

Special Specification 4115

Thermoplastic Pipe



1. DESCRIPTION

Furnish and install thermoplastic pipe for constructing thermoplastic pipe culverts. Provide pipes of the sizes, types, design, and dimensions shown on the plans including the connections and joints to new or existing pipes, sewer, manholes, inlets, headwalls, and other appurtenances as required to complete the work.

2. MATERIALS

Furnish materials in accordance with the following:

- Item 400, "Excavation and Backfill for Structures,"
- Item 401, "Flowable Backfill,"
- Item 460, "Corrugated Metal Pipe,"
- Item 464, "Reinforced Concrete Pipe," and
- Item 467, "Safety End Treatment."

Unless otherwise specified on the plans or in this Item, provide thermoplastic pipe and joint fittings that conform to the following:

2.1. High Density Polyethylene (HDPE) Pipe.

2.1.1. **General.** Provide high density polyethylene pipe from a manufacturer certified to the National Transportation Project Evaluation Program (NTPEP) for HDPE Thermoplastic Pipe. Provide high density polyethylene pipe and fittings meeting the requirements in AASHTO M 294.

2.1.2. **Raw Materials.** Provide HDPE pipes and fittings manufactured from virgin polyethylene (PE) compounds, conforming to the requirements of cell class 335400C as defined and described in ASTM D 3350, except that the maximum allowable carbon black content is 5%. Use PE compound meeting the environmental stress crack resistance according to the SP-NCTL test set forth in AASHTO M 294.

2.1.3. **Designation of Type.** For HDPE pipes used in gravity flow drainage applications, use Type S (outer corrugated wall with smooth inner liner) or Type D (inner and outer smooth walls braced circumferentially or spirally with projections or ribs).

2.1.4. **Section Properties.** The minimum wall thickness of the inner walls of Type S pipe and inner the outer walls of Type D pipe is specified in Section 7.2.2 of AASHTO M 294. The pipe stiffness at 5% deflection, when determined in accordance with ASTM D 2412, is specified in Section 7.4 of AASHTO M 294.

2.2. Polyvinyl Chloride (PVC) Pipe.

2.2.1. **General.** Provide polyvinyl chloride pipes and fittings meeting the requirements of ASTM F 949.

2.2.2. **Raw Materials.** Provide PVC pipes and fittings manufactured from PVC compounds which conform to the requirements of cell class 12454B or 12454C as defined and described in ASTM D 1784.

2.2.3. **Section Properties.** The minimum wall thickness is specified in ASTM F 949, Table 1. The pipe stiffness at 5% deflection, when determined in accordance with ASTM D 2412, is specified in ASTM D 2412, Table 1.

Ensure the manufacturer performs the appropriate test procedures on representative samples of each type of pipe furnished, and verifies that the pipe complies with the specifications. Submit a certificate of compliance to the Engineer for review and approval. Provide a certificate including the following information: 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.

- 2.3. **Inspection.** The quality of materials, the process of manufacture, and the finished pipe will be subject to inspection and approval by the Engineer at the manufacturing plant. In addition, the finished pipe will be subject to further random inspection by the Engineer at the project site before and during installation.
- 2.4. **Marking.** Furnish pipe clearly marked at maximum 12 ft. intervals and clearly mark fittings and couplings as follows:
- manufacturer's name or trade mark,
 - nominal size,
 - specification designation (e.g. AASHTO M 294 or ASTM F 949),
 - plant designation code, and
 - date of manufacture.
- 2.5. **Joints.** Install the joints so that the connection of the pipe sections forms a continuous line free from irregularities in the flow line.

Suitable joints are the following:

- Integral Bell and Spigot. Ensure the bell overlaps a minimum of 2 corrugations of the spigot end when fully engaged. Ensure the spigot end has an O-ring gasket that meets ASTM F 477.
- 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. Provide the spigot end with an O-ring gasket that meets ASTM F 477.

Joint type definitions are the following:

- Soiltight Joints. Joints meeting the soiltightness definition in accordance with AASHTO *Standard Specifications for Highway Bridges*, Section 26.4.2.4.
- Watertight Joints. Joints meeting the requirements of ASTM 3212.

If no joint type is specified, provide a watertight joint.

- 2.6. **End Sections.** For pipe installations beneath paved public roadways, provide non-flammable end sections of the minimum length shown in Table 1 for each exposed pipe end. Minimum length shown in the table refers to the portion of pipe completely embedded into the embankment or natural ground. All exposed and mitered pipe sections must consist of the same non-flammable material.

Unless otherwise specified on the plans, non-flammable end sections must be corrugated metal as described in Item 460, "Corrugated Metal Pipe," reinforced concrete as described in Item 464, "Reinforced Concrete Pipe," or other non-flammable material deemed acceptable by the Engineer.

Table 1
Minimum Length of Non-Flammable End Section

Nominal Pipe Diameter (in.)	Minimum Length of End Section (ft.)
18	4
24	4
30	5
36	6

2.7 **Aprons.** For pipe installations beneath paved public roadways, provide non-flammable aprons consisting of concrete riprap or other approved material at each exposed pipe end. Limits of the aprons are shown in Figure 1.

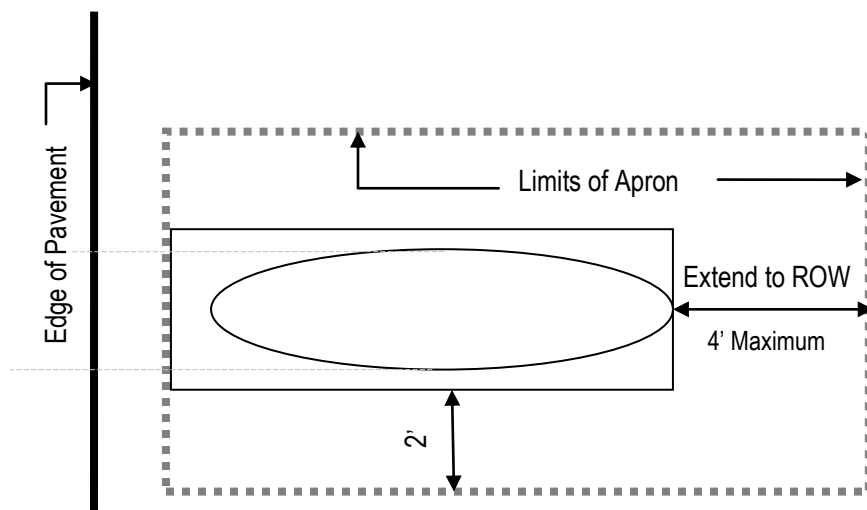


Figure 1
Limits of Non-Flammable Apron

3. CONSTRUCTION

Construct the pipe at locations shown on the plans or as directed. Only trench installation of thermoplastic pipe will be permitted.

3.1. **Excavation.** Excavate in accordance with Item 400, "Excavation and Backfill for Structures."

Provide enough trench width for the pipe installation and to ensure enough working room to properly and safely place and compact materials 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.

When using Type I backfill, the minimum allowable trench width is the pipe outside diameter plus 12 in.

When using Type II or Type III backfill, the minimum allowable trench width is specified in Table 2.

Table 2
Minimum Trench Width

Nominal Pipe Diameter (in.)	Minimum Trench Width (in.)
18	44
24	54
30	66
36	78

- 3.2. **Installing Pipe in Embankment.** If any portion of the pipe projects above the existing ground level, construct an embankment as shown on the plans or as directed, for a minimum distance outside each side of the pipe location of 5 times the diameter and to a minimum elevation of 2 ft. above the top of the pipe. Next, excavate the trench to a width as specified in Section 3.1. In areas with a high water table, install the thermoplastic pipe in accordance with the manufacturer's recommendations to prevent pipe floatation.
- 3.3. **Shaping and Bedding.** Bed the pipe in a foundation of compacted cohesionless material, such as sand, crushed stone, or pea gravel, with a maximum allowable size of 1 in. Extend this material a minimum of 6 in. below the outermost corrugations or ribs, and carefully and accurately shape it to fit the lowest part of the pipe exterior for a minimum of 10% of the overall height. When requested by the Engineer, furnish a template for each size and shape of pipe to be placed for use in checking the shaping of the bedding. Provide a template consisting of a thin plate or board cut to match the lower half of the cross section of the pipe.
- 3.4. **Handling and Storing Pipe.** Store pipe above ground on adequate blocking. Always keep pipe clean and fully drained during storage. Store the PVC pipe and fittings out of direct sunlight. Handle and store thermoplastic pipe in accordance with the pipe manufacturer's instructions. Provide proper facilities for hoisting and lowering the pipe into the trench without damaging the pipe or disturbing the bedding or the walls of the trench.
- 3.5. **Laying Pipe.** Unless otherwise authorized, start laying pipe on the bedding at the outlet end with the separate sections firmly joined together. Hoist and lower sections of pipe into the trench without damaging the pipe or disturbing the bedding or the sides of the trench. Remove and re-lay any pipe that is not in alignment or that shows excessive settlement after laying, at no expense to the Department.

Lay multiple installation of thermoplastic pipe with the centerlines of the individual barrels parallel. Unless otherwise shown on the plans, maintain the clear distances between outer surfaces of adjacent pipes shown in Table 3.

Table 3
Minimum Clear Distance Between Pipes

Nominal Pipe Diameter (in.)	Min. Clear Distance Between Pipes (in.)
18	14
24	17
30	20
36	23

- 3.6. **Connecting End Sections.** Where non-flammable end sections are required, connect the thermoplastic pipe to those sections utilizing prefabricated connections or other approved methods. The resulting connection must be soil and water-tight.
- 3.7. **Reusing Existing Appurtenances.** When existing appurtenances are specified on the plans for reuse, sever the portion to be reused from the existing culvert and move it to the new position previously prepared, by approved methods.
- Provide connections conforming to the requirements for joining sections of pipes as indicated in this specification or as shown on the plans. Restore any headwalls and any aprons or pipes attached to the headwall that are damaged during moving operations, to their original condition, at no expense to the Department. The Contractor has the option to remove and dispose of the existing headwalls and aprons and construct new headwalls at no expense to the Department, in accordance with the pertinent specifications and design indicated on the plans or as furnished by the Engineer.
- 3.8. **Sewer Connections and Stub Ends.** Make connections of pipe sewer to existing sewers or sewer appurtenances as shown on the plans or as directed. Mortar or concrete the bottom of the existing structures, if necessary, to eliminate any drainage pockets created by the new connection. Where the sewer is connected into existing structures which are to remain in service, restore any damage to the existing

structure resulting from making the connection to the satisfaction of the Engineer. Seal stub ends, for connections to future work not shown on the plans, by installing watertight plugs into the free end of the pipe. Include the cost for the above in cost of the pipe.

- 3.9. **Backfilling.** Backfill from the pipe bedding up to 1 ft. above the top of the pipe to provide necessary structural support to the pipe and control pipe deflection. Take special precautions when placing and compacting the backfill material. Place special emphasis obtaining uniform backfill material and uniform compacted density throughout the length of the pipe, to avoid unequal pressure. Use extreme care to ensure proper backfill under the pipe, in the haunch zone.

Provide backfill material meeting the following specifications:

- Type I – Provide backfill consisting of flowable fill in accordance with Item 401, “Flowable Backfill.” Place the flowable backfill across the entire width of the trench and maintain a minimum depth of 12 in. above the pipe. Wait a minimum of 24 hr. before backfilling the remaining portion of the trench with other backfill material in accordance with Item 400, “Excavation and Backfill for Structures.”
- Type II – Provide backfill consisting of cement stabilized backfill in accordance with Section 400.3.3.4, “Cement Stabilized Backfill.” Place and compact cement stabilized backfill to completely fill any voids.
- Type III – Provide backfill consisting of hard, durable, clean granular material that is free of organic matter, clay lumps, and other deleterious matter. Provide backfill meeting the gradation requirements shown in Table 4. Place the backfill material along both sides of the completed structure to a depth of 12 in. above the pipe. Place the backfill in uniform layers a minimum 6 in. deep (loose measurement), wet if required, and thoroughly compact it between adjacent structures and between the structure and the sides of the trench. Until a minimum cover of 12 in. is obtained, only hand-operated tamping equipment will be allowed within vertical planes 2 ft. beyond the horizontal projection of the outside surfaces of the structure. If using Type III backfill, place filter fabric between the native soil and the backfill. Use filter fabric conforming to the requirements of DMS-6200, “Filter Fabric,” Type 1.

Table 4
Gradation Requirements for Type III Backfill Material

Sieve Size	Percent Retained (Cumulative)
1 in.	0-5
7/8 in.	0-35
1/2 in.	0-75
3/8 in.	0-95
No. 4	35-100
No. 10	50-100
No. 200	90-100

- 3.10. **Protecting the Pipe.** Unless otherwise shown on the plans or permitted in writing, do not use heavy earth-moving equipment over the structure until a minimum of 4 ft. of permanent or temporary compacted fill is placed over the top of the structure.

Before adding each new layer of loose backfill material, until a minimum of 12 in. of cover is obtained, an inspection will be made of the inside periphery of the structure for local or unequal deformation caused by improper construction methods. Evidence of such will be reason for corrective measures as may be directed.

Remove and replace pipe damaged by the Contractor at no expense to the Department.

4. MEASUREMENT

This Item will be measured by the foot. Measurement will be made between the ends of the pipe barrel along the flow line, including non-flammable end sections, but not including safety end treatments or non-flammable aprons. Safety end treatments will be measured in accordance with Item 467, "Safety End Treatment." Measurement of spurs, branches, or connections to existing pipe will be made from the intersection of the flow line with the outside surface of the pipe into which it connects.

Where inlets, headwalls, catch basins, manholes, junction chambers, or other structures are included in lines of pipe, the length of pipe tying into the structure wall will be included for measurement, but no other portion of the structure length or width will be included.

For multiple pipes, the measured length will be the sum of the lengths of the barrels.

This is a plans quantity measurement Item. The quantity to be paid for is the quantity shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Thermoplastic Pipe" of the size and backfill type specified. This price is full compensation for furnishing, hauling, placing, and joining pipes, including non-flammable end sections and aprons; connecting to new or existing structures; moving and reusing headwalls where required; removing and disposing of portions of existing structures as required; cutting of pipe ends on skew; and labor, tools, equipment, and incidentals.

Excavation, shaping, bedding, and backfill will be paid for in accordance with Item 400, "Excavation and Backfill for Structures."

Type I backfill will be paid in accordance with Item 401, "Flowable Backfill."

Safety end treatment will be paid for in accordance with Item 467, "Safety End Treatment." The portion of non-flammable apron extending beyond the limits of safety end treatment will not be paid for separately.