INTERNATIONAL STANDARD

ISO 1927-8

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Monolithic (unshaped) refractory products —

Part 8: Determination of complementary properties

Produits réfractaires monolithiques (non façonnés) —

Partie 8: Détermination des caractéristiques complémentaires

Reference number
ISO 1927-8:2012(E)

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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

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Contents

Page

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 1927-8 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 8: Determination of complementary properties

1 Scope

This part of ISO 1927 specifies methods for the determination of the properties of unshaped refractory materials from test pieces prepared and stored in accordance with ISO 1927-5. The methods complement those described in ISO 1927-6.

The methods have been adapted from standards for shaped refractory products to make them applicable to dense and insulating castables, and ramming materials as defined in ISO 1927-1, before and after firing.

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 8841, *Dense, shaped refractory products — Determination of permeability to gases*

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

ISO 1927-2, *Monolithic (unshaped) refractory products — Part 2: Sampling for testing*

ISO 1927-3, *Monolithic (unshaped) refractory products — Part 3: Characterization as received*

ISO 1927-5, *Monolithic (unshaped) refractory products — Part 5: Preparation and treatment of test pieces*

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

ISO 8894-1, *Refractory materials — Determination of thermal conductivity — Part 1: Hot-wire methods (cross-array and resistance thermometer)*

ISO 8894-2, *Refractory materials — Determination of thermal conductivity — Part 2: Hot-wire method (parallel)*

ISO 8890, *Dense shaped refractory products — Determination of resistance to sulfuric acid*

ISO 10060, *Dense, shaped refractory products — Test methods for products containing carbon*

ISO 12676, *Refractory products — Determination of resistance to carbon monoxide*

ISO 16282, *Methods of test for dense shaped refractory products — Determination of resistance to abrasion at ambient temperature*

EN 993-11:2007, *Methods of test for dense shaped refractory products — Part 11: Determination of resistance to thermal shock*

3 Principle

The complementary properties of unshaped refractory products are determined by the procedures given in ISO 8890, ISO 8841, ISO 8894-1, ISO 8894-2, ISO 10060, ISO 16282, ISO 1927-1, ISO 1927-2, ISO 1927-3, ISO 1927-5, ISO 1927-6, ISO 12676 and EN 993-11.

The methods complement those described in ISO 1927-6. It is not necessary to use all the methods to characterize a material.

4 Determination of permeability to gases

4.1 Principle

This determination shall be carried out on test pieces after drying or after firing at a temperature and time to be agreed between the parties involved.

4.2 Test pieces

Use cylindrical test pieces with dimensions as defined in ISO 8841 and obtained from shapes A, B or C by sawing or coring, and prepared, stored, dried and/or fired according to the relevant sections of ISO 1927-5. The direction from which the test pieces are cut with regard to the direction of shaping shall be stated in the test report; the plane faces of the cylinder shall be at least at 4 mm away from the initial faces of the shape.

If the test pieces cannot be obtained by sawing or coring, due to the nature of the material, they may be prepared directly and this shall be noted in the test report.

In all cases, the test pieces shall be dried at 110 °C ± 5 °C for a minimum of 24 h and fired at a temperature and time to be defined between the parties and noted in the test report.

4.3 Procedure

Determine the permeability to gases in accordance with ISO 8841.

5 Determination of the resistance to thermal shock

5.1 Principle

This determination shall be carried out on test pieces fired at a temperature equal to or higher than the temperature of the test.

The standard quenching temperature shall be 950 °C and prefiring of the test pieces shall be carried out at 950 °C or above for 5 h.

Other quenching and prefiring temperatures and times may be agreed upon by the parties concerned and shall be noted in the test report.

5.2 Test pieces

Test pieces with dimensions of shape B, i.e. 230 mm × 64 mm × 54 mm shall be used. They shall be prepared and prefired according to ISO 1927-5 at a temperature and time agreed between the involved parties (see 5.1).

NOTE The use of other shapes may be agreed by the parties, but the results are not comparable with those using the test pieces stated above.

5.3 Procedure

Determine the resistance to thermal shock of the prefired test pieces in accordance with method B of EN 993-11:2007.

6 Determination of thermal conductivity

6.1 Principle

This determination may be carried out on fired or unfired, dried test pieces in accordance with ISO 8894-1 (hot wire, cross array) or with ISO 8894-2 (hot wire, parallel).

For both fired and unfired, dried test pieces, variation in thermal conductivity can occur due to time-dependent mineralogical and microstructural changes if the test piece has not been prefired to a temperature equal to or higher than the measurement temperature.

It is therefore necessary to take special care to ensure that equilibrium is attained when testing such test pieces. This can entail holding the test furnace at the measurement temperature for prolonged periods.

6.2 Test pieces

Test pieces shall be used corresponding to shape A as defined in ISO 1927-5.

For fired test pieces, the firing shall be carried out in accordance with ISO 1927-5 or as agreed between the parties.

6.3 Procedure

Determine the thermal conductivity at each defined measurement temperature in accordance with ISO 8894-1 (hot wire, cross array) or ISO 8894-2 (hot wire, parallel). For unfired test pieces, the rate of rise of the test furnace shall be in accordance with that specified in ISO 1927-5 for the type of material under test.

In all cases where the test piece has been prefired, (either before or during the test) to a lower temperature than the measurement temperature, it may be necessary to maintain the furnace at this temperature for extended periods to attain equilibrium. In some cases, it is advisable to maintain the temperature overnight.

7 Determination of sulfuric acid resistance

7.1 Principle

Determination of sulfuric acid resistance consists of the chemical attack by sulfuric acid on test pieces crushed to a specific grain size.

7.2 Test pieces

Use shape A test pieces prepared in accordance with ISO 1927-5, stored and dried at 110 °C ± 5 °C for a minimum of 24 h. Samples shall be taken out from test pieces in accordance with ISO 8890.

Any pre-treatment of the test pieces shall be agreed between the parties and noted in the test report.

7.3 Procedure

Determine the resistance to sulfuric acid in accordance with ISO 8890.

8 Tests for products containing carbon

8.1 Principle

The physical properties of products containing carbon are determined before and after removal of volatile components by carbonization and after removal of all of the carbon.

8.2 Test pieces

The test pieces shall be of the size specified for each individual test method and shall be taken from shapes A, B or C, and prepared in accordance with ISO 1927-5.

8.3 Procedure

8.3.1 Tests before carbonization

The physical properties of the prepared test pieces shall be determined in accordance with ISO 10060.

8.3.2 Tests after carbonization

Volatile components shall be removed according to the carbonizing procedure defined in ISO 10060 which also entails the determination of the following properties:

— carbonization mass loss;

— residual carbon content;

— carbon yield.

Determination of the physical properties of the carbonized test pieces shall be carried out in accordance with ISO 10060.

8.3.3 Tests after removal of all of the carbon

Total carbon removal from the carbonized test pieces shall be in accordance with ISO 10060. The test pieces shall be tested by the methods described in ISO 8841, ISO 8894-1, ISO 8894-2, ISO 10060, ISO 16282, ISO 1927-1, ISO 1927-2, ISO 1927-3, ISO 1927-5, ISO 1927-6, ISO 12676 and EN 993-11, as appropriate.

9 Determination of the resistance to carbon monoxide

This determination shall be carried out in accordance with ISO 12676.

10 Determination of resistance to abrasion at ambient temperature

This determination shall be carried out in accordance with ISO 16282.

11 Test report

The test report shall include the following:

a) all information necessary for identification of the sample tested, including the designation of the material tested, i.e. type, group, etc.;

b) a reference to this International Standard, i.e. ISO 1927-8:2012;

c) the methods used, including reference to the other standards used, as necessary;

d) the state of the test piece or sample for each test performed, including its preparation and any information required by the preparation standards ISO 1927-2, ISO 1927-1, ISO 1927-3 and ISO 1927-5;

e) the results of the tests, as appropriate, including the results of the individual determinations and their mean, calculated in accordance with the standards used, i.e.

    1) the determination of permeability to gases in accordance with Clause 4 and ISO 8841 ;

2) the determination of the resistance to thermal shock in accordance with Clause 5 and EN 993-11;

3) the determination of of thermal conductivity in accordance with Clause 6 and ISO 8894-1 or ISO 8894-2;

4) the determination of sulfuric acid resistance in accordance with Clause 7 and ISO 8890;

5) the result of tests for products containing carbon in accordance with Clause 8 and ISO 10060;

6) the determination of the resistance to carbon monoxide in accordance with Clause 9 and ISO 12676;

7) the determination of resistance to abrasion at ambient temperature in accordance with Clause 10 and ISO 16282 ;

f) any additional information required by the standard methods used;

g) any deviations from the procedure specified;

h) any unusual features (anomalies) observed during the test;

i) the name of the testing establishment;

j) the date of the test.

The test report shall also include any additional information required by the methods in ISO 8890, ISO 8841, ISO 8894-1, ISO 8894-2, ISO 10060, ISO 16282, ISO 1927-1, ISO 1927-2, ISO 1927-3, ISO 1927-5, ISO 1927-6 and ISO 12676.

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