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Designation: D 5593 – 99$^{\epsilon 1}$

Standard Classification for Thermoplastic Elastomers—Olefinic (TEO)[1]

This standard is issued under the fixed designation D 5593; 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.

ε[1] NOTE—Editorially corrected the description for Group 02, Class 1 in Table TEO in April 2002.

INTRODUCTION

This classification is intended to be a system for calling out olefinic thermoplastic elastomers 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 the performance required of the part, the environment to which it will be exposed, the fabrication processes to be employed, and the inherent properties of the material other than those covered by this classification.

1. Scope *

1.1 This classification covers olefinic thermoplastic elastomers (TEOs) made directly in a reactor or through a compounding process and suitable for injection molding, extrusion, blow molding, or other melt processing. Compounding ingredients may be present as necessary for the applications and may consist of reinforcements, fillers, stabilizers, colorants, and other ingredients.

1.2 This classification allows for the use of those TEO materials, which can be recycled, reground, and reprocessed, provided that the requirements as stated in this classification are met. The proportions of recycled material used, as well as the nature and the amount of any contaminant, however, cannot be practically covered in this classification.

1.3 The properties included in this classification are those required to identify the compositions for most applications. Other requirements may be necessary to further identify particular characteristics. These may be specified by using the suffixes in accordance with Section 5.

1.4 The values stated in SI units are to be regarded as the standard. The inch-pound units are for information only.

1.5 The following precautionary caveat pertains only to the test method portion, Section 11, of this classification: *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 similar or equivalent ISO standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 256 Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials[2]

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension[3]

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing[2]

D 624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer[3]

D 638 Test Method for Tensile Properties of Plastics[2]

D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load[2]

D 696 Test Method for Coefficient of Linear Thermal Expansion of Plastics[2]

D 746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact[2]

D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials[2]

D 792 Test Methods for Density and Specific Gravity (Relative Density) and Density of Plastics by Displacement[2]

D 883 Terminology Relating to Plastics[2]

D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer[2]

D 1435 Practice for Outdoor Weathering of Plastics[2]

D 1566 Terminology Relating to Rubber[3]

D 1600 Terminology Relating to Abbreviated Terms Relating to Plastics[2]

[1] This classification 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] *Annual Book of ASTM Standards*, Vol 08.01.

[3] *Annual Book of ASTM Standards*, Vol 09.01.

*A Summary of Changes section appears at the end of this standard.

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D 1898 Practice for Sampling Plastics[4]
D 2240 Test Method for Rubber Property—Durometer Hardness[3]
D 3418 Test Method for Transition Temperatures of Polymers by Thermal Analysis[5]
D 3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials[5]
D 3763 Test Method for High-Speed Puncture Properties of Plastic Using Load and Displacement Sensors[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 Proper Use of Recycled Plastics[5]
E 29 Practice for Using Significant Digits in Test Data to Determine Conformance to Specifications[5, 6]
E 380 Practice for Use of the International System of Units (SI)[6]

2.2 *DOT Standard:*

Department of Transportation Federal Motor Vehicle Safety No. FMVSS 302—Flammability of Interior Materials—Passenger Car, Multi-Purpose Passenger Vehicles[7]

2.3 *UL Standard:*

UL-94 Standards for Tests for Flammability of Plastic Materials for Parts, Devices and Appliances[8]

3. Terminology

3.1 *Definitions*—Definitions of terms pertaining to plastics used in this classification are in accordance with Terminology D 883, Terminology D 1566, and Guide D 5033.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *thermoplastic elastomer (TPE)*—a diverse family of rubber-like materials that, unlike conventional vulcanized rubbers, can be processed and recycled like thermoplastics.

3.2.2 *thermoplastic elastomer, olefinic (TEO)*—a class of materials consisting of blends of elastomers and olefinic thermoplastics that can be manufactured either directly in a reactor or through a compounding process and can be processed using conventional thermoplastics equipment.

4. Basis of Classification

4.1 Olefinic thermoplastic elastomers (TEO) are classified into three groups according to their major chemical composition (PP, PE, and other polyolefins). These groups are subdivided into three classes and four grades, depending on their flexural modulus. Table TEO lists the basic property requirements for these materials.

4.1.1 An example of this classification system is illustrated as follows:

TEO 0123 is a line-callout (specification) for a semi-flexible polypropylene-based material with the following properties:

Flexural modulus	= 600 MPa, min
Tensile strength	= 15 MPa, min
Tensile elongation	= 500 %, min
Shore hardness	= 55D ± 3
Tear resistance	= 70 kN/m, min

4.1.2 To facilitate the incorporation of future or special materials, the "other," category for group (00), class (0), and grade (0) is included in Table TEO. The basic properties of these materials are called out using Table A for example:

TEO 0120A33525 is a polypropylene-based semiflexible material with the following properties (see Table A):

Flexural modulus (3)	= 100 MPa, min
Tensile strength (3)	= 7 MPa, min
Elongation (5)	= 500 %, min
Shore hardness (2)	= 50A, min
Tear resistance (5)	= 50 kN/m, min

4.2 Compounded TEOs are of a proprietary nature, consequently there is no distinction between reinforced and unreinforced or filled and unfilled versions. Additives and modifiers are also used in this family of materials, and their presence is normally not disclosed.

5. Suffixes

5.1 Specific requirements that supersede or supplement Table A shall be shown by a suffix following the callout.

5.2 The list of suffixes found in Table 3 of Classification D 4000 may be used for additional requirements as appropriate. Other requirements might include color, specific gravity, melt flow rate, notched Izod impact, multiaxial impact strength, coefficient of linear thermal expansion, mold shrinkage, fogging, UV weatherability, thermal performance, chemical resistance, and other properties that are not listed in Table A. List of suffix properties appropriate for some of the more typical TEO applications are as follows:

A	= color
B	= fluid resistance
F	= flammability
G	= specific gravity
H	= heat resistance
J	= hardness
PA	= notched Izod impact
PX	= multiaxial impact
VC	= viscosity - melt flow rate
WE	= xenon-arc type weather resistance
WF	= florida outdoor weather resistance
ZC	= coefficient of linear thermal expansion
ZF	= fogging
ZM	= mold shrinkage

Acceptance criteria of these properties shall be specified by the user.

5.3 *Examples of Use of Suffixes*:

5.3.1 TEO0120A33525**PA000** is a TEO with properties in accordance with 4.1.2 and in addition a notched Izod impact requirement of no break in accordance with Table 3 of Classification D 4000.

5.3.2 TEO0120A33525**WF002** is the same TEO in 4.1.2 that needs to pass two-year Florida exposure (as specified by the user).

5.4 Other suffixes that may be used are listed in Table 3 of Classification D 4000.

[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.
[7] Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.
[8] Available from Underwriters Laboratories, 333 Pfingsten Road, Northbrook, FL 60062-2096.

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ASTM D5593-99e1
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