

SECTION 600 INCIDENTAL CONSTRUCTION

SECTION 601—PIPE CULVERTS

601.1 DESCRIPTION—This work is construction or reconstruction and cleaning of pipe culverts, and storm drains; including the direct design, manufacturing and testing of reinforced concrete pipes.

601.2 MATERIAL—

(a) Pipes. Comply with the following:

1. **Certification.** [Section 106.03\(b\)3](#)
2. **Size and Type of Pipe.** As indicated.
3. **Reinforced Concrete (RC) Pipe.**

3.a Round and Elliptical Reinforced Concrete Pipe. [Publication 280M\(280\)](#). Provide RC pipe conforming to [BD-636M](#), PENNDOT Design Manual Part 4M, Appendix H, and the Pennsylvania Installation Direct Design (PAIDD) computer program. Manufacture and test according to [Publication 280M \(280\)](#).

3.b Plant Acceptance.

3.b.1 General. Do not begin fabrication before the Structural Materials Engineer's inspection and acceptance of the plant. Provide a permanent building offered for the Department's acceptance.

Currently accepted plants will retain approved status, unless the acceptance is rescinded for failure to comply with the specified plant requirements, or unless ownership is changed. Reinstatement is based on owners conforming to the requirements as stated herein.

Material, equipment, test procedures, methods of fabrication, handling, storage, and transportation are subject to inspection.

3.c QC.

3.c.1 General. Establish a level of QC based on uniform production practices. Submit the plant's QC Plan and mix design(s) to the Structural Materials Engineer, MTD, for review and approval. Include with the QC Plan a company organizational chart indicating a separate chain of command from the QC Manager to the Owner/Plant Manager independent of the Production Manager. Resubmit the QC Plan, mix design, and/or organizational chart, when required, due to changes in processes, materials, or personnel.

3.c.2 QC Manager. Provide a QC Manager who has the overall responsibility for the adequacy of production facilities, QC, sampling, and testing, and fabrication of the product, and who will ensure that items are fabricated as designed and specified.

3.d Testing and Inspection.

3.d.1 Testing. Publication 280M (280).

3.d.2 Inspection. Publication 280M(280). Provide the necessary pipe inspection equipment. Before installation, pipes may have non-through wall cracks of less than 80 μm (0.003 inch) in width. Any pipe having both an unloaded surface crack width of 80 μm (0.003 inch) or greater and extending 300 mm (12 inches) or longer, will be rejected. To determine whether rejection or remediation is required, measure crack widths with leaf

gages as described in AASHTO T 280. Use gages having a thickness of 80 μm (0.003 inches) to determine pipe acceptability before installation.

4. Metal Pipes.

4.a Ductile Iron Pipe. [ASTM A 716](#)

4.b Corrugated Steel Pipe, Metallic Coated. AASHTO M 36/M 36M, Types I and IR; AASHTO M 218; AASHTO M 274; and AASHTO M 289

4.c Corrugated Aluminum Alloy Pipe. AASHTO M 196, Types I and IR

4.d Coated Corrugated Galvanized Steel Pipe. AASHTO M 245/M 245M, Type I; AASHTO M 246/M 246M; and AASHTO M 218. Fabricate pipes with coatings as follows:

- Grade 250/250 (Grade 10/10)—250 μm (10 mil) coating on all surfaces.

5. Half-Circle Pipe. Conforming to the requirements of the type indicated, except modified to meet the half-circle configuration.

6. Thermoplastic Pipes. Provide cell class of material (actual and minimum), minimum pipe stiffness, and the dimension ratio, when applicable, if not included in pipe markings.

6.a Group I. 4.5 m (15-foot) maximum fill—0.5 m (1.5-foot) minimum cover

6.a.1 Polyethylene.

- [ASTM F 714](#), Type S, SDR
- [ASTM F 714](#), Type S, SDR=26, cell class 335434C, 525 mm (21-inch) diameter—1200 mm (48-inch) diameter only
- [ASTM F 894](#), Type S, RSC=100, cell class 335434C, 900 mm (36-inch) maximum diameter
- [ASTM F 894](#), Type S, RSC=160, cell class 335434C, 450 mm (18-inch) diameter—1050 mm (42-inch) diameter only

6.a.2 Polyvinyl Chloride.

- [ASTM F 794](#), Type S, PS=46, cell class 12454C or 12364C, 1200 mm (48-inch) diameter maximum
- AASHTO M 304, Type S, cell class 12454C, 1200 mm (48-inch) maximum diameter
- AASHTO M 304, Type S, cell class 12364C, 450 mm to 1200 mm (18-inch to 48-inch) diameter
- [ASTM F 679](#), Types S, T1, or T2, PS=46, cell class 12364C or 12454C, 900 mm (36-inch) maximum diameter
- AASHTO M 278, Type S, cell class 12454B, 300 mm (12-inch) diameter and 375 mm (15-inch) diameter only

6.b Group II. 3.5 m (12-foot) maximum fill—0.5 m (1.5-foot) minimum cover. [Section 601.2\(a\)6.a](#) and as follows:

6.b.1 Polyethylene. [ASTM F 894](#), Type S, RSC=100, cell class 335434C, 1050 mm (42-inch) diameter

6.c Group III. 2.5 m (8-foot) maximum fill—0.6 m (2-foot) minimum cover. [Section 601.2\(a\)6.a](#) and as follows:

6.c.1 Polyethylene.

- AASHTO M 294M, Types D and S, cell class 335400C, 750 mm (30-inch) maximum diameter; and 1998 AASHTO LRFD Bridge Design Specifications (with 2001 interims) Chapter 12.

6.c.2 Polyvinyl Chloride.

- AASHTO M 304, cell class 12364C, 300 mm (12-inch) diameter and 375 mm (15-inch) diameter

6.d Group IV. 2.0 m (7-foot) maximum fill—0.8 m (2.5-foot) minimum cover.

6.d.1 Polyethylene.

- AASHTO M 294M, Types D and S, cell class 335400C, 900 mm (36-inch), 1050 mm (42-inch), 1200 mm (48-inch); and 1998 AASHTO LRFD Bridge Design Specifications (with 2001 interims) Chapter 12.
- AASHTO M 294M, Type S, cell class 335400C, 1350 mm (54-inch) and 1500 mm (60-inch) diameters; and 1998 AASHTO LRFD Bridge Design Specification (with 2001 interims) Chapter 12.

6.e Group V. 2.0 m (7-foot) maximum fill—0.8 m (2.5-foot) minimum cover

6.e.1 Polyethylene.

- AASHTO M 294M, Type C, cell class 335400C, 600 mm (24-inch) maximum diameter

6.f Group VI. 4.5 m (15-foot) maximum fill—0.6 m (2.0-foot) minimum cover

6.f.1 Polyethylene.

- AASHTO M 294M, Types D and S, cell class 335400C; and 1998 AASHTO LRFD Bridge Design Specifications (with 2001 interims) Chapter 12.

(b) Other Material.

- Premolded Expansion Joint Filler—[Section 705.1](#)
- Mortar—[Section 705.7\(a\)](#)
- Caulking Compound—[Section 705.8\(a\)](#)
- Preformed Pipe Joint Gaskets—[Section 705.5\(b\)](#)

- Cement Concrete for Miscellaneous Drainage—[Section 704](#)
- Reinforcement Steel—[Section 709](#)
- Coarse Aggregate—Type C or better, [Section 703.2](#)
- Curing Compound—[Section 711.2](#)
- Curing and Protecting Covers—[Section 711.1](#)
- Bituminous Paint—Federal Specification TT-V-51F. Certify as specified in [Section 106.03\(b\)3](#).
- Zinc Chromate Primer—Federal Specification TT-P-645. Certify as specified in [Section 106.03\(b\)3](#).
- Flowable Backfill—[Section 220.1\(a\)](#)
- Geotextile, Class 4, Type A—[Section 735](#)

(c) Grout. Mix one part cement and two parts fine aggregate with the minimum amount of water necessary to obtain grout of the required consistency containing 3% to 7% entrained air. The Contractor may use air entraining cement in place of the plain cement and air entraining admixture. Use materials conforming to the following requirements:

- Cement—[Section 701](#)
- Fine Aggregate—Type A or C, [Section 703.1](#)
- Water—[Section 720.1](#)
- Admixtures—[Section 711.3](#)

601.3 CONSTRUCTION—As shown on the [Standard Drawings](#) and as follows:

(a) General. Provide 300 mm (12-inch) minimum cover from top of finished pavement grade to top of pipe barrel. Construct the embankment to 1.2 m (4 feet) above the top of pipe elevation or to subgrade, whichever is less, before excavating for the pipe. Do not haul over pipe with less than 1.2 m (4 feet) of cover. Maintain a minimum pipe slope of 0.35% unless otherwise specified.

If running water is encountered and cannot be diverted, provide an acceptable temporary pipe or other structure before placing embankment, or as otherwise directed.

(b) Trench and Bedding. Excavate trench and construct bedding as shown on the [Standard Drawings](#). Compact the bottom of the trench before placement of bedding material. If flowable backfill material is used, provide support for pipe as specified in [Section 220.3\(b\)2](#).

(c) Laying Pipe. Lay pipe as shown on the [Standard Drawings](#) before constructing base course or pavement. Lay pipe with bells or grooves up grade in shaped recesses when required, spigot ends fully entered into the hubs. Begin placement of the pipe at the outlet end with a full length of pipe and continue towards the inlet end, unless otherwise directed. Fill lift holes with a manufactured lift hole plug that is soil-tight

Control the pipe alignment and grade with suitable string lines, with an electronic laser beam system, or by other acceptable methods.

Camber the grade line to offset anticipated settlement due to the height of embankment and bedding used, if directed.

On straight-line pipe placements, join pipe sections within 20 mm/m (1/4 inch per foot) of inside diameter or 25 mm (1 inch), whichever is less. Join pipes placed on a radius to within these tolerances as measured at a point

halfway up the pipe, springline, along the interior of the curve. For pipe runs placed on curves with a radius less than 700 m (765 yards) (greater than 2 degrees, 30 minutes) use shorter lengths of precast pipe to minimize the joint gap.

If pipes are protected by endwalls or connected with drainage structures, place exposed pipe end within cast-in-place wall or cut off flush with precast structure face and finish with mortar, as directed. Provide satisfactory connections to existing drainage structures.

Coat all aluminum surfaces that will be embedded into concrete with one coat of zinc chromate primer, or a coat of bituminous paint. Allow coating to dry completely before placement of concrete.

(d) Joints. Lay pipe, except interlocking style and pipe joined with bands, with pipe joint caulk or preformed pipe joint gaskets as follows:

1. Pipe Joint Caulk. Before placing succeeding pipe sections, place the caulk on the inside of the bell end of the pipe, such that a sufficient layer of material is placed around the entire circumference of the pipe. After the joint is assembled, remove excess caulk on the inside of the pipe, such that the flow of water is not obstructed and seal the outside circumference of the joint.

2. Preformed Pipe Joint Gaskets. Before placing succeeding pipe sections, place preformed pipe joint gaskets according to manufacturer's recommendation.

(e) Elongation of Metal Pipes. When indicated, elongate metal pipe vertically 5%, using acceptable shop methods. Elongate coated pipe by acceptable shop methods only. Satisfactorily repair coating damaged by elongation procedures.

(f) Backfilling Trench. After the pipe is laid, backfill the trench as shown on the [Standard Drawings](#). Place material in 100 mm (4-inch) layers. However, 200 mm (8-inch) layers will be permitted if vibratory compaction equipment is used. Compact each layer of backfill to the density shown on the [Standard Drawings](#) to a height of 1.2 m (4 feet) above the top of the pipe, for the full trench width. Use mechanical tampers or other acceptable compaction equipment that will not damage the pipe. Do not use excavator-mounted hydraulic plate compactors. Compact backfill material to the density shown on the Standard Drawing as determined by Standard Proctor Density (SPD). Test as specified in [Section 206.3\(b\)1](#). Test the coarse aggregate backfill for reinforced concrete pipe before placing remaining backfill. If flowable backfill material is used, backfill the trench as shown in the Flowable Backfill Detail on the [Standard Drawings](#), and as specified in [Section 220.3](#).

(g) Shored or Trench Box Installation. Construct shored or trench box installation where indicated and as specified in [Section 107.08](#). Construct shored or trench box installation as required for reinforced concrete pipe.

Construct shored or trench box installations for thermoplastic or metal pipe as follows:

- Leave trench sheeting in place to prevent loss of foundation support and backfill materials unless otherwise directed. When the top of trench sheeting is to be cut off, make the cut 460 mm (18 inches) or more above the crown of the pipe. Leave rangers, walers, and braces in place as required to support the cut off sheeting and trench wall in the vicinity of the pipe zone. Leave timber sheeting in place. Treat timber sheeting against biological degradation and decay if placed above the ground water table.
- Do not disturb the installed pipe and its embedment when using movable trench boxes and shields. Do not use movable supports below the top of the pipe backfill pay limit zone unless approved methods for maintaining the integrity and level of compaction of the backfill material are used. Before moving supports, place and compact embedment to sufficient depths to ensure protection of the pipe. Finish placing and compacting the backfill material as supports are moved.
- If the use of sheeting or other trench wall supports is permitted below the pipe backfill pay limit zone, ensure that pipe, bedding, and backfill materials are not disturbed by support removal. Fill voids left upon removal of supports and compact all material to required densities.

(h) Jacked Pipe. Jack pipe by means of conventional tunneling or boring methods, when indicated. Before commencement of this work, submit a complete plan and schedule for pipe installation. Include complete details of

sheeting, shoring, and bracing for the protection of facilities above the pipe, as well as materials and equipment pertinent to the jacking operation. Do not proceed with pipe installation until the plan and schedule are accepted.

Do not disturb facilities or cause settlement of the ground above the pipe. Provide free and unobstructed use of facilities above the pipe, without delay or danger to life, equipment, or property.

Install pipe immediately following the heading or tunneling excavation. After completion of the jacking operation, fill voids around the pipe with grout placed under pressure. Properly protect the grout for at least 3 days.

Place joint sealant material on concrete pipe in front of the jacking frame. Replace or repair pipe damaged during the jacking operations as directed. If steel casing pipe is used, butt-weld the joints as installation progresses. Make joints watertight.

If it is determined that the pipe installation is being conducted in an unsatisfactory manner, stop this work and place a bulkhead at the heading until an alternate procedure is proposed and accepted.

(i) Extension of Existing Pipe. If extensions of pipe culverts or drains are indicated or required, remove the existing endwalls as directed. Cut the existing pipe to a true edge, as required, to make a satisfactory joint. Join the new pipe to the existing pipe or endwalls, using acceptable collars constructed of Class A Concrete or acceptable metal connecting bands. Clean the existing pipe, as specified in [Section 601.3\(j\)](#). Repair or replace existing pipe damaged during construction.

As an alternate to removing the endwall, if permitted, extend the pipe using a concrete collar for pipe extension, as specified in [Section 618](#).

(j) Cleaning Existing Pipes. Clean existing pipe culverts, as indicated and as directed, before the start of roadway paving operations. Clean inlets, bridge scuppers and piping, manholes, endwalls, and other drainage appurtenances connected to the pipes, as directed. Clean in an acceptable manner and repair damage resulting from the cleaning operation. Remove any material deposited in inlets during paving operations. Prevent material cleaned from the drainage system from entering streams or other bodies of water, and dispose of this material in a satisfactory manner.

(k) Relaid Pipe. Remove and clean existing pipes as indicated, and have them inspected by the Representative. Transport and relay accepted existing pipes at the indicated locations, in the same manner specified for new pipes.

(m) Removal and Replacement. Remove and replace pipe that is not true to alignment, shows settlement after installation, or is broken or damaged.

(n) Final Inspection of Pipes. Before final acceptance, inspect all of the following types of installed pipe with total load applied. Provide pipe inspection equipment and inspect all pipes over 750 mm (30 inches) in diameter from inside the pipe. Inspect 450 mm (18-inch) to 750 mm (30-inch) diameter pipes from access points. Provide written documentation of all inspections to the Representative within 72 hours following each inspection. Provide training to Contractor personnel and Department personnel and provide all safety and testing equipment required by OSHA, Section 1910.146, to both department representatives and Contractor personnel to ensure the safety of all the workers and inspectors during pipe inspections. Also, provide certification of training for the individuals doing the inspections on the proper use of the testing equipment and all safety procedures to ensure a safe operation.

1. Concrete Pipes. Provide pipe gages, as specified in [Section 601.2\(a\)3.d.2](#), and inspect concrete pipes for [signs of damage](#) including cracks greater than 180 μm (0.007 inch) in width, spalls, damaged or cracked ends, and visible reinforcement. Submit a plan for repair or replacement as specified in [Section 601.3\(o\)](#) for approval.

2. Metal Pipes. Inspect metal pipes for damage including rust, cracking of coatings, damaged galvanization or lining, loose bolts, and areas of local buckling. Repair damaged coatings according to AASHTO M 36/M 36M and AASHTO M 245/M 245M. Develop a repair or replacement plan as specified in [Section 601.3\(o\)](#) for damage repairs not covered by AASHTO M 36/M 36M or AASHTO M 245/M 245M, buckling, or other major damage, and submit it for approval.

3. Thermoplastic Pipes. Inspect thermoplastic pipes for cracking and joint separation, and perform deflection testing at least 30 days after the embankment is completed. If the pipe run is 12 m (40 feet) or less in length, not under the roadway, and the initial visual inspection does not indicate any deflection or other deficiencies, additional testing will be waived. In all other cases, perform the deflection testing using either electronic

deflectometers, calibrated television or video cameras, properly sized “go, no-go” mandrel, direct measurement by extension rulers or tape measures in pipes that allow safe entry, or other acceptable devices. Perform deflection testing at a minimum if pipe cannot be physically inspected. Develop a remediation or replacement plan as specified in [Section 601.3\(o\)](#) if deflection is greater than 5% of the unloaded inside diameter of the pipe, or cracking or joint separation is found, and submit it for approval.

(o) **Remediation.** Remedial action may include but is not limited to removal and replacement or an accepted repair procedure.

601.4 MEASUREMENT AND PAYMENT—

(a) Pipe Culverts and Relaid Pipe Culverts. Meter (Linear Foot)

Measured to the point of centerline intersection of “T,” “Y,” and other branches. The unit price includes the pipe, the bedding material, and the backfill as shown on the [Standard Drawings](#). Furnishing personnel and equipment for dewatering operations, inspection of pipes, and all remedial measures are incidental to the pipe items.

If the pipe item for shore/trench box is indicated or required; the unit price includes placement and removal or keeping in place of shoring, supports, shield systems and trench boxes as specified in [Section 601.3\(g\)](#).

(b) Half-Circle Pipe. Meter (Linear Foot)

(c) Cement Concrete for Miscellaneous Drainage. Cubic Meter (Cubic Yard)

As indicated, for the class specified, for the item indicated.

The unit price includes reinforcement when required.

(d) Class 1 Excavation. Cubic Meter (Cubic Yard)

Pay limits as shown on the [Standard Drawings](#).

(e) Class 2 Excavation. Cubic Meter (Cubic Yard)

For Half-Circle Pipe including bedding and anchors.

(f) Class 4 Excavation. Cubic Meter (Cubic Yard)

Pay limits as shown on the Standard Drawing for pipe culverts and relaid pipe culverts. Where inlets are installed, measurement terminates 300 mm (1 foot) from the outside face of the inlet wall.

(g) Cleaning Existing Pipe Culverts. Meter (Linear Foot)

Measured from inlets, manholes, endwalls, and other drainage appurtenances along the pipe centerline.

Pay items will establish a break point based on the sizes of pipes to be cleaned. The Department will pay for cleaning of pipe culverts having diameters up to and including 900 mm (36 inches) under one pay item, and cleaning of pipe culverts having diameters over 900 mm (36 inches) under a separate pay item.

(h) Jacked Pipe. Meter (Linear Foot)

The unit price includes excavation.

(i) Flowable Backfill Material. As indicated, for all pipe installations, flowable backfill and geotextile are incidental to meter (linear foot) of pipe payment.