INTERNATIONAL STANDARD

ISO 21304-1

First edition
2019-03

Plastics — Ultra-high-molecular-weight polyethylene (PE-UHMW) moulding and extrusion materials —

Part 1: Designation system and basis for specifications

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Plastiques — Matériaux à base de polyéthylène à très haute masse moléculaire (PE-UHMW) pour moulage et extrusion —

Partie 1: Système de désignation et base de spécifications

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https://standards.iteh.ai/catalog/standards/sist/1e1ad844-5252-4e0b-a69b-7883bba537f1/iso-21304-1-2019

Reference number
ISO 21304-1:2019(E)

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Published in Switzerland

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Foreword

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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.

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This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

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This first edition of ISO 21304-1 cancels and replaces ISO 11542-1:2001, which has been technically revised to introduce a new designation system.

The revised designation system is published under a new ISO number, as many existing documents refer to ISO 11542-1. If the existing ISO 11542-1 would be replaced by the new designation system, these documents would refer to the incorrect designation system.

The new designation system according to ISO 21304-1 is intended to replace gradually any designation system according to ISO 11542-1.

During this period, ISO 11542-2 will effectively be Part 2 of this document.

A list of all parts in the ISO 21304 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.

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Plastics — Ultra-high-molecular-weight polyethylene (PE-UHMW) moulding and extrusion materials —

Part 1:
Designation system and basis for specifications

1 Scope

This document establishes a system of designation for thermoplastic PE-UHMW materials, which can be used as the basis for specifications.

For the purposes of this document, PE-UHMW materials are polyethylene materials having a melt mass-flow rate (MFR) of less than 0,1 g/10 min, measured at 190 °C and 21,6 kg load.

NOTE It has been confirmed that the melt volume-flow rate (MVR) is useful for characterizing some PE-UHMW materials (e.g. pipe materials) under the test condition of 230 °C/21,6 kg and bore diameter of die with 3,628 mm (see ISO 21304-2).

The types of PE-UHMW are differentiated from each other by a classification system based on appropriate levels of the designatory properties:

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a) viscosity number;

b) elongational stress;

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c) Charpy double-notched impact strength;

and on information about the intended application and/or method of processing, important properties, additives, colorants, fillers and reinforcing materials.

This designation system is applicable to all PE-UHMW homopolymers and to ultra-high-molecular-weight copolymers of ethylene having a content of other 1-olefinic monomers of less than 50 % by mass and a content of non-olefinic monomers with functional groups up to a maximum of 3 % by mass. It applies to materials ready for normal use in the form of powder, granules or pellets, unmodified or modified by colorants, fillers and other additives.

It is not intended to imply that materials having the same designation give necessarily the same performance. This document does not provide engineering data, performance data or data on processing conditions which can be required to specify a material. If such additional properties are required, they are intended to be determined in accordance with the test methods specified in ISO 21304-2, if suitable.

In order to specify a thermoplastic PE-UHMW material to meet particular specifications, the requirements are to be given in data block 5 (see 4.1).

2 Normative references

The following documents are referred to in the text in such a way 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 1043-1, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics*

ISO 1628-3, *Plastics — Determination of viscosity number and limiting viscosity number — Part 3: Polyethylenes and polypropylenes*

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ISO 5834-1, *Implants for surgery — Ultra-high molecular weight polyethylene — Part 1: Powder form*

ISO 21304-2[1], *Plastics — Ultra-high-molecular-weight polyethylene (PE-UHMW) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties*

3 Terms and definitions

No terms and definitions are listed in this document.

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/

4 Designation system

4.1 General

The designation system for thermoplastics is based on the following standardized pattern:

<table>
<tr><td colspan="7">Designation</td></tr>
<tr><td rowspan="3">Description block (optional)</td><td colspan="6">Identity block</td></tr>
<tr><td rowspan="2">International Standard number block</td><td colspan="5">Individual-item block</td></tr>
<tr><td>Data block 1</td><td>Data block 2</td><td>Data block 3</td><td>Data block 4</td><td>Data block 5</td></tr>
</table>

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The designation consists of an optional description block, reading "Thermoplastics", and an identity block comprising the International Standard number and an individual-item block. For unambiguous coding, the individual-item block is subdivided into five data blocks comprising the following information:

— Data block 1: Identification of the plastic by its symbol PE-UHMW, it shall be in accordance with ISO 1043-1 (see 4.2).

— Data block 2: Fillers or reinforcing materials and their nominal content (see 4.3).

— Data block 3: Position 1: Intended application or method of processing (see 4.4).

Positions 2 to 8: Important properties, additives and supplementary information (see 4.4).

— Data block 4: Designatory properties (see 4.5).

— Data block 5: For the purpose of specifications, a fifth data block contains appropriate information (see 4.6).

The first character of the individual item block shall be a hyphen. The five data blocks shall be separated from each other by commas. If a data block is not used, this shall be indicated by doubling the separation sign, i.e. by two commas (,,).

4.2 Data block 1

In this data block, after the hyphen, PE-UHMW plastics are identified by the symbol "PE-UHMW", in accordance with ISO 1043-1.

1) Under preparation. Stage at the time of publication: ISO/FDIS 21304-2:2019.

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4.3 Data block 2

In this data block, the type of filler and/or reinforcing material is represented by a single code-letter in position 1, and the form is represented by a second code-letter in position 2, the code-letters being as specified in Table 1. Subsequently (without a space), the mass content can be given by a two-figure number in positions 3 and 4.

Table 1 — Code-letters for fillers and reinforcing materials in data block 2

Code-letter	Material	Code-letter	Form
B	Boron	B	Beads, spheres, balls
C	Carbon[a]		
		D	Powder
		F	Fibre
G	Glass	G	Ground
		H	Whiskers
K	Calcium carbonate		
M	Mineral[a,b], metal[a]		
S	Synthetic organic[a]	S	Scales, flakes
T	Talc		
X	Not specified	X	Not specified
Z	Others[a]	Z	Others[a]

[a] These materials can be further defined by their chemical symbol, for example, or additional symbols defined in the relevant International Standard. In the case of metals (M), it is essential to indicate the type of metal by means of its chemical symbol.

[b] Mineral fillers should be designated more precisely if a symbol is available.

Mixtures of minerals and/or forms shall be indicated by combining the relevant codes using the sign "+" and placing the whole between parentheses. For example, a mixture of 25 % glass fibres (GF) and 10 % mineral powder (MD) would be indicated by (GF25+MD10).

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4.4 Data block 3

In this data block, information about intended application and/or method of processing is given in position 1 and information about important properties, additives and colour in positions 2 to 8. The code-letters used are specified in Table 2.

If information is presented in positions 2 to 8 and no specific information is given in position 1, the letter X shall be inserted in position 1.

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Table 2 — Code-letters used in data block 3

Code-letter	Position 1	Code-letter	Positions 2 to 8
		A	Processing stabilized
		C	Coloured
		D	Powder
E	Extrusion of pipes, profiles and sheets	E	Expandable
F	Extrusion of films	F	Special burning characteristics
G	General use	G	Granules
		H	Heat aging stabilized
		K	Metal deactivated
		L	Light or weather stabilized
M	Injection moulding		
		N	Natural (no colour added)
Q	Compression moulding		
		R	Mould release agent
S	Sintering	S	Lubricated
X	No indication	X	No indication
Y	Textile yarns, spinning	Y	Increased electrical conductivity
		Z	Antistatic

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4.5 Data block 4

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4.5.1 General

In this data block, the range of the viscosity number is represented by a single-figure code-number (see 4.5.2), the elongational stress by a single-figure code-number (see 4.5.3), and the Charpy double-notched impact strength by a single-figure code-number (see 4.5.4). The code-numbers are separated from each other by hyphens.

If a property value falls on or near a range limit, the manufacturer shall state which range will designate the material. If subsequent individual test values lie on, or either side of, the limit because of manufacturing tolerances, the designation is not affected.

NOTE Not all combinations of the values of the designatory properties are provided by currently available polymers.

4.5.2 Viscosity number

The viscosity number shall be determined in accordance with ISO 1628-3, using a nitrogen atmosphere.

The possible values of viscosity number are divided into seven ranges, each represented by a single-figure code-number, as specified in Table 3. Only materials with code-numbers 2 to 6 in Table 3 shall be used if the abrasion resistance of the material is important to the application.

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Table 3 — Ranges of viscosity number in data block 4

Code-number	Range of viscosity number mL/g
0	≤1 200
1	>1 200 but ≤1 710
2	>1 710 but ≤2 190
3	>2 190 but ≤2 700
4	>2 700 but ≤3 400
5	>3 400 but ≤4 100
6	>4 100

4.5.3 Elongational stress

The elongational stress shall be determined in accordance with Annex B of ISO 21304-2.

The possible values of the elongational stress are divided into six ranges, each represented by a single-figure code-number as specified in Table 4.

Table 4 — Ranges of elongational stress in data block 4

Code-number	Range of elongational stress MPa
0	≤0,10
1	>0,10 but ≤0,20
2	>0,20 but ≤0,30
3	>0,30 but ≤0,50
5	>0,50 but ≤0,70
7	>0,70

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4.5.4 Charpy double-notched impact strength

The Charpy double-notched impact strength shall be determined in accordance with ISO 21304-2:—, Annex C.

The possible values of the Charpy double-notched impact strength are divided into five ranges, each represented by a single-figure code-number as specified in Table 5.

Table 5 — Ranges of Charpy double-notched impact strength in data block 4

Code-number	Range of Charpy double-notched impact strength kJ/m^2
0	≤40
1	>40 but ≤80
2	>80 but ≤120
3	>120 but ≤170
4	>170

4.6 Data block 5

Indication of additional requirements in this optional data block is a way of transforming the designation of a material into a specification for a particular application. This shall be done for example by reference to a suitable national standard or to a standard-like, generally established specification.

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