Designation: D 4000 – 00

An American National Standard

Standard Classification System for Specifying Plastic Materials[1]

This standard is issued under the fixed designation D 4000; 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 standard provides a classification system for tabulating the properties of unfilled, filled, and reinforced plastic materials suitable for processing into parts.

NOTE 1—The classification system may serve many of the needs of industries using plastic materials. The standard is subject to revision as the need requires; therefore, the latest revision should always be used.

1.2 The classification system and subsequent line callout (specification) is intended to be a means of identifying 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 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 process to be employed, the inherent properties of the material not covered in this document, and the economic factors.

1.3 This classification system is based on the premise that plastic materials can be arranged into broad generic families using basic properties to arrange the materials into groups, classes, and grades. A system is thus established which, together with values describing additional requirements, permits as complete a description as desired of the selected material.

1.4 In all cases where the provisions of this classification system would conflict with the referenced ASTM specification for a particular material, the latter shall take precedence.

NOTE 2—When using this classification system the two-letter, three-digit suffix system applies.

NOTE 3—When a material is used to fabricate a part where the requirements are too specific for a broad material callout, it is advisable for the user to consult the supplier to secure callout of the properties to suit the actual conditions to which the part is to be subjected.

1.5 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 149 Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies[2]

D 150 Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials[2]

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

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

D 395 Test Methods for Rubber Property—Compression Set[4]

D 471 Test Method for Rubber Property—Effect of Liquids[4]

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension[4]

D 495 Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation[2]

D 569 Method for Measuring the Flow Properties of Thermoplastic Molding Materials[5]

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

D 573 Test Method for Rubber—Deterioration in an Air Oven[4]

D 575 Test Methods for Rubber Properties in Compression[4]

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

D 621 Test Methods for Deformation of Plastics Under Load[5]

D 624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers[4]

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 638 Test Method for Tensile Properties of Plastics[3]

D 648 Test Method for Deflection Temperature of Plastics

[1] This classification system is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.94 on Government/Industry Standardization (Section D20.94.01).

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[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 09.01.

[5] *Discontinued*—See *1994 Annual Book of ASTM Standards*, Vol 08.01.

Under Flexural Load[3]
D 695 Test Method for Compressive Properties of Rigid Plastics[3]
D 706 Specification for Cellulose Acetate Molding and Extrusion Compounds[3]
D 707 Specification for Cellulose Acetate Butyrate Molding and Extrusion Compounds[3]
D 746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact[3]
D 747 Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam[3]
D 756 Practice for Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions[6]
D 759 Practice for Conducting Physical Property Tests of Plastics at Subnormal and Supernormal Temperatures[7]
D 785 Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials[3]
D 789 Test Methods for Determination of Relative Viscosity, Melting Point, and Moisture Content of Polyamide (PA)[3]
D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials[3]
D 792 Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement[3]
D 794 Practice for Determining Permanent Effect of Heat on Plastics[6]
D 817 Test Methods of Testing Cellulose Acetate Propionate and Cellulose Acetate Butyrate[8]
D 883 Terminology Relating to Plastics[3]
D 955 Test Method for Measuring Shrinkage from Mold Dimensions of Molded Plastics[3]
D 1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics[3]
D 1149 Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber[4]
D 1203 Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods[3]
D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer[3]
D 1434 Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting[9]
D 1435 Practice for Outdoor Weathering of Plastics[3]
D 1457 Specification for Polytetrafluoroethylene PTFE Molding and Extrusion Materials[10]
D 1505 Test Method for Density of Plastics by the Density-Gradient Technique[3]
D 1525 Test Method for Vicat Softening Temperature of Plastics[3]
D 1531 Test Methods for Relative Permittivity (Dielectric Constant) and Dissipation Factor by Fluid Displacement Procedure[2]
D 1562 Specification for Cellulose Propionate Molding and Extrusion Compounds[3]
D 1600 Terminology for Abbreviated Terms Relating to Plastics[3]
D 1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics[3]
D 1709 Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method[3]
D 1822 Test Method for Tensile-Impact Energy to Break Plastics and Electrical Insulating Materials[3]
D 1870 Practice for Elevated Temperature Aging Using a Tubular Oven[6]
D 1898 Practice for Sampling of Plastics[6]
D 1929 Test Method for Ignition Properties of Plastics[3]
D 2116 Specification for FEP-Fluorocarbon Molding and Extrusion Materials[3]
D 2137 Test Methods for Rubber Property—Brittleness Point of Flexible Polymers and Coated Fabrics[4]
D 2240 Test Method for Rubber Property—Durometer Hardness[4]
D 2288 Test Method for Weight Loss of Plasticizers on Heating[3]
D 2445 Test Method for Thermal Oxidative Stability of Propylene Plastics[11]
D 2565 Practice for Operating Xenon Arc-Type Light-Exposure Apparatus With and Without Water for Exposure of Plastics[12]
D 2583 Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor[12]
D 2584 Test Method for Ignition Loss of Cured Reinforced Resins[12]
D 2632 Test Method for Rubber Property—Resilience by Vertical Rebound[4]
D 2794 Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)[13]
D 2843 Test Method for Density of Smoke from the Burning or Decomposition of Plastics[12]
D 2857 Test Method for Dilute Solution Viscosity of Polymers[12]
D 2863 Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)[12]
D 2951 Test Method for Resistance of Types III and IV Polyethylene Plastics to Thermal Stress-Cracking[12]
D 3012 Test Method for Thermal Oxidative Stability of Propylene Plastics, Using a Biaxial Rotator[12]
D 3029 Test Methods for Impact Resistance of Flat, Rigid Plastic Specimens by Means of a Tup (Falling Weight)[14]
D 3418 Test Method for Transition Temperatures of Polymers by Thermal Analysis[12]

[6] *Discontinued*—See *1997 Annual Book of ASTM Standards*, Vol 08.01.
[7] *Discontinued*—See *1982 Annual Book of ASTM Standards*, Part 35.
[8] *Annual Book of ASTM Standards*, Vol 06.03.
[9] *Annual Book of ASTM Standards*, Vol 15.09.
[10] *Discontinued*—See *1995 Annual Book of ASTM Standards*, Vol 08.01. Replaced by Specification D 4894.
[11] *Discontinued*—See *1986 Annual Book of ASTM Standards*, Vol 08.02. Replaced by Test Method D 3012.
[12] *Annual Book of ASTM Standards*, Vol 08.02.
[13] *Annual Book of ASTM Standards*, Vol 06.01.
[14] *Discontinued*—See *1994 Annual Book of ASTM Standards*, Vol 08.02. Replaced by Test Methods D 5420 and D 5628.

D 3638 Test Method for Comparative Tracking Index of Electrical Insulating Materials[15]
D 3713 Test Method for Measuring Response of Solid Plastics to Ignition by a Small Flame[12]
D 3801 Test Method for Measuring the Comparative Extinguishing Characteristics of Solid Plastics in a Vertical Position[12]
D 3892 Practice for Packaging/Packing of Plastics[12]
D 3895 Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry[12]
D 3935 Specification for Polycarbonate (PC) Unfilled and Reinforced Material[12]
D 3985 Test Method for Oxygen Gas Transmission Rate Through Plastic Film and Sheeting Using a Coulometric Sensor[9]
D 4066 Specification for Nylon Injection and Extrusion Materials[12]
D 4067 Specification for Reinforced and Filled Polyphenylene Sulfide Injection Molding and Extrusion Materials[12]
D 4101 Specification for Propylene Plastic Injection and Extrusion Materials[12]
D 4181 Specification for Acetal (POM) Molding and Extrusion Materials[12]
D 4203 Specification for Styrene-Acrylonitrile (SAN) Injection and Extrusion Materials[12]
D 4349 Specificaton for Polyphenylene Ether (PPE) Materials[16]
D 4364 Practice for Performing Accelerated Outdoor Weathering of Plastics Using Concentrated Natural Sunlight[16]
D 4474 Specification for Styrenic Thermoplastic Elastomer Injection Molding and Extrusion Materials (TES)[16]
D 4507 Specification for Thermoplastic Polyester (TPES) Materials[17]
D 4549 Specification for Polystyrene Molding and Extrusion Materials (PS)[16]
D 4550 Specification for Thermoplastic Elastomer-Ether-Ester (TEEE)[16]
D 4617 Specification for Phenolic Compounds (PF)[16]
D 4634 Specification for Styrene-Maleic Anhydride Materials (S/MA)[16]
D 4673 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Molding and Extrusion Materials[16]
D 4812 Test Method for Unnotched Cantilever Beam Impact Strength of Plastics[16]
D 4976 Specification for Polyethylene Plastics Molding and Extrusion Materials[16]
D 5021 Specification for Thermoplastic Elastomer–Chlorinated Ethylene Alloy (TECEA)[16]
D 5046 Specification for Fully Crosslinked Elastomeric Alloys (FCEAs)[16]
D 5138 Specification for Liquid Crystal Polymers (LCP)[16]
D 5279 Test Method for Measuring the Dynamic Mechanical Properties of Plastics in Torsion[16]
D 5420 Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)[16]
D 5628 Test Method for Impact Resistance of Flat, Rigid Plastic Specimens by Means of a Falling Dart (Tup or Falling Weight)[16]
E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[18]
E 84 Test Method for Surface Burning Characteristics of Building Materials[19]
E 96 Test Methods for Water Vapor Transmission of Materials[20]
E 104 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions[21]
E 162 Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source[19]
ES 27 Emergency Standard Practice for Rubber—Establishing Replacement Immersion Reference Oils for ASTM No. 2 and No. 3 Immersion Oils as Used in Test Method D 471[22]
F 372 Test Method for Water Vapor Transmission of Flexible Barrier Materials Using an Infrared Detection Technique[9]
F 814 Test Method for Specific Optical Density of Smoke Generated by Solid Materials for Aerospace Applications[23]
G 23 Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials[24]
G 53 Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials[18]

2.2 *Federal Standard:*[25]

Department of Transportation Federal Motor Vehicle Safety Standard No. 302

2.3 *Underwriters Laboratories:*[26]

UL94 Standards for Tests for Flammability for Parts in Devices and Appliances

2.4 *IEC and ISO Standards:*[27]

IEC 93 Recommended Methods of Tests for Volume and Surface Resistivities of Electrical Insulation Materials
IEC 112 Recommended Method for Determining the Comparative Tracking Index of Solid Insulation Materials Under Moist Conditions
IEC 243 Recommended Methods of Test for Electrical

[15] *Annual Book of ASTM Standards*, Vol. 10.02.
[16] *Annual Book of ASTM Standards*, Vol 08.03.
[17] *Discontinued*—See *1998 Annual Book of ASTM Standards*, Vol 08.03. Replaced by Specification D 5927.
[18] *Annual Book of ASTM Standards*, Vol 14.02.
[19] *Annual Book of ASTM Standards*, Vol 04.07.
[20] *Annual Book of ASTM Standards*, Vol 04.06.
[21] *Annual Book of ASTM Standards*, Vol 11.03.
[22] *Discontinued*—See *1995 Annual Book of ASTM Standards*, Vol 09.01. Replaced by Practice D 5964.
[23] *Discontinued*—See *1994 Annual Book of ASTM Standards*, Vol 04.07.
[24] *Annual Book of ASTM Standards*, Vol 14.04.
[25] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.
[26] Available from Underwriters Laboratories, Inc., Publication Stock, 333 Pfingsten Rd., Northbrook, IL 60062.
[27] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

Strength of Solid Insulating Materials at Power Frequencies

IEC 250 Recommended Methods for the Determination of the Permittivity and Dielectric Dissipation Factor of Electrical Insulation Materials at Power, Audio, and Radio Frequencies Including Metre Wavelengths

ISO 62 Plastics—Determination of Water Absorption

ISO 75-2 Plastics—Determination of Temperature of Deflection Under Load—Part 2: Plastics and Ebonite

ISO 178 Plastics—Determination of Flexural Properties of Rigid Plastics

ISO 179 Plastics—Determination of Charpy Impact Strength of Rigid Materials

ISO 180 Plastics—Determination of Izod Impact Strength of Rigid Materials

ISO 294-4 Plastics—Injection Moulding of Test Specimens of Thermoplastic Materials—Part 4: Determination of Moulding Shrinkage

ISO 527–1 Plastics—Determination of Tensile Properties—Part 1: General Principles

ISO 537 Plastics—Testing with the Torsional Pendulum

ISO 604 Plastics—Determination of Compressive Properties

ISO 868 Plastics—Determination of Indention Hardness by Means of a Durometer (Shore Hardness)

ISO 877 Plastics—Determination of Resistance to Change Upon Exposure Under Glass to Daylight

ISO 974 Plastics—Determination of the Brittleness Temperature by Impact

ISO 1183 Plastics—Methods for Determining the Density and Relative Density of Non-Cellular Plastics

ISO 1210 Plastics—Determination of the Burning Behavior of Horizontal and Vertical Specimens in Contact with a Small-Flame Ignition Source

ISO 2039-2 Plastics—Determination of Hardness—Part 2: Rockwell Hardness

ISO 3146 Plastics—Determination of Melting Behaviour (Melting Temperature or Melting Range) of Semi-Crystalline Polymers

ISO 3795 Road Vehicles, Tractors, and Machinery for Agriculture and Forestry—Determination of Burning Behavior of Interior Materials

ISO 4577 Plastics—Polypropylene and Propylene—Copolymers—Determination of Thermal Oxidative Stability in Air-Oven Method

ISO 4589 Plastics—Determination of Flammability by Oxygen Index

ISO 4607 Plastics—Method of Exposure to Natural Weathering

ISO 4892 Plastics—Methods of Exposure to Laboratory Light Source

ISO 6603-1 Plastics—Determination of Multiaxial Impact Behavior of Rigid Plastics—Part 1: Falling Dart Method

TABLE 1 Standard Symbols for Generic Families With Referenced Standards and Cell Tables

Standard Symbol	Family Name	ASTM[A] Standard	Suggested Reference Cell Tables for Materials Without an ASTM Standard[B]	
			Unfilled	Filled
ABA	Acrylonitrile-butadiene-acrylate		E	
ABS	Acrylonitrile-butadiene-styrene	D 4673		
AMMA	Acrylonitrile-methyl methacrylate		E	
ARP	Aromatic polyester	(see LCP)		
ASA	Acrylonitrile-styrene-acrylate		E	
CA	Cellulose acetate	D 706		
CAB	Cellulose acetate butyrate	D 707		
CAP	Cellulose acetate proprionate	D 1562		
CE	Cellulose plastics, general		E	D
CF	Cresol formaldehyde		H	H
CMC	Carboxymethyl cellulose		E	
CN	Cellulose nitrate		E	D
CPE	Chlorinated polyethylene		F	
CPVC	Chlorinated poly(vinyl chloride)	D 5260		
CS	Casein		H	H
CTA	Cellulose triacetate		E	D
EC	Ethyl cellulose		E	D
E-CTFE	Ethylene-chlorotrifluoroethylene copolymer	D 3275		
EEA	Ethylene-ethyl acrylate		F	
EMA	Ethylene-methacrylic acid		F	
EP	Epoxy, epoxide		H	H
EPD	Ethylene-propylene-diene			
EPM	Ethylene-propylene polymer		F	D
ETFE	Ethylene-tetrafluoroethylene copolymer	D 3159		
EVA	Ethylene-vinyl acetate		F	
FCEA	Fully crosslinked elastomeric alloy	D 5046		
FEP	Perfluoro (ethylene-propylene) copolymer	D 2116		
FF	Furan formaldehyde		H	H
HCTPV	Highly crosslinked thermoplastic vulcanizate	D 6338		
HIPS	Impact polystyrene	(see PS)		
LCP	Liquid crystal polymer	D 5138		
MF	Melamine-formaldehyde		H	H
MFA	Fluorocarbon Perfluoromethoxy	D 6314		
PA	Polyamide (nylon)	D 4066		
PAEK	Polyaryletherketone			
PAI	Polyamide-imide	D 5204		
PARA	Polyaryl amide			
PB	Polybutene-1	D 2581		
PBT	Poly(butylene terephthalate)	(see TPES)		
PC	Polycarbonate	D 3935		
PCTFE	Polymonochlorotrifluoroethylene	D 1430		
PDAP	Poly(diallyl phthalate)		H	H
PE	Polyethylene	D 4976		
PES	Poly(ether sulfone)	D 6394		
PEBA	Polyether block amide			
PEEK	Polyetheretherketone			
PEI	Polyether-imide	D 5205		
PEN	Poly(ethylene napthlate)			
PEO	Poly(ethylene oxide)	D 6394		
PES	Poly(ether sulfone)	D 6394		
PET	Poly(ethylene terephthalate), general	(see TPES)		
PETG	Glycol modified polyethylene terephthalate comonomer	(see TPES)		
PF	Phenol-formaldehyde	D 4617		
PFA	Perfluoro alkoxy alkane	D 3307		
PI	Polyimide		G	G
PIB	Polyisobutylene		F	
PMMA	Poly(methyl methacrylate)	D 788		
PMP	Poly(4-methylpentene-1)		F	
POM	Polyoxymethylene (acetal)	D 4181		
PPO	Polyphenylene oxide	(see PPE)		
PP	Poly(propylene plastics)	D 4101		
PPA	Polyphthalamide	D 5336		
PPE	Polyphenylene ether	D 4349		
PPOX	Poly(propylene oxide)			
PPS	Poly(phenylene sulfide)	D 4067, D 6338		
PPSU	Poly(phenyl sulfone)	D 6394		
PS	Polystyrene	D 4549		
PSU	Polysulfone	D 6394		
PTFE	Polytetrafluoroethylene	D 1710		

TABLE 1 *Continued*

Standard Symbol	Family Name	ASTM[A] Standard	Suggested Reference Cell Tables for Materials Without an ASTM Standard[B]	
			Unfilled	Filled
PUR	Polyurethane		F	D
PVAC	Poly(vinyl acetate)		F	D
PVAL	Poly(vinyl alcohol)		F	D
PVB	Poly(vinyl butyral)		F	D
PVC	Poly(vinyl chloride)		F	D
PVDC	Poly(vinylidene chloride)		F	D
PVDF	Poly(vinylidene fluoride)	D 3222		
PVF	Poly(vinyl fluoride)		F	D
PVFM	Poly(vinyl formal)		F	D
PVK	Poly(vinylcarbazole)		F	D
PVP	Poly(vinyl pyrrolidone)		F	D
SAN	Styrene-acrylonitrile	D 4203		
SB	Styrene-butadiene copolymer		E	D
SI	Silicone plastics		G	G
S/MA	Styrene-maleic anhydride	D 4634		
SMS	Styrene/alpha-methylstyrene		E	D
SP	Sulfone polymers	D 6394		
TECEA	Thermoplastic elastomer-chlorinated ethylene alloy	D 5021		
TEEE	Thermoplastic elastomer, ether-ester	D 4550		
TEO	Thermoplastic elastomer-olefinic	D 5593		
TES	Thermoplastic elastomer-stryenic	D 4474		
TPE	Thermoplastic elastomer	(see individual material)		
TPES	Thermoplastic polyester (general)	D 5927		
TPU	Thermoplastic polyurethane	D 5476		
UF	Urea-formaldehyde		H	H
UP	Unsaturated polyester			
VDF	Vinylidene fluoride	D 5575		

[A]The standards listed are those in accordance with this classification.
[B]Cell Tables A and B have been reserved for the referenced standards and will apply to unfilled and filled materials covered in those standards.

3. Terminology

3.1 *Definitions*—The definitions used in this classification system are in accordance with Terminology D 883.

4. Significance and Use

4.1 The purpose of this classification system is to provide a method of adequately identifying plastic materials in order to give industry a system that can be used universally for plastic materials. It further provides a means for specifying these materials by the use of a simple line call-out designation.

4.2 This classification system was developed to permit the addition of property values for future plastics.

5. Classification

5.1 Plastic materials shall be classified on the basis of their broad generic family. The generic family is identified by letter designations as found in Table 1. These letters represent the standard abbreviations for plastics in accordance with Terminology D 1600.

NOTE 4—For example: PA = polyamide (nylon).

5.1.1 The generic family is based on the broad chemical makeup of the base polymer. By its designation, certain inherent properties are specified.

TABLE 2 Reinforcement-Filler[A] Symbols[B] and Tolerances

Symbol	Material	Tolerance
C	Carbon and graphite fiber-reinforced	±2 percentage points
G	Glass-reinforced	±2 percentage points
L	Lubricants (for example, PTFE, graphite, silicone, and molybdenum disulfide)	depends upon material and process—to be specified.
M	Mineral-reinforced	±2 percentage points
R	Combinations of reinforcements and fillers	±3 percentage points (Based on the total reinforcements or fillers, or both)

[A]Ash content of filled or reinforced materials may be determined using Test Method D 2584 where applicable.
[B]Additional symbols will be added to this table as required.