Designation: D 1562 – 98

Standard Specification for Cellulose Acetate Propionate Molding and Extrusion Compounds[1]

This standard is issued under the fixed designation D 1562; 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 specification covers requirements for plasticized cellulose acetate propionate thermoplastic compounds suitable for injection molding and extrusion. These compounds have a propionyl content less than 48 % and an acetyl content less than 3 % and may or may not contain dyes and pigments. Cellulosic plastic materials, being thermoplastic, are reprocessable 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 specification.

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

1.5 The following safety hazards caveat pertains only to the test method portion, Section 11, 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.

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 Frequencies[2]

D 256 Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics[3]

D 257 Test Methods for DC Resistance or Conductance of Insulating Materials[2]

D 570 Test Method for Water Absorption of Plastics[3]

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing[3]

D 635 Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position[3]

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 Materials[3]

D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement[3]

D 883 Terminology Relating to Plastics[3]

D 1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics[3]

D 1600 Terminology for Abbreviated Terms Relating to Plastics[3]

D 1729 Practice for Visual Evaluation of Color Differences of Opaque Materials[4]

D 1898 Practice for Sampling of Plastics[3]

D 3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials[5]

D 3892 Practice for Packaging/Packing of Plastics[5]

D 4000 Classification System for Specifying Plastic Materials[5]

D 5033 Guide for the Development of Standards Relating to

[1] This specification is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

Current edition approved July 10, 1998. Published March 1999. Originally published as D 1562–58 T. Last previous edition D 1562–96.

[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 Plastics[6]

E 308 Practice for Computing the Colors of Objects by Using the CIE System[4]

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 CAP):

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 CAP.

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

4.1.5 *Grade 2*—For extrusion (see requirements in 6.4).

5. Suffixes

5.1 When requirements are needed that are not covered in Table CAP, 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 propionate are shown as follows:

E = electrical requirements (see Table 1) 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 designed designated by the following digits:

First Digit

1 = total luminous transmittance 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 propionate formulation would be as follows:

CAP0122F11 (1)

CAP = Table CAP property requirements
01 = Group 1—High impact strength
2 = Class 2—Plasticizer range from 8 to 20 % (see Table CAP, 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—CAP0122 corresponds to the following physical property requirements in Table CAP:

Specific gravity: 1.19–1.20.
Tensile stress at yield: 19 MPa min.
Flexural modulus: 1,000 MPa min.
Izod impact strength: 200 J/m min.
Water absorption: 2.0 % max.
Weight loss on heating: 2.0 % max.

6. Materials and Manufacture

6.1 Materials supplied 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 CAP.

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.

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 CAP 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.

[6] *Annual Book of ASTM Standards,* Vol 08.03.

10. Specimen Preparation

10.1 Physical property requirements in Table CAP are based on injection molded specimens 3.2 mm thick. Specimens 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 propionate, dry the material 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 melt temperature 25 to 35°C above the "cold point." (The "cold point" is the lowest melt 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 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 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" (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. 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" (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. 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:

$$\text{weight loss on heating, \%} = \frac{(W_1 - W_2)}{W_1} \times 100 \quad (2)$$

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 CAP, Footnote 1, and 11.1.3) 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 all the requirements of this specification may not be certified.

14. Packaging, Packing, and Marking

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

15. Keywords

15.1 cellulose acetate propionate; classification system; line callout; plastic; recycled; specification

TABLE CAP Detailed Physical Property Requirements

Material: CAP (Cellulose Acetate Propionate)							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	10-25	MH	1	injection	1.18-1.20	15	830	230	1.8	0.2	2.2
					2	extrusion	1.18-1.20	15	830	230	1.8	0.2	2.2
					0	other							
		2	8-20	H	1	injection	1.19-1.20	19	1000	200	2.0	0.2	2.0
					2	extrusion	1.19-1.20	19	1000	200	2.0	0.2	2.0
					0	other							
		3	6-16	H2	1	injection	1.19-1.21	23	1170	160	2.1	0.2	1.8
					2	extrusion	1.19-1.21	23	1170	160	2.1	0.2	1.8
					0	other							
		0	other	-	0	other							
02	high tensile strength	1	4-13	H3	1	injection	1.20-1.22	29	1310	105	2.2	0.1	1.2
					2	extrusion	1.20-1.22	29	1310	105	2.2	0.1	1.2
					0	other							
		2	2-10	H4	1	injection	1.21-1.22	34	1520	80	2.3	0.1	0.8
					2	extrusion	1.21-1.22	34	1520	80	2.3	0.1	0.8
					0	other							
00	other	0	other	-	0	other							

[A]The method for plasticizer content, as well as the target level for the product supplied, shall be as agreed upon between manufacturer and purchaser. Limits of ± 2 % shall be maintained unless a closer tolerance is practical.

[B]Flow 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.

[C]Weight gain includes soluble matter loss.

TABLE 1 Electrical Requirements

Property	Units	Requirements	ASTM Test Method	Practice D 618 Condition Procedure
Volume resistivity	ohm-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[A]
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]

[A]Remove from water, wipe with damp cloth, and dry with dry cloth immediately before testing.