



Designation: D7211 – 13 (Reapproved 2018)

Standard Specification for Parts Machined from Polychlorotrifluoroethylene (PCTFE) and Intended for General Use¹

This standard is issued under the fixed designation D7211; 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 specification is intended to be a means of calling out finished machined parts ready for commercial use.

1.2 This specification establishes requirements for parts machined from unplasticized, 100 % polychlorotrifluoroethylene (PCTFE) homopolymers.

1.3 This specification does not cover parts machined from PCTFE copolymers, PCTFE film or tape less than 0.25-mm (0.010-in.) thick, or modified PCTFE (containing pigments or plasticizers).

1.4 This specification allows for parts containing regrind and recycled material.

1.5 The specification does not cover PCTFE parts used in aerospace applications involving storage and handling of oxygen media, air media, inert media, and certain reactive media (specifically ammonia, gaseous hydrogen, and liquid hydrogen), in which dimensional stability, high molecular weight, molecular weight retention, and crystallinity control are important considerations. For aerospace grade, machined PCTFE parts, use Specification [D7194](#).

1.6 *Application*—PCTFE parts covered by this specification are made of 100 % PCTFE resin, free of plasticizers, fillers, or other additives. The parts meet specific physical characteristics appropriate for their end use, and are typically used in applications requiring good electrical properties or resistance to aggressive chemical media. General purpose PCTFE parts include seals, gaskets, valve and pump parts (cryogenic and noncryogenic), translucent tubing, sight glasses, flowmeter tubes, heavy-walled solid pipes and fittings, gears, cams, bearings, laboratory ware, circuit boards, electrical connector covers and switches, radome covers, and a variety of other stock shapes. They are removed and replaced during normal maintenance procedures. The parts also experience static or dynamic mechanical loading, and temperatures ranging from

cryogenic to temperatures at or above the glass transition temperature, $T_g = 55^\circ\text{C}$ (131°F).

NOTE 1—Quick-quenched PCTFE will potentially exhibit dimensional relaxation in the vicinity of T_g .

NOTE 2—Although no recommendations are made regarding the limiting upper use temperature of PCTFE, the heat deflection temperature of PCTFE as determined by Test Method [D648](#) is 126°C (259°F).

1.7 The values stated in SI units are to be regarded as standard. The values in parentheses are for information only.

1.8 The following precautionary caveat pertains only to the test methods portion, Section 11, of this specification: *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.*

NOTE 3—There is no known ISO equivalent to this standard.

1.9 *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

- D618 Practice for Conditioning Plastics for Testing
- D648 Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
- D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D883 Terminology Relating to Plastics
- D1430 Classification System for Polychlorotrifluoroethylene (PCTFE) Plastics
- D1600 Terminology for Abbreviated Terms Relating to Plastics

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.

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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.

D2117 Test Methods for Carbon Black—Surface Area by Nitrogen Adsorption (Withdrawn 1999)³

D4591 Test Method for Determining Temperatures and Heats of Transitions of Fluoropolymers by Differential Scanning Calorimetry

D7194 Specification for Aerospace Parts Machined from Polychlorotrifluoroethylene (PCTFE)

3. Terminology

3.1 Definitions:

3.1.1 Terms are defined in accordance with Terminologies **D883** and **D1600** unless listed below.

3.1.2 *oxygen media, n*—liquid oxygen and gaseous oxygen.

3.1.3 *air media, n*—liquid air and pressurized air (including breathing air).

3.1.4 *inert media, n*—for example, gaseous helium and gaseous nitrogen.

3.1.5 *reactive media, n*—for example, ammonia, gaseous hydrogen, and liquid hydrogen, nitrous oxide, and nitrogen trifluoride.

3.1.6 *Zero Strength Time (ZST), n*—time measured in accordance with Section 10 of Classification **D1430** to check the relative molecular weight of the PCTFE material.

4. Classification

4.1 Part shape and size shall be defined by the applicable purchase order.

4.2 General purpose grade PCTFE shall be Class 1 homopolymer in accordance Classification **D1430**.

4.3 The grade of product shall be categorized in accordance with Classification **D1430** as follows:

4.3.1 Grade 0 having an undetermined or unspecified ZST.

4.3.2 Grade 1 having an as-polymerized ZST of 100 to 199 seconds.

4.3.3 Grade 2 having an as-polymerized ZST of 200 to 299 seconds.

4.3.4 Grade 3 having an as-polymerized ZST of 300 to 450 seconds.

4.4 The finished part shall be received in an unannealed or annealed state as specified in the applicable purchase order. If annealed, annealing shall be accomplished as described in **11.4**.

5. Ordering Information

5.1 All parts covered by this specification shall be ordered by grade and annealed state as listed in Section **4**.

6. Materials and Manufacture

6.1 Annealed and unannealed parts shall be made from polymers meeting all requirements of Classification **D1430**, Group 01, Class 1, Grades 0, 1, 2, or 3.

6.2 Parts shall be made from virgin, unfilled, unplasticized, 100 % polychlorotrifluoroethylene (PCTFE) homopolymer and up to 30 percent (by volume) regrind or recycled polymer.

³ The last approved version of this historical standard is referenced on www.astm.org.

6.3 The base material shall be free of all defects or contaminants that would be detrimental to final fabrication or performance of the finished parts.

7. Property Requirements

7.1 Specification values listed in this specification are minimum specification values or minimum-maximum specification ranges. Any additional requirement for specific tests or data shall be made at the time of the order.

8. General Requirements

NOTE 4—If so specified in the purchase contract or order, the molder producing the semifinished article from which finished parts are made will be responsible for insuring the requirement in **8.8** is met. All other requirements listed in this section pertain to the finished part, and therefore, will be the responsibility of the supplier of the finished, machined part.

8.1 Finished parts shall have a natural translucent appearance. The color shall be white or gray with no yellowing or other unnatural color.

8.2 Finished parts shall be free of voids, scratches, fissures, inclusions, or entrapped air bubbles that will affect serviceability. No particles (for example, black specks) shall be visible to the naked eye.

8.3 Depending on commercial resin grade, processing route (for example, extrusion, compression molding, injection molding), quenching method (water or air cooling), and thickness of the starting semifinished article from which the finished part is made, the specific gravity, sp. gr. 23/23°C of finished PCTFE parts when determined by **11.1**, can vary from 2.11 to 2.17. However, to ensure consistent properties and performance in the intended application, the specific gravity of a finished part shall not be allowed to fluctuate freely within the 2.11 to 2.17 range.

8.4 The melting point of finished parts shall be determined to be in the range of 210 to 220°C (410 to 428°F) as determined in **11.2**.

8.5 Finished parts shall be made from semifinished articles having an as-molded zero strength time (ZST_{stock}) of 300 to 450 s (Grade 3), or 200 to 299 s (Grade 2), or 100 to 199 s (Grade 1), as determined in **11.3**, or shall be undetermined or unspecified (Grade 0).

NOTE 5—To ensure that the process route does not cause excessive thermal degradation and accompanying molecular weight drop, it is recommended that the maximum allowable ZST drop, ΔZST , shall not exceed <20 % as determined in **11.3.4**.

8.6 All finished parts are to be supplied in annealed condition in accordance with **11.4**, or in an unannealed condition.

8.7 No dimension of an annealed, finished part shall change more than 0.003 mm/mm (0.003 in./in.) measured at $23 \pm 2^\circ\text{C}$ ($73 \pm 4^\circ\text{F}$) before and after being held for 48 ± 5 h at $70 \pm 5^\circ\text{C}$ ($158 \pm 9^\circ\text{F}$), as determined in **11.5**.

8.8 If so specified in the purchase contract or order, the maximum allowable ZST drop, ΔZST , shall be <20 % as determined in **11.3.4**.