



Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings¹

This standard is issued under the fixed designation D 2661; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers fittings and single and coextruded acrylonitrile-butadiene-styrene (ABS) plastic drain, waste, and vent pipe (DWV) made to Schedule 40 iron pipe sizes (IPS). Plastic which does not meet the material requirements specified in Section 5 is excluded from single layer and all coextruded layers.

1.2 Specification for fittings for use with pipe meeting the requirements of this specification are given in Annex A1.

1.3 Acrylonitrile-butadiene-styrene plastic, which does not meet the definition of virgin ABS plastic as given in 3.2.2, 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 Appendix X1, Appendix X2, and Appendix 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 for Testing²
- D 883 Terminology Relating to Plastics²
- D 1600 Terminology for Abbreviated Terms Relating to Plastics²

- D 1898 Practice for Sampling of Plastics²
 - D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings³
 - D 2135 Specification for Molded Drain, Waste, and Vent (DWV) Short-Pattern Plastic Fittings²
 - D 2235 Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings³
 - D 2321 Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications³
 - D 2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Pipe Loading³
 - D 2444 Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)³
 - D 3311 Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns³
 - D 3965 Specification for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Materials for Pipe and Fittings⁴
 - E 105 Practice for Probability Sampling of Materials⁵
 - E 122 Practice for Calculating Sample Size to Estimate, With a Specified Tolerable Error, the Average for a Characteristic of 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 Threads 60° for Thermoplastic Pipe and Fittings³
 - F 2135 Specification for Molded Drain, Waste, and Vent (DWV) Short-Pattern Plastic Fittings³
- ### 2.2 Federal Standard:
- Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁶
- ### 2.3 Military Standard:

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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 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.

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 is ABS.

3.1.1 *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.

3.1.2 *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.

3.1.3 *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 of the same size produced 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 usually prepared from 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 The requirements of this specification are intended to provide pipe suitable for the drainage and venting of sewage and certain other liquid wastes.

NOTE 1—Industrial waste disposal lines should be installed only with the specific approval of the cognizant building code authority since chemicals not commonly found in drains and sewers and temperatures in excess of 180°F (82°C) may be encountered.

5. Materials

5.1 *Material Specification*—Virgin black ABS plastic shall conform to the requirements prescribed in Specification D 3965 with a cell classification of 4-2-2-2. The 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 containing polymers or blends of polymers shall contain a minimum of 15 % acrylonitrile, 6 % butadiene, and 15 % styrene or substituted styrene, or both. 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 pipe or fitting rework material conforming with these cell class requirements. The pipe or fittings produced shall meet all the requirements of this specification.

6. Requirements

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

6.1.1 The requirements in this section are intended only for use as quality control tests, not as simulated service tests.

6.2 Dimensions and Tolerances:

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

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

6.2.3 *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).

6.3 Performance Requirements:

6.3.1 *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 6.3.1.1. If all three fail, the sample does not meet the requirement.

6.3.1.1 *Pipe Stiffness and Lower Confidence Limit*—In the event that one or two of the specimens tested in 6.3.1 fail to meet the minimum requirement, the average pipe stiffness of

TABLE 1 Outside Diameters and Tolerances for ABS Schedule 40 Plastic Drain, Waste, and Vent Pipe

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)	0.030 (0.76)
6	6.625 (168.28)	+0.011, -0.011 (+0.28, -0.28)	0.050 (1.27)

^AMeasured at time of manufacturing.

TABLE 2 Wall Thickness and Tolerance for ABS Schedule 40 Drain, Waste, and Vent Pipe

Nominal Pipe Size, in.	Wall Thickness ^A	
	Minimum Wall, in. (mm)	Tolerance, in. (mm)
1¼	0.140 (3.56)	+0.015 (+0.38) -0.000 (-0.00)
1½	0.145 (3.68)	+0.015 (+0.38) -0.000 (-0.00)
2	0.154 (3.91)	+0.015 (+0.38) -0.000 (-0.00)
3	0.216 (5.42)	+0.020 (+0.51) -0.000 (-0.00)
4	0.237 (6.02)	+0.024 (+0.61) -0.000 (-0.00)
6	0.280 (7.11)	+0.030 (+0.76) -0.000 (-0.00)

^AThe 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

Nominal Pipe Size, in.	Minimum Pipe Stiffness at 5 % Deflection	
	psi	(MPa)
1¼	870	(6.00)
1½	630	(4.34)
2	370	(2.55)
3	320	(2.20)
4	190	(1.31)
6	95	(0.65)

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 PS 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 6.3.1, and an additional eight with rotation by 35°, as specified in Test Method D 2412, continuing throughout the remaining specimens.

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

$$LCL = (\text{avg PS}) - \{2.76(\text{std. dev.})/\sqrt{N}\} \quad (1)$$

where:

$$(\text{avg PS}) = [\Sigma(PS_i)]/(11)$$

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

$$N = 11.$$

6.3.1.3 The 15 % requirement is calculated as follows:

$$(\text{Avg} - LCL)/(\text{Avg}) \times 100 \leq 15 \% \quad (2)$$

NOTE 2—For quality control testing, a single specimen may be used

with the thinnest wall at the top.

NOTE 3—The 5 % deflection criteria is arbitrarily selected for testing convenience. It 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 because the term derives from rigid pipe and refers to its ultimate strength at rupture.

6.3.2 *Pipe Flattening*—There shall be no evidence of rupture when pipe is deflected 40% of the initial inside diameter when tested in accordance with Test Method D 2412. The rate of head approach shall be 0.20 to 0.25 in./min (5.1 to 6.3 mm/min). 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.

6.3.3 *Impact Resistance*—The minimum impact resistance, when tested at the time of manufacture, shall comply with Table 4. Test in accordance with Test Method D 2444 using Tup B and Holder B. Use a 30-lb (13.6 kg) tup for testing all pipe sizes.

6.3.3.1 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.

6.3.3.2 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.

6.4 Coextruded Pipe:

6.4.1 *Thickness of Outer Layer*—For pipe produced by the coextrusion process, that is, pipe containing two or more concentric layers, the outer layer shall be at least 0.020 in. (0.50 mm) thick and shall contain pigments or screening agents to provide protection against UV radiation.

6.4.2 *Bond*—For pipe produced by the coextrusion process, that is, pipe containing two or more concentric layers, the bond between the 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 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.

TABLE 4 Impact Resistance of ABS Schedule 40 Plastic Drain, Waste, and Vent Pipe

Nominal Pipe Size, in.	Minimum Impact Resistance, ft-lbf (J)	
	At 73°F	(23°C)
1¼	20	(27)
1½	30	(41)
2	40	(54)
3	60	(81)
4	60	(81)
6	100	(136)

6.5 Other Requirements:

6.5.1 *Inspection*—Before installation the pipe shall be inspected. Pipe which does not meet the requirements of this specification shall be returned to the seller.

6.5.2 *Joining*—ABS schedule 40 drain, waste, and vent (DWV) are joined using molded fittings meeting the requirements of Annex A1 of this specification.

6.5.3 *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.

7. Sampling and Conditioning

7.1 *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 5—Refer to Practices E 105 and E 122.

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

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

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

7.2.3 *Length*—One specimen per extrusion line.

7.2.4 *Pipe Stiffness*—A minimum of three specimens per extrusion line. (See Note 2.)

7.2.5 *Pipe Flattening*—A minimum of three specimens per extrusion line.

7.2.6 *Impact Strength*—A minimum of ten specimens and a maximum of 40.

7.2.7 *Bond*—One specimen for each extrusion line.

7.3 Conditioning:

7.3.1 For referee purposes, condition the specimens prior to test at $73.4 \pm 3.6^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and $50 \pm 5\%$ relative humidity in accordance with Practice D 618, Procedure A.

7.3.2 For routine quality control testing, condition the specimens at the temperature and humidity of the manufacturers testing facility for not less than 1 h or until the specimens are at room temperature.

7.4 Test Conditions:

7.4.1 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 $50 \pm 5\%$ relative humidity.

7.4.2 For routine quality control testing, conduct tests at the room temperature and humidity of the manufacturers testing area.

7.5 *Test Methods*—Use only the specified ASTM test methods.

8. Retest and Rejection

8.1 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.

9. Product Marking

9.1 *Quality of Marking*—The markings shall be applied to the pipe in such a manner that they remain legible (easily read) after installation and inspection.

9.2 *Content of Marking*—The pipe shall be marked on two sides 180° apart at least every 2 ft (0.6 m) in letters not less than $\frac{3}{16}$ in. (5 mm) high, in a contrasting color with the following information:

9.2.1 The manufacturer's name (or trademark).

9.2.2 The designation "ASTM D 2661".

9.2.3 Nominal pipe size (for example, 2 in. (51 mm)).

9.2.4 The manufacturer's code for resin manufacturer, lot number, and date of manufacture.

9.2.5 *Single Extrusion Pipe*—The pipe produced by single extrusion process shall be marked "ABS DWV".

9.2.6 *Coextruded Pipe*—The pipe produced by the coextrusion process shall be marked "COEXTRUDED ABS DWV".

10. Quality Assurance

10.1 When the product is marked with this designation, D 2661, 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.

11. Keywords

11.1 ABS; DWV; fittings; pipe; plastic; Schedule 40; thermoplastic