Standard Specification for

Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

AASHTO Designation: M 294-21

Technically Revised: 2021

Technical Subcommittee: 4b, Flexible and Metallic Pipe

American Association of State Highway and Transportation Officials
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1. SCOPE

1.1. This specification covers the requirements and methods of tests for corrugated polyethylene (PE) pipe, couplings, and fittings for use in surface and subsurface drainage applications.

1.1.1. Nominal sizes of 300 to 1500 mm (12 to 60 in.) are included.

1.1.2. Materials, workmanship, dimensions, pipe stiffness, slow-crack-growth resistance, joining systems, brittleness, perforations, and form of markings are specified.

1.2. Corrugated PE pipe is intended for surface and subsurface drainage applications where soil provides support to its flexible walls. Its major use is to collect or convey drainage water by open gravity flow, as culverts, storm drains, etc.

Note 1—When PE pipe is to be used in locations where the ends may be exposed, consideration should be given to protection of the exposed portions due to combustibility of the PE and the deteriorating effects of prolonged exposure to ultraviolet radiation.

1.3. *Units*—The values stated in SI units are to be regarded as standard. Within the text, the U.S. Customary units are shown in parentheses, and may not be exact equivalents.

1.4. This specification does not include requirements for bedding, backfill, or earth cover load. Successful performance of this product depends on proper type of bedding and backfill, and care in installation. The structural design of corrugated PE pipe and the proper installation procedures are given in *AASHTO LRFD Bridge Design Specifications,* Section 12, and *LFRD Bridge Construction Specifications,* Section 30, respectively. Upon request of the user or engineer, the manufacturer shall provide profile wall section detail required for a full engineering evaluation.

1.5. The following precautionary caveat pertains only to the test method portion, Section 9.4, of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- T 341, Determination of Compression Capacity for Profile Wall Plastic Pipe by Stub Compression Loading
- *AASHTO LRFD Bridge Construction Specifications*

- *AASHTO LRFD Bridge Design Specifications*

2.2. *ASTM Standards*:

- D618, Standard Practice for Conditioning Plastics for Testing
- D638, Standard Test Method for Tensile Properties of Plastics
- D883, Standard Terminology Relating to Plastics
- D2122, Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- D2444, Standard Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
- D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- D3895, Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
- D4218, Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- D4703, Standard Practice for Compression Molding Thermoplastic Materials into Test Specimens, Plaques, or Sheets
- D4883, Standard Test Method for Density of Polyethylene by the Ultrasound Technique
- F412, Standard Terminology Relating to Plastic Piping Systems
- F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F2136, Standard Test Method for Notched, Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE Corrugated Pipe
- F3181, Standard Test Method for the Un-notched, Constant Ligament Stress Crack Test (UCLS) for HDPE Materials Containing Post-Consumer Recycled HDPE

2.3. *Federal Standard*:

- 29 CFR 1910.1200; see also Permissible Exposure Limits—Annotated Tables, available from https://www.osha.gov/dsg/annotated-pels

2.4. *Other:*

- Pluimer, Michael L. (2016). Evaluation of Corrugated HDPE Pipes Manufactured with Recycled Materials in Commuter Railroad Applications (Doctoral dissertation). Proquest Publishing, Villanova University.
- Pluimer, Michael, Joel Sprague, Richard Thomas, Leslie McCarthy, Andrea Welker, Shad Sargand, Ehab Shaheen, and Kevin White. *National Cooperative Highway Research Report 870: Field Performance of Corrugated Pipe Manufactured with Recycled Polyethylene Content*. NCHRP, Transportation Research Board, Washington, DC, 2018. See Appendix L, AASHTO's proposed *Standard Practice for Service Life Determination of Corrugated HDPE Pipes Manufactured with Recycled Materials*. Available online at http://www.trb.org/NCHRP/Blurbs/176741.aspx

3. TERMINOLOGY

3.1. The terminology used in this standard is in accordance with the definitions given in ASTM D883 and ASTM F412 unless otherwise specified.

3.2. *buckling*—During pipe flattening testing, any decrease or downward deviation in the pipe load-deflection test curve at or below the calculated buckling deflection limit shall be considered a buckling point.

3.3. *contaminant*—inorganic particulate matter or other non-HDPE organic material that creates inclusions or stress risers in the crystalline structure of HDPE.

3.4. *crack*—any break or split that extends through the wall or liner.

3.5. *crack initiation*—the portion of the slow-crack-growth mechanism associated with the initial development of a craze zone and micro-cracks around a contaminant, void, or discontinuity; also referred to as slow-crack-growth initiation or stress-crack initiation.

3.6. *crack propagation*—the portion of the slow-crack-growth mechanism associated with successive yielding of HDPE material ahead of a crack tip; also referred to as slow-crack-growth propagation or stress-crack propagation.

3.7. *crease*—a visible irrecoverable indentation.

3.8. *buckling deflection limit*—the percentage reduction of the inside diameter of the pipe for the extreme fiber of the wall profile to reach the factored combined compressive strain limit of 6.15 percent for HDPE pipe per *AASHTO LRFD Bridge Design Specifications*, Section 12.

3.9. *delamination*—A separation between the inner liner and outer corrugated wall of Type S pipe as evidenced by a visible gap extending completely through at least one corrugation valley at any point around the circumference of the pipe. For Type D pipe, delamination is a separation of the liner and outer wall as evidenced by a visible gap extending completely between the internal supports and liner or outer wall at any point around the circumference of the pipe.

3.10. *polyethylene (PE) plastics*—plastics based on polymers made with ethylene as essentially the sole monomer (ASTM D883).

3.11. *post-consumer recycled (PCR) PE*—PE materials from products that have served a previous consumer purpose (for example, laundry detergent bottles, milk bottles, and other containers for consumer goods).

3.12. *post-industrial recycled (PIR) PE*—PE materials diverted from the waste stream during a manufacturing process that have never reached the end user.

3.13. *reworked plastic*—a plastic from a processor's own production that has been reground, pelletized, or solvated after having been previously processed by molding, extrusion, etc. (ASTM D883).

3.14. *slow crack growth (SCG)*—a phenomenon by which a stress crack may form. A stress crack is an external or internal crack in plastic caused by tensile stresses less than its short-time mechanical strength. The slow-crack-growth mechanism is comprised of a crack initiation phase and a crack-propagation phase.

3.15. *virgin polyethylene material*—PE plastic material in the form of pellets, granules, powder, floc, or liquid that has not been subject to use or processing other than required for initial manufacture.

4. CLASSIFICATION

4.1. *The corrugated PE pipe covered by this specification is classified as follows*: