SLOVENSKI STANDARD
SIST EN 993-20:2004

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Metode preskušanja gostih oblikovanih ognjevzdržnih izdelkov – 20. del: Ugotavljanje odpornosti proti obrabi pri sobni temperaturi

Methods of test for dense shaped refractory products - Part 20: Determination of resistance to abrasion at ambient temperature

Prüfverfahren für dichte geformte feuerfeste Erzeugnisse - Teil 20: Bestimmung der Beständigkeit gegen Abrieb bei Raumtemperatur

Méthodes d'essai des produits réfractaires façonnés denses - Partie 20: Détermination de la résistance a l'abrasion a température ambiante

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Methods of test for dense shaped refractory products - Part 20: Determination of resistance to abrasion at ambient temperature

Méthodes d'essai des produits réfractaires façonnés denses - Partie 20: Détermination de la résistance à l'abrasion à température ambiante

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This European Standard was approved by CEN on 24 March 2004.

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Foreword

This document (EN 993-20:2004) has been prepared by Technical Committee CEN/TC 187 “Refractory products and materials”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2004, and conflicting national standards shall be withdrawn at the latest by November 2004.

EN 993 with the general title “*Methods of test for dense shaped refractory products”* consists of 20 Parts:

Part 1: Determination of bulk density, apparent porosity and true porosity

Part 2: Determination of true density

Part 3: Test methods for carbon-containing refractories

Part 4: Determination of permeability to gases

Part 5: Determination of cold crushing strength

Part 6: Determination of modulus of rupture at ambient temperature

Part 7: Determination of modulus of rupture at elevated temperatures

Part 8: Determination of refractoriness-under-load

Part 9: Determination of creep in compression

Part 10: Determination of permanent change in dimensions on heating

Part 11: Determination of resistance to thermal shock[1]

Part 12: Determination of pyrometric cone equivalent (refractoriness)

Part 13: Specification for pyrometric reference cones for laboratory use

Part 14: Determination of thermal conductivity by the hot-wire (cross-array) method

Part 15: Determination of thermal conductivity by the hot-wire (parallel) method

Part 16: Determination of resistance to sulphuric acid

Part 17: Determination of bulk density of granular materials by the mercury method with vacuum

Part 18: Determination of bulk density of granular materials by the water method with vacuum

Part 19: Determination of thermal expansion by a differential method

Part 20: Determination of resistance to abrasion at ambient temperature

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

[1] Published as a TS with the general title *“Dense shaped refractory products”*

1 Scope

This European Standard describes a method for the determination of the abrasion resistance of shaped refractory materials at ambient temperature. It provides an indication of its suitability for service in abrasive or erosive conditions. It can also be used for unshaped refractory materials.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 993-1, *Methods of test for dense shaped refractory products - Part 1: Determination of bulk density, apparent porosity and true porosity.*

EN 1402-5, *Unshaped refractory products — Part 5: Preparation and treatment of test pieces.*

EN 1402-6, *Unshaped refractory products — Part 6: Measurement of physical properties.*

ISO 565, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet - Nominal sizes of openings.*

3 Terms and definitions

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

3.1
resistance to abrasion
resistance of refractory test-pieces to the surface wear caused by the mechanical action of moving solids

3.2
resistance to erosion
resistance of refractory test-pieces to the surface wear caused by the mechanical action of a fluid, whether or not it contains solid material

4 Principle

Determination of the volume of material abraded from a flat surface of the test-piece placed at a right angle to a nozzle through which 1000 g of size-graded silicon carbide is blasted by air at 450 kPa.

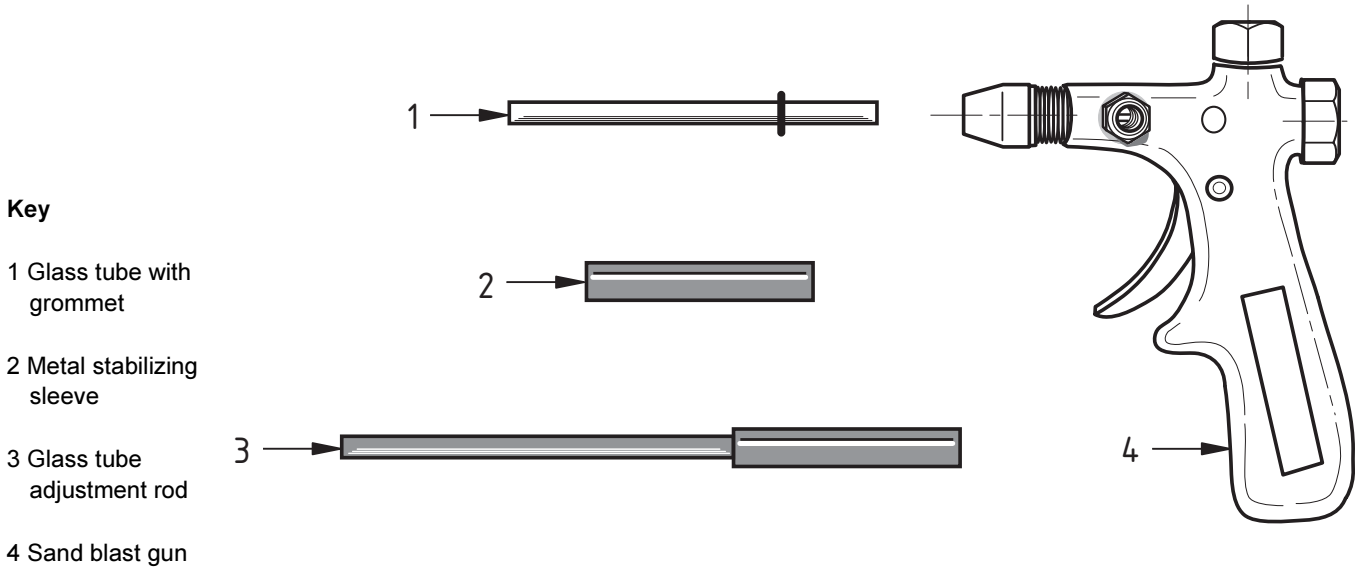
5 Apparatus

5.1 Abrasion tester

An abrasion tester shall consist of the following equipment (see Figures 1 to 3).

a) Blast gun, (see Figure 1) consisting of a pistol type housing with an air nozzle delivering air into the barrel of the gun which acts as a venturi with the abrasive medium entering the barrel at the side. The air delivery nozzle shall have an inlet inside diameter between 2,84 mm and 2,92 mm and an outlet inside diameter between 2,36 mm and 2,44 mm. The air nozzle may be protected from abrasion by covering it with a nominal 9,4 mm long piece of vinyl tubing, 4,7 mm inside diameter with a 1,5 mm wall thickness. The inside diameter of the barrel of the gun shall not exceed 10 mm and should be checked periodically for wear.

NOTE Any gun similar to that specified in ASTM C-704 can be used.



Key

1 Glass tube with grommet

2 Metal stabilizing sleeve

3 Glass tube adjustment rod

4 Sand blast gun

Figure 1 — Breakdown of blast gun

b) Nozzle, for directing the abrading medium onto the test piece, consisting of a piece of glass tubing 115 mm long, 7 mm in outside diameter, with a nominal 1,1 mm wall. This glass tube is attached to the blast gun and held perpendicular to the test piece using a 70 mm long piece of stainless steel tubing, 7,15 mm inside diameter. The steel tube is flared at one end and glued inside a 9,53 mm tubing nut which is screwed on to the end of the blast gun barrel. The glass tube is inserted through this steel tube and an air pressure seal made using a suitable rubber grommet compressed when the tubing nut is attached to the gun barrel.

The end of the glass tube within the blast gun barrel shall be positioned at a distance of 2 mm from the air-delivery nozzle. This is achieved by placing the glass tube on a brass rod 4,5 mm in diameter with a 7,9 mm shoulder, 117 mm from the tip. This allows the glass tube to be inserted through the steel tube and into the barrel of the gun until the end of the brass rod touches the air delivery nozzle, thus ensuring a 2 mm gap between the end of the glass tube and the air delivery nozzle.

A new piece of glass tubing shall be used for each determination.

5.2 Compressed air supply, clean, dry, supplied to the gun at a desired pressure using a regulator and an air gauge capable of being read to 7 kPa increments, mounted as close to the gun as possible.

5.3 Feeding mechanism system, capable of supplying 1 000 g of abrading medium to the blast gun in a time of (450 ± 15) s. Secondary air shall be allowed to enter the system with the abrading medium. A suitable feeding mechanism is shown in Figures 2 and 3, and consists of three funnels:

a) an upper feed stock funnel;

b) a middle feed control funnel which is fitted with a metal, glass or plastic orifice to provide the required feed rate;

c) a lower feed delivery funnel.

Key

1 Air supply line
2 Pressure regulator
3 Pressure gauge
4 Feed system
5 Stop cock
6 Blast gun
7 Butterfly valve
8 Manometer
9 Steel tube
10 Exhaust flue
11 Test chamber
12 Glass nozzle
13 Test piece

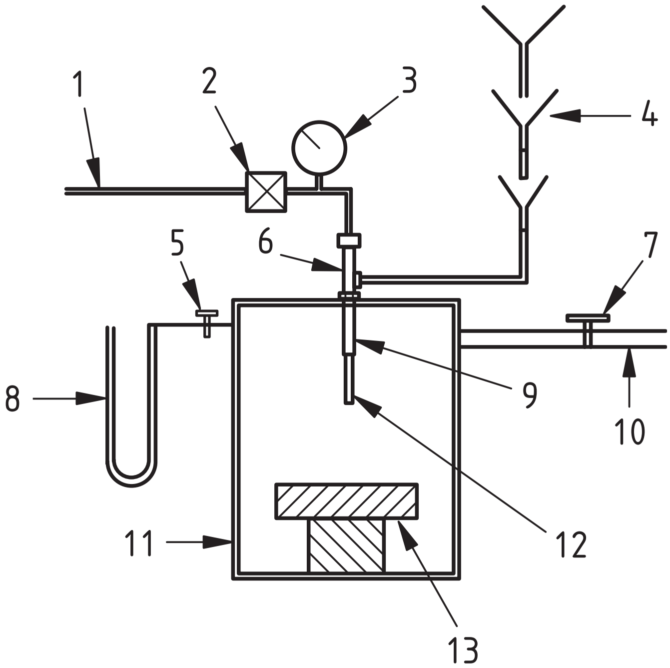


Figure 2 — Schematic diagram of abrasion tester

Key

1 Blast gun
2 Air pressure regulator
3 Glass tube and metal stabilizing sleeve
4 Test piece
5 Adjustable platform

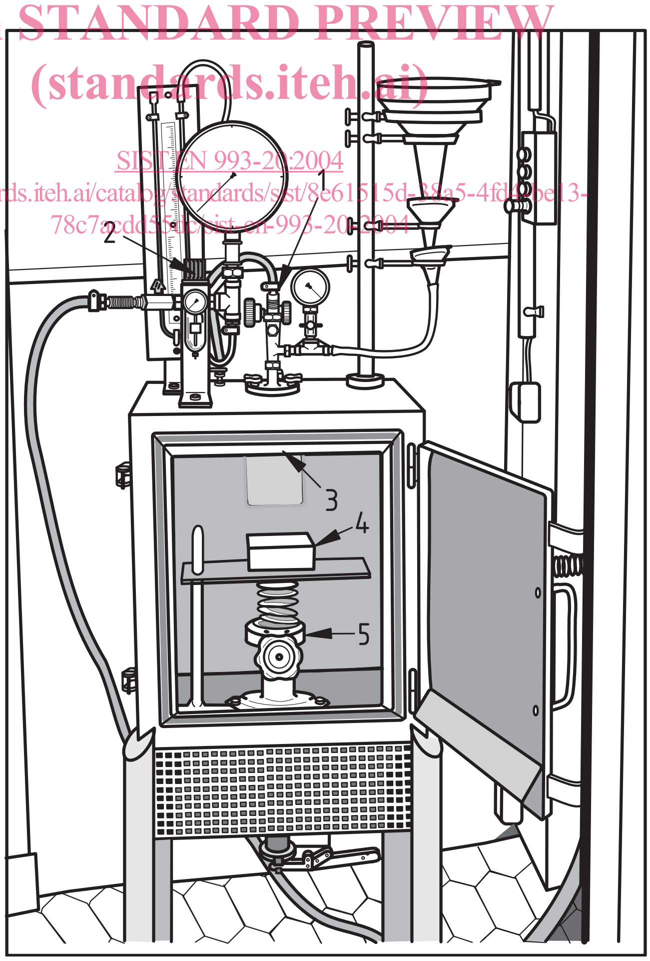


Figure 3 — Abrasion tester - Setting of the test piece

5.4 Test chamber

The test chamber shall consist of a tightly sealed closure with a door to permit ready access for mounting and removing the test-pieces. The blast gun is mounted vertically in the top of the test chamber by cutting a 13 mm hole so that the downward stream of abrading medium travels 203 mm ± 1 mm from the tip of the glass tube (see 5.1.b)) to the surface of the test-piece.

The chamber shall be fitted with an exhaust flue and a butterfly valve to regulate the pressure in the chamber during the test. A dust-collecting cloth bag of adequate capacity may be used on the end of the exhaust flue.

The upper part of the chamber shall also be fitted with a stop cock to allow the connection of a manometer (see 5.5).

5.5 Manometer, capable of measuring up to 400 Pa to measure the pressure inside the chamber during the test.

5.6 Vacuum gauge, capable of measuring up to 750 mm of mercury to check the pressure at the medium entry port of the blast gun.

5.7 Balance, capable of weighing to the nearest ± 0,1 g.

5.8 Callipers, capable of measuring to the nearest ± 0,5 mm.

5.9 Test sieves, conforming to the requirements of ISO 565.

5.10 Abrading medium

Silicon carbide with a particle size distribution as given in Table 1. Before use, remove the material retained on 850 µm ISO sieve and passing 300 µm ISO sieve.

Table 1 — Screen analysis for abrading medium

Opening (µm) (ISO 565 – R 40/3)	Retained (%)
850	Trace
600	20 ± 2
300	80 ± 3
212	2 max
< 212	trace

NOTE The silicon carbide is abrasive quality grit n° 36 according to FEPA.

6 Test-pieces

6.1 General

The number of items to be tested and the number of test pieces per item shall be agreed between the parties and mentioned in the test report.