



Designation: D7194 – 12

Standard Specification for Aerospace Parts Machined from Polychlorotrifluoroethylene (PCTFE)¹

This standard is issued under the fixed designation D7194; 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 aerospace use. Such parts may also find use in selected commercial applications where there are clear benefits derived from the use of parts with known or controlled crystallinity, high molecular weight, good molecular weight retention during processing, dimensional stability in the finished part, and tightly controlled engineering tolerances.

1.2 This specification establishes requirements for parts machined from virgin, 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 does not allow parts containing recycled material.

1.5 The specification does not cover PCTFE parts intended for general use applications, in which control of dimensional stability, molecular weight, and crystallinity are not as important. For machined PCTFE parts intended for general use, use Specification [D7211](#).

1.6 This specification classifies parts into three classes based upon intended uses and exposures: oxygen-containing media, reactive media, and inert media.

1.7 *Application*—PCTFE components covered by this specification are virgin, 100 % PCTFE resin, free of plasticizers and other additives. The components are combustion resistant in oxygen, dimensionally stable, and meet other specific physical characteristics appropriate for their end use. They are used in valves, regulators, and other devices in oxygen, air, helium, nitrogen, hydrogen, ammonia, and other aerospace media systems. The components typically are used as valve seats,

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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o-rings, seals, and gaskets. They are removed and replaced during normal maintenance procedures. The components provide reliable sealing surfaces resulting in proper closure of valves and related devices and no leakage from the system into the environment. They will experience static mechanical loading, cyclic mechanical loading, temperatures ranging from cryogenic to 71 °C (160 °F), and pressures up to 68.9 MPa (10,000, psig) for oxygen and air media, and 103.4 MPa (15,000 psig) for inert media.

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

1.9 The following precautionary caveat pertains only to the test methods portion, Section [12](#), 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 and health practices and to determine the applicability of regulatory limitations prior to use.*

NOTE 1—There is no known ISO equivalent to this standard.

2. Referenced Documents

- 2.1 *ASTM Standards*:²
- [D618 Practice for Conditioning Plastics for Testing](#)
 - [D638 Test Method for Tensile Properties of Plastics](#)
 - [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](#)
 - [D1708 Test Method for Tensile Properties of Plastics by Use of Microtensile Specimens](#)
 - [D2512 Test Method for Compatibility of Materials with Liquid Oxygen \(Impact Sensitivity Threshold and Pass-Fail Techniques\)](#)

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.

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

D7211 Specification for Parts Machined from Polychlorotrifluoroethylene (PCTFE) and Intended for General Use

G86 Test Method for Determining Ignition Sensitivity of Materials to Mechanical Impact in Ambient Liquid Oxygen and Pressurized Liquid and Gaseous Oxygen Environments

2.2 *Federal Standards*³

NASA-STD-6001B Flammability, Offgassing, and Compatibility Requirements and Test Procedures—Mechanical Impact for Materials in Ambient Pressure LOX (Test 13A) and Mechanical Impact for Materials in Variable Pressure GOX and LOX (Test 13B)

3. Terminology

3.1 *Definitions:*

3.1.1 Terms are defined in accordance with Terminologies **D883** and **D1600** unless otherwise indicated.

3.1.2 *air media, n*—liquid air, pressurized air, and breathing air.

3.1.3 *cognizant engineering organization, n*—the company, agency, or other authority responsible for the system or component in which aerospace grade PCTFE is used. This, in addition to design personnel, may include personnel from material and process engineering, or quality groups and others as appropriate.

3.1.4 *inert media, n*—gaseous helium (GHe) and gaseous nitrogen (GN₂) up to 103.4 MPa (15,000 psig).

3.1.5 *oxygen media, n*—liquid oxygen (LOX) and gaseous oxygen (GOX) up to 68.9 MPa (10,000 psig).

3.1.6 *processing route, n*—the method whereby a thermoplastic is taken above its melting point and processed into a semifinished article, typically sheet or rod stock. For PCTFE, the common processing methods are extrusion and compression molding.

3.1.7 *reactive media, n*—ammonia (NH₃) up to 3.5 MPa (500 psig), gaseous hydrogen (GH₂) up to 46.2 MPa (6700 psig), and liquid hydrogen (LH₂) up to 2.8 MPa (400 psig).

4. Classification

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

4.2 The type of product shall be categorized by the intended use category:

4.2.1 *Type I* for use in air and oxygen media (see 3.1.2 and 3.1.5) at service pressures above 11.4 MPa (1650 psi) that require batch testing..

4.2.2 *Type II* for use in (1) air and oxygen media (at service pressures below 11.4 MPa (1650 psi), or at service pressures above 11.4 MPa (1650 psi) that do not require batch testing); or (2) inert and reactive media up to the pressures specified in 3.1.4 and 3.1.7.

4.2.3 *Type III* for use in media other than air, oxygen, GHe, GN₂, ammonia, GH₂ and LH₂, at service pressures specified by the cognizant engineering organization.

5. Ordering Information

5.1 All parts covered by this specification shall be ordered by Specification D7194, Type, as listed in Section 4, or as listed on the procurement drawing when Type is not specified explicitly..

6. Materials and Manufacture

6.1 Parts shall be made from as-polymerized resin meeting all requirements of Classification System **D1430**. Type *I, II* and *III* parts shall be fabricated from as-polymerized resin classified as meeting Classification System **D1430**, Group 01, Class 1, Grade 3.

6.2 Parts shall be made from virgin, unplasticized, 100 % polychlorotrifluoroethylene (PCTFE) homopolymer.

6.3 No recycled polymer or regrind shall be permitted.

6.4 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. Any additional requirement for specific tests or data shall be specified at the time of the order.

8. General Requirements

NOTE 2—Unless otherwise 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 requirements in 8.6 are met. All other requirements listed in Section 8 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 All finished parts are to be supplied after being annealed in accordance with 12.4.

8.4 No dimension of a finished part shall change more than 0.003 mm/mm (0.003 in./in.) measured at 23 ± 2 °C (73 ± 4 °F) before and after being held for 48 ± 5 h at 71 ± 5 °C (160 ± 9 °F), as determined by the method in 12.5.

8.5 Finished parts shall be made from semifinished articles having a zero strength time (ZST_{stock}) of 300 to 450 s (Grade 3) when determined in accordance with 12.1.

8.6 The maximum allowable ZST drop, ΔZST , shall be <20 % as determined in 12.1.4.

8.7 For nonmandatory requirements; namely, specific gravity variation, melting point range, and minimum tensile strength, that can be imposed to help ensure lot-to-lot

³ Available from the U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: DE, Washington, DC 20401.