
**Plastics — Polytetrafluoroethylene
(PTFE) semi-finished products —**

**Part 1:
Requirements and designation**

*Plastiques — Semi-produits en polytétrafluoroéthylène (PTFE) —
Partie 1: Spécifications et désignation*

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Contents

	Page
Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Requirements for PTFE semi-finished products	2
4.1 General.....	2
4.2 Dimensions and dimensional tolerances.....	2
4.2.1 General.....	2
4.2.2 Skived tape, skived sheet or film.....	2
4.2.3 Moulded sheet.....	2
4.2.4 Extruded or moulded rod.....	3
4.2.5 Tube extruded from coagulated dispersion powder.....	3
4.2.6 Extruded or moulded heavy-walled tube.....	4
4.3 Tensile strength and percentage elongation at break.....	4
4.4 Dimensional stability.....	4
4.5 Density.....	4
4.6 Hardness.....	5
4.7 Colour.....	5
4.8 Dielectric strength (DS).....	5
4.8.1 General.....	5
4.8.2 Skived tape, skived sheet or film.....	5
4.8.3 Moulded sheet.....	5
4.8.4 Moulded basic shape.....	6
4.8.5 Extruded or moulded rod.....	6
4.8.6 Tube extruded from coagulated dispersion powder.....	6
4.8.7 Extruded or moulded heavy-walled tube.....	7
4.9 Requirements that can be specified depending on the specific application.....	7
5 Format for presenting a designation	8
5.1 General.....	8
5.2 Order of presenting codes.....	8
5.3 Examples of coding a designation.....	9
Bibliography	10

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 249, *Plastics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 13000-1:2005), which has been technically revised.

The main changes compared to the previous edition are as follows:

- in [Clause 1](#), any requirement and permission have been removed, and the note has been deleted;
- in [Clause 2](#), introductory wording has been updated;
- in [Clause 3](#), the clause title has been changed from "Terminology" to "Terms and definitions";
- in [Clause 4](#), all tables have been numbered, titles have been provided; and the data in the tables have been revised;
- in [Clause 5](#), designation examples have been added;
- former Annex A has been changed to Bibliography, and titles for standards have been corrected.

A list of all parts in the ISO 13000 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Plastics — Polytetrafluoroethylene (PTFE) semi-finished products —

Part 1: Requirements and designation

1 Scope

This document establishes a system of designation for processed unfilled polytetrafluoroethylene (PTFE) products, which can occur in several forms.

The PTFE used to make the semi-finished product is described in ISO 20568-1. The PTFE used to make the semi-finished product are virgin, reprocessed or recycled resin. The addition of up to 1,5 % by mass of pigment or colorant can be used.

2 Normative references

The following documents are referred to in the text that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 472, *Plastics — Vocabulary*

ISO 20568-1, *Plastics — Fluoropolymer dispersions and moulding and extrusion materials — Part 1: Designation system and basis for specifications*

ISO 13000-2, *Plastics — Polytetrafluoroethylene (PTFE) semi-finished products — Part 2: Preparation of test specimens and determination of properties*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472, ISO 20568-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

moulded basic shape

semi-finished product (3.2) made by preforming and sintering without additional processing

3.2

semi-finished product

material, in the form of *skived tape* (3.3), sheets, rods, tubes, tubing, *moulded basic shapes* (3.1) or special shapes, that is produced for use either directly without further fabrication or in fabricating end use products, or both

3.3

skived tape

film or sheet prepared by cutting, slicing or shaving

Note 1 to entry: The term “veneered tape” is deprecated.

4 Requirements for PTFE semi-finished products

4.1 General

After considering the specific shape, dimensions and dimensional tolerances, the primary basis for designating a semi-finished product of PTFE is the tensile strength and percentage elongation at break of the product. Tests to determine the values for designation shall be run in accordance with the methods in ISO 13000-2. The semi-finished product is identified as “type P” for as-processed or “type S” for stabilized and also can be designated as “type E” with specified electrical properties when required for a particular application. The exclusion of the use of reprocessed or recycled material shall be specified if needed in order to meet special customer requirements. The values required for other properties are given in their respective subclauses.

4.2 Dimensions and dimensional tolerances

4.2.1 General

Dimensional tolerances shall be measured at $23\text{ °C} \pm 2\text{ °C}$.

4.2.2 Skived tape, skived sheet or film

See [Table 1](#).

Table 1 — Code-letter of skived tape, skived sheet or film

Code-letter	Thickness	Tolerance
a	$\leq 0,1\text{ mm}$	$^{+0,01}_0\text{ mm}$
b	$\geq 0,1\text{ mm}$	$^{+10}_0\%$

The tolerance for width is $^{+3}_0\%$, with a maximum of 30 mm. For slit skived tape, the exact width shall be agreed upon between purchaser and supplier.

The tolerance for length is $^{+2}_0\%$.

4.2.3 Moulded sheet

For tolerance for moulded sheet, see [Table 2](#).

Table 2 — Code-letter of moulded sheet

Code-letter	Thickness	Tolerance
a	$< 5\text{ mm}$	$^{+0,75}_0\text{ mm}$
b	$\geq 5\text{ mm}$	$^{+15}_0\%$

The length and width tolerance shall be $^{+3}_0\%$.

4.2.4 Extruded or moulded rod

Tolerance for extruded or moulded rod are shown in [Table 3](#):

Table 3 — Code-letter of rod as extruded or moulded

Code-letter	Diameter	Tolerance
a	< 10 mm	$^{+0,6}_0$ mm
b	≥ 10 mm	$^{+6}_0$ %

Tolerance on length is shown in [Table 4](#):

Table 4 — Code-letter of tolerance on length for rod as extruded or moulded

Code-letter	Length	Tolerance
a	< 500 mm	$^{+10}_0$ mm
b	≥ 500 mm	$^{+2}_0$ %

For centreless ground, tolerance on diameter for all diameters is: $^{+0,04}_0$ mm.

Tolerance on length is shown in [Table 5](#):

Table 5 — Code-letter of tolerance on length for rod as centreless ground

Code-letter	Length	Tolerance
a	< 500 mm	$^{+10}_0$ mm
b	≥ 500 mm	$^{+2}_0$ %

4.2.5 Tube extruded from coagulated dispersion powder

NOTE The tube in 4.2.5 is extruded from coagulated PTFE powder. Other semi-finished PTFE products are made with suspension polymerized PTFE powder.

The tolerance on inner diameter and wall thickness is specified in [Table 6](#).

Table 6 — Code-letter of tolerance on inner diameter and wall thickness for extruded tube from coagulated dispersion powder

Code-letter	Dimension	Tolerance
a	Inner diameter < 5 mm	±0,25 mm
b	Inner diameter ≥ 5 mm	±5 %
c	Wall thickness < 1,0 mm	±0,1 mm
d	Wall thickness ≥ 1,0 mm	±10 %

The tolerance for length is $^{+2}_0$ %.

4.2.6 Extruded or moulded heavy-walled tube

Table 7 — Code-letter of extruded or moulded heavy-walled tube

Code-letter	Outer diameter	Tolerance on	
		inner diameter	outer diameter
a	< 10 mm	$\begin{smallmatrix} 0 \\ -0,6 \end{smallmatrix}$ mm	$\begin{smallmatrix} +0,6 \\ 0 \end{smallmatrix}$ mm
b	≥ 10 mm	$\begin{smallmatrix} 0 \\ -6 \end{smallmatrix}$ %	$\begin{smallmatrix} +6 \\ 0 \end{smallmatrix}$ %

The tolerance for length is as shown in [Table 8](#):

Table 8 — Code-letter of tolerance on length for extruded or moulded heavy-walled tube

Code-letter	Length	Tolerance
a	<500 mm	$\begin{smallmatrix} +10 \\ 0 \end{smallmatrix}$ mm
b	≥500 mm	$\begin{smallmatrix} +2 \\ 0 \end{smallmatrix}$ %

The tube shall be capable of being machined concentrically to the required nominal dimensions and the eccentricity of the bore shall not exceed 4,0 % of the nominal inside diameter.

NOTE The machining of the tube to the nominal dimensions with the inner and outer surfaces concentric is feasible if the maximum inner diameter, calculated by difference between the outer diameter and two times the minimum wall thickness, is within the specified tolerance.

For a moulded tube, the tolerance on the outer diameter shall be a minimum value. A larger diameter than is provided for by the plus tolerance is acceptable for moulded tube, either type P or S, that is to be machined to the final dimension.

4.3 Tensile strength and percentage elongation at break

The grade for semi-finished products is determined by the values of tensile strength and percentage elongation at break shown in [Table 9](#), determined as specified in ISO 13000-2.

Table 9 — Tensile strength and percentage elongation at break

Grade	1	2	3	4	5
Tensile strength MPa	≥25,0	20,0 to <25,0	15,0 to <20,0	10,0 to <15,0	<10,0
Elongation at break %	≥280	200 to <280	150 to <200	75 to <150	<75

4.4 Dimensional stability

This requirement applies only to type S (stabilized) material.

The maximum change in any dimension shall not exceed 0,5 %, determined as specified in ISO 13000-2.

4.5 Density

All semi-finished products shall have a density in the range of 2,13 g/cm³ to 2,19 g/cm³ except that:

- products made from reprocessed material or blends with reprocessed material shall have a density in the range of 2,14 g/cm³ to 2,23 g/cm³;

- b) tubing extruded from coagulated dispersion powders shall have a density in the range of 2,13 g/cm³ to 2,23 g/cm³.

4.6 Hardness

All products that have a shape or dimensions such that measurements can be made precisely shall have a ball indentation hardness of more than 23 MPa or the hardness determined using the Shore D test shall have a value greater than 54. Both of the hardness tests are described in ISO 13000-2.

4.7 Colour

PTFE that does not contain a colorant shall be white to transparent after sintering. Visual perception of whiteness is usually adequate to appraise this characteristic of semi-finished products. If a quantitative value is required for whiteness, the test procedure in ISO 13000-2 shall be used. The value required shall be as agreed upon between producer and purchaser. If pigment or colorant has been added, its presence shall be reported in all documentation related to a particular product.

4.8 Dielectric strength (DS)

4.8.1 General

This requirement applies only to materials coded E with specified electrical properties required for an application.

4.8.2 Skived tape, skived sheet or film

The values required for dielectric strength for each grade of skived tape, skived sheet or film are shown in [Table 10](#). The requirements are based on a test specimen in same thickness prepared from the skived tape, skived sheet and film. For thickness 1 mm and thicker of skived sheet, the requirements shall be based on a test specimen 1,0 mm ± 0,10 mm in thickness prepared from the skived sheet.

Table 10 — Dielectric strength of skived tape, skived sheet or film

Grade	DS kV/mm
E1	≥100,0
E2	80,0 to <100,0
E3	60,0 to <80,0
E4	40,0 to <60,0
E5	30,0 to <40,0
E6	20,0 to <30,0
E7	10,0 to <20,0
E8	<10,0

4.8.3 Moulded sheet

The values required for dielectric strength for each grade of moulded sheet are shown in [Table 11](#). The requirements are based on a test specimen 1,0 mm ± 0,10 mm in thickness prepared from the moulded sheet.

Table 11 — Dielectric strength of moulded sheet

Grade	DS kV/mm
E1	≥30,0
E2	20,0 to <30,0
E3	10,0 to < 20,0
E4	<10,0

4.8.4 Moulded basic shape

The values required for dielectric strength for each grade of a moulded basic shape are shown in [Table 12](#). The requirements are based on a test specimen 1,0 mm ± 0,10 mm in thickness prepared from the moulded basic shape.

Table 12 — Dielectric strength of moulded basic shape

Grade	DS kV/mm
E1	≥30,0
E2	20,0 to <30,0
E3	10,0 to <20,0
E4	<10,0

4.8.5 Extruded or moulded rod

The values required for dielectric strength (DS) for each grade of rod are shown in [Table 13](#). The requirements are based on a test specimen 1,0 mm ± 0,10 mm in thickness prepared from the rod.

Table 13 — Dielectric strength of extruded or moulded rod

Grade	DS kV/mm
E1	≥30,0
E2	20,0 to <30,0
E3	10,0 to <20,0
E4	<10,0

4.8.6 Tube extruded from coagulated dispersion powder

The values required for dielectric strength (DS) for each grade of tube extruded from coagulated dispersion powder are shown in [Table 14](#). The requirements are based on a test specimen in same thickness prepared from the tube. For thickness 1 mm and thicker of the tube, the requirements shall be based on a test specimen 1,0 mm ± 0,10 mm in thickness prepared from the tube.

Table 14 — Dielectric strength of tube extruded from coagulated dispersion powder

Grade	DS kV/mm
E1	≥50,0
E2	40,0 to <50,0
E3	30,0 to <40,0
E4	20,0 to <30,0
E5	10,0 to <20,0
E6	<10,0

4.8.7 Extruded or moulded heavy-walled tube

The values required for dielectric strength (DS) for each grade of heavy-walled tube are shown in [Table 15](#). The requirements are based on a test specimen 1,0 mm ± 0,10 mm in thickness prepared from the heavy-walled tube.

Table 15 — Dielectric strength of extruded or moulded heavy-walled tube

Grade	DS kV/mm
E1	≥30,0
E2	20,0 to <30,0
E3	10,0 to <20,0
E4	<10,0

4.9 Requirements that can be specified depending on the specific application

4.9.1 Tolerance on the surface finish and other requirements for the nature of the surface.

4.9.2 Tolerance on the straightness of rod or tube.

4.9.3 Tolerance on the parallelism or flatness, or both, of sheet.

4.9.4 Limits to the size and frequency of internal defects, voids or inclusions.

4.9.5 Colour of the product, determined by the procedure in ISO 13000-2.

4.9.6 Loss in mass at 300 °C, which shall be less than 0,5 %, determined by the procedure in ISO 13000-2.

4.9.7 Resistance to environmental stress cracking (ESC). For the rare occasions when testing for ESC is desired, general ISO tests for ESC of plastics are referenced in ISO 13000-2.

4.9.8 Use of reprocessed or recycled material can be restricted if necessary for a particular application.

5 Format for presenting a designation

5.1 General

A designation can be written in a one-line system as outlined below. The alphanumeric codes used are included in the order shown without use of separators except that a space can be used between the individual items of a designation.

5.2 Order of presenting codes

5.2.1 A code-letter for the semi-finished product selected from the list in [Table 8](#), with the code-letter for the dimension and dimensional tolerance from the appropriate part of [4.2](#).

Table 16 — Code-letters for the shape of the semi-finished product

F	Skived tape, skived sheet or, film
O	Other shapes
R	Extruded or moulded rod
S	Moulded sheet
T	Extruded or moulded heavy walled tube
W	Tube extruded from coagulated dispersion powder

5.2.2 A code-letter for the type: P for “as-processed” and S for “as stabilized”.

5.2.3 The code-number for the grade based on the minimum values of tensile strength and percentage elongation at break from [Table 1](#).

5.2.4 Codes for special requirements:

5.2.4.1 Dielectric strength: The code-letter E, with a number in accordance with [4.8](#), shows compliance with the requirements for dielectric strength of the particular semi-finished product. This requirement shall be used only when electrical properties are required for the application.

5.2.4.2 Other requirements: A code system for requirements listed in [4.9](#) can be agreed upon between purchaser and supplier.