



Designation: D6338 – 17

Standard Classification System for Highly Crosslinked Thermoplastic Vulcanizates (HCTPV) Based on ASTM Standard Test Methods¹

This standard is issued under the fixed designation D6338; 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 highly crosslinked thermoplastic vulcanizates (HCTPV) for extrusion, molding and other fabrication methods. Highly crosslinked thermoplastic vulcanizates (HCTPV) are thermoplastic elastomers (TPE) consisting of two or more polymer systems at least one of which is rubbery and highly (>95 %) crosslinked and at least one of which is thermoplastic, with each system having its own phase. The thermoplastic phase will tend to be continuous and the rubbery phase discontinuous. The high level of crosslinking and ultrafine particle size (ca 1 μm diameter) of the rubbery phase give rise to properties more closely approaching those of conventional thermoset rubber, when compared to the same thermoplastic/rubbery polymer composition with a lower level (≤ 95 %) of crosslinking. The HCTPV polymer compositions may contain fillers, reinforcing agents, plasticizers, resins, antidegradants, colorants and other beneficial constituents. Recycled HCTPV are not covered in this classification system.

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

1.3 This classification system and subsequent line callout (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 can be made by those having expertise in the plastic field only 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 costs involved, and the inherent properties of the material other than those covered by this standard.

1.4 As given in **IEEE/ASTM SI-10**, values in SI units are to be regarded as standard.

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.

Current edition approved Aug. 1, 2017. Published August 2017. Originally approved in 1998. Last previous edition approved in 2010 as D6338 - 10. DOI: 10.1520/D6338-17.

NOTE 1—There is no known ISO equivalent to this standard.

1.5 This standard is based on testing completed in accordance with ASTM standard test methods.

1.6 The following safety hazards caveat pertains only to the test methods portion, Section 11, 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.*

1.7 *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

- D395 Test Methods for Rubber Property—Compression Set
- D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
- D471 Test Method for Rubber Property—Effect of Liquids
- D573 Test Method for Rubber—Deterioration in an Air Oven
- D618 Practice for Conditioning Plastics for Testing
- D638 Test Method for Tensile Properties of Plastics
- D883 Terminology Relating to Plastics
- D1434 Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting
- D1566 Terminology Relating to Rubber
- D2240 Test Method for Rubber Property—Durometer Hardness
- D3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets
- D3892 Practice for Packaging/Packing of Plastics

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

- [D4000 Classification System for Specifying Plastic Materials](#)
- [D6869 Test Method for Coulometric and Volumetric Determination of Moisture in Plastics Using the Karl Fischer Reaction \(the Reaction of Iodine with Water\)](#)
- [E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)
- [IEEE/ASTM SI-10 Standard for Use of the International System of Units \(SI\): The Modern Metric System](#)

3. Terminology

3.1 *Definitions*—Except for the terms defined below, technical terms pertaining to materials covered by this classification system are given in Terminologies [D883](#) and [D1566](#).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *dynamic vulcanization, n*—the process of intimate melt mixing a thermoplastic polymer with a suitably reactive rubbery polymer to generate a thermoplastic elastomer with a chemically crosslinked rubbery phase, resulting in properties closer to those of a thermoset rubber when compared to the same uncrosslinked composition.

3.2.2 *thermoplastic elastomer (TPE), n*—a diverse family of rubberlike materials that, unlike conventional vulcanized rubbers, can be reprocessed and recycled like thermoplastic materials.

3.2.3 *thermoplastic vulcanizate (TPV), n*—a thermoplastic elastomer with a chemically crosslinked rubbery phase, produced by the dynamic vulcanization.

4. Classification

4.1 Highly crosslinked thermoplastic vulcanizates are classified into groups according to the rubbery polymer(s) present. These groups are subclassified into classes and grades as shown in Table HCTPV.

4.1.1 To illustrate this classification system: the designation HCTPV 0121 would indicate HCTPV = highly crosslinked thermoplastic vulcanizate, 01 (group) = EPDM rubber >95 % crosslinked, 2 (class) = medium hardness, and 1 (grade) meeting the requirements in Table HCTPV.

4.1.2 To enable the incorporation of special or future materials, the “Other” category for group (00), class (0), and grade (0) is shown in Table HCTPV. Basic properties are to be obtained from Table A.

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

4.1.3 There is no distinction between reinforced and unreinforced highly crosslinked thermoplastic vulcanizates.

4.1.4 A six-character designation shall show the specific requirements for the HCTPV in the “Other” category. This designation shall consist of the letter A and five digits comprising the property requirements in the order they appear in Table A.

4.1.5 The following is an example of this classification system: Designation HCTPV 0110 A45643 indicates the following, with the Table A requirements:

where:

- | | | |
|------------|---|---|
| HCTPV 0110 | = | fully crosslinked thermoplastic vulcanizate, based on EPDM rubber >95 % crosslinked, low hardness from Table HCTPV, |
| A | = | Table A property requirements, |
| 4 | = | 65 ± 5 Shore A hardness, Test Method D2240 , 5 s delay, |
| 5 | = | 14 MPa, tensile strength, min, Test Method D412 at 23°C, |
| 6 | = | 6.0 MPa, tensile strength, min, Test Method D412 at 100°C, |
| 4 | = | 80 %, weight change, max, Test Method D471 , IRM 903 oil, 24 h/121°C, and |
| 3 | = | 30 %, compression set, max, Test Method D395 , Procedure B, 22 h/100°C. |

4.1.6 If no properties are specified, the designation would be HCTPV 0110 A00000.

5. Suffixes

5.1 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.

5.1.1 A list of suffixes can be found in Classification System [D4000](#) (Table 3) 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.

6. General Requirements

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

6.2 The plastics composition shall be uniform and shall conform to the requirements specified herein.

7. Detail Requirements

7.1 The materials shall conform to the requirements in Tables HCTPV, A, and suffix requirements as they apply.

7.2 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](#).

7.2.1 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.

8. Sampling

8.1 Sampling shall be statistically adequate to satisfy the requirements of [12.4](#).

8.2 A unit of manufacture for shipment shall be a production lot of HCTPV or a uniformly mixed blend of two or more such production lots.

9. Specimen Preparation

9.1 Test specimens shall be prepared by a rigorously specified injection molding process. This process shall be as specified in Practice [D3182](#), or as specified by the HCTPV

supplier, with due regard given to the anisotropic nature of HCTPV molded parts.

10. Conditioning

10.1 Prior to testing, test specimens shall be conditioned in the standard laboratory atmosphere in accordance with Procedure A of Practice **D618**.

10.2 Tests shall be carried out at $23 \pm 2^\circ\text{C}$ and $50 \pm 10\%$ relative humidity.

11. Test Methods

11.1 Properties covered by this classification shall be measured by the following Test Methods, as applicable: **D395**; **D412**; **D471**; **D573**; **D638**; **D1434**; **D2240**; **D6869**.

11.1.1 The number of samples tested shall be consistent with the requirements of **8.1** and **12.4**.

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: hardness; weight change in IRM 903 oil; moisture content; air permeability.

12.3 Periodic-check inspection 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).

NOTE 2—The ASTM publication *Manual on Presentation of Data and Control Chart Analysis, 8th Edition*, stock number MNL7-8TH-EB, provides detailed information about statistical process control.

12.5 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.

13. Packaging and Marking

13.1 Practice **D3892** shall apply to packing; packaging and markings.

14. Keywords

14.1 dynamic vulcanization; highly crosslinked thermoplastic vulcanizate; line callout; thermoplastic elastomer; thermoplastic vulcanizate

(<https://standards.iteh.ai>)
Document Preview

[ASTM D6338-17](#)

<https://standards.iteh.ai/catalog/standards/sist/c3f8a9bc-a72c-4a7d-8dae-1e7e73c4ebe1/astm-d6338-17>