



Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80¹

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

^{ε1} NOTE—Keywords were editorially added in November 2003.

1. Scope

1.1 This specification covers acrylonitrile-butadienestyrene (ABS) pipe produced by single extrusion or simultaneous multiple coextrusion, in Schedule 40 and 80 sizes and pressure-rated for water (see Appendix). 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.*

¹ This specification is under the jurisdiction of ASTM Committee F-17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.61 on Water. Current edition approved May 10, 1999. Published July 1999. Originally published as D 1527 – 58. Last previous edition D 1527 – 96a.

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 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings³
- D 2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials³
- D 3965 Specification for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Compounds for Pipe and Fittings⁴
- F 412 Terminology Relating to Plastic Piping Systems³

2.2 *Federal Standard:*

- Fed. Std. No. 123 Marking for Shipments (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. 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:

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.

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 *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 dimensions, hydrostatic design stress, and pressure rating*—the following expression is used in this specification to relate dimensions, hydrostatic design stress, and pressure rating:

$$2 SP = (D_o t) - 1 \tag{1}$$

where:

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

3.2.5 *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 X1.1) 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 shall be used before the number. Thus a complete material code shall consist of three letters and four figures for ABS plastic pipe materials (see 6.3).

4. Pipe Classification

4.1 *General*—This specification covers ABS pipe, produced by single extrusion or simultaneous multiple coextrusion from three ABS plastic pipe materials in Schedule 40 and 80 sizes. Pipe produced by simultaneous multiple coextrusion shall be classified “CoeX.”

5. Requirements

5.1 *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.

5.2 Dimensions and Tolerances:

5.2.1 *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.

5.2.2 *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 Schedules 40 and 80, in.

Nominal Pipe Size	Average Outside Diameter	For Average Diameter	Tolerances	
			For Max and Min Diameter (Out-of-Roundness)	
			Schedule 40 sizes 3½ in. and over, Schedule 80 sizes 8 in. and over	Schedule 40 sizes 3 in. and less, Schedule 80 sizes 6 in. and less
⅛	0.405	±0.004	±0.015	±0.008
¼	0.540	±0.004	±0.015	±0.008
⅜	0.675	±0.004	±0.015	±0.008
½	0.840	±0.004	±0.015	±0.008
¾	1.050	±0.004	±0.015	±0.010
1	1.315	±0.005	±0.015	±0.010
1¼	1.660	±0.005	±0.015	±0.012
1½	1.900	±0.006	±0.030	±0.012
2	2.375	±0.006	±0.030	±0.012
2½	2.875	±0.007	±0.030	±0.015
3	3.500	±0.008	±0.030	±0.015
3½	4.000	±0.008	±0.050	±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 Schedules 40 and 80, in.

Nominal Pipe Size	Wall Thickness ^A			
	Schedule 40		Schedule 80	
	Min	Tolerance	Min	Tolerance
⅛	0.068	+0.020	0.095	+0.020
¼	0.088	+0.020	0.119	+0.020
⅜	0.091	+0.020	0.126	+0.020
½	0.109	+0.020	0.147	+0.020
¾	0.113	+0.020	0.154	+0.020
1	0.133	+0.020	0.179	+0.021
1¼	0.140	+0.020	0.191	+0.023
1½	0.145	+0.020	0.200	+0.024
2	0.154	+0.020	0.218	+0.026
2½	0.203	+0.024	0.276	+0.033
3	0.216	+0.026	0.300	+0.036
3½	0.226	+0.027	0.318	+0.038
4	0.237	+0.028	0.337	+0.040
5	0.258	+0.031	0.375	+0.045
6	0.280	+0.034	0.432	+0.052
8	0.322	+0.039	0.500	+0.060
10	0.365	+0.044	0.593	+0.071
12	0.406	+0.049	0.687	+0.082

^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.

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

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

5.3 *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 clearly at any point, nor shall separation of bond occur, between layers, during testing performed under the requirements of this specification.

5.4 *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 and Table 4 when tested in accordance with 7.5.

5.5 *Burst Pressure*—The minimum burst pressures for ABS plastic pipe shall be as given in Table 5 and Table 6, when determined in accordance with 7.6.

TABLE 3 Sustained Pressure Test-Conditions for Water at 73°F (23°C) for ABS Plastic Pipe, Schedule 40

Inch-pound Units			
Nominal Pipe Size, in.	Pressure ^A Required for Test, psi		
	ABS1208 ABS1210	ABS1316	ABS2112
1/8	860	1290	1090
1/4	830	1250	1050
3/8	670	1000	840
1/2	640	950	810
3/4	520	770	650
1	480	720	610
1 1/4	390	590	500
1 1/2	350	530	450
2	300	440	370
2 1/2	330	490	410
3	280	420	360
3 1/2	260	380	320
4	240	360	300
5	210	310	260
6	190	280	240
8	170	250	210
10	150	220	190
12	140	210	180

SI Units			
Nominal Pipe Size, in.	Pressure ^A Required for Test, MPa		
	ABS1208 ABS1210	ABS1316	ABS2112
1/8	5.95	8.90	7.50
1/4	5.70	8.60	7.25
3/8	4.60	6.90	5.80
1/2	4.40	6.55	5.60
3/4	3.60	5.30	4.50
1	3.30	4.95	4.20
1 1/4	2.70	4.05	3.45
1 1/2	2.40	3.65	3.10
2	2.05	3.05	2.55
2 1/2	2.30	3.40	2.85
3	1.95	2.90	2.50
3 1/2	1.80	2.60	2.20
4	1.65	2.50	2.05
5	1.45	2.15	1.80
6	1.30	1.95	1.65
8	1.15	1.70	1.45
10	1.05	1.50	1.30
12	0.95	1.45	1.25

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

ABS1208 ABS1210	2140 psi (14.75 MPa)
ABS1316	3200 psi (22.06 MPa)
ABS2112	2700 psi (18.62 MPa)

TABLE 4 Sustained Pressure Test Conditions for Water at 73°F (23°C) for ABS Plastic Pipe, Schedule 80

Inch-pound Units			
Nominal Pipe Size, in.	Pressure ^A Required for Test, psi		
	ABS1208 ABS1210	ABS1316	ABS2112
1/8	...	1960	...
1/4	...	1810	...
3/8	...	1470	...
1/2	910	1360	1150
3/4	740	1100	930
1	670	1010	850
1 1/4	560	830	700
1 1/2	500	750	640
2	430	650	550
2 1/2	450	680	570
3	400	600	510
3 1/2	370	550	470
4	350	520	440
5	310	460	390
6	300	450	380
8	260	390	330
10	250	370	320
12	240	360	310

SI Units			
Nominal Pipe Size, in.	Pressure ^A Required for Test, MPa		
	ABS1208 ABS1210	ABS1316	ABS2112
1/8	...	13.50	...
1/4	...	12.50	...
3/8	...	10.10	...
1/2	6.25	9.40	7.95
3/4	5.10	7.60	6.40
1	4.60	6.95	5.85
1 1/4	3.85	5.70	4.85
1 1/2	3.45	5.15	4.40
2	2.95	4.50	3.80
2 1/2	3.10	4.70	3.95
3	2.75	4.15	3.50
3 1/2	2.55	3.80	3.25
4	2.40	3.60	3.05
5	2.15	3.15	2.70
6	2.05	3.10	2.60
8	1.80	2.70	2.30
10	1.70	2.55	2.20
12	1.65	2.50	2.15

^AThe fiber stresses used to derive these tests pressures are as follows:

ABS1208 ABS1210	2140 psi (14.75 MPa)
ABS1316	3200 psi (22.06 MPa)
ABS2112	2700 psi (18.62 MPa)

6. Materials

6.1 *General*—ABS 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.

6.2 *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.

6.3 *Hydrostatic Design Stresses*—This specification covers ABS pipe made from three ABS plastics as defined by four hydrostatic design stresses developed on the basis of long-term tests (see X1.3).

TABLE 5 Burst Pressure Requirements for Water at 73°F (23°C) for ABS Plastic Pipe, Schedule 40

Inch-pound Units			
Nominal Pipe Size, in.	Minimum Burst Pressure, ^A psi		
	ABS1208 ABS1210	ABS1316	ABS2112
1/8	2110	2420	2660
1/4	2040	2340	2570
3/8	1630	1870	2060
1/2	1560	1790	1970
3/4	1260	1450	1590
1	1180	1350	1490
1 1/4	970	1110	1220
1 1/2	870	990	1090
2	730	830	920
2 1/2	800	910	1000
3	690	790	870
3 1/2	630	720	790
4	580	670	730
5	510	580	640
6	460	530	580
8	410	470	510
10	370	420	460
12	340	390	430

SI Units			
Nominal Pipe Size, in.	Minimum Burst Pressures, ^A MPa		
	ABS1208 ABS1210	ABS1316	ABS2112
1/8	14.6	16.7	18.3
1/4	14.1	16.1	17.7
3/8	11.2	12.9	14.2
1/2	10.8	12.3	13.6
3/4	8.70	10.0	11.0
1	8.15	9.30	10.3
1 1/4	6.70	7.65	8.40
1 1/2	6.00	6.85	7.50
2	5.05	5.70	6.35
2 1/2	5.50	6.25	6.90
3	4.75	5.45	6.00
3 1/2	4.35	4.95	5.45
4	4.00	4.60	5.05
5	3.50	4.00	4.40
6	3.15	3.65	4.00
8	2.85	3.25	3.50
10	2.55	2.90	3.15
12	2.35	2.70	2.95

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

ABS1208 ABS 1210	5240 psi (36.12 MPa)
ABS1316	6000 psi (41.36 MPa)
ABS 2112	6600 psi (45.50 MPa)

6.4 *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.

6.5 *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.

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.

TABLE 6 Burst Pressure Requirements for Water at 73°F (23°C) for ABS Plastic Pipe, Schedule 80

Inch-pound Units			
Nominal Pipe Size, in.	Minimum Burst Pressures, ^A psi		
	ABS1208 ABS1210	ABS1316	ABS2112
1/8	...	3680	...
1/4	...	3390	...
3/8	...	2750	...
1/2	2220	2550	2800
3/4	1800	2060	2270
1	1650	1890	2080
1 1/4	1360	1560	1720
1 1/2	1230	1410	1550
2	1060	1210	1330
2 1/2	1110	1270	1400
3	980	1120	1240
3 1/2	910	1020	1140
4	850	970	1070
5	760	870	950
6	730	840	920
8	640	740	810
10	610	700	770
12	600	680	750

SI Units			
Nominal Pipe Size, in.	Minimum Burst Pressures, ^A MPa		
	ABS1208 ABS1210	ABS1316	ABS2112
1/8	...	25.4	...
1/4	...	23.4	...
3/8	...	19.0	...
1/2	15.3	17.6	19.3
3/4	12.4	14.2	15.6
1	11.4	13.0	14.3
1 1/4	9.40	10.8	11.9
1 1/2	8.50	9.70	10.7
2	7.30	8.35	9.15
2 1/2	7.65	8.75	9.65
3	6.75	7.70	8.55
3 1/2	6.25	7.05	7.85
4	5.85	6.70	7.40
5	5.25	6.00	6.55
6	5.05	5.80	6.35
8	4.40	5.10	5.60
10	4.20	4.85	5.30
12	4.15	4.70	5.15

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

ABS1208 ABS1210	5240 psi (36.12 MPa)
ABS1316	6000 psi (41.36 MPa)
ABS2112	6600 psi (45.50 MPa)

7.2 *Test Conditions*—Conduct test 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 between 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.