Designation: D3965 – 21

Standard Classification System and Basis for Specifications for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Materials for Pipe and Fittings[1]

This standard is issued under the fixed designation D3965; 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.

1. Scope*

1.1 This classification system covers materials made from only virgin ABS polymers and blends of ABS polymers suitable for use in the extrusion of pipe and molding of fittings.

1.2 The requirements of this classification system are applicable only to the ABS polymers and blends of ABS polymers as classified and do not address the requirements of the finished pipe or fittings. The applicable ASTM standard specification for pipe or fittings shall be consulted for their requirements.

1.3 This classification system excludes ABS polymers and blends of ABS polymers made from reprocessed, regrind, reclaimed, or recycled materials. ABS rework, generated in-house by the original plastic manufacturer, is allowed to be used by that original manufacturer, provided the ABS product shipped meets the physical and mechanical properties required by its callout in Table 1.

1.4 This classification system and subsequent line callout (specification) provides a means for describing ABS materials used in the manufacture of pipe and fittings. It is not intended for the selection of materials. Material selection shall be made by those having expertise in the plastics field after careful consideration of the design and the performance required of the part, the environment to which it will be exposed, the fabrication process to be employed, the inherent properties of the material other than those covered by this classification system, and the economics.

1.5 This classification system and subsequent line callout (specification) provides for the classification of ABS polymers and blends of ABS polymers into groups based on five properties: Izod impact strength at room temperature, Izod impact strength at low temperature, deflection temperature under load, tensile stress at yield point, and modulus of elasticity in tension. The properties included are those required to identify the ABS material by the cell classifications.

NOTE 1—Other requirements necessary to identify particular characteristics of ABS polymers and blends of ABS polymers will be added as test methods become available or the need is identified.

NOTE 2—Due to pipe and fitting standards requirements a separate standard is planned for recycled materials.

1.6 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.7 The following safety hazards caveat pertains only to the test methods portion, Section 13, of this classification system: *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 3—This standard and ISO 7245-1984 address the same subject matter, but differ in technical content.

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics

D618 Practice for Conditioning Plastics for Testing

D638 Test Method for Tensile Properties of Plastics

D648 Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D883 Terminology Relating to Plastics

D1600 Terminology for Abbreviated Terms Relating to Plastics

[1] This classification system is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

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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.

***A Summary of Changes section appears at the end of this standard**

TABLE 1 Physical Property Requirements for ABS Pipe and Fitting Materials

NOTE 1—The minimum property value for any material will determine the cell number although the maximum expected value may fall within the next higher cell.

	ASTM Test Method	Cell Limits					
		0	1	2	3	4	5
Izod impact, min:	D256, Test Method A, Cantilever Beam (Izod-Type) Test						
at 23°C (73°F), J/m		[A]	110	160	210	320	430
(ft-lbf/in. of notch)		[A]	(2)	(3)	(4)	(6)	(8)
at – 30°C (–22°F), J/m		[A]	50	110	160	210	270
(ft-lbf/in. of notch)		[A]	(1)	(2)	(3)	(4)	(5)
Deflection temperature under load, min, 1.82 MPa, (264 psi) annealed, 3.18 mm (0.125 in.) thickness:	D648						
°C		[A]	76	82	88	93	99
(°F)		[A]	(170)	(180)	(190)	(200)	(210)
Tensile stress at yield point, min:	D638						
MPa		[A]	24	31	38	45	52
(psi)		[A]	(3500)	(4500)	(5500)	(6500)	(7500)
Modulus of elasticity in tension, min:	D638						
MPa		[A]	1380	1650	1930	2210	2480
(psi)		[A]	(200 000)	(240 000)	(280 000)	(320 000)	(360 000)

[A] Unspecified.

D3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials
D3892 Practice for Packaging/Packing of Plastics
D4000 Classification System for Specifying Plastic Materials
D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
F412 Terminology Relating to Plastic Piping Systems

2.2 *ISO Standard:*

ISO 7245-1984 Pipes and Fittings of Acrylonitrile-Butadiene-Styrene (ABS)—General Specification for Moulding and Extrusion Materials[3]

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminologies D883 and F412 and abbreviations are in accordance with Terminology D1600, unless otherwise indicated. The abbreviation for acrylonitrile-butadienestyrene plastic is ABS.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *blend*—a homogenous mixture of polymers prepared by melt compounding or physical combination.

3.2.2 *lot*—a unit of manufacture; can consist of a blend of two or more production runs or batches of material.

3.2.3 *natural material*—a polymer as it exists when initially made by the original producer without addition of colorants.

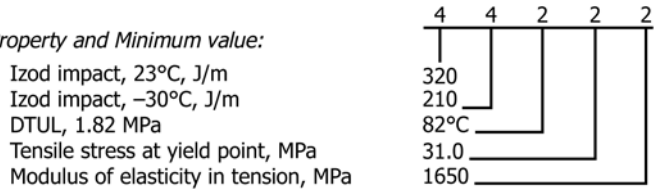
3.2.4 *reprocessed plastic*—a thermoplastic prepared from usually melt-processed scrap or reject parts by a plastics processor or from purchased nonstandard or nonuniform virgin material.

3.2.5 *original plastic manufacturer*—a company that produces ABS resin by polymerization of monomers or compounding of virgin styrene-acrylonitrile plastic (SAN) and virgin polybutadiene rubber, which meets the requirements of this classification system.

4. Classification

4.1 ABS polymers and blends of ABS polymers shall be classified in accordance with Table 1. Each ABS polymer and blend of ABS polymers is given a five-digit cell classification representing the physical properties in the order in which they are listed in Table 1.

NOTE 4—The manner in which selected materials are identified by this classification system is illustrated by an ABS Class 44222 material having the following requirements:



4.2 Although the values listed are necessary to include the range of properties available in existing materials, users shall not infer that every possible combination of the properties exists or can be obtained.

4.3 Mechanical properties of pigmented or colored materials can differ from the mechanical properties of natural material, depending on the choice of colorants and the concentration. The main property affected is ductility, as illustrated by a reduction in Izod impact strength and tensile elongation values. ABS polymers and blends of ABS polymers containing colorants or color concentrates, or both, shall meet the minimum ABS material cell classification from Table 1 for the pipe and fitting products specified.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

5. Materials and Manufacture

5.1 The ABS material shall be produced by polymerization of the monomers, acrylonitrile, butadiene, and styrene, or their closely related chemical derivatives, or from a blend of ABS polymers from those monomers. The blend of ABS polymers can be intimately mixed by melt compounding, or it can be a homogenous physical mixture of discrete ABS polymers.

5.2 The ABS polymer and each ABS polymer component of a blend shall be uniform in physical properties, as defined by a cell classification, and shall be of composition, size, and shape as specified by its product specification or purchase order or contract. The color of the ABS plastic material with added colorants shall be as required in the product specification.

5.3 The ABS material shall contain a minimum of 15 % acrylonitrile, 6 % butadiene, and 15 % styrene, or 15 % of a combination of styrene and substituted styrene. Additive(s) necessary for compounding, impact modification, and coloring are allowed. The final composition of the ABS material shall meet the minimum ABS cell class from Table 1 for the product specified.

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

6. Suffix Requirements

6.1 When additional requirements are needed that are not covered by the basic requirements or cell-table requirements, they shall be indicated through the use of suffixes.

6.2 A list of suffixes can be found in Classification System D4000 (Table 33) and are to be used for additional requirements as appropriate. Additional suffixes will be added to that standard as test methods and requirements are developed and requested.

7. Basic Requirements

7.1 Basic requirements from Table 1 are always in effect unless these requirements are superseded by specific suffix requirements, which always take precedence.

8. Detail Requirements

8.1 The material shall conform to the requirements in Table 1 and suffix requirements as they apply.

8.2 For purposes of determining conformance, all specified limits for a specification (line callout) based on this classification system are absolute limits, as defined in Practice E29.

8.2.1 With the absolute method, an observed value or a calculated value is not rounded, but is to be compared directly with the limiting value. Conformance or nonconformance is based on this comparison.

9. Sampling

9.1 Sampling shall be statistically adequate to satisfy the requirements of 14.3.

9.2 A batch or lot is construed as a unit of manufacture as prepared for shipment and can consist of a blend of two or more “production runs.”

10. Number of Tests and Retests

10.1 One set of specimens as prescribed in the test methods shall be considered sufficient for each lot. The average result for the specimens tested shall meet the requirements of Table 1 when tested in accordance with the test methods listed in Section 13.

11. Specimen Preparation

11.1 The test specimens shall be injection molded in accordance with Practice D3641 with melt temperature 215 ± 15°C and mold temperature 40 ± 15°C. Average injection velocity shall be 200 ± 100 mm/s as defined by the following formula:

$$AIV = \pi\, d^2 V_a / 4\, ns \quad (1)$$

where:

AIV = average injection velocity, mm/s,
d = screw diameter, mm,
V_a = screw advance speed, mm/s,
n = number of mold cavities, and
s = cross-sectional area of the test specimen, mm^2.

Other molding conditions shall be as specified by the manufacturer. Test specimens shall be molded in one piece and shall not be a composite of thinner sections.

12. Conditioning

12.1 Anneal the molded test specimen for use with Test Method D648 for a minimum of 16 h, but not more than 24 h at 85°C for materials in Cells 1 through 3, and at 95°C for materials in Cells 4 and 5. Condition all other molded test specimens in accordance with Procedure *A* of Practice D618, prior to testing.

12.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of 23 ± 2°C and 50 ± 10 % relative humidity, unless otherwise specified in Table 1.

13. Test Methods

13.1 All specimens shall be measured using techniques in Test Method D5947, where applicable.

13.2 *Impact Testing*—Determine the impact strength of the material in accordance with the Cantilever Beam (Izod-Type) Test of Test Methods D256, employing a 3.18 ± 0.38-mm (0.125 ± 0.015-in.) thick specimen.

13.3 *Deflection Temperature Under Load*—Determine the deflection temperature under load, in accordance with Test Method D648, employing a 3.18 by 12.7 by 127-mm (⅛ by ½ by 5-in.) specimen and a load of 1.82 MPa (264 psi).

13.4 *Tensile Stress at Yield Point*—Determine the tensile stress at yield in accordance with Test Method D638, employing a 3.2-mm (⅛-in.) thick Type I specimen. Test the specimen at a speed of 5.1 to 6.4 mm (0.20 to 0.25 in.)/min.

NOTE 5—Most ABS plastics exhibit a true yield point. Tensile stress at yield generally is greater than tensile stress (nominal) at break.

13.5 *Modulus of Elasticity in Tension*—Determine the modulus of elasticity in tension in accordance with Test Method D638, employing the same specimen size and test speed as for tensile stress indicated in 13.4.