



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

This standard is issued under the fixed designation D 2282; 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 acrylonitrile-butadienestyrene (ABS) pipe produced by single extrusion or simultaneous multiple coextrusion, 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 only, which are chemically compatible with the piping materials. 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.

1.3 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.

1.4 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.

1.5 The following safety hazards caveat pertains only to the test method 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.*

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2. Referenced Documents

2.1 ASTM Standards:²

- D 618 Practice for Conditioning Plastics for Testing
- D 1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
- D 1599 Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
- D 1600 Terminology for Abbreviated Terms Relating to Plastics
- D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- D 2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
- D 3965 Specification for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Compounds for Pipe and Fittings
- F 412 Terminology Relating to Plastic Piping Systems

2.2 Federal Standard:

- Fed. Std. No. 123 Marking for Shipment (Civil Agencies)³

2.3 Military Standard:

- MIL-STD-129 Marking for Shipment and Storage⁴

2.4 NSF Standard:

- Standard No. 14 for Plastic Piping Components and Related Materials³

3. Terminology

3.1 General—Definitions are in accordance with Terminology F 412. Abbreviations are in accordance with Terminology D 1600, 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,

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

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

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 *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.

3.2.3 *pressure rating (PR)*—the estimated maximum water pressure the pipe is capable of withstanding continuously with a high degree of certainty that failure of the pipe will not occur.

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

$$2S/P = R - 1 \text{ or } 2S/P = (D_o/t) - 1$$

where:

- S = hydrostatic design stress, psi (or MPa),
- P = pressure rating, psi (or MPa),
- D_o = average outside diameter, in. (or mm),
- t = minimum wall thickness, in. (or mm), and
- R = standard thermoplastic pipe dimension ratio (D_o/t for ABS pipe), also known as SDR.

3.2.5 *standard thermoplastic pipe dimension ratio (SDR)*—the ratio of pipe diameter to wall thickness. For ABS pipe it is calculated by dividing the average outside diameter of the pipe in millimetres or in inches by the minimum wall thickness in millimetres or in inches. If the wall thickness calculated by this formula is less than 0.060 in. (1.52 mm), it shall be arbitrarily increased to 0.060 in. (1.52 mm). SDR values shall be rounded to the nearest 0.5.

3.2.6 *standard thermoplastic pipe materials designation code*—the pipe materials designation code shall consist of the abbreviation ABS for the type of plastic, followed by the ASTM type and grade (see Table X1.2), and the hydrostatic design stress in units of 100 psi with any decimal figures dropped. When the design stress code contains less than two figures, a cipher is used before the number. Thus a complete material code consists of three letters and four figures for ABS plastic pipe materials (see 4.3).

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 strength tests and (2) long-term strength tests.

4.2 *Basic Materials*—This specification covers ABS pipe made from three ABS plastics as defined in Specification D 3965, in which the requirements are based on short-term tests. These are ABS Classes 42222, 20643, and 30444.

4.3 *Hydrostatic Design Stress*—This specification covers ABS pipe made from ABS plastics as defined by four hydrostatic design stresses developed on the basis of long-term tests (Appendix X1.2).

4.4 *Compound*—The ABS plastic extrusion compound shall meet the requirements of ABS Classes 42222, 20643, or 30444

as described in Specification D 3965. For pipe produced by simultaneous multiple coextrusion, all layers shall be of the same formulation.

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 or simultaneous multiple coextrusion from three ABS plastic pipe materials in four standard dimension ratios and six water pressure ratings for nonthreaded pipe. Pipe produced by simultaneous multiple coextrusion shall be classified as “CoeX.”

5.2 *Standard Thermoplastic Pipe Dimension Ratios (SDR)*—This specification covers ABS pipe in four standard dimension ratios, namely, 13.5, 17, 21, and 26. These are referred to as SDR13.5, SDR17, SDR21, and SDR26, respectively. The pressure rating is uniform for all nominal pipe sizes for a given ABS pipe material and SDR (see Table X1.1, Appendix).

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 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.

TABLE 1 Outside Diameters and Tolerances for ABS Plastic Pipe, in.

Nominal Pipe Size	Outside Diameter	Tolerances		
		Average	For Max and Min (Out-of-Roundness)	
			SDR26 SDR21	SDR17 SDR13.5
1/8	0.405	±0.004	±0.015	±0.008
1/4	0.540	±0.004	±0.015	±0.008
3/8	0.675	±0.004	±0.015	±0.008
1/2	0.840	±0.004	±0.015	±0.008
3/4	1.050	±0.004	±0.015	±0.010
1	1.315	±0.005	±0.015	±0.010
1 1/4	1.660	±0.005	±0.015	±0.012
1 1/2	1.900	±0.006	±0.030	±0.012
2	2.375	±0.006	±0.030	±0.012
2 1/2	2.875	±0.007	±0.030	±0.015
3	3.500	±0.008	±0.030	±0.015
3 1/2	4.000	±0.008	±0.030	±0.015
4	4.500	±0.009	±0.050	±0.015
5	5.563	±0.010	±0.050	±0.030
6	6.625	±0.011	±0.050	±0.035
8	8.625	±0.015	±0.075	±0.045
10	10.750	±0.015	±0.075	±0.050
12	12.750	±0.015	±0.075	±0.060

TABLE 2 Wall Thicknesses and Tolerances for ABS Plastic Pipe

Nominal Pipe Size, in.	Wall Thickness ^A , in.							
	SDR26		SDR21		SDR17		SDR13.5	
	Min	Tolerance	Min	Tolerance	Min	Tolerance	Min	Tolerance
1/8	...	...	...	...	...	...	0.060	+0.020
1/4	...	...	...	...	...	...	0.060	+0.020
3/8	...	...	...	...	...	...	0.060	+0.020
1/2	...	...	...	...	0.060	+0.020	0.062	+0.020
3/4	...	...	0.060	+0.020	0.062	+0.020	0.078	+0.020
1	0.060	+0.020	0.063	+0.020	0.077	+0.020	0.097	+0.020
1 1/4	0.064	+0.020	0.079	+0.020	0.098	+0.020	0.123	+0.020
1 1/2	0.073	+0.020	0.090	+0.020	0.112	+0.020	0.141	+0.020
2	0.091	+0.020	0.113	+0.020	0.140	+0.020	0.176	+0.021
2 1/2	0.110	+0.020	0.137	+0.020	0.169	+0.020	0.231	+0.026
3	0.135	+0.020	0.167	+0.020	0.206	+0.025	0.259	+0.031
3 1/2	0.154	+0.020	0.190	+0.023	0.235	+0.028	0.296	+0.036
4	0.173	+0.021	0.214	+0.026	0.265	+0.032	0.333	+0.040
5	0.214	+0.027	0.265	+0.032	0.327	+0.039	0.412	+0.049
6	0.255	+0.031	0.316	+0.038	0.390	+0.047	0.491	+0.059
8	0.332	+0.040	0.410	+0.049	...	...	...	...
10	0.413	+0.050	0.511	+0.061	...	...	...	...
12	0.490	+0.059	0.606	+0.073	...	...	...	...

^A The minimum is the lowest wall thickness of the pipe at any cross section. The maximum permitted wall thickness, at any cross section, is the minimum wall thickness plus the stated tolerance. All tolerances are on the plus side of the minimum requirement.

6.2.3 Thickness of Outer Layer—For pipe produced by simultaneous multiple extrusion, that is, pipe containing two or more concentric layers, the outer layer shall be at least 0.020 in. (0.50 mm) thick.

6.2.4 Wall Thickness Range—The wall thickness range shall be within 12 % when measured in accordance with 7.4 and 7.4.3.

6.3 Bond—For pipe produced by simultaneous multiple coextrusion, 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 at any point, nor shall separation of bond occur, between layers, during testing performed under the requirements of this specification.

6.4 Sustained Pressure—The pipe shall not fail, balloon, burst, or weep as defined in Test Method D 1598 at the test pressures given in Table 3 when tested in accordance with 7.5.

6.5 Burst Pressure—The minimum burst pressures for ABS plastic pipe shall be as given in Table 4, when determined in accordance with 7.6.

TABLE 3 Sustained Pressure Test Conditions for Water at 73°F (23°C) for ABS Plastic Pipe

Standard Dimension Ratio	Pressure ^A Required for Test					
	ABS1316		ABS2112		ABS1208, ABS1210	
	psi	MPa	psi	MPa	psi	MPa
13.5	510	3.52	430	2.96	340	2.34
17	400	2.76	340	2.34	270	1.86
21	320	2.21	270	1.86	220	1.52
26	260	1.79	220	1.52	170	1.17

^A The fiber stresses used to derive these test pressures are as follows:

ABS1316	3200 psi (22.1 MPa)
ABS2112	2700 psi (18.6 MPa)
ABS1208, ABS1210	2140 psi (14.8 MPa)

Some minor adjustments have been made to keep the test pressures uniform to simplify testing.

TABLE 4 Burst Pressure Requirements for Water at 73°F (23°C) for ABS Plastic Pipe

Standard Dimension Ratio	Min Burst Pressure ^A							
	ABS2112		ABS1316		ABS1210		ABS1208	
	psi	MPa	psi	MPa	psi	MPa	psi	MPa
13.5	1050	7.24	960	6.62	830	5.72	530	3.65
17	830	5.72	750	5.17	660	4.55	420	2.90
21	660	4.55	600	4.14	530	3.65	330	2.28
26	530	3.65	480	3.31	420	2.90	260	1.79

^A The fiber stresses used to derive these test pressures are as follows:

ABS2112	6600 psi (45.5 MPa)
ABS1316	6000 psi (41.4 MPa)
ABS1210	5240 psi (36.2 MPa)
ABS1208	3300 psi (22.8 MPa)

Some minor adjustments have been made to keep the test pressures uniform to simplify testing.

7. Test Methods

7.1 Conditioning—Condition the test specimens at 73 ± 3.6°F (23 ± 2°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.

7.2 Test Conditions—Conduct the tests in the Standard Laboratory Atmosphere of 23 ± 2°C and 50 ± 5 % relative humidity, unless otherwise specified in the test methods or in this specification.

7.3 Sampling—The selection of the sample or samples of pipe shall be as agreed upon by the purchaser and the seller. In case of no prior agreement, any sample selected by the testing laboratory shall be deemed adequate.

7.3.1 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 **D 2122**.

7.4.1 *Outside Diameter*—Measure the outside diameter of the pipe in accordance with Test Method **D 2122**. 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 micrometre measurements of the wall thickness in accordance with Test Method **D 2122** to determine the maximum and minimum values. Measure the wall thickness at both ends of the pipe to the nearest 0.001 in. (0.02 mm).

7.4.3 *Wall Thickness Range*—Measure in such a manner that the maximum, *A*, and the minimum, *B*, wall thicknesses of each cross section measured are obtained. Calculate the wall thickness range, *E*, in percent, for each cross section as follows:

$$E = [(A - B)/A] \times 100$$

The wall thickness range shall not exceed 12 % for any cross section measured.

7.5 *Sustained Pressure Test*—Select the test specimens at random. Test individually with water at the internal pressures given in **Table 3**, six specimens of pipe, each specimen at least ten times the nominal diameter in length, but not less than 10 in. (250 mm) or more than 3 ft (920 mm) between end closures and bearing the permanent marking on the pipe. Maintain the specimens at the pressure indicated for a period of 1000 h. Hold the pressure as closely as possible, but within ± 10 psi (± 70 kPa). Condition the specimens at the test temperature of 73°F (23°C) to within ± 3.6 °F (± 2 °C). Maintain the test temperature at 73 ± 3.6 °F (23 ± 2 °C). Test in accordance with Test Method **D 1598**, except maintain the pressure at the values given in **Table 3** for 1000 h. Failure of two of the six specimens tested shall constitute failure in the test. Failure of one of the six specimens tested is cause for retest of six additional specimens. Failure of one of the six specimens tested in retest shall constitute failure in the test. Evidence of failure of the pipe shall be as defined in Test Method **D 1598**.

7.6 *Burst Pressure*—Determine the minimum burst pressure with at least five specimens in accordance with Test Method **D 1599**. The time of testing each specimen shall be between 60 and 70 s.

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. 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 5 ft:

9.2.1 Nominal pipe size (for example, 2 in.).

9.2.2 Type of plastic pipe material in accordance with the designation code given in **3.2.6** (for example, ABS1210).

9.2.3 Standard thermoplastic pipe dimension ratio in accordance with the designation code given in **5.2** (for example, SDR17), or the pressure rating in pounds per square inch for water at 73°F (23°C) shown as the number followed by psi (for example, 125 psi), except that when intended for pressure application the pressure rating shall be shown (for example, 125 psi). When the indicated pressure rating is lower than that calculated in accordance with **3.2.5** (see Appendix), the SDR shall also be included in the marking code.

9.2.4 This designation “ASTM D 2282,” with which the pipe complies.

9.2.5 Manufacturer’s name (or trade mark) and code.

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. Pipe produced by simultaneous multiple coextrusion shall be marked “CoeX” in accordance with **5.1**.

10. Quality Assurance

10.1 When the product is marked with this designation, D 2282, 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; 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.

POTABLE WATER REQUIREMENT

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

S3. Products intended for contact with potable water shall be evaluated, tested and certified for conformance with ANSI/NSF **Standard No. 61** or the **health effects portion of NSF**

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 stresses recommended by the Plastics Pipe Institute are used to pressure rate ABS plastic pipe. These hydrostatic design stresses are 800 psi (5.5 MPa), 1000 psi (6.9 MPa), 1250 psi (8.6 MPa), and 1600 psi (11.0 MPa) for water at 73°F (23°C). These hydrostatic design stresses apply only to pipe meeting all the requirements of this specification.

X1.2 Four ABS pipe materials are included based on the requirements of Specification **D 3965** and the PPI-recommended hydrostatic design stresses as follows:

X1.2.1 Type 1, Grade 2, with a hydrostatic design stress of 800 psi (5.5 MPa) for water at 23°C, designated as ABS1208.

X1.2.2 Type 1, Grade 2, with a hydrostatic design stress of 1000 psi (6.9 MPa) for water at 23°C, designated as ABS1210.

X1.2.3 Type 1, Grade 3, with a hydrostatic design stress of 1600 psi (11.0 MPa) for water at 23°C, designated as ABS1316.

X1.2.4 Type 2, Grade 1, with a hydrostatic design stress of 1250 psi (8.6 MPa) for water at 23°C, designated as ABS2112.

X1.3 Information regarding the criteria used in developing these hydrostatic design stresses may be obtained from the Plastics Pipe Institute, a division of The Society of the Plastics Industry, 355 Lexington Ave., New York, NY 10017 (Note X1.1). These hydrostatic design stresses 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 made in the United States exhibit a straight-line plot under these plotting conditions.

NOTE X1.1—Refer also to Test Method **D 2837**.

X1.4 The pipe is rated for use with water at 23°C at the maximum internal pressures shown in **Table X1.1** (see also **Table X1.2**). Lower pressure ratings than those calculated in accordance with **6.5** may be recommended, at the option of the

TABLE X1.1 Standard Thermoplastic Pipe Dimension Ratios (SDR) and Water Pressure Ratings (PR) at 73°F (23°C) for Nonthreaded^A ABS Plastic Pipe

SDR	ABS 1316		ABS 2112		ABS 1210		ABS 1208	
	Pressure Rating ^B							
	psi	MPa	psi	MPa	psi	MPa	psi	MPa
13.5	250	1.72	200	1.38	160	1.10	125	0.86
17	200	1.38	160	1.10	125	0.86	100	0.69
21	160	1.10	125	0.86	100	0.69	80	0.55
26	125	0.86	100	0.69	80	0.55	...	...
Pressure Rating				Standard Dimension Ratio				
psi	MPa							
250	1.72	13.5	...	...	...	...	...	...
200	1.38	17	13.5	...	...	...	...	...
160	1.10	21	17	13.5	...	...	...	...
125	0.86	26	21	17	13.5	...	...	...
100	0.69	...	26	21	17	13.5	...	...
80	0.55	...	...	26	21	17	13.5	...

^AThese pressure ratings do not apply for threaded pipe.

^BSee 3.2.6 and 4.3 for code designation.

TABLE X1.2 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

pipe manufacturer, in which case the SDR shall be included in the marking. Experience of the industry indicates that ABS plastic pipe meeting the requirements of this specification gives satisfactory service under normal conditions for a long period

at these pressure ratings. The sustained pressure requirements (6.4) are related to these ratings through the slopes of the strength-time plots of these materials in pipe form.

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