



**SLOVENSKI STANDARD**  
**SIST EN 14447:2005**

**01-julij-2005**

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Fibre reinforced plastics - Glass mat reinforced thermoplastics (GMT) - Determination of flowability and solidification

Faserverstärkte Kunststoffe - Glasmattenverstärkte Thermoplaste (GMT) - Bestimmung der Fließfähigkeit und des Erstarrens

Plastiques renforcés de fibres - Thermoplastiques renforcés de mats de verre (GMT) - Détermination de la fluidité et de la solidification

**Ta slovenski standard je istoveten z: EN 14447:2005**

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83.120      Ubae æ ã [ |ã ^iã      Reinforced plastics

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EUROPEAN STANDARD

EN 14447

NORME EUROPÉENNE

EUROPÄISCHE NORM

April 2005

ICS 83.120

English version

## Fibre reinforced plastics - Glass mat reinforced thermoplastics (GMT) - Determination of flowability and solidification

Plastiques renforcés de fibres - Thermoplastiques renforcés de mats de verre (GMT) - Détermination de la fluidité et de la solidification

Faserverstärkte Kunststoffe - Glasmattenverstärkte Thermoplaste (GMT) - Bestimmung der Fließfähigkeit und des Erstarrens

This European Standard was approved by CEN on 15 March 2005.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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## Foreword

This document (EN 14447:2005) has been prepared by Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by IBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2005, and conflicting national standards shall be withdrawn at the latest by October 2005.

The description of flowability and solidification of glass fibre mat reinforced thermoplastic moulding compounds (GMT) is complex.

The test methods described in this document are for the determination of flowability and solidification. The flowability is the basic property of a moulding material which defines the ability to fill a given cavity.

The flowability of GMT has to be expressed by at least two parameters because of its non-Newtonian behaviour.

Parameters to express the behaviour of the compound as instantaneous values are:

- the pressure gradient – a measure of the resistance to the initiation of flow ;
- the pressure loss – a measure for the pressure change over the flow distance.

As overall or integral values are:

- the filling time – the duration of filling the cavity under given conditions ;
- the pressure integral – a measure of the resistance to overall flow ;
- the work during pressing – a measure of resistance to overall flow ;
- the partial work during pressing – a measure of resistance during a specific part of the flow.

These parameters are defined by this document plus other additional information.

The process of solidification must be determined separately and must not influence the results of the flowability test.

The complexity of the behaviour of GMT requires a large amount of testing for full understanding of the compound. This document specifies a method of test for an intensive analysis. Not all elements of the analysis may be required for every function for which this test method is applicable. The material (product) specification, or the person requesting the analysis should specify which elements of the analysis are required to be undertaken for a particular purpose e.g. product development, product qualification or quality control. To reduce the specific effort for the method and to open the applicability of the test equipment, the apparatus is similar to the one described in EN ISO 12115, *Fibre-reinforced plastics - Thermosetting moulding compounds and prepregs - Determination of flowability, maturation and shelf life (ISO 12115:1997)*.

The geometry of the mould was chosen to enable the user to produce test plates for mechanical testing separate from the flowability test.

The effect of glass fibre reinforcement properties on the flowability was also assessed using a stepped plate mould which was supposed to produce more clearly distinguishing test results compared to a flat plate. This assumption was not verified in tests run up to now.

A second mould geometry therefore may be described later if necessary.

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Orientation of the reinforcement fibres should be observed and tested by taking the samples either in the direction of the production machine or transverse to it.

Experience shows that the procedure for heating the material for moulding has a very strong influence on the results of the flowability and solidification test. To avoid unwanted effects an exact specification of heating is included.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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## 1 Scope

This document defines a method for the determination of data suited to the assessment of the flowability and solidification of polypropylene based glass fibre mat reinforced thermoplastic moulding compounds (GMT) carried out with commonly applied moulding parameters.

The influence on moulding behaviour of both the individual components of the material and the moulding parameters may be determined by this method. It is suitable for quality control purposes as well as for the development of material formulations.

Depending on the objectives of the analysis, different elements of the procedure described in this document may be chosen.

This test method may be used for the production of a test plate suitable for the preparation of test specimens for the determination of materials properties.

## 2 Normative references

The following referenced documents are indispensable for the application 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.

EN ISO 291, *Plastics — Standard atmospheres for conditioning and testing* (ISO 291:1997)

EN ISO 472:2001, *Plastics — Vocabulary* (ISO 472:1999)

EN ISO 12115:1997, *Fibre-reinforced plastics — Thermosetting moulding compounds and prepregs — Determination of flowability, maturation and shelf life* (ISO 12115:1997)

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## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 472:2001 and the following apply.

### 3.1

#### **definition of GMT**

glass mat reinforced thermoplastics

### 3.2

#### **flowability**

ability of a moulding material to flow and fill the cavity of a given mould under defined conditions

### 3.3

#### **solidification**

process of transition of the moulding material from a mouldable stage to a stage of sufficient rigidity for demoulding

### 3.4

#### **elementary unit**

smallest normally commercially available entity of a given product. The description (form, dimensions, mass, etc.) of the elementary unit will normally be defined in the product specification. This unit may be supplied in one of several forms :

- package ;
- pallet.

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NOTE For a given product, the dimensions, mass or volume of the elementary unit may change, as fabrication techniques evolve, without necessarily causing any modification in the properties or the way in which these properties vary throughout the elementary unit.

#### 4 Principle of the test method

This method is based on a moulding procedure using a normal commercial press, a plate mould and the usual conditions for moulding polypropylene GMT.

Usual moulding conditions for polypropylene GMT include:

- mould temperature c.a. 60 °C ;
- material temperature c.a. 190 °C – 230 °C ;
- closing speed of the press c.a. 15 mm/s ;
- thickness of the moulding c.a. 3 mm.

The GMT, cut to the required size and heated to moulding temperature is inserted in the centre of the cavity. Then the material is allowed to flow and solidify under pressure.

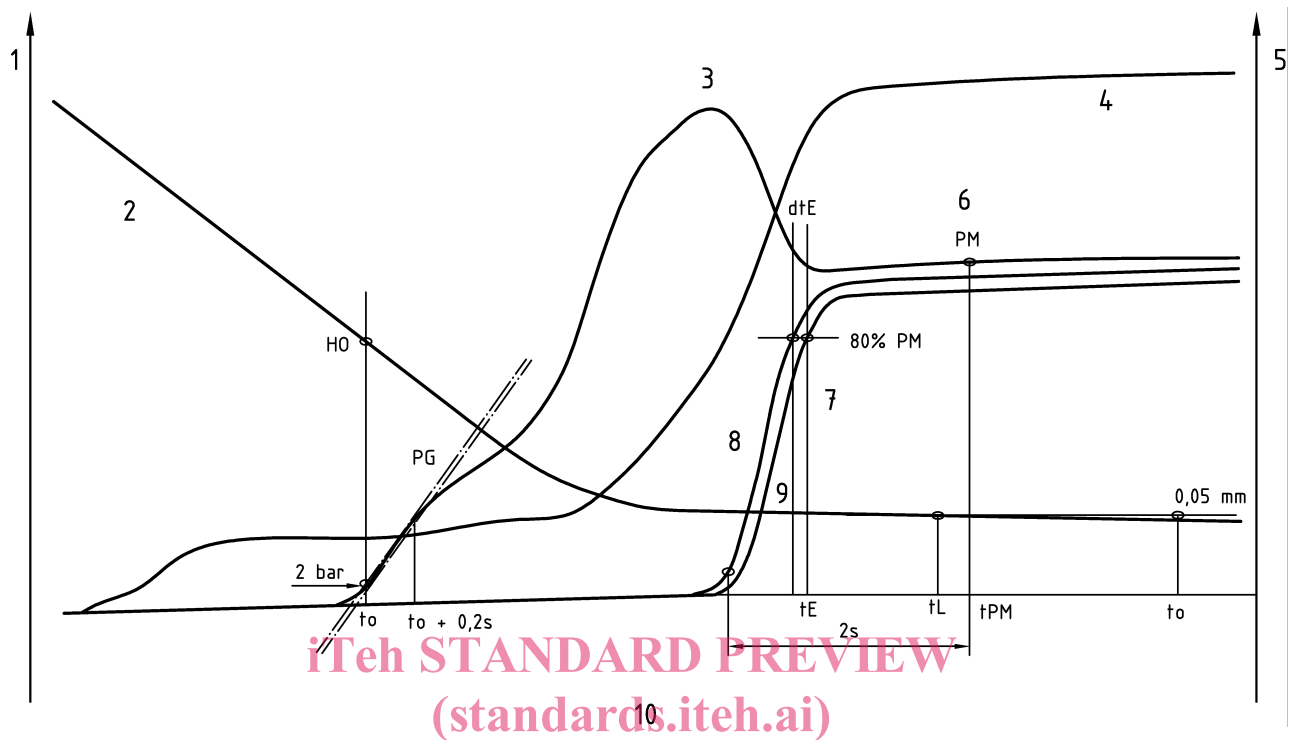
The moulding conditions are defined by a given press closing speed, force and mould temperature. Complete filling of the cavity is a precondition.

During the moulding process, the closing force and the material pressure in the centre and at the corners of the cavity are measured and recorded as a function of time (see Figure 1).

From the measured sensor signals the results are evaluated and the flowability and solidification is determined and judged in relation to the specific mould filling requirements. This document offers several elements for the analysis of this measured data. Depending on the purpose of the test some of the elements of the analysis may be omitted.

The determination of the flowability and solidification of different tests requires consistent moulding parameters.



**Key**

- |   |                      |    |                   |
|---|----------------------|----|-------------------|
| 1 | Pressure             | 6  | Material pressure |
| 2 | Closing displacement | 7  | Pressure edges    |
| 3 | Pressure centre      | 8  | Left              |
| 4 | Closing force        | 9  | Right             |
| 5 | Displacement         | 10 | Time              |

Figure 1 — Pressure and Displacement response during the test