



Standard Specification for Cellulose Acetate Butyrate Molding and Extrusion Compounds¹

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1. Scope

1.1 This specification covers requirements for plasticized cellulose acetate butyrate thermoplastic compounds suitable for injection molding and extrusion. These compounds have a butyryl content less than 38 % and an acetyl content less than 15 % and may or may not contain dyes and pigments. This specification does not include special materials compounded for special applications. Cellulosic plastic materials, being thermoplastic, are reprocessible and recyclable. This specification allows for the use of those cellulosic materials, provided that all specific requirements of this specification are met.

1.2 The properties included in this specification are those required to identify the compositions covered. There may be other requirements necessary to identify particular characteristics important to specialized applications. These may be specified by using the suffixes as given in Section 5.

1.3 This classification system and subsequent line call out (specification) are intended to provide a means of calling out plastic materials used in the fabrication of end items or parts. It is not intended for the selection of materials. Material selection should be made by those having expertise in the plastic field after careful consideration of the design and performance required of the part, environment to which it will be exposed, fabrication process to be employed, costs involved, and inherent properties of the material other than those covered by this classification system.

1.4 The values stated in SI units are to be regarded as standard.

1.5 The following safety hazards caveat pertains only to the test method portion, Section 12, 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.*

NOTE 1—There is no equivalent or similar ISO standard.

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2. Referenced Documents

2.1 ASTM Standards:

- D 149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies²
- D 256 Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastic³
- D 257 Test Methods for DC Resistance or Conductance of Insulating Materials²
- D 570 Test Method for Water Absorption of Plastics³
- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing³
- D 635 Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position³
- D 638M Test Method for Tensile Properties of Plastics [Metric]³
- D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials³
- D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement³
- D 883 Terminology Relating to Plastics³
- D 1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics³
- D 1600 Terminology for Abbreviated Terms Relating to Plastics³
- D 1729 Practice for Visual Evaluation of Color Differences of Opaque Materials⁴
- D 1898 Practice for Sampling of Plastics³
- D 3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials⁵
- D 3892 Practice for Packaging/Packing of Plastics⁵
- D 4000 Classification System for Specifying Plastic Materials⁵
- D 5033 Guide for the Development of Standards Relating to

² Annual Book of ASTM Standards, Vol 10.01.

³ Annual Book of ASTM Standards, Vol 08.01.

⁴ Annual Book of ASTM Standards, Vol 06.01.

⁵ Annual Book of ASTM Standards, Vol 08.02.

the Proper Use of Recycled Plastics⁶
E 308 Practice for Computing the Colors of Objects by
Using the CIE System⁴

3. Terminology

3.1 *Definitions*—The terminology used in this specification is in accordance with Terminologies D 883 and D 1600.

4. Classification

4.1 This specification covers the following groups, classes, and grades (see Table CAB):

4.1.1 *Group 01*—High impact strength.

4.1.2 *Group 02*—High tensile strength.

4.1.3 *Class*—According to plasticizer content and properties specified in Table CAB.

4.1.4 *Grade 1*—For injection molding (general purpose).

4.1.5 *Grade 2*—For extrusion (see requirement in 6.5).

5. Suffixes

5.1 When requirements are needed that are not covered in Table CAB they shall be indicated through the use of suffixes.

5.2 A list of suffixes can be found in Classification System D 4000 (Table 3) and may be used for additional requirements as appropriate. Additional suffixes will be added to that classification system as test methods and requirements are developed and requested.

5.3 Color and opacity shall be within the limits defined in 6.3.

5.4 Some of the more commonly used suffixes for cellulose acetate butyrate are shown as follows:

E = electrical requirements as designated by the following digits:

First Digit

1 = volume resistivity—Test Methods D 257.
dielectric strength—Test Method D 149 (short-time/step-by-step).

Second Digit

1 = volume resistivity and dielectric strength meet property requirements as shown in Table 1.

F = flammability requirements as designated by the following digits:

First Digit

1 = rate of burning—Test Method D 635, specimen size: 125 mm long by 12.7 mm wide by 3.2 mm thick.

Second Digit

1 = burn rate 5 cm/min, max.

T = transmittance requirements as designated by the following digits:

First Digit

1 = total luminous transmittance determined in accordance with Procedure A of Test Method D 1003.

Second Digit

1 = total luminous transmittance, 80 % min.

5.5 An example of this classification system for a high-impact cellulose acetate butyrate formulation would be as follows:

CAB0122F11

CAB = Table CAB property requirements.

01 = Group 01—high impact strength.

2 = Class 2—Plasticizer range from 12 to 23 % (see Table CAB, Footnote 1).

2 = Grade 2—Extrusion application.

F11 = Flammability requirement—Burn rate maximum of 5 cm/min when tested in accordance with Test Method D 635.

NOTE 2—“CAB0122” corresponds to the following physical property requirements in Table CAB:

Specific gravity: 1.15–1.19.

Tensile stress at yield: 19 MPa min.

Flexural modulus: 760 MPa min.

Izod impact strength: 285 J/m min.

Water absorption: 1.6 % max.

Weight loss on heating: 2.7 % max.

6. Materials and Manufacture

6.1 Materials supplied in these forms shall be as uniform in composition and size, and as free of contamination, as can be achieved by good manufacturing practice.

6.2 These materials may contain colorants in the nominal amounts ordinarily employed, but such additives shall not alter the ability of the materials to meet the specified properties.

6.3 The color of material supplied shall be comparable, within commercial match tolerances, to the color of standard samples prepared by the manufacturer.

6.4 Grade 2 materials shall be verified by the manufacturer to be of extrusion quality.

7. Physical Requirements

7.1 Test specimens of the material shall conform to the requirements prescribed in Table CAB.

7.2 Molded specimens, for those tests requiring them, shall be prepared in accordance with Section 10.

7.3 Conformance to the requirements of this specification shall be determined in accordance with Section 11, unless otherwise specified.

8. Sampling

8.1 The material shall be sampled in accordance with Sections 9 to 12 of Practice D 1898. Adequate statistical sampling prior to packaging shall be considered an acceptable alternative.

8.2 For sampling purposes, a batch or lot shall be considered a unit of manufacture as prepared for shipment and may consist of a blend of two or more production runs of material.

9. Number of Tests

9.1 Routine testing of each batch or lot shall be limited to properties designated in Table CAB of this specification.

9.2 One set of samples for those tests that are designated (Section 12) shall be considered sufficient for testing the batch or lot. The average results from those samples shall comply with the requirements prescribed in this specification.

9.3 If any failure occurs, the materials may not be certified to this specification.

10. Specimen Preparation

10.1 Physical property requirements in Table CAB are based on injection-molded specimens 3.2 mm thick. Specimens

⁶ Annual Book of ASTM Standards, Vol 08.03.

machined from compression-molded blanks or extruded strips may be used, provided it can be shown that the results are comparable.

10.2 Prior to molding cellulose acetate butyrate, the material should be dried to a moisture content of 0.2 % or less. The primary reason for drying the material is to eliminate visual defects such as surface imperfections and bubbles. Material spread in a tray to a maximum depth of 50 mm and exposed in a circulating-air oven at 75 to 90°C for 3 h should be satisfactory. Formulations containing either very low or very high levels of plasticizer may require slightly higher or lower drying temperatures respectively. Control the injection molding cycles in accordance with Practice D 3641, using a material temperature of 25 to 35°C above the “cold point.” (The “cold point” is the lowest material temperature at which it is possible to obtain a full shot when all other operating variables are held constant within the normal operating range.) Mold temperatures between 35 and 60°C have been found desirable. As a rule, thin-section moldings and higher material hardness (lower plasticizer content) require higher mold temperatures.

10.3 Test specimens injection molded from cellulosic materials are subject to “overpacking” if the gate size is too large, and this can result in brittleness in the gate area as well as throughout the entire specimen. To avoid this, the gate size should be significantly smaller than those recommended in Practice D 3641. A gate size 1.5 mm square has been found to produce satisfactory test specimens.

11. Test Methods

11.1 Determine the properties defined by this specification in accordance with the following test methods:

11.1.1 Unless otherwise specified, all tests shall be performed in the standard laboratory atmosphere as defined by Practice D 618.

11.1.2 Unless otherwise specified, test specimens shall be conditioned in accordance with Procedure A of Practice D 618.

11.1.3 *Color-Visual*—Practice D 1729

11.1.4 *Color-Quantitative*—Practice E 308

11.1.5 *Plasticizer Content*—The test method for plasticizer content shall be as agreed upon between the manufacturer and the purchaser.

11.1.6 *Specific Gravity*—Test Methods D 792.

11.1.7 *Tensile Stress at Yield*—Test Method D 638M, Type I test specimen, 50-mm/min testing speed.

11.1.8 *Flexural Modulus*—Test Methods D 790, 1.27-mm/min testing speed.

11.1.9 *Impact Strength (Izod)*—Test Method A of Test Method D 256. Specimen size: 63.5 mm long by 12.7 mm wide by 3.2 mm thick.

11.1.10 *Water Absorption*—Test Method D 570, 24-h immersion.

NOTE 3—The ungated “tab end” (75 mm long) of a Test Method D 638M, Type I tensile bar will give comparable results and can be used

if the primary specimen type is not available. Condition in accordance with Test Method D 570.

11.1.11 *Weight Loss on Heating*—Condition test specimens, 50.8 mm in diameter or 50.8 mm wide by 63.5 mm long by 3.2 mm thick, for 48 h over anhydrous calcium chloride at 23 ± 2°C or 4 h at 70 ± 2°C.

NOTE 4—The ungated “tab end” (75mm long) of a Test Method D 638M, Type I tensile bar will give comparable results and can be used if the primary specimen type is not available. Weigh three specimens and place them in a circulating-air oven for 72 h at 82 ± 2°C. Support the specimens flatwise on a screen in the oven. Upon removal from the oven, cool the specimens in a desiccator over anhydrous calcium chloride to 23 ± 2°C. Weigh the specimens and calculate the weight loss on heating as a percentage of the conditioned weight as follows:

$$\text{weight loss on heating, \%} = \frac{(W_1 - W_2)}{W_1} \times 100 \quad (1)$$

where:

W_1 = original weight, g, after initial conditioning, and

W_2 = weight, g, after 72 h in oven at 82°C.

12. Inspection and Certification

12.1 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.

12.2 Lot-acceptance inspection shall be the basis on which acceptance or rejection of the lot is made. The lot-acceptance inspection shall consist of plasticizer content determination (see Table CAB, Footnote 1) and color as specified in 6.3.

12.3 Periodic check inspection with reference to a specification based on this classification system shall consist of the tests for all requirements of the material under the specification. Inspection frequency shall be adequate to ensure that the material is certifiable in accordance with 12.4.

12.4 Certification shall be that the material was manufactured by a process in statistical control, sampled, tested, and inspected in accordance with this classification system and that the average values for the lot meet the requirements of the classification system (line call out).

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

13. Rejection

13.1 Material that fails to conform to the requirements of this specification may not be certified.

14. Packaging and Package Marking

14.1 The provisions of Practice D 3892 apply to packaging, packing, and marking of containers for plastic materials.

15. Keywords

15.1 acetate; butyrate; cellulose; extrusion; molding; plasticized; recycled; specification

TABLE CAB Detailed Physical Property Requirements

Material: CAB(Cellulose Acetate Butyrate)							Specific Gravity, Test Methods D 792	Tensile Stress at Yield, Test Method D 638M, min, MPa	Flexural Modulus, Test Methods D 790, min, MPa	Izod Impact Strength, Test Method D 256, min, J/m	Water Absorption, Test Method D 570, max, %		Weight Loss on Heating, Paragraph 11.1.11, max, %
Group	Description	Class	Plasticizer Content ^A , %	Flow Designation ^B	Grade	Description					Weight Gain ^C	Soluble Loss	
01	High impact strength	1	15-26	S2	1	injection	1.15-1.19	16	620	335	1.5	0.8	3.2
					2	extrusion	1.15-1.19	16	620	335	1.5	0.8	3.2
					0	other							
		2	12-23	S	1	injection	1.15-1.19	19	760	285	1.6	0.6	2.7
					2	extrusion	1.15-1.19	19	760	285	1.6	0.6	2.7
					0	other							
		3	10-20	MS	1	injection	1.16-1.20	22	900	240	1.6	0.4	2.2
					2	extrusion	1.16-1.20	22	900	240	1.6	0.4	2.2
					0	other							
		4	8-16	M	1	injection	1.16-1.20	24	1030	190	1.7	0.3	1.8
					2	extrusion	1.16-1.20	24	1030	190	1.7	0.3	1.8
					0	other							
5	6-13	MH	1	injection	1.17-1.21	27	1170	155	1.7	0.3	1.3		
			2	extrusion	1.17-1.21	27	1170	155	1.7	0.3	1.3		
			0	other									
0	other	-	0	other									
02	High tensile strength	1	4-10	H	1	injection	1.18-1.21	31	1310	120	1.8	0.2	1.0
					2	extrusion	1.18-1.21	31	1310	120	1.8	0.2	1.0
					0	other							
		2	2-8	H2	1	injection	1.19-1.21	34	1450	90	1.9	0.2	0.6
					2	extrusion	1.19-1.21	34	1450	90	1.9	0.2	0.6
					0	other							
		3	1-5	H3	1	injection	1.20-1.22	37	1590	70	2.0	0.2	0.5
					2	extrusion	1.20-1.22	37	1590	70	2.0	0.2	0.5
					0	other							
		4	< 1-3	H4	1	injection	1.21-1.22	40	1720	65	2.2	0.2	0.3
					2	extrusion	1.21-1.22	40	1720	65	2.2	0.2	0.3
					0	other							
0	other	-	0	other									
00	Other	0	other	-	0	other							

^AThe test method for plasticizer content, as well as the target level for the product supplied, shall be as agreed upon between the manufacturer and the purchaser. Limits of $\pm 2\%$ shall be maintained unless a closer tolerance is practical.

^BFlow designations are for information only and will be dropped from this specification at the next five-year review since Test Method D 569 (determination of flow temperature) has been withdrawn.

^CWeight gain includes soluble matter loss.

TABLE 1 Electrical Requirements

Property	Units	Requirements	ASTM Test Method	Practice D 618 Condition Procedure
Volume Resistivity	Ω -cm	10 ¹³ min.	D 257	Condition 96/23/50
		10 ¹¹ min.	D 257	Condition 96/23/50 + 48/50/water + 1/23/water ^A
Dielectric Strength, Short-Time Test	V/mm	12,800 min.	D 149	Condition 96/23/50
		11,800 min.	D 149	Condition 96/23/50 + 48/50/water + 1/23/water
Dielectric Strength, Step-by-Step Test	V/mm	12,800 min.	D 149	Condition 96/23/50
		11,800 min.	D 149	Condition 96/23/50 + 48/50/water + 1/23/water ^A

^ARemove from water, wipe with damp cloth, and dry with dry cloth immediately before testing.

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