

International Standard



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Plastics — Polypropylene and propylene-copolymer thermoplastics — Part 1 : Designation

Plastiques — Thermoplastiques à base de polypropylène et de copolymères de propylène — Partie 1 : Désignation

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 1873/1 was developed by Technical Committee ISO/TC 61, *Plastics*, and was circulated to the member bodies in January 1979.

It has been approved by the member bodies of the following countries :

Belgium	Israel	South Africa, Rep. of
Bulgaria	Italy	Spain
China	Japan	Switzerland
Czechoslovakia	Korea, Rep. of	Turkey
Egypt, Arab Rep. of	Libyan Arab Jamahiriya	United Kingdom
France	Netherlands	USA
Germany, F. R.	New Zealand	USSR
Hungary	Poland	
India	Romania	

The member body of the following country expressed disapproval of the document on technical grounds :

Sweden

The annex to this International Standard cancels and replaces Recommendation ISO/R 922-1969 of which it constitutes a technical revision.

Plastics — Polypropylene and propylene-copolymer thermoplastics — Part 1 : Designation

1 Scope and field of application

1.1 This International Standard establishes a designation system for propylene thermoplastics. The types of propylene plastics are differentiated from each other by a designation system based on main polymer types, basic polymer parameters, relevant modifications, and recommended end-uses.

1.2 The designation is applicable to all propylene homopolymers and to copolymers of propylene containing at least 50 % (m/m) of propylene. It applies to compositions thereof, in the form of powder, granules or pellets, and to propylene plastics unmodified and modified by colorants, additives, fillers etc.

1.3 This International Standard does not provide engineering data or performance data which may be required to specify materials for particular end-use applications and processes.

It is not intended to imply that materials having the same designation give the same performance.

2 Reference

ISO 1133, *Thermoplastics — Determination of melt flow rate*.¹⁾

ISO 1873/2,

3 Designation system

Propylene thermoplastics are designated by the letters PP, followed, in the order given, by :

- a) a letter indicating the plastic composition type (see 3.1);
- b) a letter indicating the major recommended end-use (see 3.2);

c) two figures indicating the nominal isotactic index (see 3.3);

d) three figures denoting the nominal melt flow rate (see 3.4);

e) the letters "Nat", if the material is unmodified, or "Mod", if the material is modified (see 3.5).

3.1 Plastic composition types

The propylene plastics defined in 1.2 are divided into four main types. The supplier shall declare the appropriate type for his material.

3.1.1 Type H

This type covers all propylene homopolymers.

3.1.2 Type C

This type covers all thermoplastic propylene block copolymers having not more than 50 % (m/m) of another monomer or monomers copolymerised with propylene, and their blends with elastomeric and/or other 1-olefinic polymers in which the total polymer fraction consists of at least 50 % (m/m) of propylene.

3.1.3 Type R

This type covers all thermoplastic propylene random copolymers having not more than 50 % (m/m) of another monomer or monomers copolymerised with propylene, and their blends with elastomeric and/or other 1-olefinic polymers in which the total polymer fraction consists of at least 50 % (m/m) of propylene.

3.1.4 Type M

This type covers all propylene plastic compositions consisting of mixtures of types H, C and R.

1) At present at the stage of draft.

3.2 Major recommended end-use

The major end-use intended or recommended for the material is identified by a letter according to the following list :

- B = Blow moulding
- C = Extrusion coating
- E = General extrusion
- F = Film extrusion
- K = Cable coating
- L = Monofilaments manufacture
- M = Injection moulding
- P = Pipe extrusion
- R = Rotational moulding and other typical powder processing
- S = Foam manufacture
- T = Textile yarns
- Y = Tape manufacture

3.3 Isotactic index (II)

Isotactic index is defined as the percentage by mass of types H, C or R propylene plastics which is not soluble in boiling *n*-heptane, as determined under the conditions specified in 5.1.

The isotactic index is indicated by two figures denoting the mean value of the cells as shown in table 1. The supplier shall declare the nominal isotactic index for his material and it shall always refer to the base polymer.

For type M propylene plastics, the code 00 shall be used.

Table 1 — Isotactic index and cell range

Isotactic index	Cell range
95	> 90 to 100
85	> 80 to 90
75	> 70 to 80
65	> 60 to 70
55	> 50 to 60

3.4 Melt flow rate (MFR)

For the purposes of this designation, the nominal melt flow rate shall be determined under the conditions specified in 5.2 [MFR at 230 °C and 21,2 N (2,16 kgf) load]. The melt flow rate is classified by ten cells, as shown in table 2, each cell being designated by three figures. If the above conditions for melt flow rate cannot be used, then the conditions used shall be specified in brackets after the cell designation (see 5.2).

Table 2 — Melt flow rate and cell designation

Nominal melt flow rate, g/10 min	Cell designation
0,10 to 0,25	002
> 0,25 to 0,50	004
> 0,50 to 1,0	007
> 1 to 2	015
> 2 to 4	030
> 4 to 8	060
> 8 to 16	120
> 16 to 32	240
> 32 to 64	480
> 64 to 100	820

3.5 Modifications

Pure propylene plastics are identified by the letters "Nat". The only additives present are those required to protect the polymer during normal processing and/or normal end-use.

Modified propylene plastics are identified by the letters "Mod". This means that the product contains special additives, fillers, colorants or other materials (see 3.1.4). Information about the functional uses of additives, or the actual colour, may be stated in full (see clause 4).

4 Coding examples

4.1 A natural propylene homopolymer (PP) (type H), intended for film extrusion (F), of isotactic index 94 % (95), nominal melt flow rate 3,4 g/10 min (030), and without special modifications, would be coded :

PP-HF-95-030 Nat.

4.2 The same propylene homopolymer specified in 4.1, but intended for injection moulding (M), and stabilized against high-temperature ageing (Mod), would be coded :

PP-HM-95-030 Mod (heat-resistant).

4.3 A natural block copolymer (type C), intended for general-purpose sheets (E), of isotactic index 88 % (85), nominal melt flow rate 0,8 g/10 min (007), and without special modification, would be coded :

PP-CE-85-007 Nat.

4.4 A 40 % (m/m) talc-filled homopolymer (type H), intended for injection moulding (M), based on a polymer of isotactic index 92 % (95), and having a nominal melt flow rate of 3,5 g/10 min (030), would be coded :

PP-HM-95-030 Mod (40 % talc-filled).

4.5 A random copolymer (type R), intended for film (F), of isotactic index 84 % (85), nominal melt flow rate 10 g/10 min (120), and coloured white (Mod), would be coded :

PP-RF-85-120 Mod (white).

4.6 A mixed propylene plastic composition (type M) in which the polymer fraction consists of 65 % (*m/m*) of propylene, filled with 60 % (*m/m*) calcium carbonate (Mod), intended for injection moulding (M), and having a nominal melt flow rate of 2 g/10 min (015), would be coded :

PP-MM-00-015 Mod (60 % calcium carbonate filled).

5 Methods of test

5.1 Determination of isotactic index

See the annex.

5.2 Melt flow rate (MFR)

5.2.1 The melt flow rate shall be measured by the general procedure specified in ISO 1133, using a temperature of 230 °C and a load of 21,2 N (2,16 kgf), provided that the melt extrudate output falls within the range 0,1 to 100 g extruded in 10 min.

For material having a melt flow rate outside this range when

tested at 230 °C and with a load of 21,2 N (2,16 kgf), alternative conditions may be chosen from ISO 1133, provided the temperature and load are stated.

For example, the code MFR 190/5 shall be added in brackets when the conditions are 190 °C and 49 N (5 kgf) load.

5.2.2 All commercial grades of propylene thermoplastics are usually stabilized against degradation caused by melt processing similar to MFR conditions.

In the case of unstabilized propylene plastics in powder form, and in case of dispute or doubt, as for unknown samples, any thermal degradation during MFR testing can be avoided by the following procedure.

Prepare a 1 % (*m/m*) solution of anti-oxidant 2,6-di-*tert*-butyl-*p*-cresol (BHT) in pure acetone.

Add *n* ml of this solution to 2*n* g of the propylene plastic sample in a glass dish.

Gently stir the mixture and allow it to evaporate for 10 min at room temperature or on a warm water bath.

The sample is then ready for MFR testing.

5.3 Other properties

The preparation of specimens and the exact conditions for determining other properties will form the subject of ISO 1873/2.

Annex

Determination of isotactic index

A.1 Introduction

A.1.1 This annex specifies a method for determining the percentage of matter which can be extracted from crystalline propylene plastics by boiling *n*-heptane under standard conditions of testing.

A.1.2 This method provides for the identification and coding of types H, C and R propylene plastics referred to in 3.1 of this International Standard.

A.1.3 This method is not applicable to the testing of type M propylene plastics because it is intended and is suitable only for base polymers and not for mixtures such as those covered by type M.

A.1.4 This method starts with solid propylene plastics in the form of particles of specified fineness.

A.2 Apparatus

A.2.1 Extractor, of the type shown in the figure, or any other type giving the same results. This extractor shall be suitable for use at the boiling point of *n*-heptane.

A.2.2 Glass fibre or paper cartridges (thimbles), of diameter 30 ± 3 mm and length 100 ± 10 mm.

A.2.3 Drying ovens, capable of being maintained at temperatures of 70 ± 2 °C and 140 ± 2 °C respectively, both of them provided with vacuum lines of less than 250 mbar.

A.2.4 Balance, accurate to the nearest 0,000 1 g.

A.2.5 Grinding mill or equivalent machine.

A.2.6 Sieve, of mesh size not greater than 1 mm. A mesh size of $0,5 \pm 0,1$ mm is recommended.

A.3 Procedure

A.3.1 Preparation of sample

A.3.1.1 Reduce the propylene plastic solid matter to particles fine enough to pass through the sieve (A.2.6). For powder, flakes, fibres or films, grinding and screening are unnecessary if at least one dimension is less than 0,6 mm. Films shall be cut into small fragments or changed to a crushable form by melting to the shape of ribbons or small plaques.

A.3.1.2 Grind the sample as follows.

Mix at least 10 g of the sample with solid carbon dioxide or liquid nitrogen in excess, place in the grinding mill and crush until reduced to small particles.

After screening, collect the matter which passes through the sieve (A.2.6) and allow to stand at room temperature until it is tested.

A.3.2 Determination

A.3.2.1 Weigh the glass fibre or paper cartridge (A.2.2) dried to constant mass at 140 °C and cooled to room temperature in a desiccator, to the nearest 0,000 1 g (mass m_1) (see note 1 in A.3.2.4).

Then fill it with approximately 5 g of the sample and place it in the oven (A.2.3) controlled at 140 ± 2 °C under 250 mbar nitrogen vacuum or less. This means that the existing residual pressure of nitrogen in the apparatus must be 250 mbar or lower (see note 2 in A.3.2.4).

Usually, 2 h are sufficient for complete drying and sample annealing, but calibration of the oven efficiency is recommended to determine the minimum time required to achieve constant mass of the samples.

A.3.2.2 Cool the cartridge containing the test portion to room temperature in a desiccator and weigh again to the nearest 0,000 1 g (mass m_2). Record the mass of the propylene plastic test portion by difference ($m_2 - m_1$). Then place the cartridge in the extractor trap (see figure) and extract with boiling *n*-heptane (analytical grade, free from aromatic components) for 24 h (see notes 1 and 3 in A.3.2.4).

A.3.2.3 Regulate the solvent boiling rate to give 15 to 25 extractions per hour, using 300 ml of *n*-heptane in the flask.

A.3.2.4 After 24 h of extraction, cool the cartridge containing residual polymer to room temperature, carefully wash it with acetone (analytical grade) and dry it in the oven (A.2.3), controlled at 70 ± 2 °C, to constant mass, under 250 mbar nitrogen vacuum, or less.

Usually 4 to 6 h are sufficient to reach constant mass, but it is recommended that the oven drying efficiency be checked by a preliminary test.

Weigh the dried cartridge containing the residual polymer to the nearest 0,000 1 g after cooling to room temperature in a desiccator (mass m_3) (see note 1).

NOTES

1 If paper cartridges are used, they shall be placed in a glass weighing bottle before weighing, in order to avoid the influence of atmospheric humidity absorbed by the paper walls.