Designation: D787 – 12

# Standard Specification for Ethyl Cellulose Molding and Extrusion Compounds[1]

This standard is issued under the fixed designation D787; 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.

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

## 1. Scope*

1.1 This specification covers requirements for plasticized ethyl cellulose thermoplastic compounds suitable for injection molding and extrusion. It does not include special materials compounded for special applications.

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

1.3 The following precautionary statement pertains only to the Test Methods portion, Section 10 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 known ISO equivalent to this specification.

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
D570 Test Method for Water Absorption 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
D785 Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
D883 Terminology Relating to Plastics
D1505 Test Method for Density of Plastics by the Density-Gradient Technique
D3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials
D3892 Practice for Packaging/Packing of Plastics

## 3. Terminology

3.1 Terms in this specification are in accordance with Terminology D883.

## 4. Classification

4.1 This specification covers two types and eleven grades of ethyl cellulose molding and extrusion compounds as classified in accordance with Table 1. Type I materials are general purpose and Type II are characterized by improved resistance to impact, especially at low temperatures. The grades are classified in accordance with their physical properties as specified in Table 1.

## 5. Ordering Information

5.1 Purchase orders for, or inquiries about, the materials described in this specification shall identify the following:

5.1.1 The number of this specification and the required type and grade chosen from Table 1, for example, D787 Type 1, Grade 1.

5.1.2 Supplementary requirements in accordance with this specification if necessary.

5.1.3 Color and opacity within the limits defined in 6.4.

5.1.4 Particle form and size if choice is available.

5.1.5 Such other requirements as may be agreed between the seller and the purchaser.

## 6. Materials and Manufacture

6.1 Materials supplied under this specification shall be ethyl cellulose plastics in the form of pellets unless otherwise specified.

6.2 Material 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.

6.3 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.

6.4 The color and transparency or opacity of items fabricated under the conditions recommended by the manufacturer

[1] This specification 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 Detailed Requirements for Molded Test Specimens**

NOTE 1—ft·lbf/in. × 53.3378660 = joules per metre. Megapascals (MPa) = newtons × $10^6$ per metre squared.

| Property | Type I | | | | | Type II | | | | | Test Methods |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | Grade 6 | Grade 7 | Grade 8 | Grade 9 | Grade 10 | Grade 11 | |
| Specific gravity, unpigmented, max at 23/23°C (73.4/73.4°F) | 1.13 | 1.13 | 1.12 | 1.12 | 1.11 | 1.10 | 1.12 | 1.12 | 1.11 | 1.11 | 1.10 | D792 |
| Hardness (Rockwell) R scale, min | 110 | 110 | 105 | 105 | 100 | 95 | 105 | 80 | 75 | 75 | 50 | D785 |
| Tensile strength at 23°C, min: | | | | | | | | | | | | |
| MPa | 44.8 | 41.4 | 38.1 | 33.0 | 31.0 | 24.2 | 27.6 | 24.1 | 20.7 | 20.0 | 15.9 | D638 |
| psi | 6500 | 6000 | 5400 | 4800 | 4500 | 3800 | 4000 | 3500 | 3000 | 3300 | 2900 | |
| Impact strength (Izod), min | | | | | | | | | | | | |
| at 23°C (73.4°F): | | | | | | | | | | | | |
| J/m of notch | 90.7 | 90.7 | 106.7 | 106.7 | 117.3 | 149.5 | 186.7 | 213.5 | 293.4 | 213.5 | 320.3 | D256 |
| ft·lbf/in. of notch | 1.7 | 1.7 | 2.0 | 2.0 | 2.2 | 2.8 | 3.5 | 4.0 | 5.5 | 4.0 | 6.0 | |
| at – 40°C (–40°F): | | | | | | | | | | | | |
| J/m of notch | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 53.4 | 64.1 | 80.1 | 53.4 | 80.1 | D256 |
| ft·lbf/in. of notch | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 1.0 | 1.2 | 1.5 | 1.0 | 1.5 | |
| Deflection temperature, min: | | | | | | | | | | | | |
| at 1820-kPa (264-psi) fiber stress: | | | | | | | | | | | | |
| °C | 82 | 77 | 71 | 66 | 60 | 49 | 66 | 77 | 71 | 60 | 49 | D648 |
| °F | 180 | 170 | 160 | 150 | 140 | 120 | 150 | 170 | 160 | 140 | 120 | |
| at 455-kPa (66-psi) fiber stress: | | | | | | | | | | | | |
| °C | 94 | 88 | 82 | 77 | 71 | 66 | 82 | 82 | 82 | 77 | – | D648 |
| °F | 200 | 190 | 180 | 170 | 160 | 150 | 180 | 180 | 180 | 170 | – | |
| Water absorption (24-h immersion), max % | 1.7 | 1.5 | 1.4 | 1.2 | 1.1 | 1.0 | 1.3 | 1.5 | 1.5 | 1.5 | 1.5 | D570 |
| Weight loss on heating (72 h at 82°C), max % | 0.3 | 0.4 | 0.6 | 0.8 | 1.5 | 1.8 | 2.0 | 1.2 | 2.0 | 2.0 | 2.0 | |

of the material shall be comparable within commercial match tolerances to the color and transparency or opacity of samples submitted in advance by the manufacturer and approved by the purchaser.

## 7. Physical Requirements

7.1 Test specimens of the material shall conform to the requirements prescribed in Table 1.

7.2 Molded specimens for those tests requiring them shall be prepared as described in Section 10.

7.3 Flow temperature of a given compound shall be within ±5°C of the flow temperature designated in the contract or order.

7.4 Conformance to the requirements of this specification shall be determined by means of the tests identified in Section 11 unless otherwise specified.

## 8. Sampling

8.1 Sampling shall be statistically adequate to satisfy the requirements of 12.4.

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 1 of this specification.

## 10. Specimen Preparation

10.1 Requirements in Table 1 are based on injection molded specimens 3.2 mm (⅛ in.) thick. Machined specimens 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 ethyl cellulose, the material should be dried to a moisture content of 0.2 % or less. Material spread in a tray to a maximum depth of 51 mm (2 in.) and exposed in a circulating-air oven at 76.5 to 88°C (170 to 190°F) for 3 h should be satisfactory. Control the injection molding condition on cycle in accordance with Practice D3641, using a material temperature of 10 to 25°C (13 to 45°F) below the level that causes discoloration of the plastic. Mold temperatures of 48 to 71°C (120 to 160°F) have been found desirable. As a rule, thin section molding and the higher molecular weight compounds require the higher mold temperature.

## 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 D618.

11.1.2 Unless otherwise specified, molded test specimens shall be conditioned in accordance with Procedure A of Practice D618.

11.1.3 *Rockwell Hardness*—Procedure A of Test Method D785.

11.1.4 *Specific Gravity*—Method A of Test Methods D792, or Test Method D1505.

11.1.5 *Tensile Strength*—Test Method D638, Type I test specimen, 5.0-mm (0.2-in.)/min testing speed.

11.1.6 *Impact Strength (Izod)*—Method A of Test Method D256. Specimen size: 63.5 mm (2½ in.) long, by 12.7 mm (½ in.) wide, by 3.2 mm (⅛ in.) thick.

11.1.7 *Deflection Temperature*—Test Method D648. Condition test specimens in accordance with Procedure B of Practice D618.

11.1.8 *Water Absorption*—Test Method D570, 24-h immersion. Condition in accordance with Test Method D570.

11.1.9 *Weight Loss on Heating*—Condition test specimens, 50.8 mm (2 in.) in diameter or 50.8 mm wide by 63.5 mm (2½ in.) long by 3.2 mm (⅛ in.) thick, for 48 h over anhydrous calcium chloride at 23 ± 1°C (73.4 ± 1.8°F). Weigh three specimens and then place them in a circulating-air oven for 72 h at 82 ± 1°C (180 ± 1.8°F). 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 ± 1°C (73.4 ± 1.8°F). Then weigh the specimens and calculate the percentage weight loss on heating on the basis of the conditioned weight.

## 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 the tests listed as they apply:

*(1)* Tensile Strength
*(2)* Izod Impact Strength
*(3)* Deflection Temperature

12.3 Periodic-check inspection with reference to a specification based upon this classification system shall consist of the tests specified for all requirements of the material under this classification system. Inspection frequency shall be adequate to ensure 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 specification (line callout).

12.5 A report of the 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.

NOTE 2—The ASTM publication *Manual on Presentation of Data and Control Chart Analysis, 7th Edition*, stock number MNL7A,[3] provides detailed information about statistical process control.

## 13. Rejection

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

## 14. Packaging and Package Marking

14.1 *Packaging*—The material shall be packaged in standard commercial containers, so constructed as to ensure acceptance by common or other carriers for safe transportation to the point of delivery.

14.2 *Package Marking*—Shipping containers shall identify the material and its supplier, the batch or lot number, its type, and the quantity contained.

14.3 All packing, packaging, and marking provisions of Practice D3892 shall apply to this specification.

## 15. Keywords

15.1 cellulose; ethylcellulose; extrusion; molding; plasticized; specification

[3] Available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428, http://www.astm.org.

## SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D787 - 09) that may impact the use of this standard. (August 1, 2012)

*(1)* Replaced the term *flow temperature* with the term *molecular weight* in 10.2.