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

**Part 1:  
Designation system and basis  
for specifications**

*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*



Reference number  
ISO 11542-1:2001(E)

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Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.ch](mailto:copyright@iso.ch)  
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Printed in Switzerland



## 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 3.

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 part of ISO 11542 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11542-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

This second edition cancels and replaces the first edition (ISO 11542-1:1994), which has been technically revised. The major change is that density has been replaced by Charpy notched impact strength as one of the designatory properties.

ISO 11542 consists of the following parts, under the general title *Plastics — Ultra-high-molecular-weight polyethylene (PE-UHMW) moulding and extrusion materials*:

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



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

## Part 1: Designation system and basis for specifications

### 1 Scope

1.1 This part of ISO 11542 establishes a system of designation for PE-UHMW thermoplastic materials which may be used as the basis for specifications.

For the purposes of this part of ISO 11542, PE-UHMW materials are polyethylene materials having a melt mass-flow rate (MFR), measured at 190 °C and 21,6 kg load, of less than 0,1 g/10 min.

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

- a) viscosity number
- b) elongational stress
- c) Charpy notched impact strength

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

1.3 This part of ISO 11542 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 and to materials unmodified or modified by colorants, additives, fillers, etc.

1.4 It is not intended to imply that materials having the same designation give necessarily the same performance. This part of ISO 11542 does not provide engineering data, performance data or data on processing conditions which may be required to specify a material for a particular application and/or method of processing.

If such additional properties are required, they shall be determined in accordance with the test methods specified in part 2 of this International Standard, if suitable.

1.5 In order to specify a thermoplastic material for a particular application or to ensure reproducible processing, additional requirements may be given in data block 5 (see 3.1).

### 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 11542. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 11542 are encouraged to investigate the

possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 1043-1:—<sup>1)</sup>, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics.*

ISO 1628-3:1991, *Plastics — Determination of viscosity number and limiting viscosity number — Part 3: Polyethylenes and polypropylenes.*

ISO 5834-1:1998, *Implants for surgery — Ultra-high molecular weight polyethylene — Part 1: Powder form.*

ISO 11542-2:1998, *Plastics — Ultra-high-molecular-weight polyethylene (PE-UHMW) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties.*

### 3 Designation system

#### 3.1 General

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

| Designation                     |  |                       |                    |                    |                    |                    |
|---------------------------------|--|-----------------------|--------------------|--------------------|--------------------|--------------------|
| Description block<br>(optional) | Identity block                               |                       |                    |                    |                    |                    |
|                                 | International<br>Standard<br>number<br>block | Individual-item block |                    |                    |                    |                    |
|                                 |  | Data<br>block<br>1    | Data<br>block<br>2 | Data<br>block<br>3 | Data<br>block<br>4 | Data<br>block<br>5 |

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 in accordance with ISO 1043-1 (see 3.2).
- Data block 2: Position 1: Intended application or method of processing (see 3.3).  
Positions 2 to 8: Important properties, additives and supplementary information (see 3.3).
- Data block 3: Designatory properties (see 3.4).
- Data block 4: Fillers or reinforcing materials and their nominal content (see 3.5).
- Data block 5: For the purpose of specifications, a fifth data block may be added containing additional information (see 3.6).

The first character of the individual-item block shall be a hyphen. The 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 (,,).

1) To be published. (Revision of ISO 1043-1:1997)

### 3.2 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.

### 3.3 Data block 2

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 1.

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.

**Table 1 — Code-letters used in data block 2**

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

### 3.4 Data block 3

#### 3.4.1 General

In this data block, the range of the viscosity number is represented by a single-figure code-number (see 3.4.2), the elongational stress by a single-figure code-number (see 3.4.3), and the Charpy notched impact strength by a single-figure code-number (see 3.4.4). 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 may be possible for currently available polymers.

### 3.4.2 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 six ranges, each represented by a single-figure code-number, as specified in Table 2. Only materials with code-numbers 1 to 5 in Table 2 shall be used if the abrasion resistance of the material is important to the application.

**Table 2 — Ranges of viscosity number in data block 3**

| Code-number | Range of viscosity number    |
|-------------|------------------------------|
| 0           | $\leq 1\,710$                |
| 1           | $> 1\,710$ but $\leq 2\,190$ |
| 2           | $> 2\,190$ but $\leq 2\,700$ |
| 3           | $> 2\,700$ but $\leq 3\,400$ |
| 4           | $> 3\,400$ but $\leq 4\,100$ |
| 5           | $> 4\,100$                   |

### 3.4.3 Elongational stress

The elongational stress shall be determined in accordance with annex A of ISO 11542-2:1998.

The possible values of the elongational stress are divided into five ranges, each represented by a single-figure code-number as specified in Table 3.

**Table 3 — Ranges of elongational stress in data block 3**

| Code-number | Range of elongational stress<br>MPa |
|-------------|-------------------------------------|
| 0           | $\leq 0,1$                          |
| 1           | $> 0,1$ but $\leq 0,2$              |
| 2           | $> 0,2$ but $\leq 0,3$              |
| 5           | $> 0,3$ but $\leq 0,7$              |
| 7           | $> 0,7$                             |



### 3.4.4 Charpy notched impact strength

The Charpy notched impact strength shall be determined in accordance with annex B of ISO 11542-2:1998.

The possible values of the notched impact strength are divided into three ranges, each represented by a single-figure code-number as specified in Table 4.

**Table 4 — Ranges of Charpy notched impact strength in data block 3**

| Code-number | Range of notched impact strength |
|-------------|----------------------------------|
|             | kJ/m <sup>2</sup>                |
| <b>0</b>    | ≤ 40                             |
| <b>1</b>    | > 40 but ≤ 170                   |
| <b>2</b>    | > 170                            |

### 3.5 Data block 4

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 5. Subsequently (without a space), the mass content may be given by a two-figure number in positions 3 and 4.

**Table 5 — Code-letters for fillers and reinforcing materials in data block 4**

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

<sup>a</sup> These materials may 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.

<sup>b</sup> 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).

**3.6 Data block 5**

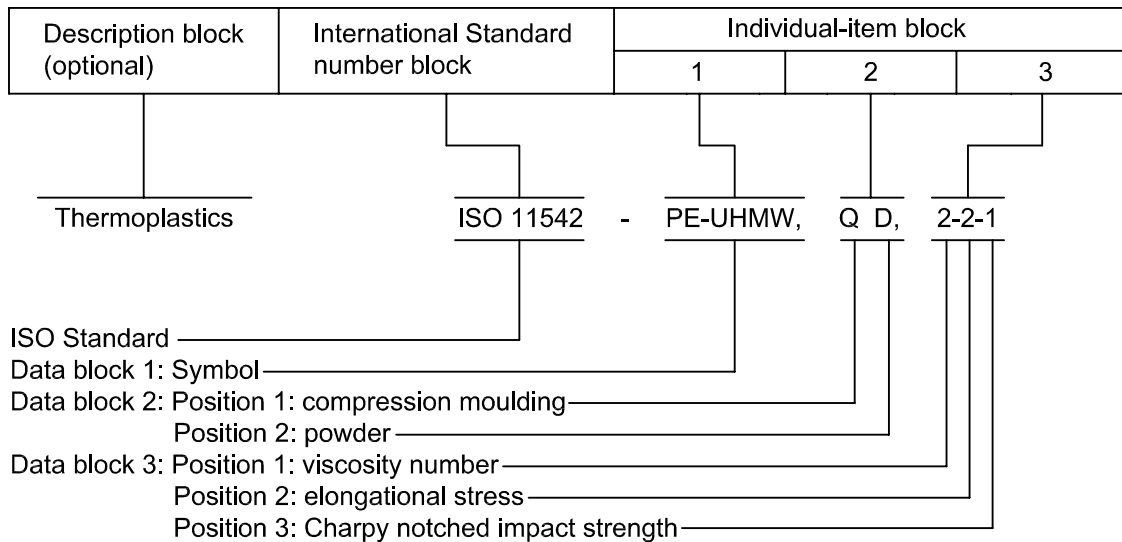
Indication of additional requirements in this optional data block is a way of transforming the designation of a material into a specification for a particular application. This shall be done for example by reference to a suitable national standard or to a standard-like, generally established specification.

Only material with code-numbers 1 to 5 in Table 2 shall be used if the abrasion resistance of the material is important to the application.

**4 Examples of designations**

**4.1 Designation only**

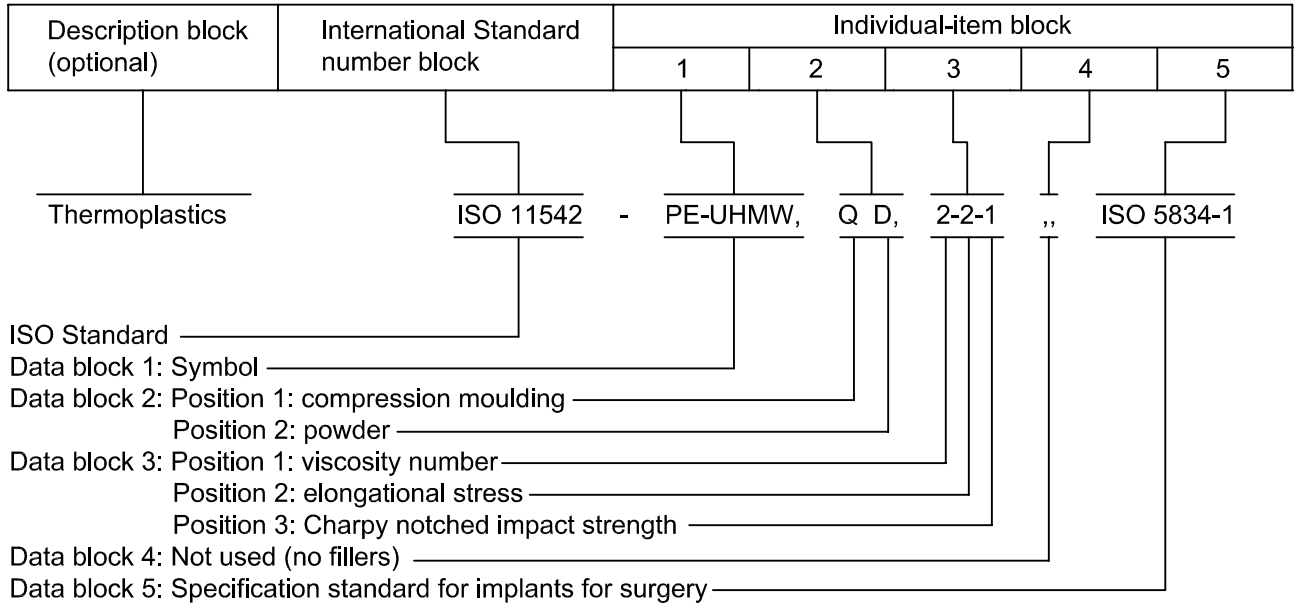
An ultra-high-molecular-weight polyethylene (PE-UHMW) thermoplastic material, intended for compression moulding (Q), in the form of powder (D), with a viscosity number of 2400 ml/g (2), an elongational stress of 0,25 MPa (2) and a Charpy notched impact strength of 150 kJ/m<sup>2</sup> (1), would be designated:



**Designation:** ISO 11542-PE-UHMW,QD,2-2-1

### 4.2 Designation transformed into a specification

An ultra-high-molecular-weight polyethylene (PE-UHMW) thermoplastic material, intended for compression moulding (Q), in the form of a powder (D), with a viscosity number of 2 400 ml/g (2), an elongational stress of 0,25 MPa (2), and a Charpy notched impact strength of 150 kJ/m<sup>2</sup> (1), and intended for implants for surgery (ISO 5834-1), would be designated:



**Designation:** ISO 11542-PE-UHMW,QD,2-2-1,,ISO 5834-1

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**ICS 83.080.20**

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