



Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core¹

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1. Scope

1.1 This specification covers coextruded acrylonitrile-butadiene-styrene (ABS) plastic drain, waste, and vent pipe made to Schedule 40 iron pipe sizes (IPS) and produced by the coextrusion process with concentric inner and outer solid ABS layers and the core consisting of closed-cell cellular ABS. Plastic which does not meet the material requirements specified in Section 5 is excluded from single layer and all coextruded layers.

1.2 Fittings suitable for use with pipe meeting the requirements of this specification are given in Annex A1. Fittings meeting the requirement of Specification D 2661 are also acceptable.

1.3 Acrylonitrile-butadiene-styrene plastic which does not meet the definitions of virgin ABS plastic as given in 3.2.4 is excluded, as performance of plastic other than those defined as virgin was not determined. ABS rework plastic which meets the requirements of rework plastic as given in 5.3 is acceptable.

1.4 Reprocessed plastic or recycled plastic as defined in Terminology D 883 is excluded.

1.5 Recommendations for storage, joining, and installation are provided in Appendixes X1, X2, and X3, respectively.

1.6 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.

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

2. Referenced Documents

2.1 ASTM Standards:

- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²
- D 883 Terminology Relating to Plastics²
- D 1600 Terminology for Abbreviated Terms Relating to Plastics²
- D 1898 Practice for Sampling of Plastics²

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² *Annual Book of ASTM Standards*, Vol 08.01.

- D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings³
- D 2235 Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings³
- D 2321 Practice for Underground Installation of Flexible Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications³
- D 2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading³
- D 2444 Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)³
- D 2661 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings³
- D 3311 Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns³
- D 3965 Specification for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Compounds for Pipe and Fittings⁴
- E 105 Practice for Probability Sampling of Materials⁵
- E 122 Practice for Choice of Sample Size to Estimate a Measure of Quality for a Lot or Process⁵
- F 402 Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings³
- F 412 Terminology Relating to Plastic Piping Systems³
- F 1498 Specification for Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings³
- 2.2 *Federal Standard:*
 - Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁶
- 2.3 *Military Standard:*
 - MIL-STD-129 Marking for Shipment and Storage⁶

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 acrylonitrile-butadiene-styrene plastic is ABS.

3.1.1 *cellular plastic*—a plastic containing numerous cells,

³ *Annual Book of ASTM Standards*, Vol 08.04.

⁴ *Annual Book of ASTM Standards*, Vol 08.02.

⁵ *Annual Book of ASTM Standards*, Vol 14.02.

⁶ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

intentionally introduced, interconnecting or not, distributed throughout the mass.

3.1.2 *closed-cell cellular plastic*—cellular plastic in which almost all the cells are noninterconnecting.

3.1.3 *coextruded pipe*—pipe consisting of two or more concentric layers of material bonded together in processing by any combination of temperature, pressure, grafting, crosslinking, or adhesion.

3.1.4 *coextrusion*—a process whereby two or more heated or unheated plastic material streams forced through one or more shaping orifice(s) become one continuously formed piece.

3.1.5 *room temperature*—a temperature in the range from 68 to 85 ± 3.6°F (20 to 30 ± 2°C).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *lot*—a lot shall consist of all pipe produced, of one size, from one extrusion line, during one designated 24-h period.

3.2.2 *recycled plastic*—a plastic prepared from discarded articles that have been cleaned and reground.

3.2.3 *reprocessed plastic*—a thermoplastic prepared from usually melt processed scrap or reject parts by a plastics processor, or from nonstandard or nonuniform virgin material.

3.2.4 *virgin ABS plastic*—plastic in the form of pellets, granules, powder, floc, or liquid that has not been subjected to use or processing other than that required for its initial manufacture.

4. Classification

4.1 Pipe produced in accordance with this specification is intended to provide pipe suitable for the drainage and venting of sewage and certain other liquid wastes.

NOTE 1—Before installing pipe for waste disposal use, the approval of the cognizant building code authority should be obtained as conditions not commonly found in normal use may be encountered and temperatures in excess of 180°F (82°C) may be encountered.

5. Materials

5.1 *Material Specification*—Virgin ABS plastic shall conform to the requirements prescribed in Specification D 3965 with a cell classification of 4-2-2-2. The color and form of the material shall be as agreed upon between the seller and the purchaser in accordance with Specification D 3965.

5.2 The ABS plastic shall conform to the following requirements:

5.2.1 *Acrylonitrile-Butadiene-Styrene (ABS) Plastic*—Plastic shall contain a minimum of 15 % acrylonitrile, 6 %

butadiene, and 15 % styrene or substituted styrene, or both, of polymers or blends of polymers.

5.2.2 ABS plastic shall contain no more than 10 % of other monomeric or polymeric components plus other necessary compounding ingredients.

5.3 *Rework Material*—The manufacturer shall use only his own clean rework pipe material conforming with these cell class requirements. Use it only in the core layer. The pipe produced shall meet all the requirements of this specification.

6. Requirements

6.1 *Dimension and Tolerance:*

6.1.1 *Outside Diameter*—The outside diameter and tolerances shall meet the requirements of Table 1 when measured in accordance with Test Method D 2122. The tolerances for out-of-roundness shall apply to pipe prior to shipment.

6.1.2 *Wall Thickness*—The wall thickness and tolerances shall meet the requirements of Table 2 when measured in accordance with Test Method D 2122.

6.1.3 *Length*—The pipe shall be in either 10 or 20-ft (3.05 or 6.1-m) lengths, unless otherwise specified. The allowable tolerance on length shall be +½, -0 in. (+12, -0 mm).

6.2 *Performance Requirements:*

6.2.1 *Pipe Stiffness*—The minimum pipe stiffness values at 5 % deflection when measured in accordance with Test Method D 2412, shall equal or exceed the values in Table 3. The rate of crosshead motion shall be 0.20 to 0.25 in./min (5.1 to 6.3 mm/min). Three specimens shall be tested. If all three meet this requirement, the sample meets this requirement. If one or two fail, additional testing shall be conducted in accordance with 6.2.1.1. If all three fail, the sample does not meet the requirement.

6.2.1.1 *Pipe Stiffness and Lower Confidence Limit*—In the event that one or two of the specimens tested in 6.2.1 fail to meet the minimum requirement, the average pipe stiffness of eleven specimens shall meet or exceed the minimum requirement given in Table 3. The 99 % lower confidence limit (LCL) shall be within 15 % of the average value. The LCL shall be calculated using the Student's "t" distribution, with N-1 degrees of freedom, where N is the number of specimens. The critical t value shall be used to at least three significant digits. Alternatively, if the LCL exceeds the minimum pipe stiffness requirement in Table 3, but is not within 15 % of the average, the sample meets the requirements of the Pipe Stiffness testing. The eleven specimens include the three tested under 6.2.1, and an additional eight with rotation by 35°, as specified in Test

TABLE 1 Outside Diameters and Tolerances for ABS Schedule 40 Plastic Drain, Waste, and Vent Pipe Produced by the Coextrusion Process with Concentric Inner and Outer Solid ABS-Layers and the Core Consisting of Closed-Cell Cellular ABS

Nominal Pipe Size, in.	Outside Diameter		
	Average, in. (mm)	Tolerance on Average, in. (mm)	Out-of-Roundness Maximum Diameter Minus Minimum Diameter, in. (mm) ^A
1¼	1.660 (42.16)	+0.010, -0.000 (+0.25, -0.00)	0.024 (0.60)
1½	1.900 (48.26)	+0.010, -0.000 (+0.25, -0.00)	0.024 (0.60)
2	2.375 (60.32)	+0.010, -0.000 (+0.25, -0.00)	0.024 (0.60)
3	3.500 (88.90)	+0.015, -0.000 (+0.38, -0.00)	0.030 (0.76)
4	4.500 (114.30)	+0.015, -0.000 (+0.38, -0.00)	0.100 (2.54)
6	6.625 (168.28)	+0.011, -0.011 (+0.28, -0.28)	0.100 (2.54)

^A Measured at time of manufacturing.

TABLE 2 Wall Thickness and Tolerance for ABS Schedule 40 Plastic Drain, Waste, and Vent Pipe Produced by the Coextrusion Process with Concentric Inner and Outer Solid ABS Layers and the Core Consisting of Closed-Cell Cellular ABS

Nominal Pipe Size, in.	Wall Thickness ^A	
	Minimum Total Wall, in. (mm)	Tolerance, in. (mm)
1¼	0.140 (3.56)	+0.020 (+0.50)
1½	0.145 (3.68)	+0.020 (+0.50)
2	0.154 (3.91)	+0.020 (+0.50)
3	0.216 (5.42)	+0.026 (+0.66)
4	0.237 (6.02)	+0.028 (+0.71)
6	0.280 (7.11)	+0.034 (+0.86)

^A The minimum is the lowest wall thickness of the pipe at any cross section.

TABLE 3 Pipe Stiffness of ABS Schedule 40 Plastic Drain, Waste, and Vent Pipe Produced by the Coextrusion Process with Concentric Inner and Outer Solid ABS Layers and the Core Consisting of Closed-Cell Cellular ABS

Nominal Pipe Size, in.	Minimum Pipe Stiffness at 5 % Deflection	
	psi	(MPa)
1¼	600	(4.13)
1½	535	(3.69)
2	300	(2.06)
3	280	(1.93)
4	175	(1.21)
6	75	(0.52)

Method D 2412, continuing throughout the remaining specimens.

6.2.1.2 The LCL based on testing eleven specimens is calculated as follows:

$$LCL = (\text{avg PS}) - \{2.76(\text{std. dev.})/\sqrt{(N)}\}$$

where:

$$(\text{avg PS}) = [\sum(PS_i)]/(11) \tag{1}$$

$$(\text{std. dev.}) = \left[\frac{\sum PS^2 - (\sum PS)^2/N}{N - 1} \right]^{1/2}$$

$$N = 11.$$

6.2.1.3 The 15 % requirement is calculated as follows:

$$(\text{avg} - LCL)/(\text{avg}) [m]P5 100 \leq 15 \%$$

NOTE 2—For quality control testing, a single specimen may be used with the thinnest wall at the top.

NOTE 3—The 5 % deflection criterion, which was arbitrarily selected for testing convenience, should not be considered as a limitation with respect to in-use deflection. The engineer is responsible for establishing the acceptable deflection limit.

NOTE 4—The strength and load-carrying capabilities of plastic pipe are measured and reported as pipe stiffness, which is determined in accordance with Test Method D 2412. The term “crush strength” is not applicable to plastic piping because the values obtained can be significantly different, depending on the bedding, loading, or testing technique used, and the term derives from rigid pipe and refers to its ultimate strength at rupture.

6.2.2 *Pipe Flattening*—There shall be no evidence of rupture when pipe is deflected 25 % of the initial inside diameter

when tested in accordance with Test Method D 2412. Three specimens shall be tested; all shall meet the requirements. Failure shall be a crack or break extending entirely through the pipe wall visible to the unaided eye.

NOTE 5—This test is intended only for use as a quality control test, not as a simulated service test.

6.2.3 *Impact Strength*—The minimum impact resistance, when tested at the time of manufacture, shall comply with Table 4. Test in accordance with Test Method D2444 using Tup A and Holder B. Use 12-lb (5 kg) tup for testing pipe sizes 4in. and smaller and a 20-lb (10-kg) tup for sizes larger than 4 in.

6.2.3.1 Test 10 specimens. When 9 or 10 specimens pass accept the lot. when 2 or more specimens fail, test 10 additional specimens. When 17 of 20 specimens tested pass, accept the lot. When 4 or more of 20 specimens fail, test 20 additional specimens. When 32 of 40 specimens pass accept the lot. When 9 or more of 40 specimens fail, the lot does not meet the requirements of this specification.

6.2.3.2 Failure of the test specimen shall be shattering or any crack or break extending entirely through the pipe wall and visible to the unaided eye.

6.2.4 *Bond*—The bond between layers shall be strong and uniform. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly, or so the probe or knife blade moves freely between the layers; nor shall separation of bond occur between layers during testing performed under the requirements of this specification (see Note 5).

6.2.5 *Pigments or Screening Agents*—The ABS compound used in the outer layer shall contain pigments or screening agents to provide protection against UV radiation.

6.3 *Other Requirements:*

6.3.1 *Inspection*—Inspection shall be made prior to installation of all pipe. Pipe that does not meet the requirements of Section 7 shall be returned to the seller.

6.3.2 *Joining*—Coextruded ABS Schedule 40 drain, waste, and vent pipe with a cellular core are joined using molded fittings meeting the requirements of Specifications D 2661 and D 3311 or the requirements for fittings listed in the Annex of this specification.

6.3.3 *Solvent Cement*—In the assembly of solvent cement joints, the safety requirements of Practice F 402 shall be followed using solvent cement meeting the requirements of Specification D 2235.

TABLE 4 Impact Resistance of ABS Schedule 40 Plastic Drain, Waste, and Vent Pipe Produced by the Coextrusion Process and Concentric Inner and Outer Solid ABS Layers and the Core Consisting of Closed-Cell Cellular ABS

Nominal Pipe Size, in.	Minimum Impact Resistance, ft-lbf (J)
	At 32°F (0°C)
1¼	15 (20)
1½	20 (27)
2	30 (41)
3	40 (54)
4	40 (54)
6	40 (54)

7. Workmanship, Finish, and Appearance

7.1 *Workmanship*—The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.

8. Sampling and Conditioning

8.1 *Sampling*—For the purpose of testing, the lot shall consist of all pipe produced of one size, from one extrusion line, during one designated 24-h period. The number of specimens designated for each test shall be taken from pipe selected at random from each lot in accordance with the random sampling plan of Practice D 1898.

NOTE 6—Also see Practices E 105 and E 122.

8.2 *Number of Test for Quality Control*—When evaluating a product against this specification, the following minimum number of specimens shall be tested for each lot.

8.2.1 *Outside Diameter*—One specimen per extrusion line.

8.2.2 *Wall Thickness*—One specimen per extrusion line.

8.2.3 *Length*—One specimen per extrusion line.

8.2.4 *Pipe Stiffness*—A minimum of three specimens per extrusion line. (See Note 5.)

8.2.5 *Pipe Flattening*—A minimum of three specimens per extrusion line. (See Note 5.)

8.2.6 *Impact Strength*—A minimum of 10 specimens and a maximum of 40.

8.2.7 *Bond*—One specimen per extrusion line.

8.3 *Conditioning* :—

8.3.1 For referee testing at 73°F, condition the specimens prior to the test at $73.4 \pm 3.6^\circ$ ($23 \pm 2^\circ\text{C}$) and $50 \pm 5\%$ relative humidity in accordance with Practice D618, Procedure A.

8.3.2 For routine quality control testing at 73°F, condition the specimens at the temperature and humidity of the manufacturer's testing facility for not less than 1 h or until the specimens are at the room temperature.

8.3.3 For referee testing at 32°F, condition the specimens at $32 \pm 3.6^\circ\text{F}$ ($0 \pm 2^\circ\text{C}$) for at least 2h, or in ice water for at least 1h.

8.4 *Test Conditions* :—

8.4.1 For referee purposes, conduct tests in the standard laboratory atmosphere of $73.4 \pm 3.6^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and 50 ± 5% relative humidity.

8.4.2 For routine quality control testing, conduct tests at the temperature and humidity of the manufacturer's testing area.

8.4.3 For testing at 32° F, complete the test as soon as possible after removal from the conditioning atmosphere, but in any case within 15s.

8.5 *Test Methods*—Only ASTM test methods specified shall be used.

9. Retest and Rejection

9.1 If the results of any test(s) do not meet the requirements of this specification, the test(s) shall be conducted again only by agreement between the purchaser and the seller. Under such agreement, minimum requirements shall not be lowered, changed, or modified, nor shall specification limits be changed. If, upon retest, failure occurs, the quantity of product represented by the test(s) does not meet the requirements of this specification.

10. Product Marking

10.1 *Quality of Marking*—The marking shall be applied to the pipe in such a manner that it remains legible (easily read) after installation and inspection.

10.2 *Content of Marking*—The pipe shall be marked in letters not less than $\frac{3}{16}$ in. (5 mm) high, in a contrasting color, spaced at intervals of not more than 5 ft. (1.5 m), with the following information:

10.2.1 Manufacturer's name (or trademark).

10.2.2 This designation "ASTM F 628."

10.2.3 The wording "COEXTRUDED ABS CELLULAR CORE DWV".

10.2.4 Nominal pipe size (for example: 2 in. (51 mm)).

10.2.5 Manufacturer's code for resin manufacture, lot number, and date of manufacture.

11. Quality Assurance

11.1 When the product is marked with this designation, F 628, the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with this specification and has been found to meet the requirements of this specification.

12. Keywords

12.1 ABS; cellular; DWV; fittings; pipe; plastic; thermo-plastic; Schedule 40