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**ISO 294-3**

Third edition
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# Plastics — Injection moulding of test specimens of thermoplastic materials —

## Part 3: Small plates

*Plastiques — Moulage par injection des éprouvettes de matériaux thermoplastiques —*

*Partie 3: Plaques de petites dimensions*

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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).

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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 9, *Thermoplastic materials*, 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 third edition cancels and replaces the second edition (ISO 294-3:2002), which has been technically revised. It also incorporates the Amendment ISO 294-3:2002/Amd 1:2006.

The main changes compared to the previous edition are as follows:

— the requirements in Clause 4 have been clarified;

— the position of $h_G$ in Figure 2 has been corrected.

A list of all parts in the ISO 294 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.

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# Plastics — Injection moulding of test specimens of thermoplastic materials —

# Part 3: Small plates

## 1 Scope

This document specifies two two-cavity moulds, the type D11 and D12 ISO moulds, for the injection moulding of small plates measuring 60 mm × 60 mm with a preferred thickness of 1 mm (type D11) or 2 mm (type D12), which can be used for a variety of tests. The moulds can additionally be fitted with inserts for studying the effects of weld lines on the mechanical properties (see Annex A).

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 294-1:2017, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 1: General principles, and moulding of multipurpose and bar test specimens*

ISO 294-4, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 4: Determination of moulding shrinkage*

ISO 6603-1, *Plastics — Determination of puncture impact behaviour of rigid plastics — Part 1: Non-instrumented impact testing*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 294-1 apply.

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

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

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

## 4 Apparatus

### 4.1 Type D11 and D12 ISO moulds

Type D11 and D12 ISO moulds are two-cavity moulds (see Figure 1) intended for the preparation of plates measuring 60 mm × 60 mm. The plates produced using these moulds shall have the dimensions shown in Figure 2 and given in Table 1.

The main constructional details of type D11 and D12 ISO moulds shall be as shown in Figure 1 and Figure 2 and shall meet the following requirements.

a) The sprue diameter on the nozzle side shall be at least 4 mm according to ISO 294-1:2017, 4.1.1.4, item a).

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b) Runner length $l_R$ and runner depth $h_R$ see Table 1; runner design according to Figure 2.

c) The cavities as shown in Figure 1 shall be one-end gated according to ISO 294-1:2017, 4.1.1.4, item c).

d) The height of the gate shall be at least (75 ± 5) % of 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 length shall be (4 ± 0,1) mm.

f) The draft angle of the runners shall be according to ISO 294-1:2017, 4.1.1.4, item f).

g) The dimensions of the cavities shall fulfill requirement of ISO 294-1:2017, 4.1.1.4, item g). According to ISO 6603-1, the main dimensions, in millimetres, of the cavities shall be as follows (see also Figure 2):

   — length: 60 to 62;

   — width: 60 to 62;

   — depth: type D12 mould 2,0 to 2,1

     type D11 mould 1,0 to 1,1.

h) Ejector pins, if used, shall be located outside the test area, i.e. outside the 50-mm-diameter central section of the plate specimen.

i) Heating/cooling system for the mould plates shall be designed according to ISO 294-1:2017, 4.1.1.4, item i).

j) Interchangeable cavity plates as well as gate inserts shall be designed according to ISO 294-1:2017, 4.1.1.4, item j).

k) Figure 2 shows the position of a pressure sensor P within the cavity, which is mandatory for the measurement of moulding shrinkage according to ISO 294-4. It might be useful, however, in controlling the injections period with any ISO mould (see ISO 294-1:2017, 4.1.1.4 item k)). The pressure sensor shall be flush with the cavity surface in order to avoid interference of the melt flow.

l) To ensure that cavity plates are interchangeable between different ISO moulds see ISO 294-1:2017, 4.1.1.4, item l) for construction details.

m) Marking of individual cavities according to ISO 294-1:2017, 4.1.1.4, item m).

n) Polishing of surface imperfections according to ISO 294-1:2017, 4.1.1.4, item n).

NOTE 1 Gates which are severely limited in height have a great influence on the orientation of the material within the cavity, even at large distances from the gate. The change in height at the gate has therefore been fixed at a value which facilitates subsequent measurement of the moulding shrinkage (see ISO 294-4).

NOTE 2 The height and length of the gate strongly influence the process of solidification of the melt as it flows into the cavity, and hence the moulding shrinkage (see ISO 294-4). The dimensions of the gate are therefore defined with tight tolerances.

NOTE 3 The value specified for the gate length $l_G$ allows the two test specimens to be cut from the runners with a fixed distance $l_C$ between the cuts (see Figure 1), even when the moulding shrinkage varies from one material to another.

NOTE 4 The distance $l_C$ between the lines along which the test specimens are cut from the runners (see Figure 1) is given by $l_C = 2(l_G + l_R + l^*)$ (see Figure 2). Taking this distance as 80 mm gives the advantage that the same cutting machine can be used to cut 80 mm × 10 mm × 4 mm bars from the central sections of multipurpose test specimens [see ISO 294-1:2017, 4.1.1.4, item l)].

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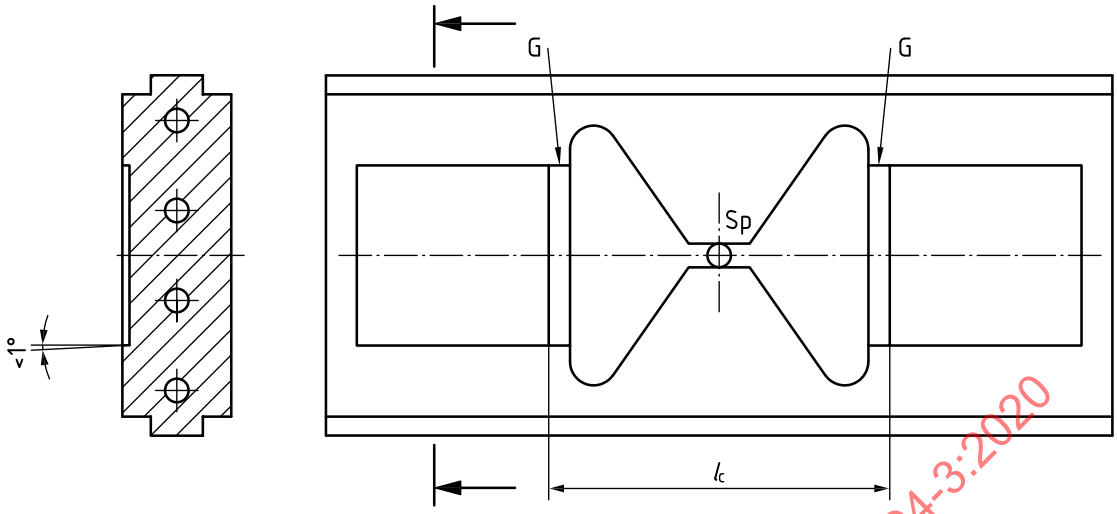


**Key**

Sp sprue

G gate

$l_C$ distance between the lines along which the test specimens are cut from the runners (see 4.1, NOTEs 3 and 4)

NOTE 1 Moulding volume $V_M$ approximately 23 000 mm$^3$ (at 2 mm thickness).

NOTE 2 Projected area $A_P$ approximately 11 000 mm$^2$.

**Figure 1 — Cavity plate for type D11 and D12 ISO moulds**

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**Table 1 — Dimensions of plates produced with type D11 and D12 ISO moulds**

Dimensions in millimetres

| | | | |
|---|---|---|---|
| $l$ | Length of plate | | 60 ± 2[a] |
| $b$ | Width of plate | | 60 ± 2[a] |
| $h$ | Thickness of plate: | type D11 mould | 1,0 ± 0,1 |
| | | type D12 mould | 2,0 ± 0,1[a] |
| $l_G$ | Length of gate | | 4,0 ± 0,1[b] |
| $h_G$ | Height of gate | | (0,75 ± 0,05) × $h$[c] |
| $l_R$ | Length of runner | | 25 to 30[d] |
| $b_R$ | Width of runner at gate | | ≥ ($b$ + 6) |
| $h_R$ | Depth of runner | | $h$ |
| $l$* | Unspecified distance | | — |
| $l_P$ | Distance of pressure sensor from gate | | 5 ± 2<br>$l_P + r_P \leq 10$[e]<br>$l_P - r_P \geq 0$ |

NOTE The dimensions of the plates given in this table differ from the cavity dimensions given in 4.1 g), because shrinkage can be accounted for by larger mould dimensions compared to the final part dimensions.

[a] These dimensions are for the preferred test specimen used in ISO 6603-1.

[b] See 4.1, NOTEs 2 and 3.

[c] See 4.1, NOTEs 1 and 2.

[d] See 4.1, NOTE 4.

[e] Where $r_P$ is the radius of the sensor.

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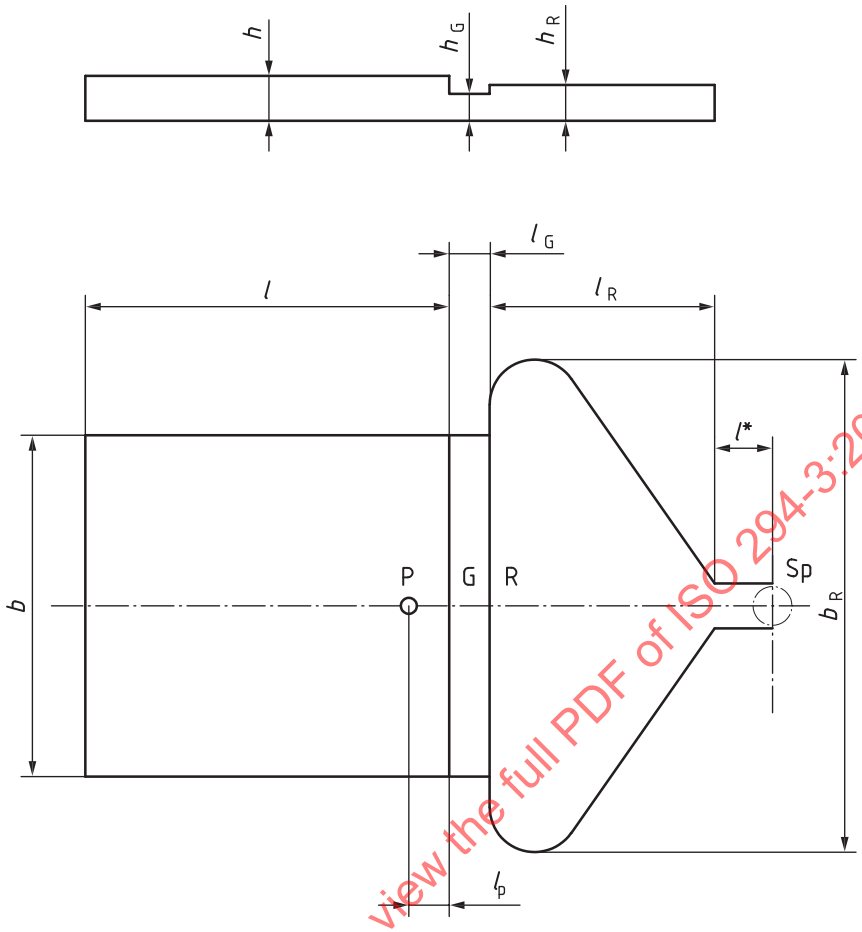


**Key**

| | |
|---|---|
| Sp | sprue |
| R | runner |
| G | gate |
| P | pressure sensor |
| $l^*$ | unspecified distance |
| $l_G$ | length of gate |

NOTE For the other symbols, see Table 1.

**Figure 2 — Details of type D11 and D12 ISO moulds**

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## 4.2 Injection-moulding machine

As specified in ISO 294-1:2017, 4.2, with the following exception:

In ISO 294-1:2017, 4.2.5, the recommended minimum locking force $F_M$ for type D11 and type D12 ISO moulds is given by

$$F_M \geq 11\,000 \times p_{max} \times 10^{-3}, \text{ i.e. } 880 \text{ kN}$$

for a maximum melt pressure $p_{max}$ of 80 MPa.

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# 5 Procedure

## 5.1 Conditioning of material

As specified in ISO 294-1:2017, 5.1.

## 5.2 Injection moulding

As specified in ISO 294-1:2017, 5.2, except for 5.2.2 which is replaced by the following.

For type D11 and type D12 ISO moulds, it is recommended that the injection velocity $v_1$ chosen be comparable to that used for the type A ISO mould.

# 6 Report on test-specimen preparation

The report shall include the following information:

a) a reference to this document, i.e. ISO 294-3:2020;

b) to h) see ISO 294-1:2017, Clause 6, items b) to h).

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# Annex A
(informative)

# Weld lines

The effects of weld lines on mechanical properties can be studied by fitting suitable inserts in the mould cavities (see Figure A.1 and Figure A.2).

Figure A.1 shows a single insert (hatched) near the gate, the weld line (full line) from which is formed between the two parallel melt flows produced. Type 4 tensile-bar specimens as specified in ISO 8256[8] can be machined from the moulding (shown by dashed lines) allowing the effect of the weld line to be studied, using tensile or tensileimpact testing in accordance with ISO 527-1[3] and ISO 8256[8], as a function of the distance from the insert.

Figure A.2 shows the use of a multiple insert (hatched) which generates weld lines (full lines) from opposed melt flows, each weld line representing a flow path of a different length.

The parallel melt flows shown in Figure A.1 and the opposed ones in Figure A.2 represent the two basic types of weld-line formation. In each case, only symmetrical arrangements of the two-cavity mould should be used.

NOTE For some materials, the data which can be obtained from the mould configurations shown in Figure A.1 and Figure A.2 can only be valid if flow distance is factored into the results, due to the drop in the pressure of the molten plastic as the distance from the gate increases. Other factors such as packing uniformity and crystallization rate of semi-crystalline materials can also have an influence. As a result, the strength of the weld line can vary with distance from the gate.

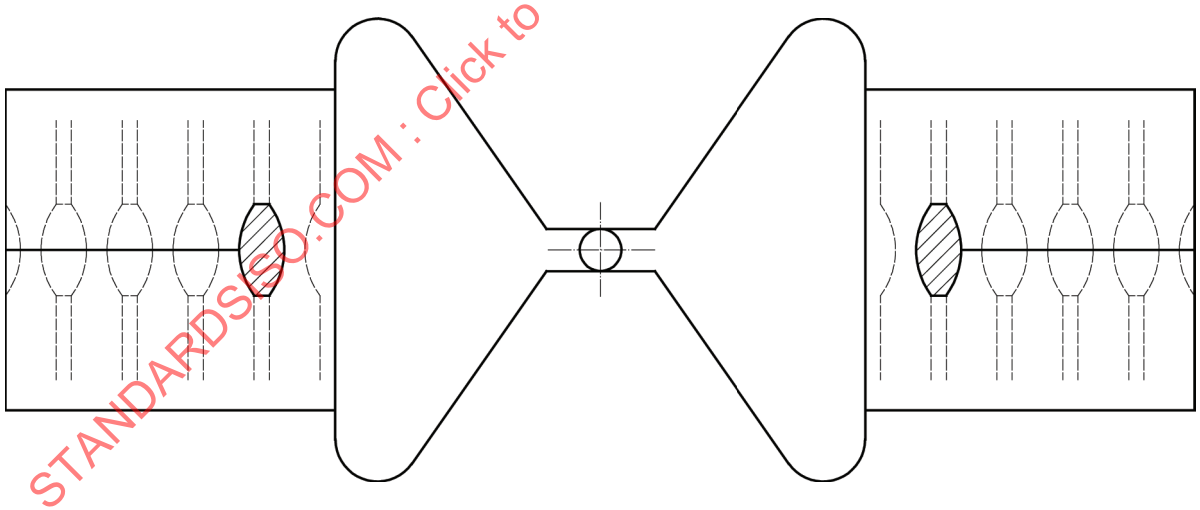

**Figure A.1 — Moulding produced using single inserts (hatched), showing the locations from where tensile test specimens can be taken (dashed lines)**

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