INTERNATIONAL STANDARD

ISO 294-1

First edition
1996-12-15

AMENDMENT 2
2005-09-01

Plastics — Injection moulding of test specimens of thermoplastic materials —

Part 1: General principles, and moulding of multipurpose and bar test specimens

AMENDMENT 2: Methods of determining the hold pressure and hold time

Plastiques — Moulage par injection des éprouvettes de matériaux thermoplastiques

Partie 1: Principes généraux, et moulage des éprouvettes à usages multiples et des barreaux

AMENDEMENT 2: Méthodes pour mesurer la pression de maintien et la durée de maintien

Reference number
ISO 294-1:1996/Amd.2:2005(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

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.

Amendment 2 to ISO 294-1:1996 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

Plastics — Injection moulding of test specimens of thermoplastic materials —

Part 1: General principles, and moulding of multipurpose and bar test specimens

AMENDMENT 2: Methods of determining the hold pressure and hold time

Page 10, Subclause 5.2.3

Add the following text at the end of the subclause:

The hold pressure can be determined using one of the following methods:

a) using the mass of the moulding;

b) using the sink mark ratio;

c) using the maximum melt pressure that does not yield flash marks.

Each of these methods is described in Clause D.1.

Other methods of determining the correct hold pressure are also allowed.

Page 10, Subclause 5.2.4

Replace the text of the subclause by the following:

Ensure that the hold pressure is maintained constant until the material in the gate region has solidified, i.e. during the hold time t_H. The hold time can be determined using one of the following methods:

a) using the mass of the moulding;

b) using the cavity pressure.

Each of these methods is described in Clause D.2.

Other methods of determining the correct hold time are also allowed.

Page 15

Add the following annex after Annex C.

Annex D
(informative)

Methods of determining the hold pressure and hold time

D.1 Methods of determining the hold pressure

NOTE Once the hold pressure has been determined by one of the methods described in this clause, it is not necessary to repeat the determination for the same material, and the determination may be simplified for similar materials.

D.1.1 Method using the mass of the moulding

D.1.1.1 Scope

This method determines the hold pressure to be used for moulding (see 5.2.3) as that melt pressure at which the mass of the moulding reaches a constant value after increasing as the melt pressure is gradually increased. If the mass of the moulding continues to increase as the melt pressure is increased, or if a constant value is obtained only when the melt pressure has increased to an excessively high level, the hold pressure may be determined using the mass of the specimen as the indicator instead of the mass of the moulding. In this case, it is necessary to be able to measure the mass of the specimen with sufficient repeatability, since the mass of the specimen is less than that of the moulding.

D.1.1.2 Terms and definitions

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

D.1.1.2.1
mass of moulding
total mass of the test specimens, the runner(s) and the sprue in a single moulding

NOTE It is expressed in grams (g).

D.1.1.2.2
mass of test specimen
mass of a single specimen, excluding the runner(s) and the sprue

NOTE It is expressed in grams (g).

D.1.1.3 Procedure

Using a hold time that is sufficient to ensure that the melt solidifies in the gate area, produce mouldings at a series of gradually increasing melt pressures, one moulding at each melt pressure. It is recommended that the first melt pressure used is 10 % of the injection pressure and that subsequent melt pressures are integral multiples of the first (if not, results obtained on test specimens injection-moulded in different laboratories will not necessarily be comparable). Measure the mass of the moulding produced, using a balance with an accuracy of $\pm 0{,}1$ g. Plot the mass of the moulding against the melt pressure as shown in curve A in Figure D.1. If at least three of the values of the mass of the moulding are statistically constant as the melt pressure increases, take the mean value of the melt pressures corresponding to the first three of these points (points 1 to 3 on curve A) as the hold pressure.

If the mass of the moulding continues to increase as the melt pressure increases (curve C), or the mass of the moulding stabilizes only after an excessively high melt pressure, such as one at which excessive flash occurs, is reached, the hold pressure may be taken as the melt pressure at which the mass of a specimen less any flash (instead of the mass of the moulding) reaches a constant value when plotted against the melt pressure. Otherwise, the hold pressure may be determined by either of the methods described in D.1.2 and D.1.3.

D.1.2 Method using the sink mark ratio

D.1.2.1 Scope

This method determines the hold pressure using the so-called sink mark ratio (SR) which is a quantitative indication of the depth of a sink mark on the surface of a specimen. The hold pressure to be used for moulding (see 5.2.3) is taken as that melt pressure at which the SR reaches a constant value after decreasing as the melt pressure is increased (in other words, the pressure at which the sink mark is least deep). This method is effective for materials such as crystalline polymers with which sink marks on the surfaces of specimens are large and their depth clearly changes as the melt pressure increases.

D.1.2.2 Terms and definitions

D.1.2.2.1
sink mark ratio
SR
indication of the relative depth of a sink mark on the surface of the specimen, as given by Equation (D.1):

$$SR = \frac{(h_{max} - h_{min})}{h_{max}} \qquad (D.1)$$

where

h_{min} is the minimum thickness of the specimen, calculated as the average of the thicknesses at three points P_{min1}, P_{min2} and P_{min3} along the length of the specimen, as defined in Figures D.2 and D.3;

h_{max} is the maximum thickness of the specimen, calculated as the average of the thicknesses at three points P_{max1}, P_{max2} and P_{max3} along the length of the specimen, as defined in Figures D.2 and D.3

NOTE It is expressed to two significant figures (e.g. 0,032).

D.1.2.3 Procedure

Using a hold time that is sufficient to ensure that the melt solidifies in the gate area, produce mouldings at a series of gradually increasing melt pressures, one moulding at each melt pressure. It is recommended that the first melt pressure used is 10 % of the injection pressure and that subsequent melt pressures are integral multiples of the first (if not, results obtained on test specimens injection-moulded in different laboratories will not necessarily be comparable).

Using a micrometer with a hemispherical tip of radius of 4 mm and an accuracy of ± 0,01 mm, measure h_{min} at P_{min1}, P_{min2} and P_{min3}, to the nearest 0,01 mm, for each of the specimens produced.

Using vernier callipers accurate to ± 0,05 mm, measure the maximum thickness h_{max} at P_{max1}, P_{max2} and P_{max3}, to the nearest 0,01 mm, for each of the specimens produced.

Measure the thickness of all specimens at approximately the same time after moulding and under the same ambient conditions, since it changes with time.

For each melt pressure, calculate SR using Equation (D.1). Plot SR against the melt pressure as shown in curve B in Figure D.1. If at least three of the values of SR are statistically constant as the melt pressure increases, take the mean value of the melt pressures corresponding to the first three of these points (points 1 to 3 on curve B) as the hold pressure.

If h_{max} changes little as the melt pressure increases, h_{min} may be used as the indicator to determine the hold pressure instead of SR.

D.1.3 Method using the maximum melt pressure that does not produce flash

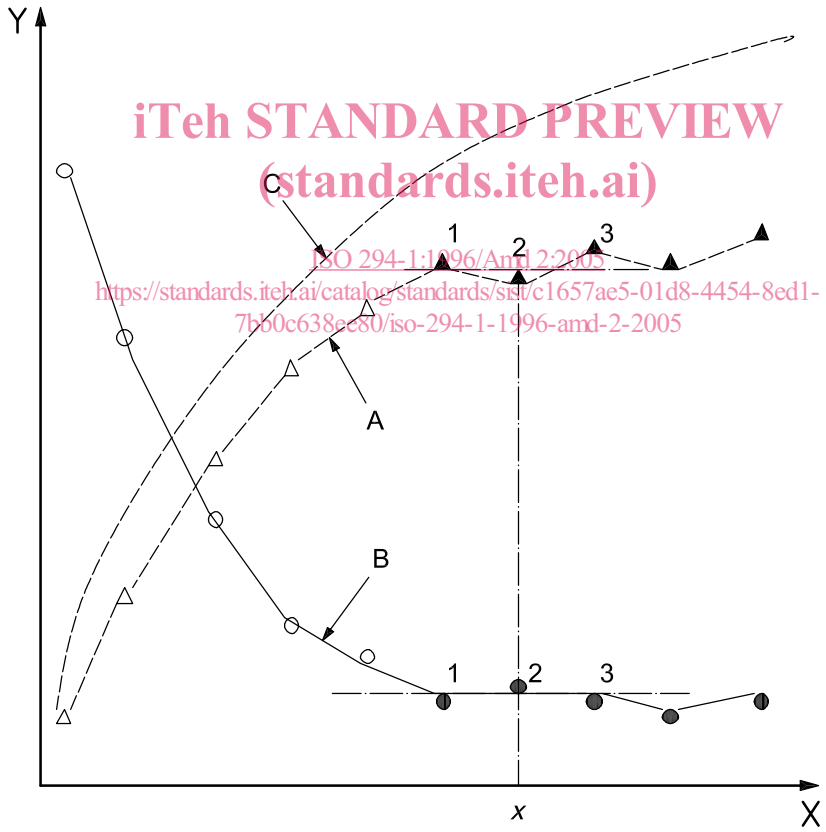
D.1.3.1 Scope

This method determines the hold pressure to be used for moulding (see 5.2.3) as that melt pressure at which flash first occurs as the melt pressure is gradually increased. This method of determining the hold pressure is applicable to those materials that are highly fluid in the molten state and likely to produce flash.

D.1.3.2 Procedure

Using a hold time that is sufficient to ensure that the melt solidifies in the gate area, produce mouldings at a series of gradually increasing melt pressures, one moulding at each melt pressure. It is recommended that the first melt pressure used is 10 % of the injection pressure and that subsequent melt pressures are integral multiples of the first (if not, results obtained on test specimens injection-moulded in different laboratories will not necessarily be comparable). Inspect each moulding for the presence of flash by observation with the naked eye or with a magnifying glass.

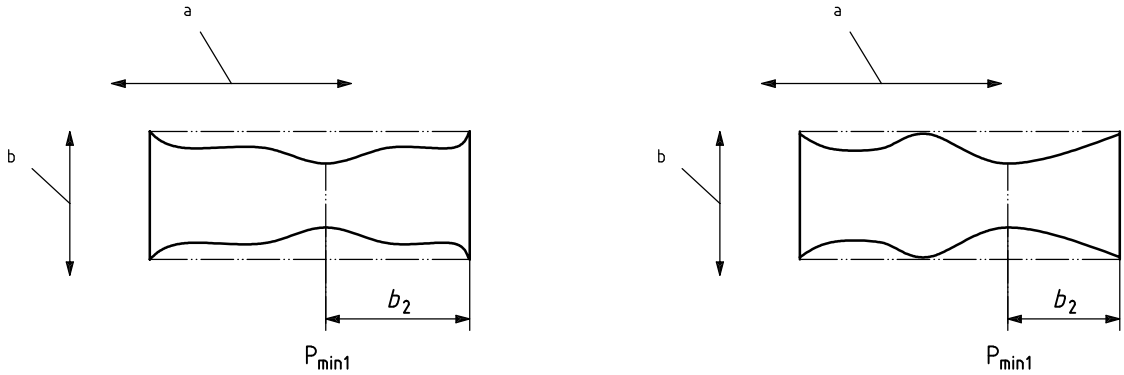
In the case of a moulding machine with facilities for monitoring pressure and time, gradually increase the shot volume and observe the sharp increase in melt pressure caused by the formation of flash. Take as the hold pressure a suitable value of the melt pressure at e.g. 5 MPa immediately below the pressure at which flash first occurs.



Key

X-axis	Y-axis	Property determined	Curve
Melt pressure	Mass of moulding or specimen	Hold pressure	A, C
Melt pressure	Sink mark ratio	Hold pressure	B
Time	Mass of moulding or specimen	Hold time	A, C
x		Value of property	A, B

Figure D.1 — Schematic diagram of the determination of hold pressure and hold time
(for cases when measurements are made at regular intervals, as recommended in e.g. D.1.3.2)



a) Sink mark in centre **b) Sink mark off-centre**

Key

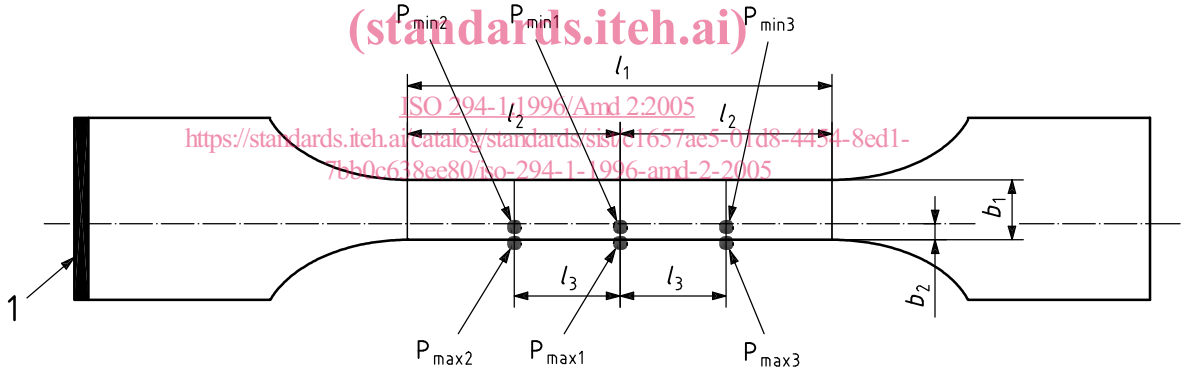
b_2 distance across the width between an edge and P_{min1}

P_{min1} located at longitudinal centre of the narrow, parallel-sided section of the specimen (see also Figure D.3) (point P_{min1} may be located at the centre of the line across the width of the specimen as shown in the left-hand drawing above or in another position off-centre as shown in in the right-hand drawing)

a Width direction.

b Thickness direction.

Figure D.2 — Position of measurement point P_{min} across width of specimen



l_1	80 mm
l_2	40 mm
l_3	15 mm to 25 mm
b_1	10 mm

Key

1 gate

b_2 distance across the width between an edge and P_{min1} (see also Figure D.2)

P_{min1} measurement point located at longitudinal centre of the narrow, parallel-sided section of the specimen (see also Figure D.2) [point P_{min1} may be located at the centre of the line across the width of the specimen as shown in Figure D.2a) or in another position off-centre as shown in Figure D.2b)]

P_{min2} and P_{min3} measurement points located at the same distance b_2 across the width from an edge as P_{min1} and at distances $+l_3$ and $-l_3$ in the longitudinal direction from P_{min1}

P_{max1}, P_{max2} and P_{max3} measurement points located at the same longitudinal positions as P_{min1}, P_{min2} and P_{min3}, respectively, but along one edge of the narrow, parallel-sided section of the specimen as shown in the figure

Figure D.3 — Points for measuring h_{min} and h_{max} for a multipurpose test specimen