



Designation: D 2666 – 96a

An American National Standard

Standard Specification for Polybutylene (PB) Plastic Tubing¹

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1. Scope

1.1 This specification covers polybutylene (PB) tubing that is outside diameter controlled, made in standard thermoplastic tubing dimension ratios and pressure rated for water (see Appendix). Included are criteria for classifying PB plastic tubing; a system of nomenclature for PB plastic tubing; and requirements and test methods for materials, workmanship, dimensions, sustained pressure, and burst pressure. Methods of marking are also given.

1.2 The text of this specification references notes, footnotes, and appendixes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the specification.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are provided for information purposes only.

1.4 The following safety hazards caveat pertains only to the test methods portion, Section 7, 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 ASTM Standards:

- D 618 Practice for Conditioning Plastics for Testing²
- D 1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure³
- D 1599 Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings³
- D 1600 Terminology for Abbreviated Terms Relating to Plastics²
- D 1603 Test Method for Carbon Black in Olefin Plastics²
- D 1708 Test Method for Tensile Properties of Plastics by Use of Microtensile Specimens²
- D 2122 Test Method for Determining Dimensions of Ther-

moplastic Pipe and Fittings³

D 2581 Specification for Polybutylene (PB) Plastics Molding and Extrusion Materials⁴

D 2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials³

F 412 Terminology Relating to Plastic Piping Systems³

F 699 Practice for Accelerated Conditioning of Polybutylene Pipe and Tubing for Subsequent Quality Control Testing³

2.2 Federal Standard:

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁵

2.3 Military Standard:

MIL-STD-129 Marking for Shipment and Storage⁵

2.4 NSF Standards:

Standard No. 14 for Plastic Piping Components and Related Materials⁶

Standard No. 61 for Drinking Water System Components—Health Effects⁶

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology F 412, and abbreviations are in accordance with Terminology D 1600, unless otherwise specified. The abbreviation for polybutylene plastic is PB.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *hydrostatic design stress*—the estimated maximum tensile stress the material is capable of withstanding continuously with a high degree of certainty that failure of the pipe will not occur. This stress is circumferential when internal hydrostatic water pressure is applied.

3.2.2 *relation between dimensions, hydrostatic design stress, and pressure rating*—the following expression, commonly known as the ISO equation,⁷ is used in this specification to relate dimensions, hydrostatic design stress, and pressure rating:

$$2S/P = (D_o/t) - 1 \quad (1)$$

¹ This specification is under the jurisdiction of ASTM Committee F-17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.26 on Olefin-Based Pipe.

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² Annual Book of ASTM Standards, Vol 08.01.

³ Annual Book of ASTM Standards, Vol 08.04.

⁴ Annual Book of ASTM Standards, Vol 08.02.

⁵ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

⁶ Available from the National Sanitation Foundation, P.O. Box 1468, Ann Arbor, MI 48106.

⁷ ISO R161-1960, Pipes of Plastics Materials for the Transport of Fluids (Outside Diameters and Nominal Pressures) Part 1, Metric Series.

where:

S = hydrostatic design stress, MPa (or psi),
 P = pressure rating, MPa (or psi),
 D_o = average outside diameter, mm (or in.), and
 t = minimum wall thickness, mm (or in.).

3.2.3 *standard dimension ratio (SDR)*—the ratio of outside diameter to wall thickness. For PB tubing, it is calculated by dividing the average outside diameter of the tubing in millimetres or in inches by the minimum wall thickness in millimetres or inches. If the wall thickness calculated by this formula is less than 0.062 in. (1.57 mm), it shall be arbitrarily increased to 0.062 in. The SDR values shall be rounded to the nearest 0.5.

3.2.4 *standard thermoplastic tubing materials designation code*—the tubing materials designation code shall consist of the abbreviation PB for the type of plastic, followed by the ASTM type and grade in Arabic numerals and the hydrostatic design stress in units of 100 psi with any decimal figures dropped. Where the hydrostatic design stress code contains less than two figures, a cipher shall be used before the number; thus a complete material code shall consist of two letters and four figures for PB plastic tubing materials (see Section 5).

3.2.5 *tubing pressure rating (PR)*—the estimated maximum pressure that water in the tubing can exert continuously with a high degree of certainty that failure of the tube will not occur.

4. Tubing Classification

4.1 *General*—This specification covers PB tubing in two standard dimension ratios, namely, 9 and 13.5. These are referred to as SDR9 and SDR13.5.

5. Materials

5.1 *General*—Polybutylene plastics used to make tubing meeting the requirements of this specification are categorized by means of two criteria, namely, (1) short-term strength tests, and (2) long-term strength tests. Since the maximum physical properties of the tubing are not developed until 10 days after extrusion, burst testing must be delayed for this period.

5.2 *Basic Materials*—This specification covers PB tubing made from PB plastic in accordance with Specification D 2581.

5.3 *Hydrostatic Design Stresses*—This specification covers PB tubing made from PB plastics as defined by hydrostatic design stress developed on the basis of long-term tests (Appendix).

NOTE 1—Information regarding the method of test and other criteria used in assigning this hydrostatic design stress may be obtained from the Plastic Pipe Institute.

5.4 *Compound*—The PB plastic extrusion compound shall meet the requirements of Type II, Grade 1, Class B with antioxidant, or Class C in accordance with Specification D 2581.

5.5 *Rework Material*—The manufacturers shall use only their own clean rework pipe material and the pipe produced shall meet all the requirements of this specification.

6. Requirements

6.1 *Workmanship*—The tubing shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions,

or other defects. The tubing shall be as uniform as commercially practicable in color, opacity, density and other physical properties.

6.2 Dimensions and Tolerances:

6.2.1 *Outside Diameters*—The outside diameters and tolerances shall be as shown in Table 1 when measured in accordance with 7.4 and 7.4.1.

6.2.2 *Wall Thickness*—The wall thicknesses and tolerances shall be as shown in Table 2 when measured in accordance with 7.4 and 7.4.2.

6.2.3 *Wall Thickness Range*—The wall thickness range shall be within 12 % when measured in accordance with 7.4 and 7.4.2.

6.3 *Carbon Black*—The polybutylene tubing extrusion compound Type II, Grade 1, Class C, shall contain at least 2 % carbon black when tested in accordance with 7.5.

6.4 *Sustained Pressure*—The tubing shall not fail, balloon, burst, or weep as defined in Test Method 1598, at the test pressures given in Table 3 when tested in accordance with 7.6.

6.5 *Burst Pressure*—The minimum burst pressure for PB plastic tubing shall be as given in Table 4, when determined in accordance with 7.7.

6.6 *Elongation Value at Break*—The minimum pipe machine-direction elongation value at break shall exceed or equal an average of 125 % when samples are tested in accordance with 7.8.

7. Test Methods

7.1 *Conditioning*—Because of the crystalline transformation which takes place after polybutylene resins are cooled from the melt, it is necessary to delay physical testing until 10 days after extrusion. During this 10-day period, store the tubing at temperatures between 40 and 100°F. Take the test specimens after 8 days and condition at $73.4 \pm 3.6^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and 50 ± 5 % relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D 618, for those tests where conditioning is required. In cases of disagreement, the tolerances shall be $\pm 1.8^\circ\text{F}$ (1°C) and ± 2 % relative humidity.

TABLE 1 Outside Diameters and Tolerances for PB Tubing

| Nominal Tubing Size | | Average Outside Diameter | | Tolerances | | | |
|---------------------|-----|--------------------------|-------|----------------------|------------------|--|--------|
| (mm) | in. | (mm) | in. | For Average Diameter | | For Maximum and Minimum ^A Diameter (Out-of-Roundness) | |
| | | | | (mm) | in. | (mm) | in. |
| (13) | ½ | (15.9) | 0.625 | (+0.20 –0.00) | +0.008 –0.000 | (±0.38) | ±0.015 |
| (16) | ⅝ | (19.1) | 0.750 | (+0.20 –0.00) | +0.008 –0.000 | (±0.38) | ±0.015 |
| (19) | ¾ | (22.2) | 0.875 | (+0.20 –0.00) | +0.008 –0.000 | (±0.38) | ±0.015 |
| (25) | 1 | (28.6) | 1.125 | (+0.25 –0.00) | +0.010 –0.000 | (±0.38) | ±0.015 |
| (32) | 1¼ | (34.9) | 1.375 | (+0.25 –0.00) | +0.010 –0.000 | (±0.38) | ±0.015 |
| (38) | 1½ | (41.3) | 1.625 | (+0.30 –0.00) | +0.012 –0.000 | (±0.38) | ±0.015 |
| (51) | 2 | (54.0) | 2.125 | (+0.30 –0.00) | +0.012 –0.000 | (±0.38) | ±0.015 |

^AThe maximum and minimum diameter (out-of-roundness) tolerances apply only to tubing before coiling.