INTERNATIONAL STANDARD 1872

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Polyethylene thermoplastic materials — Designation

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

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 1872 was drawn up by Technical Committee ISO/TC 61, *Plastics.*

It was approved in February 1970 by the Member Bodies of the following countries:

Australia	Greece	Romania
Austria	Hungary	South Africa, Rep. of
Belgium	Israel	Spain
Canada	Italy	Switzerland
Chile	Japan	Turkey
Czechoslovakia	Netherlands	United Kingdom
Egypt, Arab Rep. of	New Zealand	U.S.A.
France	Poland	U.S.S.R.
Germany	Portugal	

The Member Body of the following country expressed disapproval of the document on technical grounds:

Sweden

Printed in Switzerland

Polyethylene thermoplastic materials — Designation

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the method to be used for the identification of polyethylene materials in such a manner that manufacturer and purchaser can agree on the substantial similarity of different commercial lots or shipments. Materials are characterized by a classification system based on basic polymer parameters and recommended end uses.

Although major end use(s) are indicated, this is not intended to be restrictive, nor does it imply a guarantee of suitability under particular processing and use conditions.

This International Standard does not provide engineering data, nor for special modifications which may be necessary in certain applications; such modifications and the relevant test methods shall be agreed between purchaser and supplier.

2 REFERENCES

ISO/R 292, *Plastics — Determination of the melt flow index of polyethylene and polyethylene compounds.*

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

ISO/R 1183, *Plastics — Methods for determining the density and relative density (specific gravity) of plastics, excluding cellular plastics.*

3 CLASSIFICATION SYSTEM

This International Standard covers only ethylene homo-polymers and copolymers of ethylene containing not more than 5 % (molar) of α-olefinic co-monomer without any other functional group, and mixture of such polymers. Polyethylene materials are classified in the following basic ways:

- nominal density
- melt index
- major end use
- modifications

3.1 Nominal density at 23 °C (See 6.1)

This is identified in terms of five ranges as follows:

1) up to 0.920 g/ml
2) 0.921 to 0.930 g/ml
3) 0.931 to 0.944 g/ml
4) 0.945 to 0.954 g/ml
5) equal to or greater than 0.955 g/ml

3.2 Melt flow index (See 6.2)

This is identified in terms of five ranges, as follows:

1) less than 0.2 g/10 min
2) 0.2 to 1.0 g/10 min
3) 1.0 to 10.0 g/10 min
4) 10.0 to 25.0 g/10 min
5) greater than 25.0 g/10 min

3.3 Major end use

At present this is identified in terms of one or more of the following applications:

M = moulding
E = general extrusion
F = film
K = cable
B = bottle
C = coating
P = pipe
S = powder processing
L = monofilament
Y = tapes

3.4 Modifications

This refers to additives, fillers, etc. For the present, these modifications are defined as follows:

A = natural uncoloured grade, without special modification for particular end use(s)

B = presence of special additive and/or pigment systems to meet particular requirements.

NOTES

1 For example, these include additive systems designed to impart slip and antistatic properties and special pigment formulations, such as carbon black, to impart stability against outdoor weathering.

2 When the material is coloured, this fact shall be stated.

4 GENERAL REQUIREMENTS

The material shall be in the form of powder, granules or pellets.

It shall be of uniform composition and free from foreign matter to such contamination level as may be agreed between the manufacturer and purchaser.

5 BASIS OF PURCHASE

The purchase order or inquiry for these materials shall state nominal density range, melt flow index range and intended end use(s), and modifications (as appropriate); all as defined by the coding system. (See Note 1.)

Further and/or more detailed definition may be required and shall be on the basis of agreement between purchaser and supplier; for example:

- nominal density and tolerances thereof;
- actual melt flow index and tolerances thereof;
- functional purpose of additives, or other modifications;
- contamination level.

NOTES

1 Polyethylene materials are thus identified according to the following coding system:

- one digit indicating density range (Note 2);
- one digit indicating melt flow index range;
- one or more letters indicating end use(s);
- one or more letters indicating modification(s).

Example :

A natural polyethylene of density 0.918 g/ml and melt flow index 4 intended for film, and without special modification, would be coded: 1 – 3 – F – A.

2 When the base polymer is modified with additives according to 3.4 (Modification B), the stated nominal density range refers to the base.

6 TEST METHODS

6.1 Density

The nominal density shall be determined according to ISO/R 1183 on a piece of melt indexer extrudate obtained according to Annex A.

This procedure is rapid and convenient and is sufficiently accurate for many practical purposes. In case of dispute, the nominal density shall be calculated from the reference density by the method described in Annex B.

NOTES

1 The standard ISO test temperature of 23 °C has been adopted for this International Standard. For the guidance of those using 20 °C, the density of polyethylene decreases approximately by 0,000 6 g/ml for every 1 °C rise in temperature over the range 20 to 23 °C.

2 The gradient tube method of ISO/R 1183 has been found to be rapid, convenient and accurate, and is recommended.

6.2 Melt flow index

The melt flow index shall be determined by the relevant procedure of ISO/R 292.

ANNEX A

PREPARATION OF SAMPLE (MELT INDEXER EXTRUDATE METHOD) FOR DETERMINATION OF NOMINAL DENSITY

The sample, preferably milled, is extruded from a standard melt indexer at 190 °C in accordance with the method described in ISO/R 292. Extra care should be taken to ensure adequate packing in the cylinder to obviate any air inclusions. The extrudate should be screened from draughts.

A convenient extrudate length, visibly free from air inclusions, is cut, placed on a glass plate and allowed to cool at room temperature. The extrudate specimen is cut into several convenient lengths and its density measured according to ISO/R 1183.

This value is considered as the *nominal density*.

ANNEX B

PREPARATION OF SAMPLE (MOULDING AND ANNEALING METHOD) FOR DETERMINATION OF REFERENCE DENSITY AND CALCULATION OF NOMINAL DENSITY

The density of a given sample of polyethylene is significantly influenced by its thermal history and while the measurement of density is relatively simple, the method of sample preparation, and in particular its cooling rate, must be very closely controlled. At the present time the sample preparation method described below is among those known to give the most accurate and reproducible results over the range of density covered by this International Standard. Consequently, the value obtained by this method is considered as the *reference density*. However, the density values obtained on such samples are generally higher than those quoted in the trade literature, which are intended to approximate to the densities found for fabricated commercial articles. These trade literature values are usually based on arbitrary conditioning methods which are useful for control purposes but which are unsatisfactory for inclusion in a general standard. It has been found experimentally that a simple linear equation relates the values of the *reference density* to those of the *nominal density* obtained in accordance with Annex A. On the other hand, the nominal density falls within the range of the conventional trade values quoted for a given material.

a) This procedure shall be carried out on sheet 1 to 3 mm thick prepared as in ISO/R 293. The preferred size of this is 15 cm by 15 cm. The sheet shall be placed in a frame 15 cm by 15 cm (the frame in which it has been moulded is suitable) and a series of sheets may be built up into a stack as follows. At the botton of the stack is a separator plate of smooth surfaced aluminium of convenient size and 1.5 mm thick. The moulded sheet and frame, sandwiched between aluminium foil parting sheets, is placed on the separator plate and a follow-up plate of aluminium 14.5 cm by 14.5 cm and 15 mm thick is placed centrally on the sheet (see Note 1). The sequence of separator plate, sheet with frame and parting sheets, follow-up plate may then be repeated until the required number of samples is stacked up to a maximum of 5 sets.

This stack shall be transferred to a circulating air oven capable of maintaining a temperature of 150 ± 2 °C and fitted with a device for lowering the temperature of the oven at a rate of 5 ± 0.5 °C/h to about 40 °C. (Note 2.)

The oven shall be maintained at 150 ± 2 °C for 1 h after the temperature of the assembly has reached this temperature *and shall be cooled at the rate of 5 ± 0.5 °C/h.* The specimens shall be removed when the temperature of the oven reaches 40 °C.

From the sheet two specimens shall be cut. The specimens shall be free from voids, significant sink marks, grease and dust and from scratches or roughness which might cause air bubbles to adhere to the surface.

NOTES

1 It is preferable to keep the aluminium foil parting sheet, moulding frame and moulded sheet from the moulding operation as an integral unit for this operation. The purpose of the

follow-up plates is to maintain good contact between the parting sheets and the moulded sheet during its expansion on heating and contraction on cooling.

2 A rate of temperature change controller is suitable for this purpose. It is preferable that the oven temperature be measured by inserting the temperature sensing device in a cover of suitable size and thickness, placed on top of the stack.

b) The density of the annealed sample shall be determined according to the method given in ISO/R 1183.

The reference density (R) thus obtained shall be used to obtain the corresponding nominal density from the equation

$$\text{Nominal density} = (0.793 \times R) + 0.188$$