compliance shall be submitted to Engineer for review and approval. A document with the following information shall be provided: manufacturing plant, date of manufacture, pipe unit mass, material distribution, pipe dimensions, water inlet area, pipe stiffness, pipe flattening, brittleness, ASTM resin cell classification, and workmanship. Pipe shall be supplied by manufacturers and locations that are listed on TxDOT's Material Product List for Thermoplastic pipe,

joints, and fittings.

2.05 PIPE INSPECTION

- A. The quality of materials, the process of manufacture, and the finished pipe will be subject to inspection and approval by Engineer at the manufacturing plant. In addition, the finished pipe will be subject to further random inspection by Engineer at the project site before and during installation, and prior to acceptance. The Engineer is responsible for ensuring the integrity of the installed pipes. The Engineer will ensure the pipe, bedding, structural backfill and stable foundation are installed and inspected correctly.

2.06 JOINTS

- A. Joints shall be installed so that the connection of the pipe sections form a continuous line free from irregularities in the flowline.
- B. Joints and Fittings shall meet the following requirements:
1. Integral Bell and Spigot: The bell shall overlap a minimum of two (2) corrugations of the spigot end when fully engaged. The spigot end shall have an O-ring gasket and meet the requirements of ASTM F477.
 2. Exterior Bell and Spigot: Fully weld the bell to the exterior of the pipe and overlap the spigot end so that the flow lines and ends match when fully engaged. The spigot end shall have an O-ring gasket and meet the requirements of ASTM F477.
 3. Split Couplers: For soil-tight joint connections only, join pipe with coupling bands covering at least two full corrugations on the ends of each pipe being joined.
- C. The following are joint and fitting type definitions:
1. Soil-tight Joints: Joints shall meet the soil-tightness definition in AASHTO "Standard Specifications for Highway Bridge," Section 26.4.2.4.
 2. Watertight Joints: Joints shall meet the requirements of ASTM D3212.
 3. If no joint type is specified in the Contract Documents, a soil-tight joint shall be provided.

2.07 MARKINGS

- A. Thermoplastic pipe, fittings, and couplings furnished shall be clearly marked as follows with pipe marked at ten (10) foot intervals:
 - 1. Manufacturer's name or trademark
 - 2. Nominal size
 - 3. Specification designation (i.e. AASHTO M 294 or AASHTO M 330)
 - 4. Manufacturing plant's designation code, and date manufactured.

2.08 END SECTIONS

- A. Type II Precast Safety End Treatments shall be provided for thermoplastic pipe installations beneath and adjacent to roadways. TxDOT's PSET-SC standard shall be used for cross drainage structures and TxDOT's PSET- SP standard shall be used for parallel drainage structures. Refer to City Standard Details for end section requirements.

PART 3 EXECUTION

3.01 HANDLING AND STORING PIPE

- A. Pipe shall be stored above ground on adequate blocking. Pipe shall be kept clean and fully drained during storage. Handle and store thermoplastic pipe in accordance with the pipe manufacturer's instructions. Proper handling methods shall be used for hoisting and lowering the pipe into the trench.

3.02 EXCAVATION

- A. Conform to requirements of Section 02317 - Excavation and Backfill for Utilities. Use bedding as indicated on Drawings. Special precautions in placing and compacting the backfill shall be taken to avoid any movement of the pipe or damage to the joints. Damaged pipe shall be removed and replaced by the Contractor at no expense to the City.
- B. Minimum Trench Width: Provide enough trench width for the pipe installation and to ensure enough working room to properly and safely place and compact material placed under haunches of the pipe and other embedment materials. Provide a space between the pipe and trench wall that is greater than that of the compaction

equipment used in the pipe zone.

1. When using Type I backfill, the minimum allowable trench width is the pipe outside diameter plus 12 inches.
2. When using Type II or Type III backfill, the minimum allowable trench width is specified in Table 1.

TABLE 1
MINIMUM TRENCH WIDTH

Nominal Pipe Diameter (in.)	Minimum Trench Width (in.)
18	44
24	54
30	66
36	78
42	84
48	90
60	103

3.03 TRENCHLESS INSTALLATION

- A. Thermoplastic pipe is not approved for augering of pipe.

3.04 INSTALLATION

A. Laying Pipe

1. Unless approved by City, pipe sections shall not be placed in the presence of water or when trench conditions or weather is unsuitable for such work. Lay pipe sections on the bedding at the outlet end with the spigot or tongue end pointing downstream and proceed toward the inlet end with separate sections properly joined together, true to the established lines and grades. Sections of pipe shall be lowered into the trench without damaging the pipe or disturbing

the bedding and the sides of the trench. The ends of the pipe shall be cleaned before mitting, matching, and laying the pipe to form a continuous, uniform conduit. The joint assembly shall be completed in accordance to the recommendations of the pipe manufacturer. Foreign matter or earth and bedding material shall be prevented from entering the pipe during and after pipe laying operation. Pipe that is not in alignment or shows excessive settlement after laying shall be removed and re-laid without extra compensation.

2. Lay multiple installation of thermoplastic pipe with the centerlines of the individual barrels parallel. Unless otherwise shown on the Contract Documents, the clear distance between outer surfaces of adjacent pipes shall conform to the minimum requirements of Table 2.

TABLE 2
MINIMUM CLEAR DISTANCE BETWEEN PIPES

Nominal Pipe Diameter (in.)	Minimum Clear Distance Between Pipes (in.)
18	14
24	17
30	20
36	23
42	26
48	29
60	32

- B. Installing Pipe in Embankment: If any portion of the pipe projects above the existing ground level, an embankment shall be constructed as shown on the Contract Documents or as directed by City, for a minimum distance outside each side of the pipe location of 5 times the diameter and to a minimum elevation of 2 feet above the top of the pipe. Excavate the trench in accordance with Section 02317 - Excavation and Backfill for Utilities.

- C. Reusing Existing Appurtenances
 - 1. When existing appurtenances are specified for reuse in the Contract Documents, the portion to be reused shall be separated from the existing culvert and moved to the new position previously prepared, by approved methods.

 - 2. Connections shall conform to the requirements for joining sections of pipes as indicated in this Section or as shown in the Contract Documents. Headwalls and aprons for pipes attached to the headwall that are damaged during moving operations shall be repaired to their original condition, at no expense to the City. The Contractor has the option to remove and dispose of the existing headwalls and aprons and construct new headwalls at no expense to the City, in accordance with the pertinent specification and design indicated in the Contract Documents or as furnished by the City.

- D. Sewer Connections and Stub Ends. Connect pipe sewer to existing sewer or sewer appurtenances as shown on the Contract Documents or as directed by the City. Mortar or concrete the bottom of existing structures, if necessary, to eliminate any drainage pockets created by the new connection. Any damage to existing structures, which are to remain in service from making the pipe sewer connection, shall be restored to the satisfaction of the City. Stub ends for connection to future work not shown on the Contract Documents shall be sealed by installing watertight plugs into the free end of the pipe. Stub end seals shall be included in the cost of the pipe.

- E. Bedding and Backfilling
 - 1. Conform to requirements of Section 02317 – Excavation and Backfill for Utilities.

- F. Protecting the Pipe
 - 1. Unless otherwise shown on the Contact Documents, or permitted in writing, heavy earthmoving equipment shall not be operated over the structure until a minimum of 4 feet of permanent or temporary compacted fill is placed over the top of the structure.

2. Before adding each new layer of loose backfill material, an inspection shall be made of the inside periphery of the structure for local or unequal deformation caused by improper construction methods until a minimum of 12 inches of cover is obtained. Evidence of local or unequal deformation will be reason for corrective measures to be completed when directed by the City.

- G. Thermoplastic pipe damaged by the Contractor shall be removed and replaced at no expense to the City.

3.05 INSPECTION AND ACCEPTANCE

- A. Conform to requirements of following Sections:

1. Section 02631 – Storm Sewers.

- B. Inspection

1. The Contractor shall visually inspect pipes for damage, deflection (out of roundness), joint tightness, evidence of soil intrusion, and vertical alignment (ponding). If the pipe run is 30 feet or less in length, not under a roadway, and the initial visual inspection did not indicate any deflection or other deficiencies, additional testing described below shall be waived, unless otherwise noted. The Contractor shall use high intensity lights, laser distant measuring devices, and other equipment to facilitate visual inspection.
2. Final inspection shall be performed a minimum of 30 days after the backfill has been completed or earlier as needed to allow roadway surfacing when approved. Two test mandrels shall be available for each size of pipe. Size mandrels based on the inside diameter as outlined in ASTM F2881, Table 2. Metal mandrels shall have at least nine fixed fins evenly distributed around the circumference. A mandrel sized at 95% the pipe diameter shall be pulled through the entire length. If the 95% mandrel cannot be pulled entirely through, a mandrel sized at 92.5% the pipe diameter shall be pulled through the pipe. Additionally, if the 95% mandrel cannot be pulled entirely through the pipe or there is a substantial disruption in ease of mandrel movement through the pipe, visually inspect installed pipe utilizing a remote operated camera mounted on vehicle or sled able to move through the pipe. Check for joint separation, cracks, tears, buckling, deflection, and out of roundness, evidence of soil intrusion and vertical alignment (ponding water).
3. The Contractor shall notify the City when inspections are to occur.
4. The Contractor shall provide a letter to the City stating the thermoplastic pipes

were installed, inspected, and tested in compliance with the Contract Documents. The letter shall include copies of inspections and mandrel test results.

- C. Remediation: The Contractor shall develop a plan to address all deficiencies of joint separation, damage, evidence of soil intrusion, vertical alignment, and when pipe deflection exceeds 5% of the nominal pipe diameter.
1. Joints: Remediate pipe showing evidence of crushing at the joints. Note differential movement, improper joint sealing, movement or settlement of pipe sections, and leakage in the inspection report. Remediate joint separation of greater than 1 inch. Repair or replace pipe sections where soil migration through the joint is occurring.
 2. Cracks or Tears: Remediate cracks or splits in the interior wall of the pipe. Use remediation methods in conformance with recommendations of the pipe manufacturer and accepted and authorized by the City.
 3. Buckling, Bulging, and Racking: Note in the inspection report flat spots or dents at the crown, sides, or flowline of the pipe due to racking. Note area of wall buckling and bulging in the inspection report. The City will determine if corrective action is necessary.
 4. Deflection: Where pipe deflection exceeds 5% of the nominal diameter, submit to the City for review and approval an evaluation utilizing a Professional Engineer taking into consideration the severity of the deflection, structural integrity, environmental condition, and the design service life of the pipe. Remediate or replace pipe where the evaluation finds the deflection could be problematic or where pipe deflection exceeds 7.5% of the nominal diameter.

END OF SECTION