INTERNATIONAL STANDARD

ISO 2818

Fourth edition
2018-12

Plastics — Preparation of test specimens by machining

Plastiques — Préparation des éprouvettes par usinage

Reference number
ISO 2818:2018(E)

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Published in Switzerland

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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).

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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, *Mechanical properties*.

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.

This fourth edition cancels and replaces the third edition (ISO 2818:1994), of which it constitutes a minor revision to update the references in Clause 2. It also incorporates the Technical Corrigendum ISO 2818:1994/Cor 1:2007.

Introduction

The preparation of test specimens by machining influences the finished surfaces and, in some cases, even the internal structure of the specimens. Since test results are strongly dependent on both of these parameters, exact definitions of tools and machining conditions are required for reproducible test results with machined specimens.

Plastics — Preparation of test specimens by machining

1 Scope

This document establishes the general principles and procedures to be followed when machining and notching test specimens from compression-moulded and injection-moulded plastics, extruded sheets, plates and partially finished or wholly finished products.

In order to establish a basis for reproducible machining and notching conditions, the following general standardized conditions are applied. It is assumed, however, that the exact procedures used are selected or specified by the relevant material specification or by the standards on the particular test methods. If sufficiently detailed procedures are not thus specified, the interested parties agree upon the conditions to be used.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/

3.1 Milling

NOTE In this machining operation, the tool has a circular primary motion and the workpiece a suitable feed motion. The axis of rotation of the primary motion retains its position with respect to the tool, independently of the feed motion (see ISO 3855). Complete dumb-bell and rectangular test specimens, as well as notches in finished specimens, may be prepared by milling.

3.1.1 Geometry (see ISO 3002-1 and Figure 1)

NOTE Only a few details of the exact geometrical conditions of the milling tool and its position with respect to the workpiece given in ISO 3002-1 are relevant to this document.

3.1.1.1
tool-cutting-edge angle
α_r
angle between the tool-cutting-edge plane, P_s, and the assumed working plane, P_f, measured in the tool back plane, P_r

3.1.1.2
tool back clearance
α_p
angle between the flank, A_α, of the cutter and the tool-cutting-edge plane, P_s, measured in the tool back plane, P_p

3.1.1.3
tool side clearance
α_f
angle between the flank A_α of the cutter and the tool-cutting-edge plane P_s, measured in the assumed working plane, P_f

3.1.1.4
tool radius
R
distance between the axis of the circular primary motion of the tool and its cutting edge

3.1.1.5
number of cutting teeth
z
number of cutting edges on the outer periphery of the rotating milling tool

3.1.2 Tool and workpiece motions (see ISO 3002-1 and Figure 2)

3.1.2.1
rotational speed of tool
n
speed of the circular primary motion of the tool

Note 1 to entry: The rotational speed of tool is expressed in revolutions per minute (r/min).

3.1.2.2
cutting speed
v_c
instantaneous velocity of the primary motion of a selected point on the cutting edge relative to the workpiece

Note 1 to entry: The relationship between v_c and n is given by the formula $v_c = n \cdot 2\pi R$.

Note 2 to entry: The cutting speed is expressed in metres per minute.

3.1.2.3
feed speed
v_f
instantaneous velocity of the feed motion of a selected point on the cutting edge relative to the workpiece

Note 1 to entry: The feed speed is expressed in metres per minute.

3.1.2.4
feed path
λ
distance at any given point on the surface of the workpiece covered during the time between two successive cutting operations

Note 1 to entry: The feed path is given by the formula $\lambda = v_f / z \cdot n$.

Note 2 to entry: The feed path is expressed in millimetres.

3.1.2.5
cutting depth
a
<mean> distance between the surfaces of the workpiece before and after one complete milling run

Note 1 to entry: The cutting depth is expressed in millimetres.

3.2 Cutting of rectangular test specimens

NOTE In this machining operation, rectangular test specimens are cut by means of a circular or band saw, made from hardened steel or coated with diamond or cubic boron nitride powder, or cut with the aid of an abrasive disc of which the cutting edge may be coated with diamond or boron nitride powder. For further details on abrasive discs and abrasive products, see ISO 21950 and ISO 6104.

3.2.1 Geometry

3.2.1.1
tool radius
R
distance between the rotary axis of a circular saw or an abrasive disc and the cutting edges of the tool

Note 1 to entry: The tool radius is expressed in millimetres.

3.2.1.2
number of cutting teeth
z
number of cutting teeth on the periphery of a circular saw

3.2.2 Tool and workpiece motions

3.2.2.1
rotational speed of tool
n
speed of rotation of a circular saw or an abrasive disc

Note 1 to entry: Rotational speed of tool is expressed in revolutions per minute (r/min).

3.2.2.2
cutting speed
v_c
instantaneous velocity of the cutting tip of a saw tooth, or of a selected point on the cutting edge of an abrasive disc, relative to the workpiece

Note 1 to entry: For a circular saw or an abrasive disc, the relationship between v_c and n is given by the formula $v_c = n \cdot 2\pi R$.

Note 2 to entry: The cutting speed is expressed in metres per minute.

3.2.2.3
feed speed
v_f
instantaneous velocity of the tool feed parallel to the saw or disc plane and perpendicular to the cutting direction relative to the workpiece

Note 1 to entry: The feed speed is expressed in metres per minute.

3.3 Cutting of disc-shaped test specimens (see Figure 4)

NOTE In this machining operation, disc-shaped test specimens are cut from sheet material with the aid of a circular cutter with a saw-toothed edge of hardened steel or which may be coated with diamond or cubic boron nitride powder. The test specimens may also be cut by means of a milling cutter with one or more teeth, as described in 3.1, which moves in a circular orbit. Furthermore, the test specimens may also be cut from a roughly preshaped pack of individual sheets with the aid of a turning lathe.

3.3.1 Geometry

3.3.1.1
tool radius
R
distance between the rotary axis of the circular cutter and the inner limit of the cutting edge

Note 1 to entry: The tool radius is equal to the radius of the finished test specimen. It is expressed in millimetres.

3.3.1.2
number of cutting teeth
z
number of teeth on the sawtooth cutting edge of a circular cutter

Note 1 to entry: If a lathe is used for cutting circular test specimens, the geometrical definitions of the cutting tool are the same as those given in 3.1.

3.3.2 Tool and workpiece motions

3.3.2.1
rotational speed of tool
n
speed of rotation of a circular cutter

Note 1 to entry: The rotational speed of tool is expressed in revolutions per minute.

3.3.2.2
cutting speed
v_c
instantaneous velocity of a selected point on the cutting edge relative to the workpiece.

Note 1 to entry: The relationship between v_c and n is given by the formula $v_c = n \cdot 2\pi R$.

Note 2 to entry: The cutting speed is expressed in metres per minute.

3.3.2.3
feed speed
v_f
instantaneous velocity, in metres per minute, of the tool feed parallel to the rotary axis of the circular cutter and perpendicular to the cutting direction relative to the workpiece

3.4 Planing of rectangular bars and planing or broaching of notches in finished test specimens

NOTE In this machining operation, sawed or sliced rectangular bars are finished by planing. Also, notches in finished specimens can be cut by planing or broaching.

3.4.1 Geometry

NOTE For this machining operation, the geometry of the *tool-cutting-edge angle*, *the tool back clearance* and the *tool side clearance* is defined, respectively, in 3.1.1.1, 3.1.1.2 and 3.1.1.3.

3.4.2 Tool and workpiece motions

3.4.2.1
cutting speed
v_c
instantaneous velocity of the primary motion of a selected point on the cutting edge relative to the workpiece

Note 1 to entry: The cutting speed is expressed in metres per minute.

3.4.2.2
cutting depth
a
<mean> distance between the surfaces of the workpiece before and after one planing run

Note 1 to entry: The cutting depth is expressed in millimetres.

3.5 Stamping of arbitrarily shaped test specimens fabricated from thin sheets

NOTE In this operation, arbitrarily shaped test specimens are stamped under high pressure from thin sheets by means of a tool with a sharp edge made from hardened steel and located in a plane parallel to the plane of the sheet.

3.5.1 Geometry

3.5.1.1
shape of the stamping tool
geometric shape of the stamping edge in a plane parallel to the sheet plane

Note 1 to entry: The shape of the stamping tool depends on the shape of the test specimen to be stamped, along with its required dimensions and tolerances.

3.5.2 Forces on the tool and tool motion

3.5.2.1
contact force
F_c
force applied to the stamping tool in the direction perpendicular to the sheet plane

Note 1 to entry: Contact force is expressed in newtons.

3.5.2.2
feed speed
v_f
instantaneous velocity of the feed motion of the edge plane of the stamping tool in a direction perpendicular to the sheet plane

Note 1 to entry: The feed speed is expressed in metres per minute.

4 Test specimens

4.1 Shape and state of the test specimens

The following types of test specimen can be prepared by the machining processes described in this document:

— rectangular bars;

— notched rectangular bars;

— rectangular plates;

— curvilinear test specimens (e.g. dumb-bells);

— discs.

The exact shape, dimensions and tolerances of the test specimens shall conform to the standard for the particular test method in question. The machined surfaces and edges of the finished specimens shall be free of visible flaws, scratches or other imperfections when viewed with a low-power magnifying glass (approximately ×5 magnification).