INTERNATIONAL STANDARD

ISO 1268-9

First edition
2003-03-15

Fibre-reinforced plastics — Methods of producing test plates —

Part 9: Moulding of GMT/STC

Plastiques renforcés de fibres — Méthodes de fabrication de plaques d'essai —

Partie 9: Moulage des GMT/STC

Reference number
ISO 1268-9:2003(E)

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Published in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 1268-9 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 13, *Composites and reinforcement fibres*.

Together with the other parts (see below), this part of ISO 1268 cancels and replaces ISO 1268:1974, which has been technically revised.

ISO 1268 consists of the following parts, under the general title *Fibre-reinforced plastics — Methods of producing test plates*:

— *Part 1: General conditions*

— *Part 2: Contact and spray-up moulding*

— *Part 3: Wet compression moulding*

— *Part 4: Moulding of prepregs*

— *Part 5: Filament winding*

— *Part 6: Pultrusion moulding*

— *Part 7: Resin transfer moulding*

— *Part 8: Compression moulding of SMC and BMC*

— *Part 9: Moulding of GMT/STC*

— *Part 10: Injection moulding of BMC and other long-fibre moulding compounds — General principles and moulding of multipurpose test specimens*

— *Part 11: Injection moulding of BMC and other long-fibre moulding compounds — Small plates*

Fibre-reinforced plastics — Methods of producing test plates —

Part 9: Moulding of GMT/STC

1 Scope

This part of ISO 1268 specifies a method for preparing test plates by compression moulding of reinforced thermoplastic sheet (GMT/STC) to be used for the preparation of test specimens to determine the mechanical and physical properties of the laminate. The proposed method is applicable to laminates made from a thermoplastic matrix reinforced with glass, carbon, aramid or other reinforcing fibres, alone or in combination and in any form suitable for compression moulding.

This part of ISO 1268 is intended to be read in conjunction with ISO 1268-1.

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.

ISO 527-4, *Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*

ISO 1172, *Textile-glass-reinforced plastics — Prepregs, moulding compounds and laminates — Determination of the textile-glass and mineral-filler content — Calcination methods*

ISO 1268-1, *Fibre-reinforced plastics — Methods of producing test plates — Part 1: General conditions*

ISO 1268-4, *Fibre-reinforced plastics — Methods of producing test plates — Part 4: Moulding of prepregs*

3 Terms and definitions

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

3.1
GMT
the abbreviation generally accepted within the industry for Glass-fibre Mat reinforced Thermoplastic sheet, in which the thermoplastic is generally polypropylene

3.2
STC
the accepted abbreviation for any kind of Sheet Thermoplastic Composite, irrespective of the type of the polymer or the nature or form of the reinforcement

4 Health and safety

See ISO 1268-1.

5 Principle

This method is based on a compression-moulding procedure using a normal commercial press, a plate mould and the moulding conditions recommended by the supplier of the GMT/STC material.

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

It is absolutely essential for the cavity to be complete filled. The method may nevertheless be used for materials which do not flow in the mould, but changes are required in the procedure.

6 Materials

The method may be used for all types of GMT/STC material, irrespective of the type of thermoplastic polymer used or the type and nature of the reinforcement, providing the material is suitable for compression moulding.

The method is designed for materials which flow during the moulding process. Materials which do not flow during the moulding process can be moulded by this method, but consideration should also be given to using the method given in ISO 1268-4, which may be more suitable for the high-fibre-content, high-melt-temperature STC materials.

7 Plate dimensions

7.1 Surface area of mould: at least 200 mm $\times$ 200 mm but larger if test specimens cut from the plate are to conform to the requirements of ISO 527-4.

7.2 Plate thickness: (4 $\pm$ 0,2) mm.

8 Reinforcement content

Unless otherwise specified, it is assumed that the reinforcement content and reinforcement orientation are uniform in the x and y planes of the moulded plate. In cases where the reinforcement orientation is non-uniform, the specification of the test plate shall define the orientation required in the test plate and the stacking sequence of the material in the mould.

9 Apparatus

9.1 Hydraulic moulding press, with a closing speed of at least 15 mm/s and capable of a 2 000 kN mould-clamping force.

9.2 Temperature-controlled plate mould, with a minimum width of 200 mm and a recommended length of 590 mm, mounted on the press (9.1).

NOTE Other mould sizes may be used by agreement between the interested parties, but the shape of the mould affects the flow of the material during moulding and hence the fibre orientation and the properties of the resultant material.

9.3 Oven, capable of heating the material uniformly both over the whole surface area and through the whole thickness to within ± 2 °C. The heating time shall be measurable to within ± 1 s. The end of the heating time shall be indicated by an optical or acoustic signal.

NOTE The method of heating may affect the temperature distribution and the material consistency and even cause degradation of the polymer. Such effects may also cause variability of the test results. To avoid such unwanted effects on the material, heating by contact with heating plates covered by mould release foil is recommended.

The heating time depends upon the material and its thickness. It shall be determined by measuring the temperature of the material in a separate heating test. Usually, it is between 2 min and 5 min for a thickness of about 4 mm. When heating more than one layer, the heating time will have to be increased.

10 Procedure

10.1 Blank size

Since the test plates are moulded in a flow-moulding process, only about 50 % of the mould area needs to be covered by the stack of blanks.

NOTE A blank is a square or rectangular section cut from the material concerned.

If the thickness of the blanks is in the range 3,7 mm to 3,8 mm, take two equally sized square blanks of a size sufficient to give a plate 4 mm thick. If the sheets are thinner, the number of blanks may be increased. If the sheets are thicker, the number of blanks may be reduced to one.

If the material concerned will not flow in the mould, the blanks shall be the same size as the mould and sufficient in number to give a moulded plate of the correct thickness.

10.2 Stacking the blanks

When two blanks are used, they shall be stacked at 0°/90° in the case of randomly reinforced materials and at 0°/0° in the case of unidirectionally reinforced material.

Three or more blanks shall be stacked symmetrically (0°/90°/0°, 0°/90°/90°/0°).

10.3 Preheating the blanks

The stack of blanks shall be loaded as a stack into the oven and heated to the temperature recommended by the manufacturer for the material concerned, paying particular attention to the requirements specified in 9.3.

Should material show evidence of smoking during heating, this is an indication of thermo-oxidative degradation and shall be avoided. Material that has been seen to smoke during heating shall not be used for moulding test plates. Alternatively, evidence of smoking may indicate that there is a fault in the heating equipment.

10.4 Mould temperature

The mould temperature shall be (60 ± 5) °C unless otherwise specified.

10.5 Moulding pressure

The moulding pressure shall be > 14 MPa.

10.6 Handling time

The stack of preheated blanks shall be inserted exactly into the centre of the mould cavity and the mould closed immediately. The mould stamp shall come into contact with the material (35 ± 5) s after the end of the preheating time and no more than (5 ± 1) s after placing the blanks in the mould.

10.7 Press closing speed

The interval between the time the mould stamp comes into contact with the material and the time of maximum force shall be a maximum of 5 s.

10.8 Cooling time

The interval between the time of maximum force and the time at which the mould stamp is raised shall be a minimum of 60 s.

11 Usable area of test plate

The reinforcement may take up a preferential orientation in the corners of the mould as the mould is filled during the moulding process. Normally, therefore, test specimens shall only be cut from the central part of the test plate where the fibre orientation is isotropic. Cut away 15 % of the width and 15 % of the length of the test plate on each side, leaving an area from which test specimens can be cut. For example, a test plate measuring 400 mm × 400 mm would have 60 mm cut away on all sides, leaving an area of 280 mm × 280 mm.

In the case of the minimum test plate size of 200 mm × 200 mm, cutting away 15 % from each edge would leave only 140 mm × 140 mm. This is insufficient to make test specimens which conform with ISO 527-4 for the determination of tensile properties. In such cases, the area which would normally be cut away may be left and used as the clamping area of the test specimen. The gauge length of such test specimens shall be located in the central area defined above.

12 Verification of the characteristics of the plate obtained

Determine the fibre content in accordance with ISO 1172 and compare it with the requirement given in the specification. Check test specimens visually for unacceptably high void content before using them for testing.

13 Test plate preparation report

See ISO 1268-1.

ICS 83.120

Price based on 4 pages