INTERNATIONAL STANDARD

ISO 10724-1

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1998-11-15

Plastics — Injection moulding of test specimens of thermosetting powder moulding compounds (PMCs) —

Part 1:
General principles and moulding of multipurpose test specimens

Plastiques — Moulage par injection d'éprouvettes en compositions de poudre à mouler (PMC) thermodurcissables —

Partie 1: Principes généraux et moulage d'éprouvettes à usages multiples

Reference number
ISO 10724-1:1998(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 10724-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 12, *Thermosetting materials*.

Together with part 2, this part of ISO 10724 cancels and replaces ISO 10724:1994, which has been revised to improve the definition of the injection-moulding parameters and has been restructured to specify two types of ISO mould for the production of the basic specimen types required for the acquisition of comparable test data.

Care has been taken to ensure that the ISO moulds described can all be fitted in existing injection-moulding equipment and have interchangeable cavity plates.

As far as possible, the wording of this part of ISO 10724 and its definitions corresponds to that in its counterpart for thermoplastic materials, ISO 294:1996, *Plastics — Injection moulding of test specimens of thermoplastics materials*. Unlike the latter, however, there is no need for the separate moulding of rectangular bars (80 mm × 10 mm × 4 mm, which should be taken from the central portion of the multipurpose test specimen) or for the moulding of small tensile bars (⩾ 60 mm × 10 mm × 3 mm). Therefore the type B and type C ISO moulds specified in ISO 294 have not been included in this part of ISO 10724. Regardless of this, and to avoid confusion, the designation of the different mould types in this part of ISO 10724 and in ISO 294 correspond to each other.

ISO 10724 consists of the following parts, under the general title *Plastics — Injection moulding of test specimens of thermosetting powder moulding compounds (PMCs)*:

— *Part 1: General principles and moulding of multipurpose test specimens*

— *Part 2: Small plates*

Annexes A to D of this part of ISO 10724 are for information only.

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Introduction

Many factors in the injection-moulding process which can influence the properties of moulded test specimens and hence the measured values obtained when the specimens are used in a test method. The thermal and mechanical properties of such specimens are in fact strongly dependent on the conditions of the moulding process used to prepare the specimens. Exact definition of each of the main parameters of the moulding process is a basic requirement for reproducible and comparable operating conditions.

It is important in defining moulding conditions to consider any influence the conditions may have on the properties to be determined. Thermosets may show differences in orientation and length of anisotropic fillers such as short fibres and in curing. Residual ("frozen-in") stresses in the moulded test specimens may also influence properties. Due to the crosslinking of thermosets, molecular orientation is of less influence on mechanical properties than it is for thermoplastics. Each of these phenomena must be controlled to avoid fluctuation of the numerical values of the measured properties.

Plastics — Injection moulding of test specimens of thermosetting powder moulding compounds (PMCs) —

Part 1: General principles and moulding of multipurpose test specimens

1 Scope

This part of ISO 10724 specifies the general principles to be followed when injection moulding test specimens of thermosetting powder moulding compounds (PMCs) and gives details of mould designs for preparing one type of specimen for use in establishing reproducible moulding conditions. Its purpose is to promote uniformity in describing the main parameters of the moulding process and also to establish uniform practice in reporting moulding conditions. The particular conditions required for the reproducible preparation of test specimens which will give comparable results will vary for each material used. These conditions are given in the International Standard for the relevant material or are to be agreed upon between interested parties.

NOTE ISO round-robin tests with phenolic (PF), urea-formaldehyde (UF), melamine (MF), melamine phenolic (MP) and unsaturated-polyester (UP) injection-moulding materials have shown that mould design is an important factor in the reproducible preparation of test specimens.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 10724. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 10724 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 294-1:1996, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 1: General principles, and moulding of multipurpose and bar test specimens.*

ISO 294-2:1996, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 2: Small tensile bars.*

ISO 294-3:1996, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 3: Small plates.*

ISO 472:—[1], *Plastics — Vocabulary.*

ISO 2577:1984, *Plastics — Thermosetting moulding materials — Determination of shrinkage.*

ISO 3167:1993, *Plastics — Multipurpose test specimens.*

ISO 10350-1:1998, *Plastics — Acquisition and presentation of comparable single-point data — Part 1: Moulding materials.*

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1) To be published. (Revision of ISO 472:1988)

ISO 10724-2:1998, *Plastics — Injection moulding of test specimens of thermosetting materials — Part 2: Small plates.*

ISO 11403-1:1994, *Plastics — Acquisition and presentation of comparable multipoint data — Part 1: Mechanical properties.*

ISO 11403-2:1995, *Plastics — Acquisition and presentation of comparable multipoint data — Part 2: Thermal and processing properties.*

ISO 11403-3:—[2], *Plastics — Acquisition and presentation of comparable multipoint data — Part 3: Environmental influences on properties.*

3 Definitions

For the purposes of this part of ISO 10724, the definitions given in ISO 472 as well as the following apply.

3.1 mould temperature, T_C: The average temperature of the mould cavity surfaces measured after the system has attained thermal equilibrium and immediately after opening the mould.

It is expressed in degrees Celsius (°C).

3.2 melt temperature, T_M: The temperature of the plasticized material in a free shot.

It is expressed in degrees Celsius (°C).

3.3 melt pressure, p: The pressure of the plastic material in front of the screw at any time during the moulding process (see Figure 1).

It is expressed in megapascals (MPa).

The melt pressure, which is generated hydraulically for instance, can be calculated from the force F_S acting longitudinally on the screw using equation (1):

$$p = \frac{4 \times 10^3 \times F_S}{\pi \times D^2} \quad (1)$$

where

p is the melt pressure, in megapascals (MPa);

F_S is the longitudinal force, in kilonewtons (kN), acting upon the screw;

D is the screw diameter, in millimetres (mm).

3.4 hold pressure, p_H: The melt pressure during the hold time (see Figure 1).

It is expressed in megapascals (MPa).

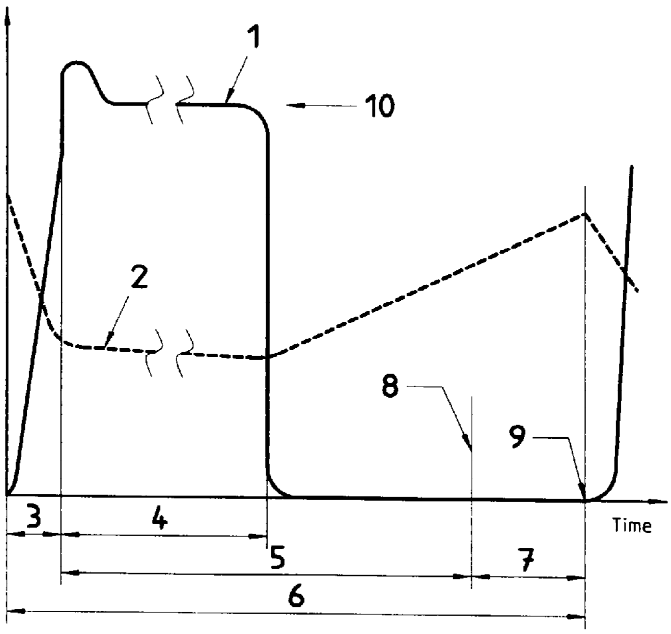
3.5 moulding cycle: The complete sequence of operations in the moulding process required for the production of one set of test specimens (see Figure 1).

3.6 cycle time, t_T: The time required to carry out a complete moulding cycle.

It is expressed in seconds (s).

The cycle time is the sum of the injection time t_I, the cure time t_{CR} and the mould-open time t_O.

2) To be published.



Key

1 Melt pressure, p
2 Longitudinal position of the screw
3 Injection time, t_I
4 Hold time, t_H
5 Cooling time, t_{CR}
6 Cycle time, t_T
7 Open time, t_O
8 Mould opening
9 Mould closing
10 Hold pressure, p_H

Figure 1 — Schematic diagram of an injection-moulding cycle, showing the melt pressure (full line) and the longitudinal position of the screw (dashed line) as a function of time

3.7 injection time, t_I: The time from the instant the screw starts to move forward until the switchover point between the injection period and the hold period.

It is expressed in seconds (s).

3.8 cure time, t_{CR}: The time from the end of the injection period until the mould starts to open.

It is expressed in seconds (s).

3.9 hold time, t_H: The time from the end of the injection period until the hold pressure p_H is released.

It is expressed in seconds (s).

3.10 mould-open time, t_O: The time from the instant the mould starts to open until the mould is closed and exerts the full locking force.

It is expressed in seconds (s).

It includes the time required to remove the mouldings from the mould.

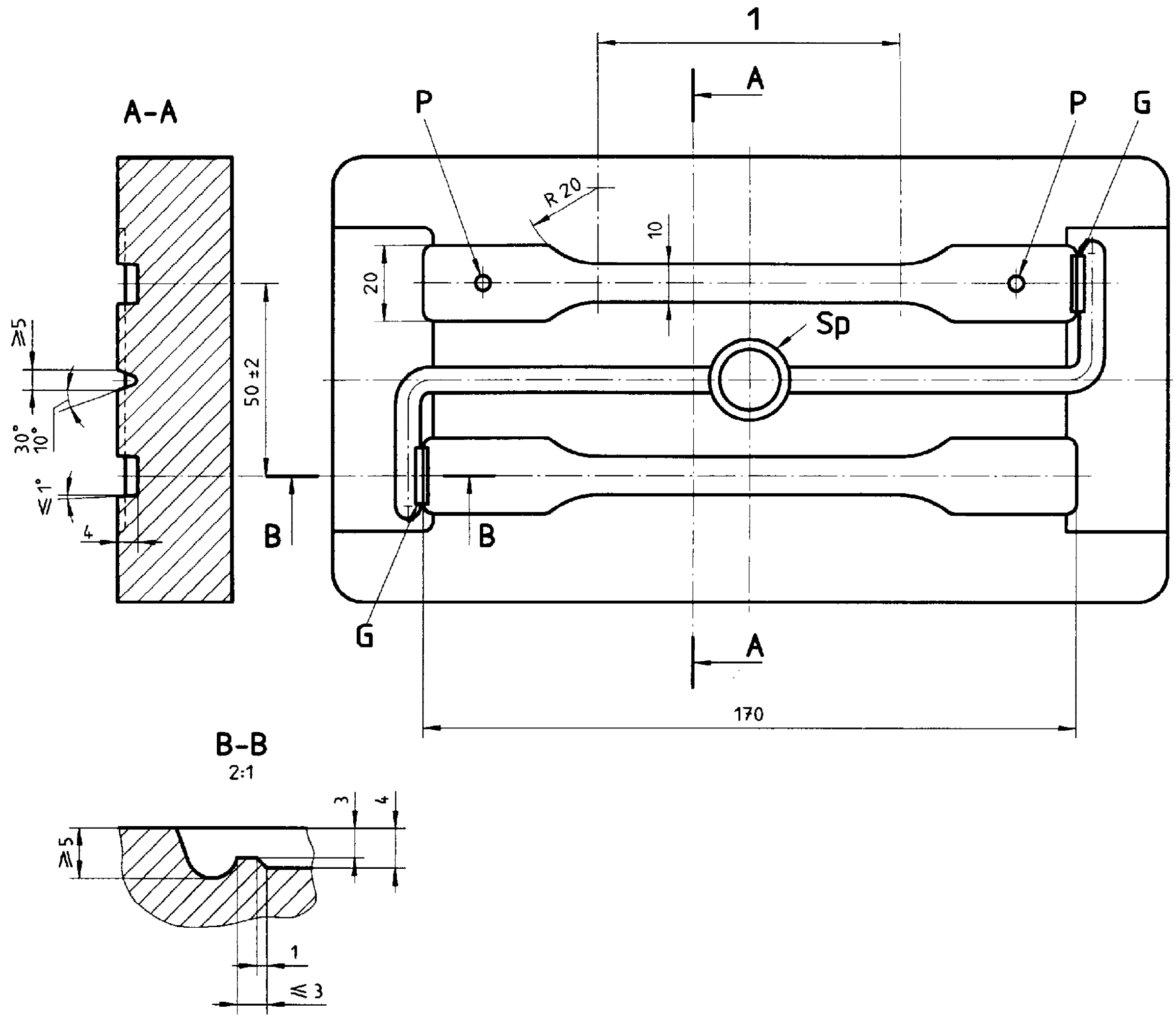
3.11 cavity: The part of the hollow space in a mould that produces one specimen.

3.12 multi-cavity mould: A mould that contains two or more identical cavities in a parallel-flow arrangement (see Figure 2).

The number of cavities in one multi-cavity mould is given by n.

Identical flow-path geometries and symmetrical positioning of the cavities in the cavity plate ensure that all test specimens from one shot are equivalent in their properties.

Dimensions in millimetres



Key

1 Preferably 82

Sp sprue

G gate

P pressure sensor (optional)

Shot capacity $V_S \approx 30\,000\ mm^3$
Projected area $A_P \approx 6\,300\ mm^2$

Figure 2 — Cavity plate for a type A ISO mould

3.13 ISO mould: Any one of several standard moulds (designated type A, D1 and D2) intended for the reproducible preparation of test specimens with comparable properties. The moulds have a fixed plate with a central sprue, plus a multi-cavity cavity plate as described in 3.12. Additional details are given in 4.1.4.

An example of a complete mould is shown in annex C.

3.14 critical cross-sectional area, A_C**:** The cross-sectional area of the cavity in a multi-cavity mould at the position where the critical portion of the test specimen, i.e. that part on which the measurement will be made, is moulded.

It is expressed in square millimetres (mm^2).

For tensile bar test specimens, for instance, the critical portion of the test specimen is the narrow section which is subjected to the greatest stress during testing.

3.15 moulding volume, V_M: The ratio of the mass of the moulding to the density of the solid plastic.

It is expressed in cubic millimetres (mm^3).

3.16 projected area, A_P: The overall profile of the moulding projected on to the parting plane.

It is expressed in square millimetres (mm^2).

3.17 locking force, F_M: The force holding the cavity plates of the mould closed.

It is expressed in kilonewtons (kN).

The minimum locking force necessary may be calculated from the inequality:

$$F_M \geqslant A_P \cdot p_{max} \times 10^{-3} \quad (2)$$

where

F_M is the locking force, in kilonewtons;

A_P is the projected area, in square millimetres;

p_{max} is the maximum value of the melt pressure, in megapascals.

3.18 injection velocity, v_I: The average velocity of the melt as it passes through the critical cross-sectional area A_C.

It is expressed in millimetres per second (mm/s).

It is applicable to multi-cavity moulds only, and is calculated from equation (3):

$$v_I = \frac{V_M}{t_I \times A_C \times n} \quad (3)$$

where

v_I is the injection velocity, in millimetres per second;

n is the number of cavities;

A_C is the critical cross-sectional area, in square millimetres;

V_M is the moulding volume, in cubic millimetres;

t_I is the injection time, in seconds.

3.19 mass of the moulding, m_M: The total mass of the moulding, including the specimens, runners and sprue.

It is expressed in grams (g).

3.20 shot capacity, V_S: The product of the maximum metering stroke of the injection moulding machine and the cross-sectional area of the screw.

It is expressed in cubic millimetres (mm^3).

4 Apparatus

4.1 ISO (multi-cavity) moulds

4.1.1 ISO moulds (see 3.13), are strongly recommended for producing test specimens for the acquisition of data which is intended to be comparable (see ISO 10350-1, ISO 11403-1, ISO 11403-2, and ISO 11403-3), as well as for use in the case of disputes involving International Standards.

4.1.2 Multipurpose test specimens as specified in ISO 3167 shall be moulded in a two-cavity type A ISO mould using a Z-runner (see annex A). The mould shall be as shown in Figure 2 and shall meet the requirements specified in 4.1.4.

4.1.3 Rectangular 80 mm (nominal) × 10 mm × 4 mm bars shall be cut symmetrically from the central parallel-sided section of the type A multipurpose test specimen (see ISO 3167) and the length shall be 80 mm ± 2 mm.

4.1.4 The main constructional details of the type A ISO mould shall be as shown in Figure 2 and shall meet the following requirements:

a) The sprue diameter on the nozzle side shall be at least 4 mm.

b) Both the width and height (or the diameter) of the runner system shall be at least 5 mm.

c) The cavities shall be one-end gated as shown in Figure 2.

d) The height of the gate shall be at least two-thirds the height of the cavity, and the width of the gate shall be equal to that of the cavity at the point where the gate enters the cavity.

e) The gate shall be as short as possible, in any case not exceeding 3 mm.

f) The draft angle of the runners shall be at least 10°, but not more than 30°. The cavity shall have a draft angle not greater than 1°, except in the area of tensile-specimen shoulders where the draft angle shall not be greater than 2°.

g) The dimensions of the cavities shall be such that the dimensions of the test specimens produced conform to the requirements given in the relevant test standard. To allow for different degrees of moulding shrinkage, the dimensions of the cavities shall be chosen so that they are between the nominal value and the upper limit of the dimensions specified for the specimen concerned. In the case of the type A ISO mould, the main cavity dimensions, in millimetres, shall be as follows (see ISO 3167):

— depth: 4,0 to 4,2;

— width of central section: 10,0 to 10,2;

— length of central parallel-sided section: 80,0 to 82,0.

h) Ejector pins, if used, shall be located outside the test area of the specimen, i.e. at the shoulders of dumbbell specimens produced from type A ISO moulds and outside the central 50-mm-diameter area of plate specimens from type D ISO moulds (see ISO 10724-2).

i) The heating system for the mould plates shall be designed so that, under operating conditions, the difference in temperature between any point on the surface of a cavity and either plate is less than 3 °C.

j) Interchangeable cavity plates and gate inserts are recommended to permit rapid changes in production from one type of test specimen to another. Such changes are facilitated by using shot capacities V_S which are as similar as possible. Examples of different runner configurations and the use of gate inserts is shown in annex A.

k) It is recommended that a pressure sensor be fitted in the central runner, to give proper control of the injection period (the sensor is mandatory for ISO 2577). A sensor position suitable for the various types of ISO mould is given in subclause 4.1, item k), and in Figure 1 of ISO 10724-2:1998.

l) To ensure that cavity plates are interchangeable between different ISO moulds, it is important to note the following constructional details in addition to those shown in Figure 2 and those given in ISO 10724-2:

1) It is recommended that a cavity length of 170 mm be used for multipurpose test specimens moulded in the type A ISO mould. This gives a maximum length of 180 mm for the hollow space in cavity plates.

2) The width of the mould plates may be affected by the minimum distance required between the connection points for the heating channels.

3) Lines along which the test specimens can be cut from the runners may be defined e.g. 170 mm apart for a type A ISO mould. A second pair of lines 80 mm apart may be defined for cutting bars from multipurpose test specimens from a type A ISO mould and may be used as well for cutting off small-plate mouldings (see ISO 10724-2).

m) To make it easier to check that all the specimens from a mould are identical, it is recommended that the individual cavities be marked, but outside the test area of the specimen [see item h) above]. This can be done very simply by engraving suitable symbols on the heads of the ejector pins, thus avoiding any damage to the surface of the cavity plate. Another option is shown in annex B.

n) Surface imperfections can influence the results, especially those of mechanical tests. Where appropriate, the surfaces of the mould cavities shall be highly polished therefore, the direction of polishing corresponding to the direction in which the test specimen will be placed under load when it is tested.

4.1.5 For more information on those mould components described in other International Standards, the reader is referred to annex D.

4.2 Injection-moulding machine

For the reproducible preparation of test specimens capable of giving comparable results, only reciprocating-screw injection-moulding machines equipped with all the necessary devices for the control of the moulding conditions shall be used.

4.2.1 Moulding volume

The ratio of the moulding volume V_M (see 3.15) to the shot capacity V_S (see 3.20) shall be between 20 % and 80 % unless a higher ratio is required by the relevant material standard or is recommended by the manufacturer.

4.2.2 Control system

The control system of the injection-moulding machine shall be capable of maintaining the operating conditions within the following tolerance limits:

Injection time, t_I	± 0,1 s
Hold pressure, p_H	± 5 %
Hold time, t_H	± 5 %
Melt temperature, T_M	± 3 °C
Mould temperature, T_C	± 3 °C
Mass of moulding, m_M	± 2 %

4.2.3 Screw

The screw shall be of a type suitable for the moulding material (e.g. length, diameter, thread height, compression ratio).

It is recommended that a screw with a diameter in the range between 18 mm and 40 mm is used.

4.2.4 Locking force

The mould-locking force F_M shall be high enough to prevent flash forming under any operating conditions.

The recommended minimum locking force F_M for a type A ISO mould is given by $F_M \geq 6500 \times p_{max} \times 10^{-3}$ (see 3.17), i.e. 520 kN for a maximum melt pressure of 80 MPa.

An injection-moulding system with interchangeable cavity plates will need to take into account the type D1 and D2 ISO moulds for which $A_P \approx 11\,000$ mm^2, thus requiring a significantly higher mould-locking force.

4.2.5 Thermometers

A needle-probe thermometer accurate to ± 1 °C shall be used to measure the melt temperature T_M (see 3.2). A surface thermometer accurate to ± 1 °C shall be used to measure the temperatures of the surface of the mould cavity, which gives the mould temperature T_C (see 3.1).

5 Procedure

5.1 Conditioning of material

Prior to moulding, condition the powder, pellets or granules of the thermosetting material as required in the relevant material standard or as recommended by the manufacturer if no standard covers this subject.

Avoid exposing materials to an atmosphere at a temperature significantly below the temperature of the workshop to avoid condensation of moisture on to the material.

5.2 Injection moulding

5.2.1 Set the machine to the conditions specified in the relevant material standard or agreed between the interested parties if no standard covers this subject.

5.2.2 For many thermosets, the most suitable range for the injection velocity v_I is 150 mm/s ± 50 mm/s when using a type A ISO mould. Note that, for a given value of the injection velocity v_I, the injection time t_I is inversely proportional to the number of cavities n in the mould [see equation (3) in subclause 3.18]. Keep any changes in the injection velocity during the injection period as small as possible.

5.2.3 To determine the hold pressure p_H, a parameter which is frequently not specified, carry out the following procedure:

Starting from zero, gradually increase the melt pressure until the mouldings are free from sink marks, voids and other visible faults and have minimum flash. Use this pressure as the hold pressure.

5.2.4 Ensure that the hold pressure is maintained constant until the material in the gate region has cured, i.e. until the mass of the moulding has reached an upper limiting value under these conditions.

5.2.5 Discard the mouldings until the machine has reached steady-state operation. Then record the operating conditions and begin test specimen collection.

During the moulding process, maintain the steady-state conditions by suitable means, e.g. by checking the mass of the moulding m_M.

5.2.6 In the event of any change in material, empty the machine and clean it thoroughly. Discard at least 10 mouldings made using the new material before beginning test specimen collection again.

5.3 Measurement of mould temperature

Determine the mould temperature T_C after the system has attained thermal equilibrium and immediately after opening the mould. Measure the temperature of the mould-cavity surface at several points on each side of the mould cavity using a surface thermometer. Between each pair of readings, cycle the mould for a minimum of 10 cycles before continuing with the next measurement. Record each measurement and calculate the mould temperature as the average of all the measurements.

5.4 Measurement of the melt temperature

Measure the melt temperature T_M by one of the following methods:

5.4.1 After thermal equilibrium has been attained, inject a free shot of at least 30 cm^3 into a non-metallic container of a suitable size and immediately insert the probe of a preheated rapid-response needle thermometer into the centre of the plasticized material, moving it about gently until the reading of the thermometer has reached a maximum.

Ensure that the preheating temperature is close to the melt temperature. Use the same injection conditions for the free shot as those to be used to mould the specimens, allowing the appropriate cycle time to elapse between each free shot.

5.4.2 The melt temperature may alternatively be measured by means of a suitable temperature sensor, provided the result obtained can be shown to be the same as that obtained using the free-shot method. The sensor shall cause only low heat losses and shall respond rapidly to melt temperature changes. Mount the sensor in a suitable place, such as in the nozzle of the injection-moulding machine. In case of doubt, use the method described in 5.4.1.

5.5 Post-moulding treatment of test specimens

Once removed from the mould, allow the test specimens to cool gradually and at the same rate to room temperature in order to avoid any differences in the history of individual test specimens.

NOTE Experience has shown that at least a part of this cooling time can have a significant influence on the degree of curing of thermosetting materials.

6 Report on test-specimen preparation

The report shall include the following information:

a) a reference to this part of ISO 10724;

b) the date, time and place the specimens were moulded;

c) a full description of the material used (type, designation, manufacturer, lot number);

d) details of any conditioning of the material carried out prior to moulding;

e) the type of mould used (type A or, in the case of another type of mould, the type of specimen produced, the relevant standard, the number of cavities and the gate size and location);

f) details of the injection-moulding machine used (manufacturer, shot capacity, mould-locking force, control systems);

g) the moulding conditions:

— melt temperature T_M (see 3.2), in degrees Celsius,
— mould temperature T_C (see 3.1), in degrees Celsius,

— injection velocity v_I (see 3.18), in millimetres per second,
— injection time t_I (see 3.7), in seconds,

— hold pressure p_H (see 3.4), in megapascals,
— hold time t_H (see 3.9), in seconds,

— cure time t_{CR} (see 3.8), in seconds,
— cycle time t_T (see 3.6), in seconds,

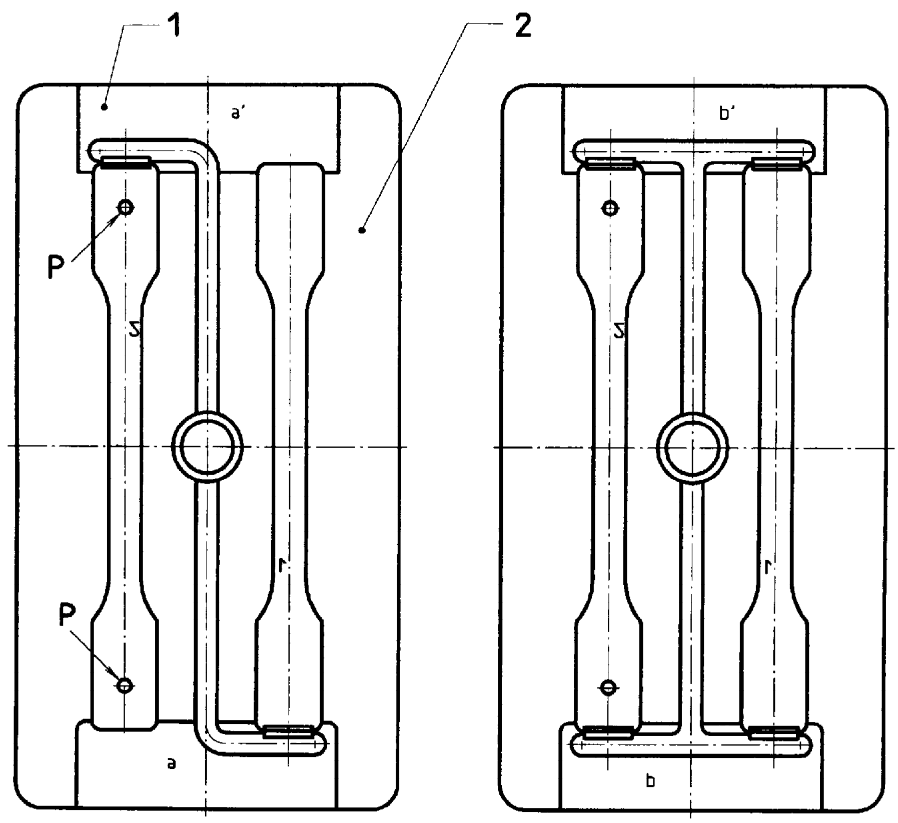
— mass of the moulding m_M (see 3.19), in grams;

h) any other relevant details (e.g. the number of mouldings initially discarded, the number retained, any post-moulding treatment).

Annex A
(informative)

Examples of runner configurations

The layout of a mould may be changed by means of gate inserts (a-a' or b-b') as shown in Figure A.1.



a) Injection mould as specified in this part of ISO 10724 (Z-runner)

b) Variant with double-T runner (e.g. for studying weld-line strength)

Key

1 Interchangeable gate insert

2 Interchangeable multi-cavity plate

P = Pressure sensor

Figure A.1 — Different types of runner configuration

Annex B
(informative)

Marking the test specimens

The purpose of marking is to permit the determination of the original position of the two specimens in the mould, even if the tabs at the ends of the specimen are cut off (e.g. to obtain a bar specimen with the dimensions of 80 mm × 10 mm × 4 mm). This kind of marking should preferably be done in additional to the marking by the heads of the ejector pins [see 4.1.4, item m)]. The requirement given in 4.1.4, item h), remains valid.

The numbers used, and their positions in the mould cavities, should preferably be as follows:

— the mirror images of the numbers "1" and "2" should be used;

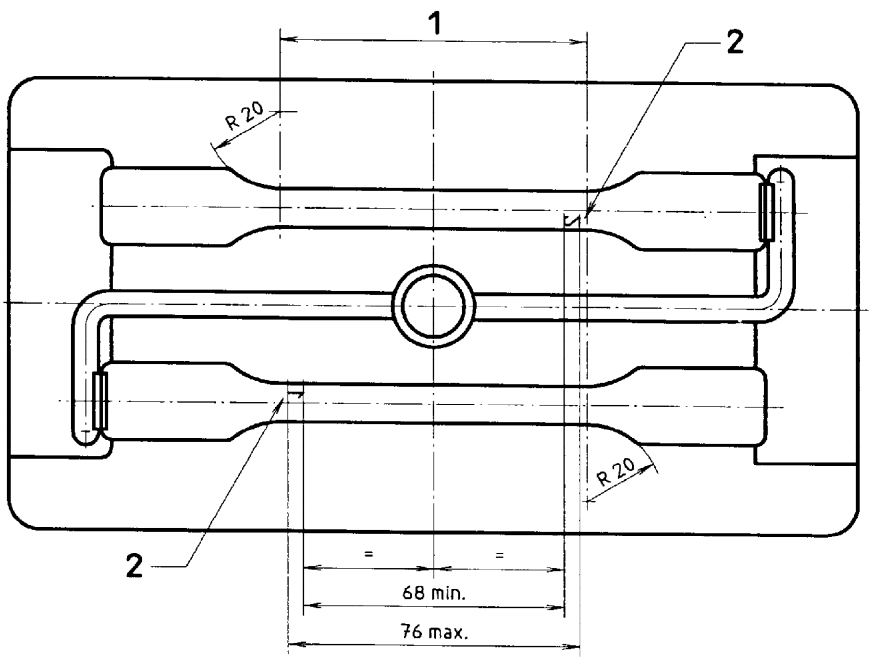
— the numbers should be legible, upright and aligned with the direction of flow of the material;

— the numbers should be outside the usual test-specimen support spans for flexural-loading tests, but within the length of an 80-mm-long bar specimen;

— the numbers should be just visible (i.e. not very deeply "engraved"), to avoid stress concentrations, etc.;

— the numbers should be located at the gate end of the cavity.

Dimensions in millimetres



Key

1 Preferably 82

2 Cavity number

Figure B.1 — Positions of the cavity numbers

Annex C
(informative)

Example of an injection mould

Figure C.1 shows an exploded view of an injection mould with interchangeable two-cavity plates for type A, B, C, D1 and D2 ISO moulds as well as for customer-tailored and possible future developments (X).

Details of the cavity plates shown in Figure C.1 are given in Table C.1 (information for thermosetting materials printed in bold).

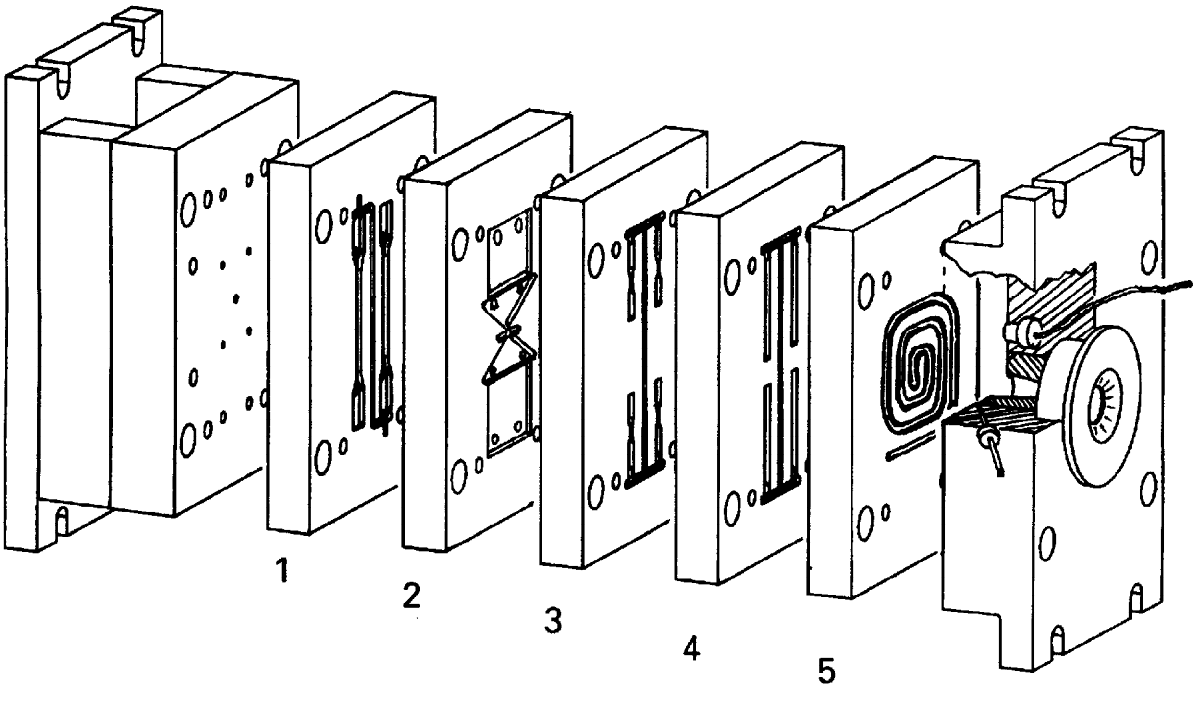


Figure C.1 — Exploded view of an injection mould with interchangeable cavity plates

Table C.1 — Details of cavity plates shown in Figure C.1

Number in Figure C.1	**1**	**2**	**3**	**4**	**5**
Type of ISO mould	A	D (D1 and D2)	C	B	X
ISO standard for mould — for thermosets — for thermoplastics	 **ISO 10724-1** ISO 294-1	 **ISO 10724-1** ISO 294-3	 — ISO 294-2	 — ISO 294-1	none
Type of test specimen and corresponding ISO standard	**Multipurpose specimen, type A** **ISO 3167**	**Small plate** **ISO 10724-2** ISO 294-3	Small tensile bar, type 4 ISO 8256	Rectangular bar ISO 3167	—
Main dimensions of test specimen, mm	**>150/80/10 × 4** ***r* = 20 to 25**	**60 × 60 × 1 (D1)** **60 × 60 × 2 (D2)**	60 × 10 × 3 *r* = 15	80 × 10 × 4	For future developments (e.g. "flow-spiral")

Annex D
(informative)

Standardized injection-moulding mould components

ISO 6751:1998, *Ejector pins with cylindrical head — Dimensions.*

ISO 6753-2:1998, *Tools for pressing and moulding — Machined plates — Part 2: Machined plates for moulds.*

ISO 8017:1985, *Mould guide pillars, straight and shouldered, and locating guide pillars, shouldered.*

ISO 8018:1985, *Mould guide bushes, headed, and locating guide bushes, headed.*

ISO 8404:1986, *Angle pins — Basis dimensions.*

ISO 8405:1998, *Tools for moulding — Ejector sleeves with cylindrical head — Basic series for general purposes.*

ISO 8406:1991, *Mould bases — Locating elements.*

ISO 8693:1998, *Tools for moulding — Flat ejector pins.*

ISO 8694:1998, *Tools for moulding — Shouldered ejector pins.*

ISO 9449:1990, *Tools for moulding — Centring sleeves.*

ISO 10072:1993, *Tools for moulding — Sprue bushes — Dimensions.*

ISO 10073:1991, *Tools for moulding — Support pillars.*

ISO 10907-1:1996, *Tools for moulding — Locating rings — Part 1: Locating rings for mounting without thermal insulating sheets in small or medium moulds — Types A and B.*

ISO 10907-2:—[3], *Tools for moulding — Locating rings — Part 2: Locating rings for mounting with thermal insulating sheets in small or medium moulds — Types C and D.*

ISO 12165:—[3], *Tools for moulding — Compression moulds, injection moulds and die-casting dies — Terms and symbols.*

3) To be published.

ICS 83.080.10

Descriptors: plastics, thermosetting materials, thermosetting resins, injection moulding, moulding materials, test specimens, specimen preparation, generalities.

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