



Designation: D 5476 – 99

Standard Classification System for Thermoplastic Polyurethane Materials (TPU)¹

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INTRODUCTION

This classification system and subsequent line callout is intended to be a means of calling out thermoplastic polyurethane 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 plastics field after careful consideration of the design and performance required of the part, environment to which it will be exposed, fabrication processes to be used, and inherent properties of the material other than those covered by this classification.

1. Scope

1.1 This classification system covers thermoplastic polyurethane materials suitable for injection molding, extrusion, compression molding, melt processing, or other applicable methods. Recycled thermoplastic polyurethanes meeting the classification requirements may be used interchangeably with virgin resin.

1.2 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, which may be designated by using the suffixes as given in Section 5.

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

1.4 *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 are no ISO standards covering the primary subject matter of this ASTM classification.

2. Referenced Documents

2.1 ASTM Standards:

D 256 Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials²

D 412 Test Methods for Rubber Properties in Tension³

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 696 Test Method for Coefficient of Linear Thermal Expansion of Plastics²

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

D 792 Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement²

D 883 Terminology Relating to Plastics²

D 1600 Terminology for Abbreviated Terms Relating to Plastics²

D 1897 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials⁴

D 2240 Test Method for Rubber Property—Durometer Hardness⁴

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 the Proper Use of Recycled Plastics⁵

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁶

3. Terminology

3.1 *Definitions*—For definitions of technical terms pertaining to plastics used in this classification, see Terminologies D 883 and D 1600 and Guide D 5033.

¹ This classification system is under the jurisdiction of ASTM Committee D-20 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.

³ Annual Book of ASTM Standards, Vol 09.01.

⁴ Annual Book of ASTM Standards, Vol 08.02.

⁵ Annual Book of ASTM Standards, Vol 08.03.

⁶ Annual Book of ASTM Standards, Vol 14.02.

4. Classification

4.1 Unreinforced thermoplastic polyurethane materials are classified into groups according to their chemical composition.

These groups are subdivided into classes and grades as shown in the basic property table (Table TPU).

TABLE TPU Requirements for Thermoplastic Polyurethanes

| Group | Description | Class | Description ^A | Grade | Description | Tensile Stress, 100 % Elongation, MPa, min, Test Methods D 412 | Elongation, Ultimate, %, min, Test Methods D 412 | Specific Gravity, ±0.04, Test Method D 792 |
|-------|-----------------------------|-------|-----------------------------|-------|-------------|--|--|--|
| 01 | aromatic polyester | 1 | nominal hardness 60 Shore A | 1 | | 1.4 | 600 | 1.10 |
| | | | | 2 | | 2.0 | 700 | 1.10 |
| | | | | 0 | other | | | |
| | | 2 | nominal hardness 70 Shore A | 1 | | 2.0 | 700 | 1.10 |
| | | | | 2 | | 3.0 | 500 | 1.10 |
| | | | | 0 | other | | | |
| | | 3 | nominal hardness 80 Shore A | 1 | | 3.0 | 300 | 1.15 |
| | | | | 2 | | 4.0 | 300 | 1.17 |
| | | | | 3 | | 5.0 | 300 | 1.17 |
| | | | | 4 | | 6.0 | 300 | 1.17 |
| | | | | 0 | other | | | |
| | | 4 | nominal hardness 90 Shore A | 1 | | 4.0 | 300 | 1.22 |
| | | | | 2 | | 6.0 | 300 | 1.22 |
| | | | | 3 | | 8.0 | 300 | 1.22 |
| | | | | 4 | | 10.0 | 300 | 1.22 |
| | | | | 5 | | 12.0 | 300 | 1.22 |
| | | | | 0 | other | | | |
| | | 5 | nominal hardness 50 Shore D | 1 | | 8.0 | 400 | 1.22 |
| | | | | 2 | | 10.0 | 400 | 1.22 |
| | | | | 3 | | 12.0 | 400 | 1.22 |
| | | | | 4 | | 14.0 | 300 | 1.22 |
| | | | | 5 | | 16.0 | 300 | 1.22 |
| | | | | 6 | | 18.0 | 300 | 1.22 |
| | | | | 0 | other | | | |
| | | 6 | nominal hardness 60 Shore D | 1 | | 12.0 | 250 | 1.22 |
| | | | | 2 | | 16.0 | 250 | 1.22 |
| | | | | 3 | | 20.0 | 250 | 1.22 |
| | | | | 4 | | 24.0 | 250 | 1.22 |
| | | | | 5 | | 28.0 | 250 | 1.22 |
| | | | | 0 | other | | | |
| 7 | nominal hardness 70 Shore D | 1 | | 18.0 | 200 | 1.23 | | |
| | | 2 | | 22.0 | 200 | 1.23 | | |
| | | 3 | | 26.0 | 200 | 1.23 | | |
| | | 4 | | 30.0 | 200 | 1.23 | | |
| | | 5 | | 34.0 | 200 | 1.23 | | |
| | | 0 | other | | | | | |
| | | 8 | nominal hardness 80 Shore D | 1 | | 30.0 | 100 | 1.24 |
| | | | | 2 | | 34.0 | 100 | 1.24 |
| 3 | | | | 38.0 | 100 | 1.24 | | |
| 0 | other | | | | | | | |
| 02 | aromatic polyether | 1 | nominal hardness 60 Shore A | 1 | | 2.0 | 700 | 1.03 |
| | | | | 0 | other | | | |
| | | | | 2 | | 2.0 | 700 | 1.03 |
| | | 2 | nominal hardness 70 Shore A | 2 | | 2.5 | 700 | 1.06 |
| | | | | 3 | | 3.0 | 500 | 1.06 |
| | | | | 4 | | 3.5 | 500 | 1.06 |
| | | | | 0 | other | | | |
| | | 3 | nominal hardness 80 Shore A | 1 | | 3.5 | 500 | 1.06 |
| | | | | 2 | | 4.5 | 400 | 1.10 |
| | | | | 3 | | 5.5 | 350 | 1.11 |
| | | | | 4 | | 6.5 | 300 | 1.12 |
| | | | | 0 | other | | | |
| | | 4 | nominal hardness 90 Shore A | 1 | | 4.5 | 400 | 1.12 |
| | | | | 2 | | 6.5 | 400 | 1.12 |
| | | | | 3 | | 8.5 | 400 | 1.13 |
| | | | | 4 | | 10.5 | 400 | 1.13 |
| | | | | 0 | other | | | |
| | | 5 | nominal hardness 50 Shore D | 1 | | 10.0 | 400 | 1.13 |
| | | | | 2 | | 14.0 | 300 | 1.14 |
| | | | | 3 | | 18.0 | 300 | 1.15 |
| | | | | 0 | other | | | |