



Standard Classification System for Acrylonitrile–Butadiene–Styrene (ABS) Plastics and Alloys Molding and Extrusion Materials¹

This standard is issued under the fixed designation D 4673; 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 only ABS materials and ABS alloys suitable for injection molding and extrusion. Some of these compositions may also be suitable for compression molding. Recycle ABS and alloys will be addressed in a separate standard.

1.2 This classification system is not intended for the selection of materials, but only as a means of calling out materials to be used in the manufacture of parts. Materials are to be selected by personnel with expertise in the plastics field where the economics, the environment to be encountered, the inherent properties of the materials, the part design, the part performance required, and the manufacturing process to be employed all enter into the selection.

1.3 The properties included in this classification system are those required to identify the compositions covered. There may be other requirements necessary to identify particular characteristics important to specialized applications. These will be agreed upon between the user and the supplier by using the suffixes given in Section 5.

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

1.5 The following precautionary caveat pertains only to the test methods portion, Section 12, 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 and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—This classification system and ISO 2580 are technically equivalent for those tests contained in both standards.

2. Referenced Documents

2.1 ASTM Standards:

D 256 Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics²

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 *Annual Book of ASTM Standards*, Vol 08.01.

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²

D 638 Test Method for Tensile Properties of Plastics²

D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load²

D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials²

D 883 Terminology Relating to Plastics²

D 1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics²

D 1525 Test Method for Vicat Softening Temperature of Plastics²

D 1898 Practice for Sampling of Plastics²

D 1999 Guide for the Selection of Specimens and Test Parameters for International Commerce²

D 2584 Test Method for Ignition Loss of Cured Reinforced Resins³

D 3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials³

D 3892 Practice for Packaging/Packing of Plastics³

D 4000 Classification System for Specifying Plastic Materials³

2.2 ISO Standards:⁴

ISO/DIS 75 Plastics and Ebonite—Determination of Temperatures of Deflection under Load

ISO/DIS 178 Plastics—Determination of Flexural Properties

ISO 180 Plastics—Determination of Izod Impact Strength of Rigid Materials

ISO 291 Plastics—Standard Atmosphere for Conditioning and Testing

ISO/DIS 294 Plastics—Injection Moulding Test Specimen of Thermoplastics Materials

ISO 306 Plastics—Determination of Vicat Softening Temperature

ISO/DIS 527, Parts 1 and 2, Plastics—Determination of Tensile Properties

ISO 2580 Acrylonitrile/Butadiene/Styrene (ABS) Moulding and Extrusion Materials, Part 2

³ *Annual Book of ASTM Standards*, Vol 08.02.

⁴ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

3. Terminology

3.1 *Definitions*—Definitions of technical terms used in this classification system are in accordance with Terminology D 883.

4. Classification

4.1 ABS materials, based on three or more monomers, are grouped rather than rigidly classified. These groups are then

subdivided by class and then grades. In cases in which a resin may be classed into more than one group, the supplier will determine the specific callout(s). Table ABS has both ASTM procedure method and ISO procedure versions for callout under the preferred test system.

TABLE ABS ASTM/ISO Values, Requirements, Natural Color Only^A

NOTE 1—For property test parameters, see Section 12.

Group	Description	Class	Description	Grade	Description	Tensile Strength, MPa, ^B Test Method D 638/ ISO 527	Flexural Modulus, MPa, Test Methods D 790/ ISO 178	Izod Impact J/m, ^C Test Method D 256	Izod Impact kJ/m ² , ^D ISO 180	Softening, Test Method D 1525, °C, 120°/h	Temperature or ISO 306, °C, 50°/h		
01	Molding	1	medium impact	1		45	2700	40	5	90	85		
				2		40	2400	125	15	90	85		
				3		40	2200	150	20	90	85		
				4		35	2200	80	10	90	85		
				5		32	1600	70	9	90	85		
				0	other								
				2	high impact	1		35	2100	200	25	90	85
						2		35	2000	250	30	90	85
						3		30	1700	275	35	90	85
						4		30	1700	325	40	90	85
		5				25	1500	400	50	90	85		
		6				30	1600	184	23	90	85		
		0	other										
		3	high heat			1		45	2300	100	10	115	110
						2		40	2000	125	15	110	105
						3		40	2400	125	15	105	100
				4		35	2000	150	20	105	100		
				5		35	2100	80	10	105	100		
				6		34	1700	65	8	98	93		
				7		32	1800	50	6	105	100		
				0	other								
				4	plating ^E	1		45	2600	150	20	105	100
						2		40	2700	80	10	105	100
		3				40	2200	200	25	100	95		
		4				35	2000	200	25	95	90		
		5				34	2200	80	10	93	88		
		0	other										
		5	clear ^F			1		40	2300	80	10	85	80
						0	other						
		6	additive FR ^G			1		40	2200	200	25	85	80
2						40	2000	150	20	85	80		
3				35	2500	80	10	90	85				
4				30	2000	150	20	90	85				
5				25	1800	80	10	85	80				
0	other												
0	other												
02	Extrusion			1	medium impact	1		50	2700	80	10	95	90
						2		45	2400	80	10	90	85
						3		40	2200	150	20	90	85
		4				40	2000	80	10	90	85		
		5				35	2200	125	15	90	85		
		0	other										
		2	high impact			1		35	2400	200	25	90	85
						2		35	2200	325	40	90	85
						3		30	2000	275	35	90	85
						4		30	2000	360	45	90	85
5				25	1800	400	50	90	85				
6				25	1800	440	55	90	85				
0	other												
3	FR	1		40	2300	280	35	90	85				
		2		35	2000	275	35	90	85				
		3		35	2000	210	30	85	80				
0	other												
03	Alloys ABS/PVC	1		0									
				1		50	2800	80	10	100	95		

TABLE Continued

Group	Description	Class	Description	Grade	Description	Tensile Strength, MPa, ^B Test Method D 638/ ISO 527	Flexural Modulus, MPa, Test Methods D 790/ ISO 178	Izod Impact J/m, ^C Test Method D 256	Izod Impact kJ/m ² , ^D ISO 180	Softening, Test Method D 1525, °C, 120°/h	Temperature or ISO 306, °C, 50°/h
				2		40	1800	200	25	90	85
				3		40	1800	275	35	80	75
				4		35	2000	400	50	70	65
				5		50	2100	440	55	110	105
				6		35	2000	475	60	70	65
				7		45	2400	200	25	80	75
				0	other						
				0	other						
04	Alloys ABS/PC	0	other	0	other						
		1	medium impact	1		55	2200	360	45	115	110
				2		55	2400	325	40	110	105
				3		50	2200	275	35	120	115
				4		45	2100	275	35	110	105
				5		40	1900	70	9	105	100
				0	other						
		2	high impact	1		55	2500	400	50	125	120
				2		50	2300	400	50	115	110
				3		50	2200	475	60	125	120
				4		48	2100	275	35	110	105
				5		45	2000	255	32	119	114
				0	other						
		3	high heat	1		60	2400	275	35	140	135
				2		55	2500	400	50	130	125
				3		55	2000	500	40	125	120
				4		50	2300	360	45	135	130
				5		45	2100	600	75	130	125
				6		45	2000	325	40	128	123
				7		45	2000	325	40	119	114
				0	other						
		4	plating	1		50	2300	440	55	130	125
				2		45	2200	400	50	120	115
				3		45	2100	360	45	110	105
				0	other						
		5	additive FR	1		60	2500	125	15	110	105
				2		55	2500	200	25	110	105
				3		55	2500	400	45	90	85
				4		50	2000	440	55	110	105
				5		45	2100	275	35	110	105
				6		40	2000	440	55	110	105
				0	other						
		0	other	0	other						

^AAll cell values are minimums.

^BMPa × 145 = psi.

^CJ/m × 18.73 × 10⁻³ = ft-lbf/in.

^DkJ/m² × 0.476 = ft-lbf/in.².

^EPlating grades are those specifically recommended for plating or sputtering applications.

^FClear ABS has a light transmission of 70 % minimum. It may be tested using Test Method D 1003.

^GSpecific flammability requirements shall be specified by the user.

NOTE 2—An example of this classification system is as follows:

The designation ABS0111 would indicate:

- ABS = acrylonitrile-butadiene-styrene,
- 01 (group) = injection-molding resin,
- 1 (class) = medium impact, and
- 1 (grade) = requirements given in Table ABS.

4.1.1 To facilitate the incorporation of future or special materials, the “other/unspecified” category (0) for group, class, and grade is shown in Table ABS. The basic properties can be obtained from Cell Table A, B, and C as they apply.

4.2 Reinforced and lubricated versions of the ABS materials are classified in accordance with Table ABS and Cell Table A. Table ABS specifies the unreinforced material and Cell Table A

specifies the properties by either ASTM or ISO procedures after the addition of reinforcements or lubricants at the nominal level indicated.

4.2.1 A single letter shall be used for the major reinforcement or combination, or both, along with two digits that indicate the percentage of addition by mass, with the tolerance as tabulated below:

Symbol	Material	Tolerance
C	Carbon- and graphite-fiber reinforced	± 2 %
G	Glass-reinforced	± 2 %
L	Lubricants (for example, PTFE), graphite, silicone and molybdenum disulfide	depends on material and process—to be specified
M	Mineral-reinforced	± 2 %

R Combinations of reinforcements or fillers, or both $\pm 3\%$ for the total reinforcement

additives can be accomplished by the use of the suffix part of the system as described in Section 8.

NOTE 3—This part of the system uses percent of reinforcements or additives, or both, in the callout of the modified basic material. The types and percentages of reinforcements and additives should be shown on the supplier's technical data sheet unless this information is proprietary in nature. If necessary, additional callout of these reinforcements and

4.2.2 Specific requirements for reinforced, filled, or lubricated materials shall be shown by a six-character designation. The designation shall consist of the letter A and the five digits comprising the cell numbers for the property requirements in the order in which they appear in Cell Table A.

CELL TABLE A Reinforced ABS/Alloys
(For property test parameters, see Section 12.)

Designation Grade	Property	Cell Limits										
		0	1	2	3	4	5	6	7	8	9	
1	Tensile strength, MPa ^A , min											
	Test Method D 638	unspecified	40	50	60	70	80	90	100	110	110	^B
2	Flexural modulus, MPa, min											
	Test Methods D 790	unspecified	3000	4000	5000	6000	7500	9000	11 000	15 000	15 000	^B
3	Izod impact, min											
	Test Method D 256, J/m ^C	unspecified	30	45	60	75	90	105	120	140	140	^B
4	Heat deflection temperature, °C, min											
	Test Method D 648	unspecified	65	85	90	95	100	105	110	115	115	^B
5	To be determined											
	ISO/DIS 75	unspecified	65	85	89	94	98	103	108	112	112	^B

^AMPa $\times 145 =$ psi.

^BSpecific value appears on drawing or contract, or both.

^CJ/m $\times 18.73 \times 10^{-3} =$ ft-lbf/in.

^DkJ/m² $\times 0.476 =$ ft-lbf/in.²

CELL TABLE B Unreinforced ABS
(For property test parameters, see Section 12.)

Designation Grade	Property	Cell Limits										
		0	1	2	3	4	5	6	7	8	9	
1	Tensile strength, MPa ^A , min											
	Test Method D 638	unspecified	20	25	30	35	40	45	50	55	55	^B
2	Flexural modulus, MPa, min											
	Test Methods D 790	unspecified	1400	1600	1800	2000	2200	2400	2600	2800	2800	^B
3	Izod impact, min											
	Test Method D 256, J/m ^C	unspecified	30	100	150	200	250	300	350	400	400	^B
4	Softening temperature, °C, min											
	Test Method D 1525	unspecified	75	90	95	100	105	110	115	120	120	^B
5	To be determined											
	ISO 306	unspecified	70	85	90	95	100	105	110	115	115	^B

^AMPa $\times 145 =$ psi.

^BSpecific value appears on drawing or contract, or both.

^CJ/m $\times 18.73 \times 10^{-3} =$ ft-lbf/in.

^DkJ/m² $\times 0.476 =$ ft-lbf/in.²

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

4.2.3 When the grade of the basic material is not known, or is not important, the use of "0" grade classification shall be used for reinforced materials in this system.

NOTE 4—An example of this classification for a reinforced ABS is as follows:

The designation ABS 120G30A55130 indicates:

- ABS 120 = Acrylonitrile-butadiene-styrene, molding resin, high impact
- G30 = Glass reinforced at 30 % nominal level,
- A = Cell Table A, property requirements,
- 5 = 80 MPa tensile strength, min,
- 5 = 7500 MPa flexural modulus, min,
- 1 = 30 J/m Izod impact strength, min,
- 3 = 90°C heat deflection temperature, min, and
- 0 = unspecified.

If no properties are specified, the designation would be ABS 120G30A00000.

4.3 Cell Table B has been incorporated into this classification system to facilitate the classification of special materials where Table ABS or Cell Table A does not reflect the required

properties of ABS material. Cell Table B shall be used in the same manner as Cell Table A.

NOTE 5—An example of a special material using this classification system is as follows:

The designation ABS 210B54220 would indicate the following, with the material requirements from Cell Table B:

- ABS 210 = Acrylonitrile–butadiene–styrene, extrusion resin, medium impact,
- B = Cell Table B property requirements,
- 5 = 40 MPa tensile strength, min,

- 4 = 2000 MPa Flexural modulus, min,
- 2 = 100 J/m Izod impact strength, min,
- 2 = 90°C vicat softening point, min, and
- 0 = unspecified.

NOTE 6—Mechanical properties of pigmented or colored ABS or alloy materials can differ from the mechanical properties of natural ABS or alloy material, depending on the choice and concentration of colorants. The main property affected is ductility, as illustrated by a reduction in Izod impact strength and tensile-elongation values. If specific properties of pigmented ABS or alloy materials are necessary, prior testing between the materials supplier and end user should be initiated.

CELL TABLE C Unreinforced ABS Alloy
(For property test parameters, see Section 12.)

Designation Grade	Property	Cell Limits										
		0	1	2	3	4	5	6	7	8	9	
1	Tensile strength, MPa ^A , min											
	Test Method D 638	unspecified	30	35	40	45	50	55	60	65	^B	
2	Flexural modulus, MPa, min											
	Test Methods D 790	unspecified	1600	1800	2000	2200	2400	2600	2800	3000	^B	
3	Izod impact, min											
	Test Method D 256, J/m ^C	unspecified	100	200	300	350	450	500	550	600	^B	
4	Softening temperature, °C, min											
	Test Method D 1525	unspecified	70	80	90	100	110	120	130	140	^B	
5	ISO 306	unspecified	65	75	85	95	105	115	125	135	^B	
	To be determined	unspecified	

^AMPa × 145 = psi.

^BSpecific value appears on drawing or contract, or both.

^CJ/m × 18.73 × 10⁻³ = ft-lbf/in.

^DkJ/m² × 0.476 = ft-lbf/in.²

4.4 Cell Table C has been incorporated into this specification to facilitate the classification of ABS alloy materials where Table ABS or Table B do not reflect the necessary properties. Cell Table C shall be used in the same manner as Cell Table A or B.

NOTE 7—An example of an ABS alloy using this classification system is as follows: The designation ABS 0420C4665 would indicate the following, with the material requirements from Cell Table BB:

- ABS 0420 = Acrylonitrile-butadiene-styrene polycarbonate alloy, high impact,
- C = Cell Table C property requirements,
- 4 = 45 MPa tensile strength, min, Test Method D 638 or ISO 527, 1 and 2,
- 6 = 2600 MPa flexural modulus, in Test Methods D 790 or ISO 178,
- 6 = 500 J/m Izod impact strength, min, Test Method D 256, or 50 kJ/m² Izod impact strength, min, ISO 180, and
- 5 = 110°C vicat softening point, 120°C/h or 50°C/h.

5. Suffixes

5.1 When additional requirements are needed that are not covered by the basic or cell table requirements, they shall be indicated through the use of suffixes. The suffixes that may be used are listed in the Suffix Symbols and Requirements table of Classification D 4000.

6. Basic Requirements

6.1 Basic requirements from property or cell tables, as they apply, are always in effect unless these requirements are superseded by specific suffix requirements, which always take precedence.

7. General Requirements

7.1 The material composition shall be uniform and shall conform to the requirements specified herein. Specification changes due to the effects of colorants shall be noted by both the materials supplier and the end user and, where necessary, shall be covered by suffixes.

8. Detail Requirements

8.1 Test specimens and testing parameters for the materials shall conform to the requirements prescribed in Table ABS, Cell Table A, B, and C, and suffix requirements as they apply.

8.2 For the purpose of determining conformance, all specified limits for a specification (line callout) based on this classification system are absolute limits.

NOTE 8—Specimen dimensions and specific test procedure requirement for ISO test methods may be found in Guide D 1999 or in referenced ISO Standards.

9. Sampling

9.1 The materials shall be sampled in accordance with the sampling procedure prescribed in Practice D 1898. Statistical

sampling that satisfies the requirements of Section 13 shall be considered as an acceptable alternative. A lot of resin shall be considered as a unit of manufacture as prepared for shipment and may consist of a blend of two or more production runs or batches of material.

10. Specimen Preparation

10.1 The test specimens shall be molded by the injection process using procedures from Practice D 3641 or ISO 294 as a guide. It is recommended that resin should be dried from 2 to 4 h at 80°C for ABS resins or 100°C for ABS/PC alloy resins.

NOTE 9—Moisture levels should typically be 0.1 % or less for injection molding and 0.05 % or less for extrusion to avoid surface defects.

10.1.1 The following conditions shall be used for molding specimens using procedures from Practice D 3641:

	General ABS	Additive FR ABS
Melt temperature	250 ± 5°C	220 ± 5°C
Mold temperature	55 ± 5°C	55 ± 5°C
Injection velocity	200 ± 100 mm/s	200 ± 100 mm/s
	High Heat ABS Reinforced ABS	ABS/PC Alloy Reinforced Alloy
	255 ± 5°C	270 ± 10°C
	55 ± 5°C	80 ± 10°C
	200 ± 100 mm/s	200 ± 100 mm/s

NOTE 10—ISO 2580 conditions are as follows: 250°C melt ± 2°C, 60°C mold at ± 2°C, and 200 ± 100 mm/s injection velocity flow front.

NOTE 11—The average injection velocity may be calculated using the following formula:

$$\frac{\pi d^2 Va}{4ns} \quad (1)$$

where:

- d = screw diameter,
- Va = screw advance speed,
- n = number of cavities, and
- s = cross-sectional area.

10.2 The use of test specimens from the gate end of the mold shall be avoided.

11. Conditioning

11.1 Test specimens shall be conditioned in the Standard Laboratory Atmosphere in accordance with Procedure A of Practice D 618 or ISO 291 after Practice D 618. Shorter times of the test specimen may be used if it is demonstrated that no significant differences in data occur before performing the required tests. The minimum conditioning time shall be 24 h.

11.2 Conduct tests in the standard laboratory atmosphere of 23 ± 2°C and 50 ± 5 % relative humidity in accordance with Practice D 618, unless otherwise specified.

12. Test Methods

12.1 The tensile strength at yield shall be determined on a Type I (ASTM) or Type I a or b (ISO) injection molding specimen tested at 5 mm/min ABS and 50 mm/min ABS/PC

alloy for Test Method D 638 or 50 mm/min for ISO 527 for ABS and alloys. ABS/PC alloys shall be tested at 50 mm/min for both Test Method D 638 and ISO 527 methods.

12.2 The flexural modulus shall be determined on an injection molded specimen 12.5 by 3.2 mm using 50 ± 1 mm span, tangent, at 1.3 mm/min for Test Methods D 790 or 10 by 4 mm, 50 mm span, chord, at 2 mm/min for ISO 178.

12.3 For Izod impact, all specimens shall be taken from the dead end (opposite gate) or the middle of a Type I tensile bar.

12.4 All specimens for thermal testing, either deflection temperature under load or vicat softening temperature, shall be unannealed.

12.5 The vicat softening point shall be determined for a 1 kg load, 12.5 by 3.2 mm injection molded specimen at 2°C/min for Test Method D 1525 or 50 N load, 10 by 4 mm injection molded specimen at 50°C/h for ISO 306.

12.6 The heat-deflection temperature shall be determined for a 1.82 MPa load on a 3.2 mm (Test Method D 648) or 4 mm (ISO 75) thickness unannealed specimen. Testing may be run either edgewise or flatwise.

12.7 The glass content of glass-reinforced materials shall be determined in accordance with Test Method D 2584.

13. Certification And Inspection

13.1 Inspection and certification of the material supplied with reference to a specification based on this classification system shall be for conformance to the requirements specified herein.

13.2 Lot-acceptance inspection shall be the basis on which acceptance or rejection of the lot is made. The lot-acceptance inspection shall consist of those tests that ensure process control during manufacture: melt viscosity, impact, or composition, as they apply.

13.3 Periodic-check inspection shall consist of the tests specified for all requirements of the material under this classification system. The inspection frequency shall be adequate to ensure that the material is certifiable in accordance with 13.4.

13.4 Certification shall be that the material was manufactured, sampled, tested, and inspected in accordance with this classification system and that the average values meet the requirements at a confidence level of 95 %.

13.5 A report of the test results shall be furnished when requested. The report shall consist of the results of the lot-acceptance inspection for the shipment and the results of the most recent periodic-check inspection.

14. Packaging and Marking

14.1 For packing, packaging, and marking, the provisions of Practice D 3892 apply.

15. Keywords

15.1 ABS; ABS/PC; ABS/PVC alloys; classification system; line callout; plastics

 **D 4673**

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