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Plastics - Fluoropolymer dispersions and moulding and extrusion materials - Part 2:
Preparation of test specimens and determination of properties (ISO 12086-2:2006)

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Kunststoffe - Fluorpolymerdispersionen, Formmassen und Extrusionsmaterialien - Teil 2:
Herstellung von Probekörpern und Bestimmung von Eigenschaften (ISO 12086-2:2006)

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Plastiques - Polymeres fluorés: dispersions et matériaux pour moulage et extrusion -
Partie 2: Préparation des éprouvettes et détermination des propriétés (ISO 12086-
2:2006)

Ta slovenski standard je istoveten z: **EN ISO 12086-2:2006**

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English Version

Plastics - Fluoropolymer dispersions and moulding and extrusion materials - Part 2: Preparation of test specimens and determination of properties (ISO 12086-2:2006)

Plastiques - Polymères fluorés: dispersions et matériaux pour moulage et extrusion - Partie 2: Préparation des éprouvettes et détermination des propriétés (ISO 12086-2:2006)

Kunststoffe - Fluoropolymerdispersionen, Formmassen und Extrusionsmaterialien - Teil 2: Herstellung von Probekörpern und Bestimmung von Eigenschaften (ISO 12086-2:2006)

This European Standard was approved by CEN on 13 February 2006.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

EN ISO 12086-2:2006 (E)**Foreword**

This document (EN ISO 12086-2:2006) has been prepared by Technical Committee ISO/TC 61 "Plastics" in collaboration with Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by IBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2006, and conflicting national standards shall be withdrawn at the latest by August 2006.

This document supersedes EN ISO 12086-2:1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Endorsement notice

The text of ISO 12086-2:2006 has been approved by CEN as EN ISO 12086-2:2006 without any modifications.

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**Plastics — Fluoropolymer dispersions
and moulding and extrusion materials —**

**Part 2:
Preparation of test specimens
and determination of properties**

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*Plastiques — Polymères fluorés: dispersions et matériaux pour
moulage et extrusion*

Partie 2: Préparation des éprouvettes et détermination des propriétés

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Reference number
ISO 12086-2:2006(E)

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ISO 12086-2:2006(E)

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 12086-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

This second edition cancels and replaces the first edition (ISO 12086-2:1995), which has been technically revised.

ISO 12086 consists of the following parts, under the general title *Plastics — Fluoropolymer dispersions and moulding and extrusion materials*:

- *Part 1: Designation system and basis for specifications*
- *Part 2: Preparation of test specimens and determination of properties*

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Plastics — Fluoropolymer dispersions and moulding and extrusion materials —

Part 2: Preparation of test specimens and determination of properties

SAFETY STATEMENT — Persons using this document should be familiar with normal laboratory practice, if applicable. This document does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any regulatory requirements. The warnings in Subclauses 8.6.2.1, 9.7 and 10.6.1.4 point out specific hazards.

1 Scope

1.1 This part of ISO 12086 describes the preparation of test specimens and provides test methods to define characteristics of thermoplastic fluoropolymer resins. Results from the testing may be used as the basis for designation, material specifications or both. This part of ISO 12086 describes the conditions of test for determining both designatory and other properties of the homopolymers and various copolymers of fluoromonomers, as dispersions or powders for moulding, extrusion and other uses. The test procedures included are appropriate for, but are not restricted to, the fluoropolymers listed in Clause 4 and for which designatory properties are specified in ISO 12086-1.

1.2 The properties of semi-finished and finished products made from fluoropolymer resins depend on the material used, the shape of the product, the physical and morphological state of the material resulting from the processing operations, and on the test conditions. Therefore, to obtain reproducible test results, the defined methods of preparation of test specimens and defined test conditions given in this part of ISO 12086 must be applied.

1.3 Agreements between vendor and purchaser should preferably be based on properties measured using the specimens and test conditions described in this part of ISO 12086.

2 Normative references

The following referenced documents are indispensable for the application 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 75-2, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*

ISO 178, *Plastics — Determination of flexural properties*

ISO 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test*

ISO 180, *Plastics — Determination of Izod impact strength*

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 293, *Plastics — Compression moulding of test specimens of thermoplastic materials*

ISO 472, *Plastics — Vocabulary*

ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

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ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

ISO 527-3, *Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets*

ISO 565, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

ISO 976, *Rubber and plastics — Polymer dispersions and rubber latices — Determination of pH*

ISO 1043-1, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics*

ISO 1043-2, *Plastics — Symbols and abbreviated terms — Part 2: Fillers and reinforcing materials*

ISO 1133:2005, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics*

ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method*

ISO 1183-2, *Plastics — Methods for determining the density of non-cellular plastics — Part 2: Density gradient column method*

ISO 4589 (all parts), *Plastics — Determination of burning behaviour by oxygen index*

ISO 11357-2, *Plastics — Differential scanning calorimetry (DSC) — Part 2: Determination of glass transition temperature*

ISO 11357-3, *Plastics — Differential scanning calorimetry (DSC) — Determination of temperature and enthalpy of melting and crystallization*

ISO 12086-1, *Plastics — Fluoropolymer dispersions and moulding and extrusion materials — Part 1: Designation system and basis for specifications*

ISO 13320-1, *Particle size analysis — Laser diffraction methods — General principles*

IEC 60093, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*

IEC 60243-1, *Electrical strength of insulating materials — Test methods — Part 1: Tests at power frequencies*

IEC 60250, *Recommended methods for the determination of the permittivity and dielectric dissipation factor of electrical insulating materials at power, audio and radio frequencies including metre wavelengths*

ASTM D 746, *Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact*

ASTM D 1430, *Standard Classification System for Polychlorotrifluoroethylene (PCTFE) Plastics*

ASTM D 1894, *Standard Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheet*

ASTM D 3418, *Standard Test Method for Transition Temperatures of Polymers by Differential Scanning Calorimetry*

ASTM D 4052, *Standard Test method for Density and Relative Density of Liquids by Digital Density Meter*

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

ASTM D 4894, *Standard Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials*

ASTM D 4895, *Standard Specification for Polytetrafluoroethylene (PTFE) Resin Produced from Dispersion*

BS 4641:1986, *Method for specifying electroplated coatings of chromium for engineering purposes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472 and the following terms and definitions apply. The terms listed in 3.1 to 3.3 are repeated from ISO 472 to be sure there is no misunderstanding.

3.1

dispersion

heterogeneous system in which a finely divided material is distributed in another material

3.2

fluoroplastic

plastic based on polymers made with monomers containing one or more atoms of fluorine, or copolymers of such monomers with other monomers, the fluoromonomer being in the greatest amount by mass

3.3

latex

colloidal aqueous dispersion of a polymeric material

3.4

amorphous

noncrystalline, or devoid of regular structure

3.5

bulk density

mass (in grams) per litre of material, measured under the conditions of the test

3.6

copolymer

polymer formed from two or more types of monomer

3.7

emulsion polymer

<fluoropolymer materials> material isolated from its polymerization medium as a colloidal aqueous dispersion of the polymer solids

NOTE This definition, used in the fluoropolymer industry, is similar to that for “latex” in ISO 472 and is quite different from the definition for “emulsion” in ISO 472.

3.8

fluorocarbon plastic

plastic based on polymers made from perfluoromonomers only

3.9

fluoropolymer

synonymous with fluoroplastic (see 3.2)

3.10

melt-processible

capable of being processed by, for example, injection moulding, screw extrusion and other operations typically used with thermoplastics

3.11

preforming

compacting powdered PTFE material under pressure in a mould to produce a solid object, called a preform, that is capable of being handled

NOTE With PTFE, “moulding” and “compaction” are terms used interchangeably with “preforming”.

ISO 12086-2:2006(E)**3.12****sintering**

〈PTFE〉 thermal treatment during which the material is melted and recrystallized by cooling, with coalescence occurring during the treatment

3.13**standard specific gravity****SSG**

specific gravity of a specimen of PTFE material preformed, sintered and cooled through the crystallization point at a rate of 1 °C per minute in accordance with the appropriate sintering schedule as described in this part of ISO 12086

NOTE The SSG of unmodified PTFE is inversely related to its molecular mass.

3.14**suspension polymer**

polymer isolated from its liquid polymerization medium as a solid having a particle size well above colloidal dimensions

3.15**zero-strength time****ZST**

measure of the relative molecular mass of PCTFE

4 Abbreviated terms and symbols

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4.1 The abbreviated terms given in ISO 1043-1 and ISO 1043-2 are applicable to this part of ISO 12086.

4.2 This part of ISO 12086 is particularly concerned with, but is not limited to, test methods for the materials listed below:

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ECTFE	ethylene-chlorotrifluoroethylene copolymer
EFEP	ethylene-tetrafluoroethylene-hexafluoropropene copolymer
ETFE	ethylene-tetrafluoroethylene copolymer
FEP	perfluoro(ethylene-propene) copolymer
PCTFE	polychlorotrifluoroethylene
PFA	perfluoro(alkoxy alkane)
PTFE	polytetrafluoroethylene
PVDF	poly(vinylidene fluoride)
PVF	poly(vinyl fluoride)
TFE/PDD	tetrafluoroethylene-perfluorodioxole copolymer
VDF/CTFE	vinylidene fluoride-chlorotrifluoroethylene copolymer
VDF/HFP	vinylidene fluoride-hexafluoropropene copolymer
VDF/TFE	vinylidene fluoride-tetrafluoroethylene copolymer
VDF/TFE/HFP	vinylidene fluoride-tetrafluoroethylene-hexafluoropropene copolymer

4.3 For the purposes of this part of ISO 12086, the following additional abbreviated terms apply.

AF	amorphous fluoropolymer
ESG	extended specific gravity (see 10.6)
MFR	melt mass-flow rate (see 11.2)
MVR	melt volume-flow rate (see 11.2)
SSG	standard specific gravity (see 10.6)
SVI	stretching-void index (see 10.7)
TII	thermal-instability index (see 10.6)
ZST	zero-strength time (see 12.3)

5 Sampling

Sampling shall be statistically adequate to satisfy the requirements of this part of ISO 12086.

6 Preparation of test specimens

Where applicable, ISO standards shall be followed for the preparation of test specimens. In some instances, special procedures are required that are described either in the general discussion or in the method.

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7 Conditioning and test conditions

7.1 For determinations of specific gravity, tensile properties and electrical properties, condition the moulded test specimens in atmosphere 23 of ISO 291 for a period of at least 4 h prior to testing. The other determinations require no conditioning.

NOTE For PVDF, some producers recommend waiting one week after moulding before testing in order to minimize the effects of post-crystallization.

7.2 Conduct tests at a laboratory temperature of $23\text{ °C} \pm 2\text{ °C}$ for determining specific gravity, tensile properties and electrical properties only. (See the Note for comments related to PTFE.) Since the fluoropolymer resins do not absorb water, the maintenance of constant humidity during testing is not necessary. Conduct tests for melt flow rate and melting-peak temperature under ordinary laboratory conditions.

NOTE A minimum temperature of 22 °C should preferably be maintained with PTFE due to its first-order transition just below 22 °C that affects properties determined at slightly lower temperatures. This effect of temperature is especially important during the determination of density/specific gravity.

8 General testing of fluoropolymers

Properties required for designation or specification, or both, shall be determined in accordance with the international or national standards listed in Clause 2 or the procedures given in this part of ISO 12086.

Tables of values of the designatory properties and corresponding codes are included in ISO 12086-1.

Tables of values and codes are also included in this part of ISO 12086 for many of the other properties that are needed to supplement the designatory properties for specification and other purposes.

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8.1 Electrical properties

8.1.1 Dielectric constant and dissipation factor

Determine these properties on three specimens, each 100 mm in diameter, in accordance with IEC 60250.

Typical frequencies used for testing are 100 Hz, 1 kHz, 1 MHz and 100 MHz. For some applications, it is important to know the values at subambient and elevated temperatures. Codes for test frequencies and values of the properties are given in Tables 1 and 2.

NOTE Electrical properties, like many other properties, vary with temperature.

Table 1 — Codes for test frequencies

Code	Test frequency
2	100 Hz
3	1 kHz
6	1 MHz
8	100 MHz

Table 2 — Codes and ranges for dielectric constant and dissipation factor

Code	Dielectric constant	Code	Dissipation factor
A	< 1,6	A	< 0,000 1
B	1,6 to < 1,8	B	0,000 1 to < 0,000 2
C	1,8 to < 2,0	C	0,000 2 to < 0,000 4
D	2,0 to < 2,2	D	0,000 4 to < 0,000 6
E	2,2 to < 2,4	E	0,000 6 to < 0,000 8
F	2,4 to < 2,6	F	0,000 8 to < 0,001 0
G	2,6 to < 2,8	G	0,001 0 to < 0,001 2
H	2,8 to < 3,0	H	0,001 2 to < 0,001 4
I	3,0 to < 3,2	I	0,001 4 to < 0,001 6
J	3,2 to < 3,4	J	0,001 6 to < 0,001 8
K	3,4 to < 3,6	K	0,001 8 to < 0,002 0
L	3,6 to < 4,0	L	0,002 0 to < 0,002 2
M	4,0 to < 4,5	M	0,002 2 to < 0,002 4
N	4,5 to < 5,0	N	0,002 4 to < 0,002 6
O	5,0 to < 5,5	O	0,002 6 to < 0,002 8
P	5,5 to < 6,0	P	0,002 8 to < 0,003 0
R	6,0 to < 6,5	Q	0,003 0 to < 0,003 5
S	6,5 to < 7,0	R	0,003 5 to < 0,004 0
T	7,0 to < 8,0	S	0,004 0 to < 0,006 0
U	8,0 to < 9,0	T	0,006 0 to < 0,008 0
V	9,0 to < 10,0	U	0,008 0 to < 0,010
W	10,0 to < 11,0	W	0,010 to < 0,030
X	11,0 to < 12,0	X	0,030 to < 0,10
Y	12,0 to < 14,0	Y	≤ 0,1
Z	≥ 14,0		

8.1.2 Dielectric strength (electric strength)

Determine this property in accordance with the procedures of IEC 60243-1. Codes for values of the property are given in Table 3.

NOTE Dielectric strength, which is expressed in kilovolts per millimetre, varies with the thickness of the test specimen.

Table 3 — Codes and ranges for dielectric strength

Code	Dielectric strength (kV/mm)
A	< 5
B	5 to < 10
C	10 to < 15
D	15 to < 20
E	20 to < 25
F	25 to < 30
G	30 to < 35
H	35 to < 40
I	40 to < 45
J	45 to < 50
K	50 to < 55
L	55 to < 60
M	60 to < 65
N	65 to < 70
O	70 to < 75
P	75 to < 80
Q	80 to < 85
R	85 to < 90
S	90 to < 95
T	95 to < 100
U	≥ 100

8.1.3 Surface resistivity

Determine this property in accordance with IEC 60093.

Codes and ranges are listed in Table 4.

Table 4 — Codes and ranges for surface resistivity

Code	Surface resistivity (Ω)
A	< 10^3
B	10^3 to 10^{12}
C	> 10^{12}