



Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (Metric SDR-PR)¹

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^ε1 NOTE—3.2.4 was editorially revised in March 2011.

1. Scope

1.1 This specification covers acrylonitrile-butadiene-styrene (ABS) pipe produced by single extrusion in standard thermoplastic pipe dimension ratios and pressure rated for water (see [Appendix X1](#)). Included are criteria for classifying ABS plastic pipe materials and ABS plastic pipe, a system of nomenclature for ABS plastic pipe, and requirements and test methods for materials, workmanship, dimensions, sustained pressure, burst pressure, and extrusion quality. Methods of marking are also given.

1.2 The products covered by this specification are intended for use with the distribution of pressurized liquids, which are chemically compatible with the piping materials. Consult with the manufacturer and local building codes before use in other applications. Due to inherent hazards associated with testing components and systems with compressed air or other compressed gases some manufacturers do not allow pneumatic testing of their products. Consult with specific product/component manufacturers for their specific testing procedures prior to pneumatic testing.

NOTE 1—Pressurized (compressed) air or other compressed gases contain large amounts of stored energy, which present serious safety hazards should a system fail for any reason.

NOTE 2—This specification addresses only pipe for use in above ground service. For buried service consult the manufacturer and local building codes.

NOTE 3—Exposure to ultraviolet radiation over a long period of time may affect the physical properties of ABS pipe. Consult the manufacturer for recommendations for handling, storage, and installations that are not protected by insulation.

1.3 Pipe meeting the requirements of this standard are not compatible with IPS sized DWV fittings. The ABS pipe covered in this standard is intended for pressure service and it shall be joined to pressure fittings. Non-pressure fittings, such as DWV fittings from any material (ABS, PVC, CPVC, etc.), are not acceptable for pressure applications.

1.4 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 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.

1.6 *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:²

- D618 Practice for Conditioning Plastics for Testing
 - D1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
 - D1600 Terminology for Abbreviated Terms Relating to Plastics
 - D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
 - D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
 - D3965 Classification System and Basis for Specifications for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Materials for Pipe and Fittings
 - F412 Terminology Relating to Plastic Piping Systems
- ### 2.2 Federal Standard:³
- Fed. Std. No. 123 Marking for Shipment (Civil Agencies)
- ### 2.3 Military Standard:³
- MIL-STD-129 Marking for Shipment and Storage

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

2.4 NSF/ANSI Standard:⁴

Standard No. 14 for Plastic Piping Components and Related Materials

Standard No. 61 Drinking Water System Components - Health Effects

2.5 ISO Standard:⁵

ISO 1167 Thermoplastic pipes, fittings and assemblies for the conveyance of fluids—Determination of the resistance to internal pressure—Part 1: General method

ISO 3127 Thermoplastic pipes—Determination of resistance to external blows—Round-the-clock method

3. Terminology

3.1 *General*—Definitions are in accordance with Terminology F412. Abbreviations are in accordance with Terminology D1600, unless otherwise indicated. The abbreviation for acrylonitrile-butadiene-styrene plastic is ABS.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *acrylonitrile-butadiene-styrene (ABS) pipe and fitting plastics*—plastics containing polymers or blends of polymers, or both, in which the minimum butadiene content is 6 %, the minimum acrylonitrile content is 15 %, the minimum styrene or substituted styrene content, or both, is 15 %, and the maximum content of all other monomers is not more than 5 %, and lubricants, stabilizers, and colorants.

3.2.2 *nominal outside diameter (d_n)*—specified outside diameter of a component, which is identical to the minimum mean outside diameter, in millimeters

3.2.3 *pressure rating (PR)*—numerical designation used for reference purposes and related to the mechanical characteristics of the components of a piping system.

3.2.4 *relation between standard dimension ratio, hydrostatic design stress (HDS), and pressure rating (PR)*—the following expression is used in this specification to relate standard dimension ratio, hydrostatic design stress, and pressure rating:

$$PR = 2 HDS / (SDR - 1) \text{ or } PR = 2 HDS / ((D_o/t) - 1) \quad (1)$$

where:

HDS = Hydrostatic design stress, MPa
PR = Pressure rating, MPa
DO = average outside diameter, mm
t = minimum wall thickness mm, and
SDR = standard dimension ratio (D_o/t)

4. Materials

4.1 *General*—Acrylonitrile-butadiene-styrene plastics used to make pipe meeting the requirements of this specification are

categorized by means of two criteria namely (1) short-term tests and (2) long-term strength tests.

4.2 *Basic Materials*—The material properties of the grade of ABS plastic are characterized using short-term tests as defined in Specification D3965.

4.3 *Hydrostatic Design Basis (HDB)*—This specification covers pipe made from material, which has been evaluated in accordance with Test Method D2837 where a pressure testing is carried out in accordance with Test Method D1598 to find the HDB value. The HDB shall be a minimum of 17.2 MPa.

4.4 *Compound*—The ABS plastic extrusion compound shall meet the requirements of ABS Classes 42222, 20643, or 30444 as described in Specification D3965.

4.5 *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.

5. Pipe Classification

5.1 *General*—This specification covers ABS pipe produced by single extrusion.

5.2 *Standard Dimension Ratios (SDR)*—This specification covers ABS pipe in eight standard dimension ratios. These are SDR 9, 11, 13.5, 17, 21, 26, 32.5, and SDR 41. The pressure rating is uniform for all nominal pipe sizes for a given ABS pipe material and SDR.

6. Requirements

6.1 *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.

6.2 Dimensions and Tolerances:

6.2.1 *Outside Diameters*—The outside diameters and tolerances and out-of-roundness 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.

6.3 *Sustained Pressure*—The pipe shall not fail, balloon, burst, or weep as defined in ISO 1167 at the test pressures given in Table 3 when tested in accordance with 7.5.

6.4 *Burst Pressure*—The minimum burst pressures for ABS plastic pipe shall be the pressure rating (PR) multiplied by a factor of 3.2, when determined in accordance with 7.6.

6.5 *Impact*—The pipe shall meet the impact requirements when tested in accordance with 7.7.

7. Test Methods

7.1 *Conditioning*—Condition the test specimens at $23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D618 for those tests where conditioning is required.

⁴ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, <http://www.nsf.org>.

⁵ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.

TABLE 1 Outside Diameters and Tolerances for Metric ABS Plastic Pipe

Nominal Pipe Size (NPS)	Average Outside Diameter, D _O (mm)	Tolerances (mm)	
		Average	For Max and Min (Out-of-Roundness)
12	12.0	+0.2	+0.5
16	16.0	+0.2	+0.5
20	20.0	+0.2	+0.5
25	25.0	+0.2	+0.5
32	32.0	+0.2	+0.5
40	40.0	+0.2	+0.5
50	50.0	+0.2	+0.6
63	63.0	+0.3	+0.8
75	75.0	+0.3	+0.9
90	90.0	+0.3	+1.1
110	110.0	+0.4	+1.4
125	125.0	+0.4	+1.5
140	140.0	+0.5	+1.7
160	160.0	+0.5	+2.0
180	180.0	+0.6	+2.2
200	200.0	+0.6	+2.4
225	225.0	+0.7	+2.7
250	250.0	+0.8	+3.0
280	280.0	+0.9	+3.4
315	315.0	+1.0	+3.8

TABLE 2 Wall Thicknesses and Tolerances for Metric ABS Plastic Pipe

Nominal Pipe Size (NPS)	Wall thicknesses (t) and tolerances for ABS plastic pipe (mm)															
	SDR 41		SDR 32.5		SDR 26		SDR 21		SDR 17		SDR 13.5		SDR 11		SDR 9	
	min.	tol	min.	tol	min.	tol	min.	tol	min.	tol	min.	tol	min.	tol	min.	tol
12	A	A	A	A	A	A	A	A	A	A	A	A	1.5	+0.4	1.5	+0.4
16	A	A	A	A	A	A	A	A	A	A	1.5	+0.4	1.5	+0.4	1.8	+0.4
20	A	A	A	A	A	A	A	A	A	A	1.5	+0.4	1.9	+0.4	2.3	+0.5
25	A	A	A	A	A	A	A	A	0.4	+0.4	1.9	+0.4	2.3	+0.5	2.8	+0.5
32	A	A	A	A	A	A	1.6	+0.4	0.4	+0.4	2.4	+0.5	2.9	+0.5	3.6	+0.6
40	A	A	A	A	1.6	+0.4	1.9	+0.4	0.5	+0.5	3	+5.0	3.7	+0.6	4.5	+0.7
50	A	A	1.6	0.4	2	+0.4	2.4	+0.5	0.5	+0.5	3.7	+0.6	4.6	+0.7	5.6	+0.8
63	1.6	+0.4	2	+0.4	2.5	+0.5	3	+0.5	0.6	+0.6	4.7	+0.7	5.8	+0.8	7.1	+1.0
75	1.9	+0.4	2.3	+0.5	2.9	+0.5	3.6	+0.6	0.7	+0.7	5.6	+0.8	6.8	+0.9	8.4	+1.1
90	2.2	+0.5	2.8	+0.5	3.5	+0.6	4.3	+0.7	0.8	+0.8	6.7	+0.9	8.2	+1.1	10.1	+1.3
110	2.7	+0.5	3.4	+0.6	4.2	+0.7	5.3	+0.8	0.9	+0.9	8.1	+1.1	10	+1.2	12.3	+1.5
125	3.1	+0.6	3.9	+0.6	4.8	+0.7	6	+0.8	1.0	+1	9.2	+1.2	11.4	+1.4	14	+1.6
140	3.5	+0.6	4.3	+0.7	5.4	+0.8	6.7	+0.9	1.1	+1.1	10.3	+1.3	12.7	+1.5	15.7	+1.8
160	4	+0.6	4.9	+0.7	6.2	+0.9	7.7	+1	1.2	+1.2	11.8	+1.4	14.6	+1.7	17.9	+2.0
180	4.4	+0.7	5.5	+0.8	6.9	+0.9	8.6	+1.1	1.3	+1.3	13.3	+0.6	16.4	+1.9	20.1	+2.3
200	4.9	+0.7	6.2	+0.9	7.7	+1.0	9.6	+1.2	1.4	+1.4	14.7	+1.7	18.2	+2.1	22.4	+2.5
225	5.5	+0.8	6.9	+0.9	8.6	+1.1	10.8	+1.3	1.6	+1.6	16.6	+1.9	20.5	+2.3	25.2	+2.8
250	6.2	+0.9	7.7	+1	9.6	+1.2	11.9	+1.4	1.7	+1.7	18.4	+2.1	22.7	+2.5	27.9	+3.0
280	6.9	+0.9	8.6	+1.1	10.7	+1.3	13.4	+1.6	1.9	+1.9	20.6	+2.3	25.4	+2.8	31.3	+3.4
315	7.7	+1.0	9.7	+1.2	12.1	+1.5	15	+1.7	2.1	+2.1	23.2	+2.6	28.6	+3.1	35.2	+3.8

^AThis size and thickness is not practical to manufacture.

TABLE 3 Sustained Pressure Test Conditions for Water at 20°C for ABS Plastic Pipe (Conditioned per 7.1)

NOTE 1—The following test conditions shall be used: Type A end caps as specified in ISO 1167. Orientation, not specified, 1 hr conditioning, water-in-water or water-in-air testing.

Characteristic	Requirement	Hydrostatic (hoop) stress, MPa	Time, h	Test Method
Resistance to Internal Pressure	No failure during test period	25.0 or σ_{LCL} at 20°C and 1 hr, whichever is greater	>1	ISO 1167
Resistance to Internal Pressure	No failure during test period	20.6 or σ_{LCL} at 20°C and 100 hr, whichever is greater	>100	ISO 1167
Resistance to Internal Pressure at 60°C	No failure during test period	7.0 or σ_{LCL} at 60°C and 1000 hr, whichever is greater	>1000	ISO 1167

7.2 Test Conditions—Conduct the tests in the Standard Laboratory Atmosphere of $23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ relative humidity, unless otherwise specified in the test methods or in this specification.

7.3 Test Specimens—Not less than 50 % of the test specimens required for any pressure test shall have at least a part of the marking in their central sections. The central section is that portion of pipe, which is at least one pipe diameter away from an end closure.

7.4 Dimensions and Tolerances—Use any length of pipe to determine the dimensions. Measure in accordance with Test Method **D2122**.

7.4.1 Outside Diameter—Measure the outside diameter and out-of-roundness of the pipe in accordance with Test Method **D2122**. The average outside diameter is the arithmetic average of the maximum and minimum diameters at any cross section on the length of the pipe. The tolerances for out-of-roundness shall apply only on pipe before shipment.

7.4.2 Wall Thickness—Make micrometer measurements of the wall thickness in accordance with Test Method **D2122** to determine the maximum and minimum values. Measure the wall thickness to the nearest 0.02 mm.

7.5 Sustained Pressure Test—Select the test specimens at random. Test individually with water at the stress levels, temperatures, and times given in **Table 3**, each specimen shall be at least ten times the nominal diameter in length, but not less than 250 mm or more than 920 mm between end closures and shall bear the permanent marking on the pipe. Hold the pressure as closely as possible, but within ± 70 kPa. Condition the specimens at the test temperature to within $\pm 2^\circ\text{C}$. Maintain the test temperature at $20 \pm 2^\circ\text{C}$. Test in accordance with ISO 1167.

7.6 Burst Pressure—For each diameter, determine the minimum burst pressure with at least five specimens in accordance with ISO 1167. The time of testing each specimen shall be between 60 and 70 s. The average minimum burst pressure shall not be less than 3.2 times the pressure rating, PR.

7.7 Impact Resistance—When tested in accordance with ISO 3127 at 0°C , pipe shall have a true impact rate (TIR) of not more than 10 % when using the weights and heights given in **Table 4**.

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.

TABLE 4 Impact Test Weights and Heights

d_n	Mass of falling weight (kg)	Drop Height (m)
20	0.5	2.0
25	1.5	2.0
32	1.6	2.0
40	2.0	2.0
50	2.5	2.0
63	4.0	2.0
75	4.0	2.0
90	5.0	2.0
110	6.0	2.0
125	6.0	2.0
140	6.0	2.0
160	7.0	2.0
180	7.0	2.0
200	8.0	2.0
>225	9.0	2.0

9. Marking

9.1 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.

9.2 Marking on the pipe shall include the following, spaced at intervals of not more than 2m:

9.2.1 Nominal pipe size (for example, NPS 110).

9.2.2 Standard pipe dimension ratio in accordance with **5.2** (for example, SDR 17),

9.2.3 The pressure rating in MPa for water at 23°C (shown as the number followed by MPa), followed by the pressure rating in PSI in parentheses - for example 1.38 MPa at 23°C .

9.2.4 This designation “ASTM F2806,” with which the pipe complies.

9.2.5 Manufacturer’s name (or trade mark) and lot code information (for example, date of manufacture).

9.2.6 Pipe intended for the transport of potable water shall also include the seal or mark of the laboratory making the evaluation for this purpose, spaced at intervals specified by the laboratory.

10. Quality Assurance

10.1 When the product is marked with this designation, F2806, 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; HDB; plastic pipe; pressure piping; SDR

SUPPLEMENTARY REQUIREMENTS**GOVERNMENT/MILITARY PROCUREMENT**

These requirements apply only to Federal/Military procurement, not domestic sales or transfers.

S1. *Responsibility for Inspection*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. The producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless the purchaser disapproves. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

NOTE S1—In U.S. Federal contracts, the contractor is responsible for inspection.

S2. Packaging and Marking for U.S. Government Procurement:

S2.1 *Packaging*—Unless otherwise specified in the contract,

the materials shall be packaged in accordance with the supplier's standard practice in a manner ensuring arrival at destination in satisfactory condition and which will be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification rules or National Motor Freight Classification rules

S2.2 *Marking* —Marking for shipment shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

NOTE S2—The inclusion of U.S. Government procurement requirements should not be construed as an indication that the U.S. Government uses or endorses the products described in this document.

ADDITIONAL SUPPLEMENTARY REQUIREMENTS**POTABLE WATER REQUIREMENT**

This requirement applies whenever a regulatory authority or user calls for product to be used to convey or be in contact with potable water.

S1. *Potable Water Requirements*

S1.1 Products intended for the transport of potable water shall be evaluated, tested and certified for conformance with NSF/ANSI 61 (Standard No. 61) or the health effects portion

of NSF/ANSI 14 (Standard No. 14) by an acceptable certifying organization when required by the regulatory authority having jurisdiction.

APPENDIX

(Nonmandatory Information)

X1. SOURCE OF HYDROSTATIC DESIGN STRESSES

X1.1 The Hydrostatic Design Basis (HDB) recommended by the Plastics Pipe Institute is used to pressure rate ABS plastic pipe. This hydrostatic design basis applies only to pipe meeting all the requirements of this specification

X1.2 Four ABS pipe materials are included based on the requirements of Specification D3965. See Table X1.1.

X1.3 Information regarding the criteria used in developing HDB values may be obtained from the Plastics Pipe Institute. These hydrostatic design bases may not be suitable for materials that show a wide departure from a straight-line plot of log

stress versus log time to failure. All the data available to date on ABS pipe materials marketed in the North America exhibit a straight-line plot under these plotting conditions.

X1.4 Typical pressure ratings for ABS water pipe with various SDR values are shown in Table X1.2. These pressure ratings are obtained using the Eq 1 and shown below. For this example, the hydrostatic design stress (HDS) is obtained by multiplying the HDB of 21.7 MPa by the design factor of 0.5.

$$HDS = HDB \times 0.5 = 8.62 \text{ MPa} \quad (\text{X1.1})$$

$$PR = 2 \text{ HDS} / (SDR - 1)$$

TABLE X1.1 Type and Grade Designations

Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Material Designation
2	0	2	1	1	Type 1, Grade 1
4	2	2	2	2	Type 1, Grade 2
2	0	6	4	3	Type 1, Grade 3
3	0	4	4	4	Type 2, Grade 1

TABLE X1.2 Pressure Ratings for ABS Water Pipe (HDB of 21.7 MPa at 23°C)

SDR	9	11	13.5	17	21	26	32.5	41
PR, MPa	2.16	1.72	1.38	1.08	0.862	0.690	0.547	0.431
(psi)	(312)	(250)	(200)	(156)	(125)	(100)	(80)	(60)

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