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Plastics — Test specimens

Plastiques — Éprouvettes

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Foreword

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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 document 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 2, *Mechanical behavior,* 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 20753:2018), which has been technically revised.

The main changes are as follows:

— Clarified overview of dimensions for reduced-scale dumb bell specimen type A.

  — That it contains harmonization of all tolerances for radii, widths and lengths, calculation of the total tolerance for l_2 (the length l_1 including radii), which now includes the summary of tolerances of the single dimensions.

  — That dimension l_2 is most important for a testing lab, as it needs to be observed to ensure distance between grips at tensile test.

— Change of dimension of test specimen type CP. The dimension is now consistent with type 3 of ISO 8256. The former dimension refers to type 2 of ISO 8256. However, the new dimension tends to be used for high-speed tensile tests for crash simulation.

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.

Introduction

Information on plastics test specimens has been specified in several different locations: in test method standards (e.g. ISO 527-2), in ISO 3167 (for multipurpose test specimens) and in ISO 294-1, ISO 294-2, ISO 294-3 and ISO 294-5 (for moulding conditions). The aim of this document is to give the designations and dimensions of test specimens used for the acquisition of comparable data, and also of other frequently used specimens, in one document for ease of reference. Other International Standards that have hitherto used different designations for the same specimen type will also be revised to bring the designations into line with those in this document.

Plastics — Test specimens

1 Scope

This document specifies dimensional requirements relating to test specimens prepared from plastics materials intended for processing by moulding, as well as to test specimens prepared by machining from sheets or shaped articles. It compiles the designations and dimensions of test specimens used for the acquisition of comparable data and of other frequently used specimens.

The following types of test specimen are specified:

A Tensile specimen, multipurpose or reduced-scale

B Bar specimen

C Small tensile specimen

D Square plate specimen

F Rectangular plate specimen

NOTE If a particular type of test specimen is not mentioned in this document, this does not mean that there is any intention to exclude the use of the specimen. Additional specimen types can be added in future if they are commonly used.

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 293, *Plastics — Compression moulding of test specimens of thermoplastic materials*

ISO 294-1, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 1: General principles, and moulding of multipurpose and bar test specimens*

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

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

ISO 294-5, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 5: Preparation of standard specimens for investigating anisotropy*

ISO 295, *Plastics — Compression moulding of test specimens of thermosetting materials*

ISO 2818, *Plastics — Preparation of test specimens by machining*

ISO 10724-1, *Plastics — Injection moulding of test specimens of thermosetting powder moulding compounds (PMCs) — Part 1: General principles and moulding of multipurpose test specimens*

3 Terms and definitions

No terms and definitions are listed in this document.

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 Symbols

l_3	overall length of the type A and type C test specimens
l_2	distance between the broad parallel-sided sections (tabs) of the type A and type CP test specimens
l_1	length of the narrow parallel-sided section (central section) of the type A and type CP test specimens, length of the type B bar specimen and length of the type D (square) and type F (rectangular) plate specimens
r	radius of the shoulder region of the type A and type C test specimens
b_2	width of the broad parallel-sided sections (tabs) of the type A and type C test specimens
b_1	width of the narrow parallel-sided section (central section) of the type A test specimen, minimum width of the type C test specimen and the width of the type D (square) and type F (rectangular) plate specimens
h	thickness of the test specimen

5 Preparation of test specimens

5.1 General

Test specimens shall be prepared in accordance with the relevant material specification. When none exists, specimens shall be either directly compression or injection moulded from the material in accordance with ISO 293, ISO 294-1, ISO 294-2, ISO 294-3, ISO 294-5, ISO 295 or ISO 10724-1, as appropriate, or machined in accordance with ISO 2818 from sheets that have been compression or injection moulded from the compound, extruded from the compound, or polymerized and cast.

Strict control of all the specimen preparation conditions is essential to ensure that all test specimens in a set are in the same state.

All surfaces of the test specimens shall be free from visible flaws, scratches, or other imperfections. With moulded specimens, any flash present shall be completely removed, taking care not to damage the moulded surface.

The broad sides of multipurpose test specimens shall be suitably marked, for injection-moulded specimens to distinguish between the sides formed by the cavity plate and the fixed plate of the mould (see ISO 294-1 or ISO 10724-1), for compression-moulded and machined specimens to identify any asymmetry resulting from the underlying moulding process.

For injection-moulded specimens, the sides can be identified by the impressions of the ejection pins and by the draft angle. Compression-moulded and machined specimens shall be marked at their shoulders. ISO bars taken from the central section of multipurpose test specimens shall be marked outside their central 64 mm section, which is loaded during flexural testing.

Asymmetry with respect to thickness may influence the flexural properties, including the temperature of deflection under load (see Annex A).

5.2 Injection moulding of test specimens

Test specimens shall be injection moulded as specified in ISO 294-1, ISO 294-2, ISO 294-3, ISO 294-5 or ISO 10724-1, as appropriate, and under the conditions defined in the relevant International Standard for the material under examination or, if no such standard exists, as recommended by the manufacturer of the material or as agreed upon between the interested parties.

5.3 Compression moulding of test specimens

Test specimens shall be compression moulded as specified in ISO 293 or ISO 295, as appropriate, and under the conditions defined in the relevant International Standard for the material under examination or, if no such standard exists, as recommended by the manufacturer of the material or as agreed upon between the interested parties.

5.4 Preparation of test specimens by machining

5.4.1 Preparation of test specimens by machining shall be performed either as specified in ISO 2818 or as agreed upon by the interested parties, using suitably processed injection- or compression-moulded sheets or shaped articles.

5.4.2 Bar test specimens having a width of 10 mm shall be cut symmetrically from the central parallel- sided section of a type A1 or type A2 test specimen.

The surface of the central parallel-sided section of the test specimens shall remain as moulded.

— The width of the machined sections of the specimen shall be not less than that of the central parallel-sided section, but may exceed the width of the latter by not more than 0,2 mm.

— During the machining operation, care shall be taken to avoid any damage to the moulded surfaces of the central parallel-sided section.

For the preparation, from type A1 or type A2 test specimens, of parallel-sided test specimens

— longer than 80 mm in the case of type A1 test specimens, or

— longer than 60 mm in the case of type A2 test specimens,

the broad ends of the specimen shall be machined to the width of the central parallel-sided section.

When machining test specimens from sheets or plates of which the history is not known, machine the specimens from locations that appear appropriate or as agreed between the interested parties. Record this information in the test specimen preparation report.

6 Types of test specimen and their dimensions

6.1 Types of test specimen

The following types of test specimen are specified:

a) Type A1 and type A2 specimens (1 = injection moulded, 2 = machined from a sheet or shaped article)

These are tensile test specimens from which, with simple machining, specimens for a variety of other tests can be taken (see Annex A).

The type A1 specimen is a multipurpose test specimen. The principal advantage of a multipurpose test specimen is that it allows all the test methods mentioned in Annex A to be carried out by all test laboratories on the basis of comparable mouldings. Consequently, the properties measured are coherent as all are measured using similar specimens prepared in the same way. In other words, it can be expected that test results for a given set of specimens will not vary appreciably due to unintentionally different moulding conditions. On the other hand, if desired, the influence of moulding conditions and/or different states of the specimens can be assessed without difficulty for all the properties measured.

Also described are reduced-scale test specimens designated type A*xy*, where *x* is the number indicating the method of specimen production (1 = injection moulded, 2 = machined from a sheet or

shaped article) and *y* is a number indicating the scale factor (1:*y*). These can be used e.g., when full-sized test specimens are not convenient or when sample material exists in small quantities only.

b) Type B specimens

These are bar specimens which can be directly moulded or can be machined from the central section of type A1 specimens or from sheets or shaped articles.

c) Type C specimens

These are small tensile test specimens which can be directly moulded or machined, e.g. from plates (Type D or type F specimens), from the central section of type A1 specimens (only Type CW) or from sheets or shaped articles.

d) Type D specimens

These are square plates of different thicknesses.

e) Type F specimens

These are rectangular plates intended for use in the analysis of mechanical anisotropy.

The designation system used for ISO test specimens shall be in accordance with Annex B.

Table 1 gives an overview of the types of test specimen which shall be used for the acquisition of comparable data in accordance with ISO 10350-1 or ISO 10350-2 or in accordance with ISO 11403-1, ISO 11403-2 or ISO 11403-3. Where applicable, type A1 specimens and specimens machined from the central section of the type A1 specimen shall always be used.

Table 1 — Types of test specimen to be used for acquisition of comparable data

Shape	Other details	Designation	Comments
Tensile specimen (with narrow parallel-sided section and tabs)	Multipurpose (see 6.2.1)	Type A1	Identical with type A of ISO 3167:2014 and with type 1A of ISO 527-2:2012, injection moulded
Bar specimen	See 6.3	Type B2	Rectangular bar, machined from central section of type A1
Small tensile specimen	See 6.4	Type CW13	Identical with type 4 of ISO 8256:2004, injection moulded
Square plate specimen	See 6.5	Type D12	Thickness 2 mm, injection moulded
Rectangular plate specimen	See 6.6	Type F12	Thickness 2 mm, injection moulded

Table 2 gives an overview of additional types of test specimen.

Table 2 — Additional types of test specimen

Shape	Other details	Designation	Comments
Tensile specimen (with narrow parallel-sided section and tabs)		Type A2	Identical with type B of ISO 3167:2014 and with type 1B of ISO 527-2:2012, machined from sheets prepared by any method
	Reduced-scale (see 6.2.2)	Type A12, A22	scale factor 1:2, Identical with type 1BA of ISO 527-2:2012, injection moulded or machined
		Type A13, A23	scale factor 1:3, injection moulded or machined e. g. from type D or F
		Type A14, A24	scale factor 1:4, injection moulded or machined
		Type A15, A25	scale factor 1:5, Identical with type 1BB of ISO 527-2:2012, injection moulded or machined
		Type A18, A28	scale factor 1:8, injection moulded or machined
Bar	See 6.3	Type B1 Type B3	Rectangular bar, injection moulded Rectangular bar, machined from sheets (prepared by any method) or compression moulded
Small tensile specimen	See 6.4	Type CW1z Type CW2z	Identical with type 4 of ISO 8256:2004 and type S of ASTM D 1822-13, injection moulded or machined e. g. from type D or F thickness *z* mm
		Type CP1z Type CP2z	Identical with type 3 of ISO 8256:2004, injection moulded or machined e. g. from type D or F thickness *z* mm
Square plate	See 6.5	Type D1y, D2y,	Injection moulded or machined, thickness y mm
Rectangular plate	See 6.6	Type F1y	Injection moulded, thickness y mm

6.2 Tensile test specimens with parallel-sided central section

6.2.1 Tensile test specimens type A1 and type A2

The general design of tensile test specimens is shown in Figure 1. Table 3 gives details of the dimensions of and acceptable tolerances for type A1 and type A2 specimens.

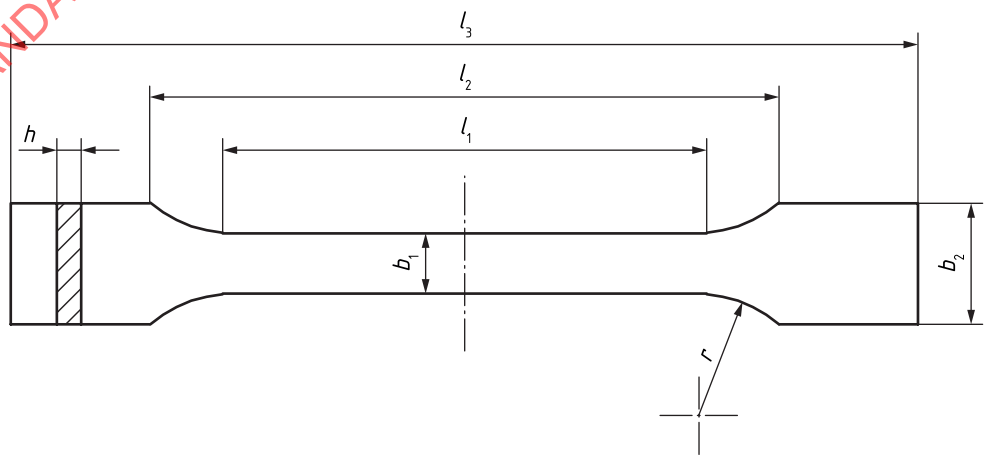


Figure 1 — General design of tensile test specimens

NOTE The type A1 specimen can be made suitable for a variety of tests by simple cutting, because the length l_1 of the narrow parallel-sided section is 80 mm ± 2 mm. It is therefore also referred to as multipurpose test specimen.

Table 3 — Dimensions of type A1 and type A2 test specimens

Dimensions in millimetres

Dimension		Type A1 multipurpose (injection moulded)	Type A2 (machined)
l_3	Overall length[a]	≥ 150	
l_2	Distance between broad parallel-sided sections[b]	109,0 ± 4,0	
l_1	Length of narrow parallel-sided section	80,0 ± 2,0[c]	60,0 ± 2,0[c]
r	Radius of shoulder	24,0 ± 1,0	60,0 ± 1,0
b_2	Width at ends	20,0 ± 0,2	
b_1	Width of narrow parallel-sided section	10,0 ± 0,2	
h	Thickness (preferred)	4,0 ± 0,2	

[a] In case of injection moulding in accordance with ISO 294-1 and ISO 10724-1, the recommended overall length should be 170 mm for the type A1 test specimen. For some materials, the length of the tabs may need to be extended (e. g. l_3 = 200 mm) to prevent breakage or slippage in the jaws of the test machine.

[b] Resulting from l_1, r, b_2, b_1, but within the indicated tolerance limits, calculated by $l_2 = l_1 + [4r(b_2 - b_1) - (b_2 - b_1)^2]^{1/2}$ (reference: ISO 527-2:2012, Table 1, note b).

[c] All tolerances for l_1, b_2, b_1, h of A1 and A2 identical with tolerances for types B, D, F.

6.2.2 Reduced-scale test specimens

The general design of tensile test specimens is shown in Figure 1. The designation of reduced-scale tensile test specimens is type A*xy*, where

A is the specimen type;

x indicates the method of preparation;

y is the scale factor.

Table 4 gives details of the dimensions of, and acceptable tolerances for, specimen types A*x*2, A*x*3, A*x*4, A*x*5 and A*x*8, *x* being either 1 for injection moulding or 2 for machining.

Table 4 — Dimensions of reduced-scale test specimens

Dimensions in millimetres

	Specimen designation									
	Ax2		Ax3		Ax4		Ax5		Ax8	
Scale factor	1:2		1:3		1:4		1:5		1:8	
	A12	**A22**	**A13**	**A23**	**A14**	**A24**	**A15**	**A25**	**A18**	**A28**
l_3 [a]	≥ 75		≥ 50		≥ 38		≥ 30		≥ 19	
l_2 [b]	54,0 ± 3,0		36,0 ± 3,0		27,0 ± 2,0		22,0 ± 2,0		13,5 ± 2,0	
l_1	40,0 ± 1,0	30,0 ± 1,0	26,5 ± 1,0	20,0 ± 1,0	20,0 ± 0,5	15,0 ± 0,5	16,0 ± 0,5	12,0 ± 0,5	10,0 ± 0,5	7,5 ± 0,5
r	12,0 ± 1,0	30,0 ± 1,0	8,0 ± 1,0	20,0 ± 1,0	6,0 ± 1,0	15,0 ± 1,0	5,0 ± 1,0	12,0 ± 1,0	3,0 ± 1,0	7,5 ± 1,0
b_2	10,0 ± 0,2		6,7 ± 0,2		5,0 ± 0,2		4,0 ± 0,2		2,5 ± 0,2	
b_1	5,0 ± 0,2		3,3 ± 0,2		2,5 ± 0,2		2,0 ± 0,2		1,25 ± 0,2	
h (preferred)	1,0 or 2,0, ± 0,1 [c]		1,0 or 2,0, ± 0,1		1,0 or 2,0, ± 0,1		1,0 or 2,0, ± 0,1		0,5 ± 0,1	

[a] For some materials, the length of the tabs may need to be extended to prevent breakage or slippage in the jaws of the test machine.

[b] Resulting from l_1, r, b_2, b_1, but within the indicated tolerance limits, calculated by $l_2 = l_1+[4r(b_2-b_1)-(b_2-b_1)^2]^{1/2}$ (reference: ISO 527-2:2012 Table 1, note b).

[c] All tolerances for l_1, b_2, b_1, h of Ax2 to Ax8 identical with tolerances for types B, D, F.

6.3 Bar test specimens (type B)

The designation of bar test specimens is type B*x*, where:

B is the specimen type;

x indicates the method of preparation.

They can be prepared as follows:

type B1: by injection moulding;

type B2: by machining from the central section of the type A1 test specimen (see also Figure 1);

type B3: by machining from sheets or shaped articles, or by compression moulding to the required dimensions.

Bar test specimens shall have the following dimensions:

length l_1: (80,0 ± 2,0) mm;

width b_1: (10,0 ± 0,2) mm;

thickness h: (4,0 ± 0,2) mm.

6.4 Small tensile specimens (type C)

The designation of small tensile specimens is type C*xyz*, where:

C (position 1) = specimen type;

x (position 1a) = W (specimen with waist) or P (specimen with parallel-sided central section);

y (position 2) indicates method of preparation (1 = injection moulding; 2 = machining);

z (position 3) = 1, 2, 3 or 4 indicating the thickness of the specimen, in millimetres.

Machining of specimens can be done from sheets or from type D or type F plate specimens (see 6.5 and 6.6).

Possible designations are:

CW11	CW21	CP11	CP21
CW12	CW22	CP12	CP22
CW13	CW23	CP13	CP23
CW14	CW24	CP14	CP24

This designation system is especially designed to describe commonly used thicknesses of injection-moulded specimens (small tensile specimens and plate specimens). Specimens machined from shaped articles or other finished parts may have different thicknesses. In that case, the essential information is the specimen shape (CW2 or CP2). The actual thickness shall be given in the test report.

Small tensile specimens shall have the dimensions given in Table 5 (see also Figure 2).

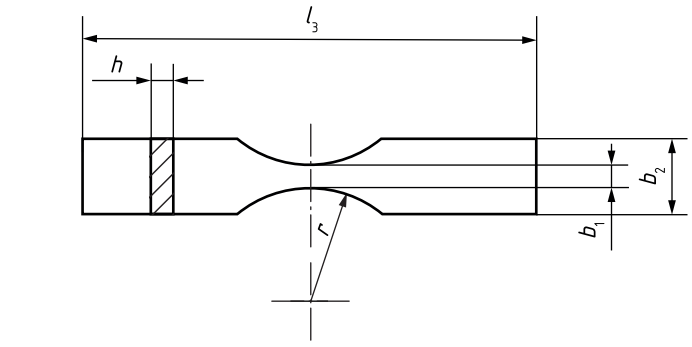
Table 5 — Dimensions of type C test specimens

Dimensions in millimetres

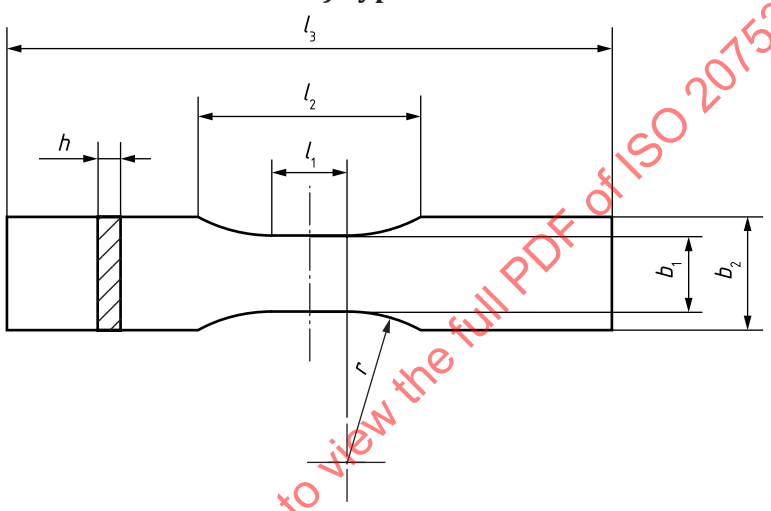
Dimension	Type CW	Type CP
l_3	60,0 ± 1,0	80,0 ± 2,0
l_2 [b]	—	29,4 ± 1,5
l_1	—	10,0 ± 0,2
r	15,0 ± 1,0	20,0 ± 1,0
b_2	10,0 ± 0,2	15,0 ± 0,2
b_1	3,0 ± 0,1	10,0 ± 0,2
h [a]	3,0 ± 0,1	3,0 ± 0,1

[a] Other thicknesses possible: 1 mm, 2 mm, 4 mm.

[b] Resulting from l_1, r, b_2, b_1, but within the indicated tolerance limits, calculated by $l_2 = l_1+[4r(b_2-b_1)-(b_2-b_1)^2]^{1/2}$ (reference: ISO 527-2:2012, Table 1, note b).



a) Type CW



b) Type CP

Figure 2 — General design of type CW and type CP test specimens

6.5 Square plate specimens (type D)

The designation is type D*xy*, where

D is the specimen type;

x indicates the method of preparation (*x* = 1: injection moulding, *x* = 2: machining);

y is the thickness, in millimetres

Square plate specimens shall have the following dimensions:

l_1: (60,0 ± 2,0) mm;

b_1: (60,0 ± 2,0) mm;

h: (1,0 ± 0,1) mm or (2,0 ± 0,1) mm or (3,0 ± 0,1) mm or (4,0 ± 0,1) mm

They can be prepared by injection moulding, by compression moulding or by machining from flat sheets of suitable thickness.

6.6 Rectangular plate specimens (type F)

The designation is type F1*y*, where

F is the specimen type;

1 indicates the method of preparation (injection moulding);

y is the thickness, in millimetres (2 mm preferred).

The preferred designation is F12.

This plate is specified specifically in ISO 294-5 (type F ISO mould) for the acquisition of data on the anisotropy induced by injection moulding. It shall have the following dimensions:

l_1: (120,0 ± 2,0) mm, preferred

NOTE ISO 294-5 allows $l_1 \geq 90$ mm.

b_1: (80,0 ± 2,0) mm;

h: (2,0 ± 0,1) mm

They shall be prepared by injection moulding.

7 Report on preparation of test specimens

The report shall contain the following information:

a) a reference to this document, i.e. ISO 20753:2023;

b) the specimen type;

c) the type of material used and the source, manufacturer's code, grade and form, including history, etc., if known;

d) the method of moulding and the conditions used;

e) the method of machining and the conditions used;

f) the specimen thickness, if modified from the standard thickness;

g) the number of test specimens prepared;

h) the date of preparation.

Annex A
(informative)

Recommended applications for multipurpose test specimens or parts thereof

Method	Reference [a]	Type of specimen and/or dimensions mm
Tensile test	ISO 527-2	A
Tensile creep test	ISO 899-1	A
Flexural test	ISO 178	B
Flexural creep test	ISO 899-2	B
Compressive test	ISO 604	(10 or 50) × 10 × 4 from A or B
Impact strength, Charpy	ISO 179-1, ISO 179-2	B
Impact strength, Izod	ISO 180	B
Impact strength, tensile	ISO 8256	B
Temperature of deflection under load	ISO 75-2	B
Vicat softening temperature	ISO 306	(≥ 10) × 10 × 4 from A or B
Hardness, ball indentation	ISO 2039-1	(≥ 20) × 20 × 4 from A or B
Hardness, Rockwell	ISO 2039-2	(≥ 20) × 20 × 4 from A or B
Hardness, Shore	ISO 868	(≥ 20) × 20 × 4 from A or B
Environmental stress cracking	ISO 22088-1, ISO 22088-2, ISO 22088-3, ISO 22088-4, ISO 22088-5, ISO 22088-6	A or B
Density	ISO 1183-1, ISO 1183-2, ISO 1183-3	B (≥ 10) × 10 × 4 from A or B
Oxygen index	ISO 4589-2, ISO 4589-3	B
Comparative tracking index (CTI)	IEC 60112	20 × 20 × 4 from A or B
Electrolytic corrosion	IEC 60426	30 × 10 × 4 from A or B
Linear expansion	ISO 11359-2	(≥ 10) × 10 × 4 from A or B

[a] See Clause 2 or Bibliography.