



Designation: D5857 – 17

# Standard Specification for Polypropylene Injection and Extrusion Materials Using ISO Protocol and Methodology<sup>1</sup>

This standard is issued under the fixed designation D5857; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## INTRODUCTION

This material specification is intended to provide a call out system for polypropylene utilizing specimen preparation procedures and test method based on ISO standards.

This specification is not intended for the determination of the suitability of performance of materials in the final application. Selection of these materials is to be made by personnel with expertise in the plastics field in which the environment, inherent properties of the materials, performance of the parts, part design, manufacturing process, and economics are considered.

### 1. Scope\*

1.1 This specification covers polypropylene materials suitable for injection molding and extrusion. Polymers consist of polypropylene homopolymers, polypropylene copolymers, and polypropylene-elastomer compounds produced with or without the addition of impact modifiers (ethylene-propylene rubber, polyisobutylene rubber, and butyl rubber, and so forth), colorants, stabilizers, lubricants, fillers, or reinforcements.

1.2 This specification allows for the use of those polypropylene materials that can be recycled, reconstituted, and reground, provided that the following conditions are met:

1.2.1 The requirements as stated in this specification and other ISO guidelines pertaining to these types of materials are met, and

1.2.2 The material has not been modified in any way to alter its conformance to food contact regulations or similar requirements.

1.3 The proportions of recycled, reconstituted, and regrind material used, as well as the nature and the amount of any contaminant, cannot be practically covered in this specification. It is the responsibility of the supplier and buyer of recycled, reconstituted, and regrind materials to ensure compliance.

1.4 The properties included in this classification system are those required to identify the compositions covered. Other requirements necessary to identify particular characteristics

important to specialized applications can be specified by using the suffixes as given in Section 5 and those in Classification System D4000.

1.5 This classification system and specification are intended to provide a means of calling out polypropylene 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 specification.

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

1.7 The following precautionary caveat pertains only to the test methods portion, Section 13, of this specification: *This specification 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 specification to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—This specification is similar to both ISO 1873-1 and ISO 1873-2, but to different degrees. This specification resembles ISO 1873-1 in title only. The content is significantly different. This specification and ISO 1873-2 differ in approach or detail; data obtained using either are technically equivalent.

1.8 *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.*

<sup>1</sup> 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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\*A Summary of Changes section appears at the end of this standard

## 2. Referenced Documents

### 2.1 *ASTM Standards*:<sup>2</sup>

- D618 Practice for Conditioning Plastics for Testing
- D883 Terminology Relating to Plastics
- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D1999 Guide for Selection of Specimens and Test Parameters from ISO/IEC Standards (Withdrawn 2000)<sup>3</sup>
- D3763 Test Method for High Speed Puncture Properties of Plastics Using Load and Displacement Sensors
- D3892 Practice for Packaging/Packing of Plastics
- D4000 Classification System for Specifying Plastic Materials
- D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)<sup>3</sup>
- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

### 2.2 *ISO Standards*:<sup>4</sup>

- ISO 62 Plastics—Determination of Water Absorption
- ISO 75-1 Plastics—Determination of Temperature of Deflection Under Load, Part 1: General Test Method
- ISO 75-2 Plastics—Determination of Temperature of Deflection Under Load, Part 2: Plastics and Ebonite
- ISO 105 Textiles—Tests for Color Fastness
- 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 293 Plastics—Compression Moulding Test Specimens of Thermoplastic Material
- ISO 294 Plastics—Injection Moulding of Test Specimens of Thermoplastic Material
- ISO 306 Plastics—Thermoplastic Materials—Determination of Vicat Softening Temperature
- ISO 527-1 Plastics—Determination of Tensile Properties, Part 1: General Principles
- ISO 527-2 Plastics—Determination of Tensile Properties, Part 2: Test Conditions for Molding and Extrusion Plastics
- ISO 537 Plastics—Testing with Torsional Pendulum
- ISO 604 Plastics—Determination of Compressive Properties
- ISO 868 Plastics and Ebonite—Determination of Indentation Hardness by Means of a Durometer (Shore Hardness)
- ISO 877 Plastics—Methods of Exposure to direct Weathering, to Weathering Using Glass-Filtered Daylight, and to Intensified Weathering by Daylight Using Fresnel Mirrors
- ISO 899 Plastics—Determination of Tensile Creep

- ISO 974 Plastics—Determination of the Brittleness Temperature by Impact
- ISO 1133 Plastics—Determination of Melt Flow Rate of Thermoplastics
- ISO 1183A Plastics—Methods for Determining the Density and Relative Density of Non-Cellular Plastics
- ISO 1191 Plastics—Polyethylene and Polypropylenes in Dilute Solutions—Determination of Viscosity Number and of Limiting Viscosity Number
- ISO 1628-3 Plastics—Determination of Viscosity Number and Limiting Viscosity Number, Part 3: Polyethylene and Polypropylene Resins
- ISO 1873-1 Plastics—Propylene and Propylene-Copolymer Thermoplastics, Part 1: Designation
- ISO 1873-2 Plastics—Polypropylene (PP) and Propylene-Copolymer Thermoplastics, Part 2: Preparation of Test Specimens and Determination of Properties
- ISO 2039-1 Plastics—Determination of Hardness, Part 1: Ball Indentation Method
- ISO 2039-2 Plastics—Determination of Hardness, Part 2: Rockwell Hardness
- ISO 2818 Plastics—Preparation of Test Specimens by Machining
- ISO 3451-1 Plastics—Determination of Ash, Part 1: General Methods
- ISO 3795 Road Vehicles, and Tractors and Machinery for Agriculture and Forestry—Determination of Burning Behavior of Interior Materials
- ISO 4582 Plastics—Determination of Changes in Colour and Variations in Properties after Exposure to Daylight Under Glass, Natural Weathering or Artificial Light
- ISO 4589 Plastics—Determination of Flammability by Oxygen Index
- ISO 4892-1 Methods of Exposure to Laboratory Light Sources, Part 1: General Guidance
- ISO 4892-2 Plastics—Methods of Exposure to Laboratory Light, Part 2: Xenon Arc Exposure
- ISO 4892-3 Plastics—Methods of Exposure to Laboratory Light, Part 3: Fluorescent UV Lamps
- ISO 6427 Plastics—Determination of Matter Extractable by Organic Solvents (Conventional Methods)
- ISO 6602 Plastics—Determination of Flexural Creep by Three-Point Loading
- ISO 6603-1 Plastics—Determination of Multiaxial Impact Behavior of Rigid Plastics, Part 1: Falling Dart Method
- ISO 6603-2 Plastics—Determination of Multiaxial Impact Behavior of Rigid Plastics, Part 2: Instrumented Puncture Test
- ISO 8256 Plastics—Determination of Tensile Impact Properties
- ISO 9113 Plastics—Polypropylene (PP) and Propylene-Copolymer Thermoplastics—Determination of Isotactic Index
- ISO 10350 Plastics—Acquisition and Presentation of Comparable Single-Point Data
- ISO 11357-3 Plastics—Differential Scanning Calorimetry (DSC), Part 3: Determination of Temperature and Enthalpy of Melting and Crystallization

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

<sup>4</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

**ISO 11403-1** Plastics—Acquisition and Presentation of Comparable Multi-Point Data, Part 1: Mechanical Properties

**ISO 11403-2** Plastics—Acquisition and Presentation of Comparable Multi-point Data—Part 3: Environmental Influences on Properties

**ISO 20753** Plastics—Test Specimens

2.3 *IEC Standards:*<sup>4</sup>

**IEC 93** Recommended Methods of Test 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 243-1** Recommended Methods of Test for Electric 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

**IEC 296** Specification for Unused Mineral Insulating Oils for Transformers and Switchgear

**IEC 60695-11-10** Fire Hazard Testing-Part 11-10: Test Flames-50 W Horizontal and Vertical Test Methods

2.4 *SAE Standards:*<sup>5</sup>

**SAE J1545** Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Color Trim

**SAE J1767** Instrumental Color Difference Measurement for Colorfastness of Automotive Interior Trim Materials

**SAE J1976** Outdoor Weathering of Exterior Materials

**SAE J2412** Accelerated Exposure of Automotive Interior Trim Components Using a Controlled Irradiance Xenon-Arc Apparatus

**SAE J2527** Performance Based Standard for Accelerated Exposure of Automotive Exterior Materials Using a Controlled Irradiance Xenon-Arc Apparatus

3.2.5 *ductile brittle transition temperature, n*—the temperature at which a minimum of 80 % of the specimens exhibit ductile failure.

3.2.6 *ductile failure, n*—one where the specimen deforms plastically before fracturing such that the cracks do not radiate more than 10 mm beyond the center of the impact point.

3.2.7 *injection pressure, n*—the constant pressure that is applied to the end of the screw, causing the melted material to fill the mold.

3.2.7.1 *Discussion*—The injection pressure along with the injection speed determines the volumetric fill rate of the mold.

3.2.8 *injection time, n*—the time during which a constant specified pressure is applied to the melted material.

3.2.9 *injection velocity, n*—the average velocity of the melt as it passes through the cross-sectional area of a cavity of a single- or multi-cavity mold at the position that forms the critical portion of the test specimen.

3.2.10 *melt temperature, n*—the temperature of the material as it is being injected into the mold, measured by a pyrometer.

3.2.11 *mold open time, n*—the time beginning when the mold is opened and ending when the mold is closed.

3.2.12 *mold temperature, n*—the temperature of the mold during the molding cycle, measured in all mold cavities and on both platens.

3.2.13 *polypropylene (PP)*—a propylene plastic prepared by the polymerization of propylene or propylene with other alpha olefins (see also *PP-H*, *PP-R*, and *PP-B*).

3.2.14 *polypropylene heterophasic copolymers (PP-B)*—a propylene plastic consisting of two or more separate phases. These include *PP+EPR*, *PP+EPDM*, *PP+IIR*, *PP+BR*, and so forth.

3.2.14.1 *Discussion*—The phases consist of a polypropylene homopolymer (*PP-H*) or a polypropylene random copolymer (*PP-R*) matrix containing a dispersed olefinic elastomer having no other functional group, added in situ or physically blended into the polypropylene matrix.

3.2.15 *polypropylene homopolymer (PP-H)*—a propylene plastic prepared by the polymerization of propylene only.

3.2.16 *polypropylene random copolymer (PP-R)*—a propylene plastic containing another olefinic monomer (or monomers) having no functional group other than the olefinic group copolymerized with propylene.

3.2.16.1 *Discussion*—Polypropylene random copolymers containing more than one additional monomer are often called terpolymers.

## 4. Classification

4.1 Unreinforced polypropylene materials are classified into groups in accordance with basic composition. These groups are subdivided into classes and grades, as shown in Table PP.

NOTE 2—An example of this classification system is as follows. The designation PP0113 would indicate: PP = polypropylene, as found in Terminology **D1600**, 01 (group) = homopolymer, 1 (class) = general purpose, and 3 (grade) = with requirements given in Table PP.

## 3. Terminology

3.1 *Definitions*—Definitions of terms and abbreviations applying to this specification appear in Terminologies **D883** and **D1600** and Guide **D7209**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *back pressure, n*—the constant pressure that is applied to the end of the screw while the screw is rotating and retracting to prepare for the next injection.

3.2.2 *brittle failure, n*—one where the specimen test area is broken into two or more pieces, with sharp edges, and shows almost no plastic flow.

3.2.3 *cooling time, n*—the time during which the material is in the closed mold with no pressure applied.

3.2.4 *cycle time, n*—the time required to complete a full injection molding cycle, including injection time, cooling time, and mold open time.

<sup>5</sup> Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.