
**Plastics — Injection moulding of test
specimens of thermoplastic materials —
Part 4:
Determination of moulding shrinkage**

*Plastiques — Moulage par injection des éprouvettes de matériaux
thermoplastiques —
Partie 4: Détermination du retrait au moulage*

ISO 294-4:2001

<https://standards.iteh.ai/catalog/standards/sist/7bac0a33-78a4-4745-ba2e-e212bf80d5c2/iso-294-4-2001>



Reference number
ISO 294-4:2001(E)

© ISO 2001

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 294-4:2001

<https://standards.iteh.ai/catalog/standards/sist/7bac0a33-78a4-4745-ba2e-e212bf80d5c2/iso-294-4-2001>

© ISO 2001

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

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.ch
Web www.iso.ch

Printed in Switzerland

Contents

	Page
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Apparatus	3
5 Procedure	3
6 Expression of results	6
7 Precision	7
8 Test report	7

Annex

A Reference points for length and width measurement.....	8
Bibliography.....	9

iTeh STANDARD PREVIEW (standards.iteh.ai)

ISO 294-4:2001

<https://standards.iteh.ai/catalog/standards/sist/7bac0a33-78a4-4745-ba2e-e212bf80d5c2/iso-294-4-2001>

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 3.

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 part of ISO 294 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 294-4 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

This second edition cancels and replaces the first edition (ISO 294-4:1997), which has been technically revised.

ISO 294 consists of the following parts, under the general title *Plastics — Injection moulding of test specimens of thermoplastic materials*:

- *Part 1: General principles, and moulding of multipurpose and bar test specimens*
- *Part 2: Small tensile bars*
- *Part 3: Small plates*
- *Part 4: Determination of moulding shrinkage*
- *Part 5: Preparation of standard specimens for investigating anisotropy*

Annex A of this part of ISO 294 is for information only.

Introduction

See ISO 294-1.

In the injection moulding of thermoplastics, the difference between the dimensions of the mould cavity and those of the moulded articles produced from it may vary with the design and operation of the mould. Such differences may depend on the size of the injection-moulding machine, the shape and dimensions of mouldings including any restrictive action this may have on the shrinkage, the degree and direction of flow or movement of the material in the mould, the sizes of the nozzle, sprue, runner and gate, the cycle on which the machine is operated, the temperature of the melt and the mould, and the magnitude and duration of the hold pressure. Moulding and post-moulding shrinkage are caused by crystallization, volume relaxation and orientation relaxation of the material and by thermal contraction of both the thermoplastic material and the mould. Post-moulding shrinkage may also be influenced by humidity uptake.

The measurement of moulding and post-moulding shrinkage is useful in making comparisons between thermoplastics and in checking uniformity of manufacture.

The method is not intended as a source of data for design calculations of components. Information on the typical behaviour of a material can be obtained, however, by carrying out measurements at different melt and mould temperatures, injection velocities and hold pressures, as well as at different values of other injection-moulding parameters. The information thus obtained is important in establishing the suitability of the moulding material for the production of moulded articles with accurate dimensions.

(standards.iteh.ai)

ISO 294-4:2001

<https://standards.iteh.ai/catalog/standards/sist/7bac0a33-78a4-4745-ba2e-e212bf80d5c2/iso-294-4-2001>

iTeh STANDARD PREVIEW **(standards.iteh.ai)**

ISO 294-4:2001

<https://standards.iteh.ai/catalog/standards/sist/7bac0a33-78a4-4745-ba2e-e212bf80d5c2/iso-294-4-2001>

Plastics — Injection moulding of test specimens of thermoplastic materials —

Part 4: Determination of moulding shrinkage

1 Scope

This part of ISO 294 specifies a method of determining the moulding shrinkage and post-moulding shrinkage of injection-moulded test specimens of thermoplastic material in the directions parallel to and normal to the direction of melt flow.

For the determination of shrinkage of thermosets see ISO 2577^[2].

Moulding shrinkage as defined in this part of ISO 294 excludes the effects of humidity uptake. This is included in post-moulding shrinkage and thus in total shrinkage. For cases when post-moulding shrinkage is caused by the uptake of humidity only, see ISO 175^[1].

Moulding shrinkage as defined in this part of ISO 294 represents the so-called free shrinkage with unrestricted deformation of the cooling plates in the mould during the hold period. It may be considered therefore as the maximum value of any restricted shrinkage.

2 Normative references

[ISO 294-4:2001](https://standards.iteh.ai/catalog/standards/sist/7bac0a33-78a4-4745-ba2e-e212bf80d5c2/iso-294-4-2001)

<https://standards.iteh.ai/catalog/standards/sist/7bac0a33-78a4-4745-ba2e-e212bf80d5c2/iso-294-4-2001>

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 294. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 294 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC 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 294-3:—¹⁾, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 3: Small plates*

1) To be revised. (Revision of ISO 294-3:1996)

3 Terms and definitions

For the purposes of this part of ISO 294, the terms and definitions given in ISO 294-1 together with the following apply.

3.1

moulding shrinkage

S_M

difference in dimensions between a dry test specimen and the mould cavity in which it was moulded, both the mould and the test specimen being at room temperature when measured

NOTE 1 It is expressed as a percentage (%) of the mould cavity dimension concerned.

NOTE 2 The moulding shrinkage S_{Mp} parallel to the melt flow direction is determined at the mid-point of the width of the test specimen, and the moulding shrinkage S_{Mn} normal to the flow direction at the mid-point of the length.

3.2

post-moulding shrinkage

S_P

difference in the dimensions of a moulded test specimen before and after a post-moulding treatment, measured at room temperature

NOTE 1 It is expressed in percent (%).

NOTE 2 The post-moulding shrinkage S_{Pp} parallel to the melt flow direction and the post-moulding shrinkage S_{Pn} normal to the flow direction are defined in analogous fashion to S_{Mp} and S_{Mn} in 3.1.

3.3

total shrinkage

S_T

difference in dimensions between a test specimen after a post-moulding treatment and the mould cavity in which it was moulded, measured at room temperature

NOTE 1 It is expressed in percent (%).

NOTE 2 The total shrinkage S_{Tp} parallel to the melt flow direction and the total shrinkage S_{Tn} normal to the flow direction are defined in analogous fashion to S_{Mp} and S_{Mn} in 3.1.

3.4

cavity pressure

p_C

pressure of the thermoplastic material in the cavity at any time during the moulding process, measured centrally near the gate

NOTE It is expressed in megapascals (MPa).

3.5

cavity pressure at hold

p_{CH}

cavity pressure (3.4) 1 s after the end of the injection time t_i (see Figure 1)

NOTE It is expressed in megapascals (MPa).

4 Apparatus

4.1 Type D2 ISO mould, giving 60 mm × 60 mm × 2 mm plate specimens, as specified in ISO 294-3:—, subclause 4.1.

Reference marks may be engraved in the mould cavity to facilitate the measurement of the dimensions of the test specimens produced from the mould using optical techniques. Such reference marks, if used, shall be located at a distance of (4 ± 1) mm from the edges of the mould cavity.

It is recommended that such marks be at most 5 µm in depth in order to ensure that they do not restrict the shrinkage process in any way (see Introduction). Pins inserted in the correct plane have also been used successfully.

Installation of a pressure sensor P, recommended for parts 1 to 3 of this International Standard [see ISO 294-1:1996, 4.1.1.4, item k) and ISO 294-3:—, Figure 2], is mandatory for shrinkage measurements.

The mould plates used shall be rigid enough to avoid the moulded plates being thicker than the depth of the cavity, for the whole range of hold pressures that result in positive shrinkage in length or width.

4.2 Injection-moulding machine, in accordance with 4.2 of ISO 294-3:—, but adding the following tolerance limits to the list of operating conditions given in 4.2.2 of ISO 294-1:1996:

Cavity pressure, $p_C \pm 5\%$

4.3 Measuring equipment, capable of measuring the length and width of each test specimen and of the mould cavity to within 0,02 mm, the measurements being made between the centres of opposite sides or between the opposite edges or between pairs of reference marks (see annex A). When measuring the length of a test specimen, take care to include the 0,5-mm-high step at the gate end of the specimen. If a mechanical instrument is used, ensure that the jaws of the instrument do not produce a significant indentation.

It is recommended that a calibration plate be used to periodically check the measuring equipment.

4.4 Oven, necessary only if post-moulding shrinkage is to be measured, by agreement between the interested parties.

5 Procedure

5.1 Conditioning of material

As specified in ISO 294-1:1996, 5.1.

5.2 Injection moulding

5.2.1 For the basic injection-moulding conditions, see ISO 294-3:—, 5.2.

5.2.2 The moulding shrinkage is preferably determined for one or more values of the cavity pressure at hold p_{CH} (see 3.5) selected from 20 MPa, 40 MPa, 60 MPa, 80 MPa and 100 MPa. Intermediate values may also be used, however.

NOTE For values higher than 80 MPa, a correspondingly high locking force will be necessary, and this may not be possible with normal commercial equipment.