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# Standard Classification System for Polychlorotrifluoroethylene (PCTFE) Plastics[1]

This standard is issued under the fixed designation D 1430; 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 classification system covers polychlorotrifluoroethylene (PCTFE) plastics that consist of at least 90 % chlorotrifluoroethylene and are suitable for extrusion and for compression and injection molding. The remaining 10 % may include chemical modifications, such as co-monomers, but not colorants, fillers, plasticizers, or mechanical blends with other resins. This classification system does not cover recycled PCTFE materials.

1.2 The physical and electrical properties of parts molded or extruded from PCTFE molding compounds vary with the crystalline content obtained during processing and subsequent annealing. Accordingly, the numerical values listed in Table 1 apply only to the test specimens molded in accordance with Section 8. These values may not be applicable as design criteria to parts prepared and annealed under other conditions.

1.3 The values stated in SI units as detailed in IEEE/ASTM SI 10 are to be regarded as the standard. The values given in parentheses are for information only.

1.4 The following precautionary statement pertains only to the test methods portion, Section 10, of this classification system: *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—Although this classification system and ISO 12086-1 (1995) and ISO 12086-2 (1995) differ in approach or detail, data obtained using either are technically equivalent.



## 2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 150 Test Methods for ~~A-C~~AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical ~~Insulating~~ Insulation

D 618~~Practice for Conditioning Plastics and Electrical Insulating Materials for Testing~~ Practice for Conditioning Plastics for Testing



D 621 Test Methods for Deformation of Plastics Under Load[3]

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

D 883 Terminology Relating to Plastics

D 1600 Terminology for Abbreviated Terms Relating to Plastics

D 2117 Test Method for Melting Point of Semicrystalline Polymers by the Hot Stage Microscopy Method[0]

D~~3418Test Method for Transition Temperatures of Polymers by Thermal Analysis~~ 3418 Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry

D 3892 Practice for Packaging/Packing of Plastics

D 4591 Test Method for Determining Temperatures and Heats of Transitions of Fluoropolymers by Differential Scanning Calorimetry

2.2 *ISO Standard:*[4]

ISO 12086-1 (1995) Plastics—Fluoropolymer Dispersions and Moulding and Extrusion Materials, Part 1

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[1] This classification system is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials (Section D20.15.12).

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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* ~~, Vol 10.01.~~volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Withdrawn

[4] ~~These test methods were withdrawn with no replacement in 1994. Test Methods D621 can be obtained from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112.~~

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

**TABLE 1 Requirements for PCTFE Molded Test Specimens**

| Group | Class | Description | Grade | Properties: Specific Gravity,[A] 23/23°C | Zero Strength Time, s[B] | Deformation Under Load[C,D] | Melting Point, °C[E] | Dielectric Constant[F], max: Khz | Dielectric Constant[F], max: MHz | Dissipation Factor[G], max: KHz | Dissipation Factor[G], max: MHz |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ~~01~~ | ~~1~~ | ~~homopolymer~~ | ~~1~~ | ~~2.10-2.12~~ | ~~100-199~~ | ~~10~~ | ~~210-220~~ | ~~2.70~~ | ~~2.50~~ | ~~0.030~~ | ~~0.012~~ |
| 01 | 1 | homopolymer | 1 | 2.10-2.15 | 100-199 | 10 | 210-220 | 2.70 | 2.50 | 0.030 | 0.012 |
| ~~powder~~ | | | ~~2~~ | ~~2.10-2.12~~ | ~~200-299~~ | ~~10~~ | ~~210-220~~ | ~~2.70~~ | ~~2.50~~ | ~~0.030~~ | ~~0.012~~ |
| | | | 2 | 2.10-2.15 | 200-299 | 10 | 210-220 | 2.70 | 2.50 | 0.030 | 0.012 |
| | | | ~~3~~ | ~~2.10-2.12~~ | ~~300-450~~ | ~~10~~ | ~~210-220~~ | ~~2.70~~ | ~~2.50~~ | ~~0.030~~ | ~~0.012~~ |
| | | | 3 | 2.10-2.15 | 300-450 | 10 | 210-220 | 2.70 | 2.50 | 0.030 | 0.012 |
| | | | 0 | | | | | | | | |
| ~~02~~ | ~~2~~ | ~~modified~~ | | | | | | | | | |
| | 2 | modified | | | | | | | | | |
| ~~pellet~~ | | ~~homopolymer~~ | ~~1~~ | ~~2.10-2.12~~ | ~~100-199~~ | ~~15~~ | ~~200-210~~ | ~~2.70~~ | ~~2.50~~ | ~~0.030~~ | ~~0.012~~ |
| | | homopolymer | 1 | 2.10-2.12 | 100-199 | 15 | 200-210 | 2.70 | 2.50 | 0.030 | 0.012 |
| | | | 2 | 2.10-2.12 | 200-299 | 15 | 200-210 | 2.70 | 2.50 | 0.030 | 0.012 |
| | | | 0 | | | | | | | | |
| | 3 | copolymer | 1 | 2.08-2.10 | 100-199 | 20 | 190-200 | 2.70 | 2.50 | 0.035 | 0.015 |
| | | | 2 | 2.07-2.10 | 200-299 | 25 | 190-200 | 2.70 | 2.50 | 0.035 | 0.015 |
| | | | 0 | | | | | | | | |
| ~~00~~ | ~~0~~ | ~~other~~ | | | | | | | | | |
| ~~Other~~ | | | | | | | | | | | |
| | 0 | other | | | | | | | | | |

[A] See 10.1.7.
[B] See 10.1.3.
[C] See 10.1.4.
[D] Maximum at 1112 N (250 lbf), 24 h, 70°C, %.
[E] See 10.1.5.
[F] See 10.1.6.
[G] See 10.1.6.



ISO 12086-2 (1995) Plastics—Fluoropolymer Dispersions and Moulding and Extrusion Materials, Part 2

## 3. Terminology

3.1 *Definitions*—Definitions of terms used in this classification system shall be in accordance with Terminology D 883.

3.1.1 *lot*, *n*—one production run or uniform blend of two or more production runs. **D 4895**

3.2 *Definitions of Terms Specific to This Standard:*



3.2.1 *preforming*, *n*—a process to compress the material under pressure in a mold to form a preform.



3.2.2 *zero strength time (ZST )*, *n*—~~time measured according to Section~~ time measured in accordance with Section 10 of this classification system to check the relative molecular weight of PCTFE material.

3.3 *Abbreviations:Abbreviations*—Abbreviated terms are in accordance with Terminology D 1600.

## 4. Classification

~~4.1The PCTFE~~ 4.1 PCTFE materials ~~are classified into groups in accordance with their physical appearance.~~ in powders and pellets are classified into one group. The ~~groups are further~~group is subdivided into classes based on chemical composition. These classes are subdivided into grades as shown in the Basic Property Table (Table 1).

An example of this classification system is given as follows:

Group 01 = ~~powder~~PCTFE
Class 1 = homopolymer
Grade 2 = having properties ~~in accordance with~~per Table 1 (Grade 2)

4.1.1 To facilitate incorporation of future material the "other" category for group ~~(00),~~(01), class (0), and grade (0) are shown in Table 1.

## 5. General Requirements

5.1 The molding or extrusion material shall be of uniform composition and so compounded as to conform to the requirements of this classification system.

## 6. Detail Requirements

6.1 Test specimens prepared in accordance with Section 9 shall conform to the requirements prescribed for the particular type and grade in Table 1.

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

## 7. Sampling

7.1 Sampling shall be statistically adequate to satisfy the requirements of 11.4.

## 8. Number of Tests

8.1 One set of test specimens as prescribed in Section 9 shall be considered sufficient for testing each batch. The average result for the specimens tested shall conform to the requirements prescribed in this classification system.

## 9. Specimen Preparation

9.1 Test specimens shall be cut from compression-molded sheets 1.58 ± 0.08 mm (0.062 ± 0.003 in.) thick, prepared from the resins in the following manner:

9.1.1 *Preforming*—Powder resin shall be preformed prior to molding in the following way: Place 30 ± 0.5 g of resin into a 57-mm (2.25-in.) diameter positive-pressure compression mold and compress the material at room temperature into a preform having a density of 1.4 to 1.5 g/cm$^3$. A pressure of 68.9 MPa (10 000 psi) will satisfactorily accomplish the densification.

9.1.2 *Molding*—Pelletized resin, granular resin, and preforms of powder resin shall be molded in the following way: Place the preform prepared in accordance with 9.1.1 or 30 ± 0.5 g of pelletized or granular resin on a 0.63-mm (0.025-in.) thick chrome-plated metal plate and cover with a similar plate. Place spacers, 1.91 ± 0.03 mm (0.075 ± 0.001 in.) thick, between the chrome-plated metal plates and far enough apart so that they do not interfere with the flow of the resin during molding. Place the plates, with spacers and resin in place, between the platens of the press, the platens having been heated to a surface temperature of 265 ± 5°C. Close and continuously load the platens, following the rate of melting so that the plates reach the stops within 3 min after closing the press. Then apply sufficient pressure for 3 min more to mold a sheet of the required thickness. Immediately after completion of the pressing, relieve the load, remove the plates and plastic sheet together, and at once quench them in cold water (15 ± 5°C) for 5 min, supporting the sandwich in a vertical position in the water. Then strip the 1.58 ± 0.08-mm (0.062 ± 0.003-in.) thick sheet from the metal plates. This sheet will be approximately 75 cm$^2$. Cut specimens from the center section of each sheet, discarding any imperfectly molded edges.

## 10. Test Methods

10.1 The properties enumerated in this classification system shall be determined in accordance with the following test methods:

10.1.1 *Conditioning*—For those tests where conditioning is required, the molded test specimens shall be conditioned in accordance with Procedure A of Practice D 618.

10.1.2 *Test Conditions*—Tests shall be conducted in the standard laboratory atmosphere of 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity unless otherwise specified in the test methods or in this classification system.

10.1.3 *Zero Strength Time* (*ZST*)—The zero strength time of PCTFE plastics shall be determined in accordance with the procedure described in the following paragraphs:

10.1.3.1 *Significance and Use*—Control of molecular weight of these polymers is necessary because the fabricating temperatures are very high and close to the point of rapid thermal degradation. The test for zero strength time is well suited to this type of control, as it is rapid, simple, and adaptable to semiautomatic operation, and for specific PCTFE resins correlates with molecular weight.

10.1.3.2 *Apparatus*—Cylindrical brass thermostat and accessory equipment as specified in Annex A1.

10.1.3.3 *Test Strip*—From the molded sheet prepared in accordance with Section 9 cut two strips 50 mm (2 in.) long, 4.8 mm (3⁄16 in.) wide, and 1.58 ± 0.08 mm (0.062 ± 0.003 in.) thick, using the sample cutter. With the notching punch make a V-notch in both sides of the strips approximately at the center line (equally distant from the ends of the 50-mm length) so that the notches are directly opposite each other. The cross-sectional width between the notches shall be 1.19 ± 0.03 mm (0.047 ± 0.001 in.), and the sides of each notch shall form an angle of 90 ± 0.5° with each other. Alternatively, cut and notch the test strips in one operation with a test specimen punch mounted in an arbor press. Dimensions of the finished test strip are shown in Fig. A1.1.

10.1.3.4 *Procedure*—Insert one end of each notched strip into a specimen holder (Fig. A1.1) and clip a weight of 7.5 ± 0.1 g on the other end of the strip. The specimen holder and weight shall be at or near room temperature (23 ± 10°C). Insert the weighted specimens into the furnaces, which shall be at a temperature of 250 ± 1°C, and start the timers at the moment of insertion. As each specimen breaks and the attached weight drops through the bottom of the furnace, stop the corresponding timer. Record the time in seconds indicated on each timer. Take the average of these two readings as the zero strength time for the duplicate specimens. If the difference between the two measurements exceeds 10 % of the average, reject these readings and test a second pair of specimens.

10.1.3.5 *Precision and Bias*—The precision and bias data for this test method is to be determined.

10.1.4 *Deformation Under Load*—Test Method A of Test Methods D 621. With 1112-N (250-lbf) load at 70 ± 1°C, except that permissible deformations may exceed 25 %.

NOTE 2—Experimental data have shown that at 1112-N (250-lbf) load and 70°C, the test for deformation under load is applicable for the purpose of classification to the materials described in this specification beyond 25 % deformation.

10.1.5 *Melting Point*—The melting point shall be determined either by optical microscopy (see Test Method D 2117) or differential scanning calorimetry (DSC) (see Test Method D 4591). Both test methods give equivalent melting points after each