SLOVENSKI STANDARD
oSIST prEN ISO 1133-1:2022

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Polimerni materiali - Ugotavljanje masnega (MFR) in prostorninskega pretoka taline (MVR) plastomerov - 1. del: Standardna metoda (ISO/FDIS 1133-1:2022)

Plastics - Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics - Part 1: Standard method (ISO/FDIS 1133-1:2022)

Kunststoffe - Bestimmung der Schmelze-Massefließrate (MFR) und der Schmelze-Volumenfließrate (MVR) von Thermoplasten - Teil 1: Allgemeines Prüfverfahren (ISO/FDIS 1133-1:2022)

Plastiques - Détermination de l'indice de fluidité à chaud des thermoplastiques, en masse (MFR) et en volume (MVR) - Partie 1: Méthode normale (ISO/FDIS 1133-1:2022)

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Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics —

Part 1: Standard method

Plastiques — Détermination de l'indice de fluidité à chaud des thermoplastiques, en masse (MFR) et en volume (MVR) —

Partie 1: Méthode normale

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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.

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 249, *Plastics,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 1133-1:2011), of which it constitutes a minor revision. The changes are as follows:

— references to withdrawn standards in Annex B (informative), Annex D (informative) and Bibliography have been updated;

— editorial corrections.

A list of all parts in the ISO 1133 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.

Introduction

For stable materials that are not rheologically sensitive to the time-temperature history experienced during melt flow rate testing, this document is recommended.

For materials whose rheological behaviour is sensitive to the test's time-temperature history, e.g. materials which degrade during the test, ISO 1133-2 is recommended. Also, ISO 1133-2 is considered to be particularly relevant for moisture-sensitive plastics.

NOTE At the time of publication, there is no evidence to suggest that the use of ISO 1133-2 for stable materials results in better precision in comparison with the use of this document.

Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics —

Part 1: Standard method

WARNING — Persons using this document should be familiar with normal laboratory practice, if applicable. This document does not purport to address all of the safety problems, 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.

1 Scope

This document specifies two procedures for the determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastic materials under specified conditions of temperature and load. Procedure A is a mass-measurement method. Procedure B is a displacement-measurement method. Normally, the test conditions for measurement of melt flow rate are specified in the material standard with a reference to this document. The test conditions normally used for thermoplastics are listed in Annex A.

The MVR is particularly useful when comparing materials of different filler content and when comparing filled with unfilled thermoplastics. The MFR can be determined from MVR measurements, or vice versa, provided the melt density at the test temperature is known.

This document is also possibly applicable to thermoplastics for which the rheological behaviour is affected during the measurement by phenomena such as hydrolysis (chain scission), condensation and cross-linking, but only if the effect is limited in extent and only if the repeatability and reproducibility are within an acceptable range. For materials which show significantly affected rheological behaviour during testing, this document is not appropriate. In such cases, ISO 1133-2 applies.

NOTE The rates of shear in these methods are much smaller than those used under normal conditions of processing, and therefore it is possible that data obtained by these methods for various thermoplastics will not always correlate with their behaviour during processing. Both methods are used primarily in quality control.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
melt mass-flow rate
MFR
rate of extrusion of a molten resin through a die of specified length and diameter under prescribed conditions of temperature, load and piston position in the cylinder of an extrusion plastometer, the rate being determined as the mass extruded over a specified time

Note 1 to entry: MFR is expressed in units of grams per 10 min. Alternative units accepted by SI are decigrams per minute, where 1 g/10 min is equivalent to 1 dg/min.

3.2
melt volume-flow rate
MVR
rate of extrusion of a molten resin through a die of specified length and diameter under prescribed conditions of temperature, load and piston position in the cylinder of an extrusion plastometer, the rate being determined as the volume extruded over a specified time

Note 1 to entry: MVR is expressed in units of cubic centimetres per 10 min.

3.3
load
combined force exerted by the mass of the piston and the added weight, or weights, as specified by the conditions of the test

Note 1 to entry: Load is expressed as the mass, in kilograms, exerting it.

3.4
preformed compacted charge
test sample prepared as a compressed charge of polymer sample

Note 1 to entry: In order to introduce samples quickly into the bore of the cylinder and to ensure void-free extrudate, it may be necessary to preform samples originally in the form of, for example, powders or flakes into a compacted charge.

3.5
time-temperature history
history of the temperature and time to which the sample is exposed during testing including sample preparation

3.6
standard die
die having a nominal length of 8,000 mm and a nominal bore diameter of 2,095 mm

3.7
half size die
die having a nominal length of 4,000 mm and a nominal bore diameter of 1,050 mm

3.8
moisture-sensitive plastics
plastics having rheological properties that are sensitive to their moisture content

Note 1 to entry: Plastics which, when containing absorbed water and heated above their glass transition temperatures (for amorphous plastics) or melting point (for semi-crystalline plastics), undergo hydrolysis resulting in a reduction in molar mass and consequently a reduction in melt viscosity and an increase in MFR and MVR.

4 Principle

The melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) are determined by extruding molten material from the cylinder of a plastometer through a die of specified length and diameter under preset conditions of temperature and load.

For measurement of MFR (procedure A), timed segments of the extrudate are weighed and used to calculate the extrusion rate, in grams per 10 min.

For measurement of MVR (procedure B), the distance that the piston moves in a specified time or the time required for the piston to move a specified distance is recorded and used to calculate the extrusion rate in cubic centimetres per 10 min.

MVR can be converted to MFR, or vice versa, if the melt density of the material at the test temperature is known.

NOTE The density of the melt is required at the test temperature and pressure. In practice, the pressure is low and values obtained at the test temperature and ambient pressure suffice.

5 Apparatus

5.1 Extrusion plastometer

5.1.1 General. The basic apparatus comprises an extrusion plastometer operating at a fixed temperature. The general design is as shown in Figure 1. The thermoplastic material, which is contained in a vertical cylinder, is extruded through a die by a piston loaded with a known weight. The apparatus consists of the following essential parts.

5.1.2 Cylinder. The cylinder shall have a length between 115 mm and 180 mm and an internal diameter of (9,550 ± 0,007) mm and shall be fixed in a vertical position (see 5.1.6).

The cylinder shall be manufactured from a material resistant to wear and corrosion up to the maximum temperature of the heating system. The bore shall be manufactured using techniques and materials that produce a Vickers hardness of no less than 500 (HV 5 to HV 100) (see ISO 6507-1) and shall be manufactured by a technique that produces a surface roughness of less than *Ra* (arithmetical mean deviation) equal to 0,25 µm (see ISO 4287). The finish, properties and dimensions of its surface shall not be affected by the material being tested.

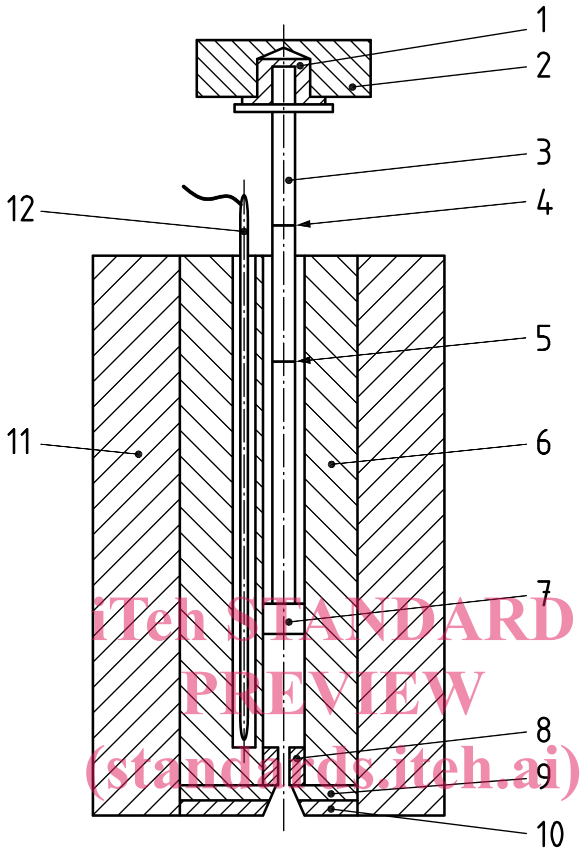
NOTE 1 For particular materials, it is possible that measurements will be required at temperatures up to 450 °C.

The base of the cylinder shall be thermally insulated in such a way that the area of exposed metal is less than 4 cm^2, and it is recommended that an insulating material such as Al_2O_3, ceramic fibre or another suitable material be used in order to avoid sticking of the extrudate.

A piston guide or other suitable means of minimizing friction due to misalignment of the piston shall be provided.

NOTE 2 Excessive wear of the piston head, piston and cylinder and erratic results can be indications of misalignment of the piston. Regular visual checking for wear and change to the surface appearance of the piston head, piston and cylinder is recommended.

5.1.3 Piston. The piston shall have a working length at least as long as the cylinder. The piston shall have a head (6,35 ± 0,10) mm in length. The diameter of the head shall be (9,474 ± 0,007) mm. The lower edge of the piston head shall have a radius of $(0{,}4_{-0{,}1}^{0{,}0})$ mm and the upper edge shall have its sharp edge removed. Above the head, the piston shall be relieved to ≤ 9,0 mm diameter (see Figure 2).



Key

1 insulation
2 removable weight
3 piston
4 upper reference mark
5 lower reference mark
6 cylinder
7 piston head
8 die
9 die retaining plate
10 insulating plate
11 insulation
12 temperature sensor

Figure 1 — Typical apparatus for determining melt flow rate, showing one possible configuration

The piston shall be manufactured from a material resistant to wear and corrosion up to the maximum temperature of the heating system, and its properties and dimensions shall not be affected by the material being tested. To ensure satisfactory operation of the apparatus, the cylinder and the piston head shall be made of materials of different hardness. It is convenient for ease of maintenance and renewal to make the cylinder of the harder material.

