INTERNATIONAL STANDARD

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Monolithic (unshaped) refractory products —

Part 7: Tests on pre-formed shapes

Produits réfractaires monolithiques (non façonnés) —

Partie 7: Essais sur pièces pré-formées

Reference number
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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.

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.

ISO 1927-7 was prepared by Technical Committee ISO/TC 33, *Refractories*.

ISO 1927 consists of the following parts, under the general title *Monolithic (unshaped) refractory products*:

— *Part 1: Introduction and classification*

— *Part 2: Sampling for testing*

— *Part 3: Characterization as received*

— *Part 4: Determination of consistency of castables*

— *Part 5: Preparation and treatment of test pieces*

— *Part 6: Measurement of physical properties*

— *Part 7: Tests on pre-formed shapes*

— *Part 8: Determination of complementary properties*

Monolithic (unshaped) refractory products —

Part 7:
Tests on pre-formed shapes

1 Scope

This part of ISO 1927 specifies methods for the testing of as-delivered pre-formed shapes. It applies to shapes fabricated from dense and insulating castables and ramming materials as defined in ISO 1927-1.

NOTE Acceptance values for the individual test methods described should be agreed between the parties involved.

2 Normative references

The following referenced documents are indispensable for the application 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.

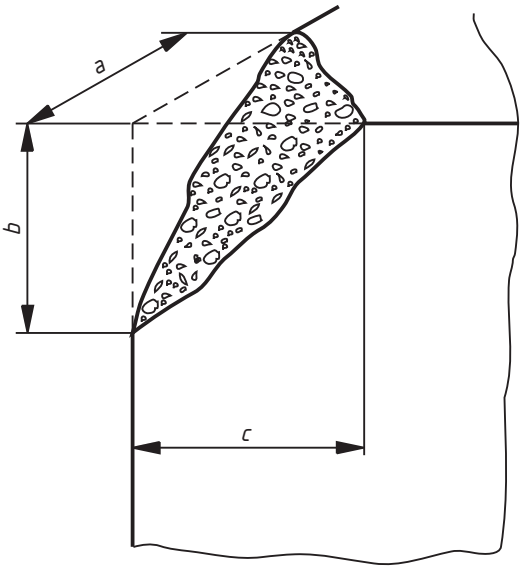
ISO 1927-1, *Monolithic (unshaped) refractory products – Part 1: Introduction and classification*

ISO 1927-6, *Monolithic (unshaped) refractory products — Part 6: Measurement of physical properties*

3 Terms and definitions

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

3.1
corner defect
missing corner, defined by the three dimensions *a*, *b* and *c* as indicated in Figure 1

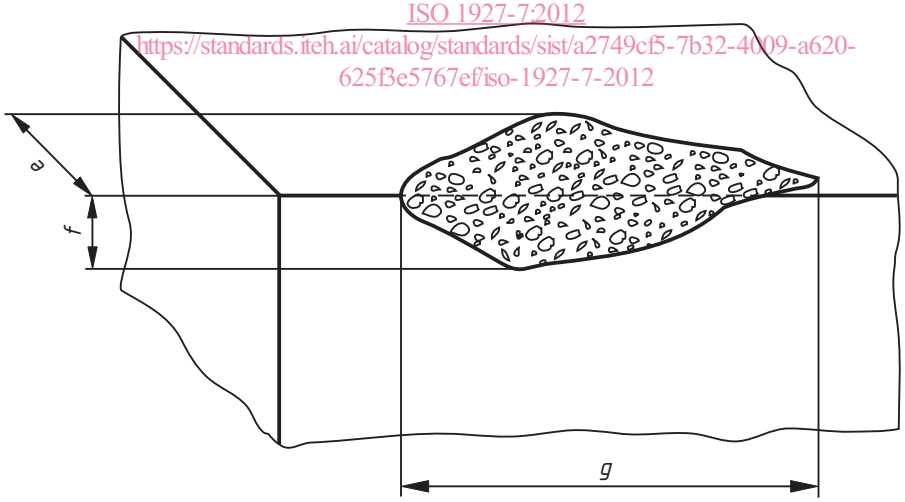


Key

a, *b* and *c* Three dimensions defining the missing corner

Figure 1 — Typical corner defect

3.2
edge defect
missing edge, defined by the three dimensions, *e*, *f*, and *g* as indicated in Figure 2



Key

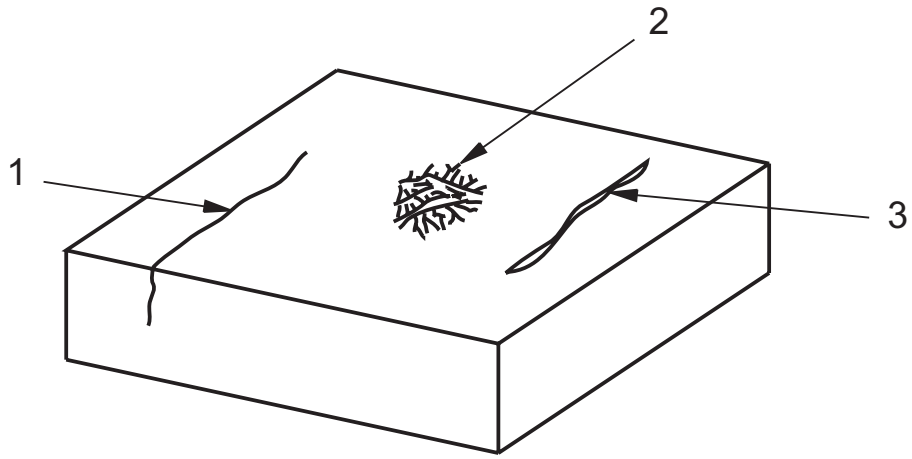
e, *f*, and *g* Three dimensions defining the missing edge

Figure 2 — Typical edge defect

3.3
crater
clearly defined hole in the surface of a shape whose parameters, i.e. maximum diameter, minimum diameter and depth, can be measured

NOTE Its origin can be a bubble produced during manufacture.

3.4
hairline cracks
fine cracks visible on the surface of a shape whose length can be measured and whose width is less than or equal to 0,2 mm, see Figure 3



Key

1	Hairline crack
2	Surface crazing
3	Open cracks

Figure 3 — Typical cracks

3.5
surface crazing
network of hairline cracks confined to the surface of the shape, see Figure 3

3.6
open cracks
cracks or tears on the surface whose length is more than 10 mm and whose width is more than 0,2 mm See Figure 3.

3.7
protrusions and indentations
imperfections that can occur during fabrication or firing, if applicable

3.8
fins
thin layer of material on the face of a shape that projects beyond the edge

3.9
segregation
separation of aggregate and fines during fabrication to leave a honeycomb appearance and/or a layer of excess fines

3.10
friability
crumbly texture due to poor consolidation and/or mould leakage

3.11
warpage
deviation of a plane surface from being flat

4 Principle

Testing of pre-formed shapes by qualitative and/or quantitative methods. These methods are of two types:

a) **Inspection by attributes** by evaluating the integrity of a refractory shape by visual inspection of cracks or other surface defects and by conformance to dimensional tolerances;

b) **Inspection by variables** by evaluating the quality of a refractory shape by determining physical properties using appropriate destructive or non-destructive test methods.

NOTE It is not obligatory to use all the test methods described in this part of ISO 1927 when determining the quality of a pre-formed shape.

5 Apparatus

5.1 Linear measuring devices, steel tape and/or callipers in accordance with the tolerance required and conforming to an accuracy that is twice the intended accuracy of the measurement.

NOTE Where possible, linear tolerances less than 1 mm should be measured with callipers. Steel tape measurements are accurate to the millimetre (0,5 mm can be estimated) whereas callipers are accurate to 0,1 mm.

5.2 Steel straightedge, at least 5 mm thick and of sufficient length to span the diagonal of the largest shape to be measured.

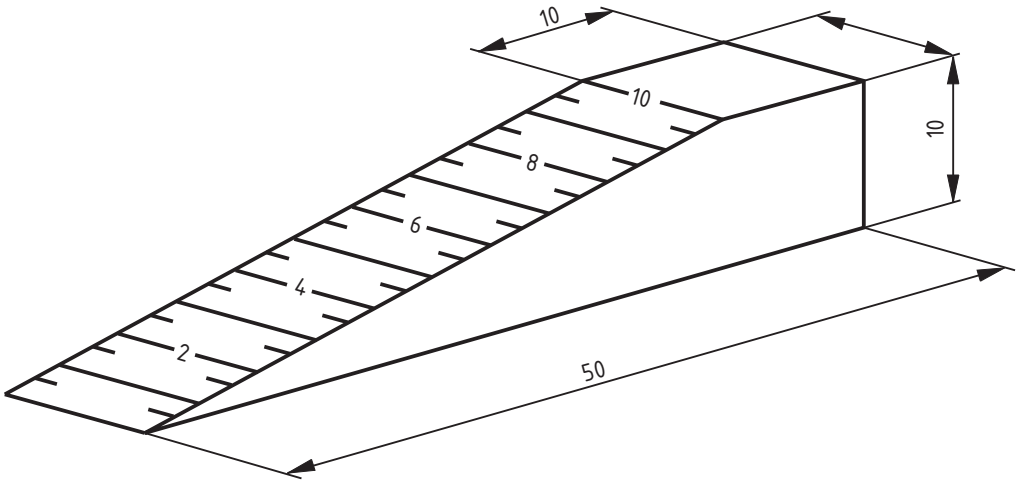
5.3 Two steel measuring wedges, which shall be either:

a) type 1, at least 50 mm in length and 10 mm in thickness at one end, of uniform cross-section for a length of at least 10 mm from that end and then tapering to zero thickness at the other end (see for example Figure 4a), or

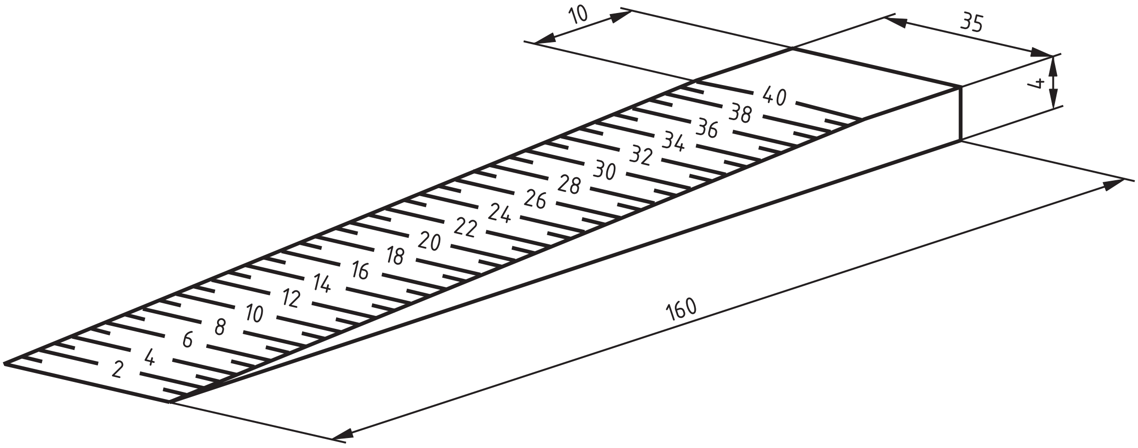
b) type 2, up to 160 mm in length with an even taper from 4 mm to zero (see for example Figure 4b).

Each wedge shall be graduated and numbered along the slope to show the thickness of the wedge between the base and the slope in increments of either 0,5 mm (type 1) or 0,1 mm (type 2).

Dimensions in millimetres



a) Type 1



b) Type 2

Figure 4 — Two types of measuring wedge

5.4 Graticule, with 0,1 mm graduations and/or **feeler gauges** of an appropriate size and accuracy to be used for the measurement of crack width. If necessary, the gauges can be replaced by measuring wedges of appropriate accuracy.

5.5 Sliding bevel, for the measurement of angles.

5.6 Depth gauge calibrated in millimetres of depth, having a probe of 3 mm diameter.

5.7 Breakage defect sizer, with a slot uncovering 2 mm on both surfaces, for determination of minimum defect sizes for corner and edge defects, according to Figure 5.

NOTE 1 One breakage defect sizer can be used together with a steel straightedge for the measurement of corner defects (see 6.5). Two breakage defect sizers can be used together with a linear measuring device for the measurement of edge defects (see 6.6).

NOTE 2 A breakage defect sizer permits an objective definition of the point of departure for the measurement of the size of a broken edge.

Dimensions in millimetres

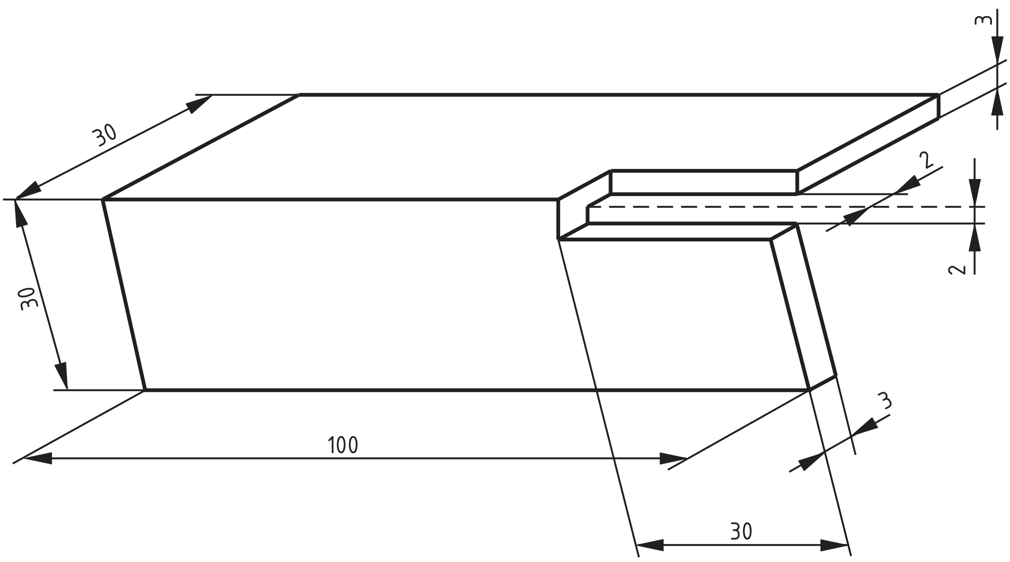


Figure 5 — Breakage defect sizer

5.8 Balance, capable of measuring to an accuracy of 1 %.

5.9 Ultrasonic pulse velocity measuring equipment.

5.10 Equipment for determining the resonant frequency by mechanical shock.

5.11 Rebound hammer.

5.12 Drying oven, capable of being controlled at 110 °C ± 5 °C.

5.13 Furnace, capable of operating at 1 050 °C ± 25 °C.

6 Inspection by attributes

6.1 Preparation of the test piece

The definition of edges may be improved, after any protrusions or indentations have been measured, by removing any projections such as fins or protrusions. This can normally be achieved by light abrasion.

6.2 Measurement of dimensions

Linear dimensions shall be measured by means of a linear measuring device (see 5.1), and unless otherwise agreed, shall be measured to the nearest 0,5 mm.

6.3 Measurement of angles

Angles shall be measured by adjusting the sliding bevel to fit the shape (see Figure 6) and the angle determined by the use of a protractor (see Figure 7).

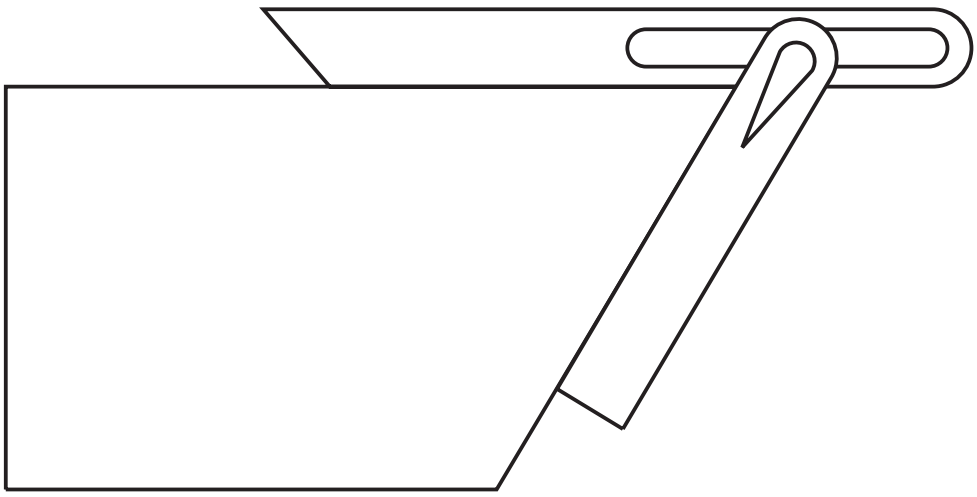


Figure 6 — Positioning the sliding bevel

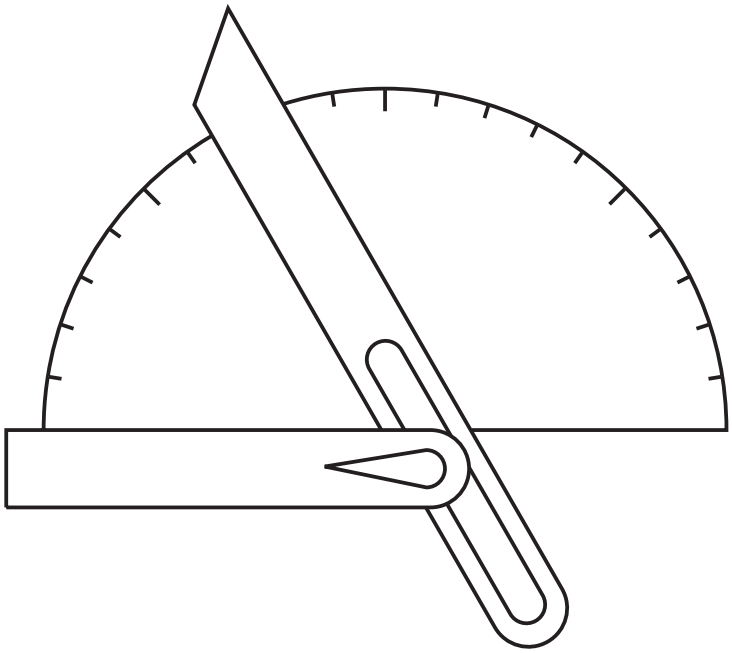


Figure 7 — Measurement of the angle

6.4 Measurement of warpage

For a concave surface, place the straightedge on edge across a diagonal of the surface being tested, insert a wedge at the point of maximum warpage (ensuring that the reading is not affected by raised imperfections on the castable surface) and record the maximum obtainable reading to the nearest 0,5 mm at the point of contact between the wedge and the straightedge.

For a convex surface, insert a wedge at each end of the straightedge and perpendicular to it as shown in Figure 8. Adjust the wedges, to a position not more than 15 mm from the corner of the shape, so that equal readings are obtained from each of them, making certain that contact is maintained by the straightedge at the point of maximum convexity. Record the readings to the nearest 0,5 mm.