INTERNATIONAL STANDARD

ISO 295

Second edition
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Plastics — Compression moulding of test specimens of thermosetting materials.

Plastiques — Moulage par compression des éprouvettes en matières thermodurcissables

Reference number
ISO 295:1991(E)

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.

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.

International Standard ISO 295 was prepared by Technical Committee ISO/TC 61, *Plastics*, Sub-Committee SC 12, *Thermosetting materials*.

This second edition cancels and replaces the first edition (ISO 295:1974), of which it constitutes a technical revision.

International Organization for Standardization
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Plastics — Compression moulding of test specimens of thermosetting materials.

1 Scope

This International Standard specifies the general principles and the procedures to be followed for the preparation of test specimens from thermosetting compounds moulded under heat and pressure and for the establishment of comparable test reports from different testing organizations. It is applicable only to thermosetting materials based upon phenolics (ISO 800), aminoplastics (ISO 2112), melamine phenolics (ISO 4896), epoxides and unsaturated polyesters.

Because the properties of the specimens moulded from thermosetting materials depend on the conditions of preparation of the specimens, this International Standard also specifies the details of specimen preparation to be included with test reports of the properties of such specimens.

It may often be necessary to prepare specimens by special methods because of their composition, their flow properties or other variable factors. In this case, an agreement shall be made between the interested parties. The tables giving the specimen properties shall refer to these specific methods.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 468:1982, *Surface roughness — Parameters, their values and general rules for specifying requirements.*

ISO 800:—[1], *Plastics — Phenolic moulding materials — Specification.*

ISO 1183:1987, *Plastics — Methods for determining the density and relative density of non-cellular plastics.*

ISO 2112:1990, *Plastics — Aminoplastic moulding materials — Specification.*

ISO 3167:1983, *Plastics — Preparation and use of multipurpose test specimens.*

ISO 4896:1990, *Plastics — Melamine/phenolic moulding materials — Specification.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 deviations of temperature in position: Deviations of temperature existing simultaneously between various points inside the mould after the temperature adjustment device has been set at a given temperature and after a permanent thermal equilibrium has been reached.

3.2 deviations of temperature in time: Deviations of temperature that may occur at a single given point on the inside of the mould at various times after the temperature adjustment device has been set at a given temperature and after a permanent thermal equilibrium has been reached.

1) To be published. (Revision of ISO 800:1977)

4 Apparatus

4.1 Compression mould, made of steel, able to withstand the specified temperatures and pressures. The mould shall be designed so that the compression force is transmitted to the moulding material with no appreciable loss. It may be of a single-cavity or a multi-cavity type. Figure 1 shows an example of a single-cavity positive mould. The cavity of the mould may have the shape of the multi-purpose test specimen described in ISO 3167. In some cases (aminoplastics for instance), a semi-positive mould is more suitable, even though the pressure on the moulding material is not as well defined. In this case, the specimen thickness shall be adjusted using spacers on the mould parting line.

The mould surface shall be free from superficial damage or contamination and have a shiny surface finish of R_{aH} 0,4 µm to 0,8 µm (see ISO 468). Chrome plating is not always necessary, but it will prevent sticking.

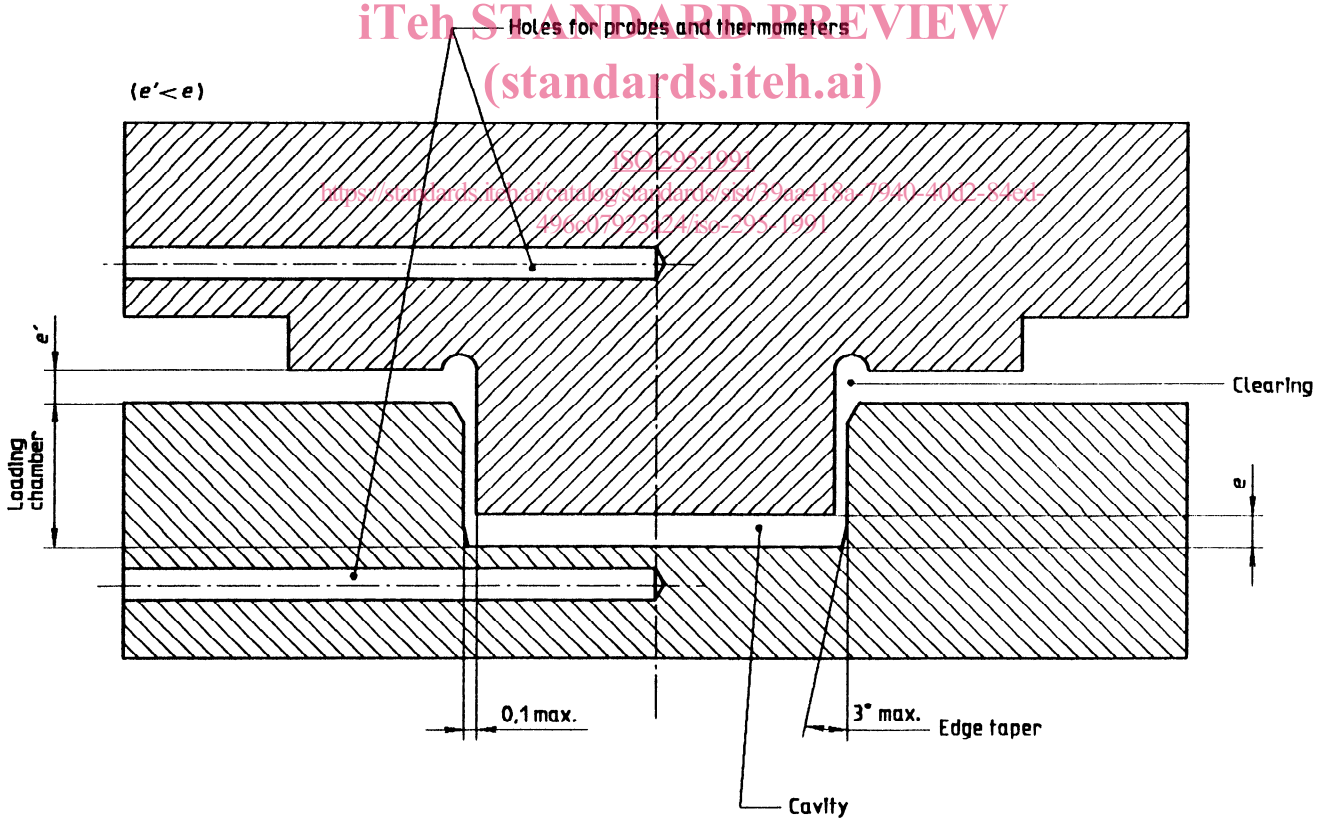
The edge taper angle shall not be greater than 3° (see figure 1). Clearance between the vertical wall of the cavity and the punch shall be not greater than 0,1 mm (see figure 1).

The mould shall have a loading chamber (see figure 1) large enough to allow the whole charge to be fed in one operation. Moulding material in bulk form is from 2 to 10 times as voluminous as the moulded object.

The mould may be fitted with an ejector. If ejector pins are used [see the example in figure 2a)], they shall not deform the specimen in any way. If the parts are ejected by the movable bottom of the mould [see the example in figure 2b)], there shall be no significant leakage of material at the joint between the bottom and the cavity wall.

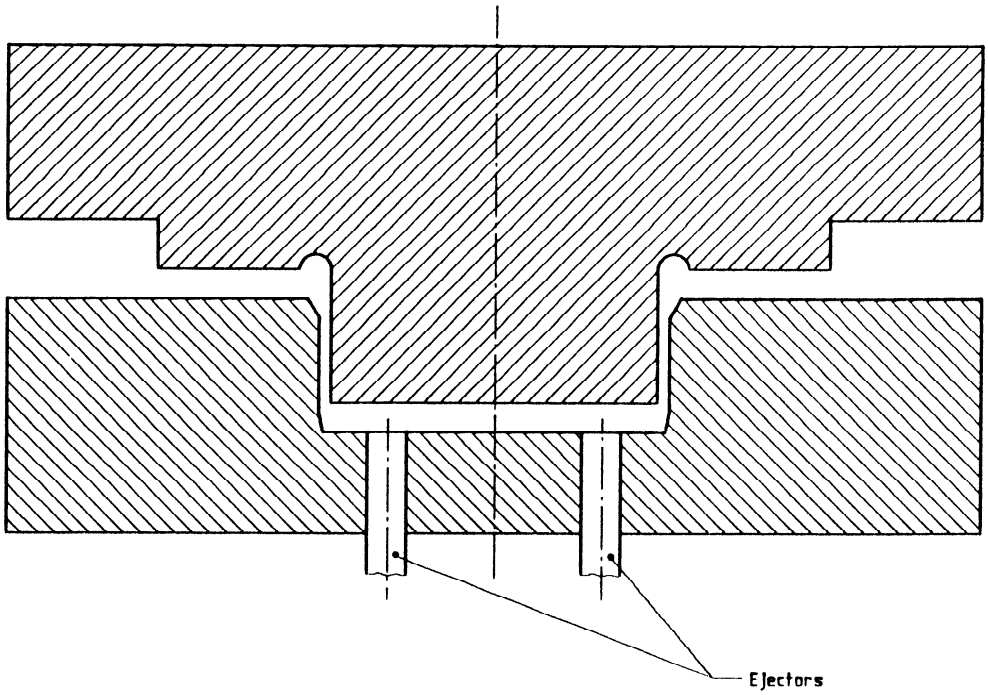
Because the face of the moulded part facing the lower die is heated for a longer time during the period between filling and compression, it may be useful to distinguish between the two faces by means of a fixed mark in the cavity.

Dimensions in millimetres

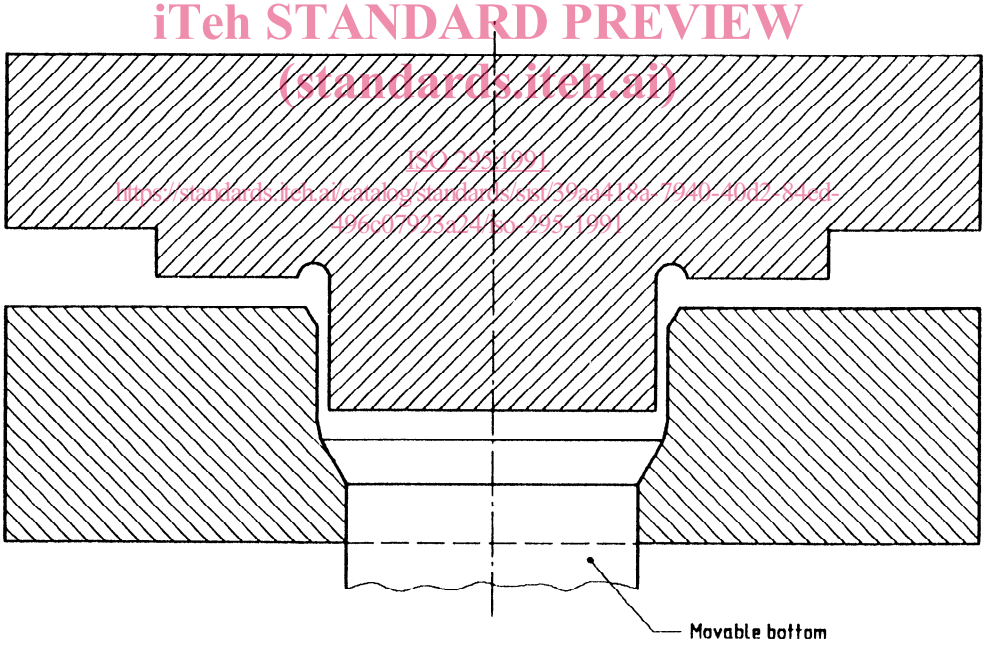


NOTE — Dimension e' shall be calculated so that there is no risk of the piston damaging the die if there is no material present.

Figure 1 — Example of single-cavity positive mould



a) With ejectors



b) With ejection by movable bottom

Figure 2 — Examples of moulds

4.2 Heating device, capable of heating the mould so that the moulding temperature remains constant and uniform over all parts of the mould within the specified tolerances.

The mould may be heated either through the platen or by means of a built-in device (for example, circulating fluid or electric heating elements). In the latter case, the mould shall be insulated from the press platens with a sheet of insulating material. For practical reasons, it is generally preferable to heat the mould electrically.

4.3 Mould temperature adjustment device, capable of ensuring that the optimum required temperature is maintained constant over the whole mould with a permissible deviation of ± 3 °C, i.e. the mould temperature shall not vary with time and position by more than ± 3 °C (see 3.1 and 3.2).

4.4 Compression-moulding press, capable of ensuring that the specified pressure is applied and maintained during the whole of the curing time. The press may be hand-operated or programmed.

It is preferable to use a press having two closing speeds:

— a fast approach speed (for example 200 mm/s to 400 mm/s) to avoid precure of the material before closing;

— a slow closing speed (for example 5 mm/s) to prevent air or gases from being entrapped.

NOTE 1 The oil pressure p_o, in megapascals, to be applied, to obtain the specified pressure p, in megapascals, is given by the equation

$$p_o = \frac{p \times A_1}{A}$$

where

A is the area, in square metres, of the press piston head.

A_1 is the total area, in square metres, of the cavities.

4.5 Stopwatch, capable of being read to an accuracy of 1 s.

4.6 Mould temperature measurement device, such as a pyrometer or fusible salts.

4.7 Balance, having an accuracy of 0,1 g.

4.8 Metal plate, about 20 mm thick and having at least the same area as the specimen, for use as a cooling fixture after stripping (see clause 7).

5 Material conditioning prior to moulding

5.1 Storage

Moulding materials that require storage in a sealed container shall be so maintained at a temperature of 23 °C ± 3 °C or as prescribed by the supplier until immediately prior to preforming (see 5.2), drying (see 6.2), preheating (see 6.3) or moulding (see clause 7), as applicable. In those cases where materials need to be put back into storage, this shall be done in accordance with instructions given by the material supplier.

5.2 Preforming

If the volume of the moulding material is too great for the capacity of the loading chamber of a conventional mould, the material may be preformed; the conditions used for such preforming shall be stated in the moulding report.

6 Moulding conditions

6.1 General

Unless special conditions are specified, the moulding conditions given in table 1 shall be used.

Table 1 — Moulding conditions

Conditions	Type of moulding material: Phenolics — Structure of filler: Fine	Phenolics — Coarse	Aminoplastics: Urea-formaldehyde	Aminoplastics: Melamine-formaldehyde — General purpose	Melamine-formaldehyde — For food contact	Epoxides	Unsaturated Polyesters
Pretreatment:							
Drying	Permissible if specimens are to undergo electric tests					Not recommended	Not recommended
Preforming	Permissible		Permissible	Permissible	Permissible	Permissible	Permissible
High-frequency preheating	Permissible to reduce curing time, but modifies material properties						
Preplastification	Permissible		Permissible	Permissible	Permissible	Not recommended	Not recommended
Breathing	Permissible		Permissible	Permissible	Permissible	Not necessary	Not recommended
Moulding:							
Temperature (°C)	165 ± 3		150 ± 3	150 ± 3	150 ± 3	150 to 180	130 to 170
Pressure (MPa)	25 to 40	40 to 60	20 to 40	20 to 40	20 to 40	20 to 30	6 to 30
Cure time (s)	20 to 60 per millimetre of thickness						
Mould:							
Surface finish	Surface finish R_{aH} 0,4 µm to 0,8 µm						
Chrome plating	Preferable		Preferable	Preferable	Preferable	Required	Required

6.2 Drying

Phenolics and aminoplastics may be dried prior to electrical tests. For drying, the material shall be spread out in a thin layer and heated in accordance with the following temperature and time schedules:

- phenolics: 30 min at 90 °C ± 3 °C, or 15 min at 105 °C ± 3 °C;
- aminoplastics: 60 min at 90 °C ± 3 °C.

The material shall be moulded immediately upon removal from the oven.

6.3 High-frequency preheating

High-frequency preheating is permissible in the case of phenolics and aminoplastics and pelletized or granular polyesters. It permits a reduction in curing time. The preheated material shall be moulded immediately after preheating.

6.4 Preplastification

Preplastification is permissible in the case of phenolics and aminoplastics. It ensures thermal and mechanical homogenization of the material. The preplasticized material shall be moulded immediately after preplastification. For the conditions for the preplastification, an agreement shall be made between the interested parties and the conditions shall be stated in the moulding report.

6.5 Release agents

Release agents, i.e. products designed to facilitate the release of the moulding from the mould, may be used only if it has been proved that they have no influence on the moulded-specimen properties. This requirement applies particularly when the specimens are to be tested for electrical properties, spectroscopic analysis or adverse taste and colour.

6.6 Breathing

If it is necessary to open the mould for the purpose of breathing, this shall be noted in the moulding report.

7 Procedure

Select the moulding conditions to be used (see clause 6). Allow the moulding temperature to reach equilibrium at ± 3 °C of the required value.

Check the temperature in the cavity (see 4.1) using the temperature measurement device (4.6).

Weigh out the required quantity of material to obtain the specified thickness of specimen. This quantity is the product of the moulded-part density and the volume of the test specimen, to which is added flash losses as determined by previous testing. Load the material, as powder or preform, in the cavity. Close the press (4.4). Allow to breathe if necessary (see note 2).

Start the stopwatch (4.5) when the pressure has reached the specified value. When the curing time is completed, open the press. Remove the specimen immediately and, unless otherwise specified in the test method (see note 3), allow it to cool on the metal plate used as the cooling fixture (4.8).

Check that the moulding is satisfactory as regards filling of the mould, appearance, absence of porosity, discoloration, flash and warpage. If necessary, check the density as determined in accordance with ISO 1183.

NOTES

2 In the case of a programme-controlled press, degasifying and opening may be performed automatically.

3 For some test methods, such as the determination of shrinkage, the requirement may be to place the hot moulding on a material of low thermal conductivity and under an appropriate load.

8 Moulding report

The moulding report shall include a reference to this International Standard and all information specified in table 2.

Table 2 — Information to be included in the moulding report

Physical form of material		Granules	
		Powder	
		Fine powder	
		Other	
Pretreatment	Drying	Without	
		Time	
		Temperature	
	Preforming	Pressure	
		Temperature	
		Weight of preform	
		Size of preform	
	High-frequency preheating	Preheater power	
		Time	
		Amperage	
		Number of preforms	
		Temperature of preforms	
	Preplastification	Cylinder temperature	
		Dynamic pressure	
		Screw speed	
		Temperature of material	
Compression moulding		Temperature	
		Temperature measurement device	
		Pressure	
		Cure time	
		Breathing	
Mould		Type	
		Number of cavities	
		Chrome plated	
		Heating device	