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Insulating refractory products - Part 9: Methods of test for alkaline earth silicate (AES) wool products

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Insulating refractory products - Part 9: Methods of test for alkaline earth silicate (AES) wool products

Feuerfeste Erzeugnisse für Wärmedämmzwecke - Teil 9: Prüfverfahren für Erzeugnisse aus Erdalkali-Silicat-(AES-)Wolle

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Page

Foreword

This document (prEN 1094-9:2005) has been prepared by Technical Committee CEN/TC 187 “Refractory products and materials”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

1 Scope

This European Standard specifies methods for determining the thickness, bulk density, resilience, permanent linear change, thermal conductivity, tensile strength and shot content of AES wool products. It applies to AES wool bulk, blankets, felts, mats, boards, pre-formed shapes and papers, with the exception of products delivered in a wet state.

The application of the individual test methods is given in Table 1, with reference to the type of products.

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.

EN 1094 *Insulating refractory products* — Part 1: *Terminology for AES wool products*.

EN 10002-2, *Metallic materials — Tensile testing* — Part 2: *Verification of the force measuring system of the tensile testing machine.*

ISO 565:1990, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

3 Preparation of test pieces

The number of items to be tested shall be determined by agreement between the parties. The number of test pieces per item shall be determined in accordance with Table 1. When the material to be tested is wound, any compressed material at the extreme ends shall be excluded. A strip shall be cut perpendicular to the length across the full material width, of sufficient size for the different tests planned. From the strip, cut the required number of test pieces of required dimensions, using a template, a sharp knife, a saw, or other method, which will not damage the sample. Avoid excess pressure as this may crush the fibre.

4 Determination of the thickness

4.1 Principle

Determination of the thickness of a product subjected to a compressive stress, which depends on its nominal bulk density. There are two methods, of which the dial gauge comparator method (4.3.1) is the referee method and is the only method applicable to AES wool paper.

4.2 Test piece dimensions

The size of the test piece shall be such that the disc entirely rests on it, and shall be at least 100 mm × 100 mm.

4.3 Methods

4.3.1 The dial gauge comparator method

4.3.1.1 Apparatus

The apparatus consists of a machined reference plate, a dial gauge comparator and its base and a metallic disc, 75 mm in diameter. The apparatus is capable of applying a 350 Pa ± 7 Pa compressive stress to products with a nominal bulk density less than 96 kg/m³ and a 725 Pa ± 15 Pa compressive stress to products with a nominal bulk density equal to or higher than 96 kg/m³. For AES wool papers, the measurement shall be carried out under a compressive stress of 10 kPa ± 1 kPa with a disc 12.5 mm in diameter.

4.3.1.2 Procedure

Put the test piece on the reference plate and let the disc rest on the product, care being taken not to induce parasitic pressure. Measure the thickness at the disc centre with respect to the reference plate and to an accuracy of ± 0.1 mm.

4.3.2 The needle method

4.3.2.1 Apparatus

Machined reference plate and a measuring device made up of a needle 150 mm ± 1 mm in length and 3 mm in diameter, and a metallic disc 75 mm in diameter which slides along the needle and is capable of being secured in position, with a dial gauge comparator and a thickness gauge. The stress determined by the mass of the disc and of its securing device shall not exceed 350 Pa ± 7 Pa for products with a nominal bulk density less than 96 kg/m³ and 725 Pa ± 15 Pa for products with a nominal bulk density equal to or higher than 96 kg/m³.

4.3.2.2 Procedure

Put the product to be measured on the reference plate, punch it with the needle and remove the needle. For the measurement, bring back the needle point in contact with the reference plate and lower the disc on to the surface of the product, care being taken not to induce parasitic pressure. Secure the disc in position, remove the whole device and measure the distance between the needle point and the disc to an accuracy of ± 0.1 mm.

Table 1 — Summary of test methods and designations, applicability to product types and number of test pieces per item required

Clause	Test	Material	Number of test pieces
4	Thickness: 725 Pa or 350 Pa method	Blanket, Felt, Mat, Board	3
	10 kPa method	Paper	3
5	Bulk Density	Blanket, Felt, Mat, Board, Paper	3
6	Resilience	Blanket, Felt, Mat	3
7	Permanent linear change on heating by the slow heat method	Blanket, Felt, Mat, Board, Paper, Pre-formed shapes	3
8	Thermal conductivity: Calorimetric method up to hot face temperature of 1300°C	Blanket, Felt, Mat, Board, Paper	1
9	Tensile strength	Blanket, Felt, Paper	5
10	Shot content	Bulk fibre, Blanket, Felt, Mat, Board, Paper	3

4.4 Test report

Report the data required by clause 11, the dimensions of each test piece, the individual values for each test piece and the mean value for each item.

5 Determination of the bulk density

5.1 Principle

Determination of the bulk density by calculation of the ratio between the mass of the product and its volume geometrically determined, thickness having been first determined according to clause 4.

5.2 Apparatus

5.2.1 Thickness measurement device, as in 4.3.1 or 4.3.2;

5.2.2 Steel rule, reading to 0,5 mm, possibly with a square angle at the readings origin, or alternatively, callipers;

5.2.3 Ventilated oven, at (110 ± 5) °C;

5.2.4 Balance, of 2 kg capacity, capable to measuring to the nearest ± 0,01 g.

5.3 Test pieces

The dimensions of the test pieces shall be in accordance with 4.2. Dry the test pieces at (110 ± 5) °C to constant mass. Constant mass can be considered as achieved when the mass variation between two weighings carried out within a one hour interval does not exceed 0,1 %. Reject any test piece where the loss of mass exceeds 5 % after drying.

5.4 Procedure

Measure the two other dimensions of the test piece with the steel rule or the callipers to an accuracy of 0.5 mm, and calculate its area, the thickness being determined according to clause 4. Carry out the measurements along the middle of each face of the test piece. Carry out the weighings to the nearest 0,1 g.

5.5 Expression of results

Calculate the bulk volume, V_b, of the test-piece, in m³, using the following equation:

$$V_b = S \times t$$

where:

S is the area in m²;

t is the thickness in m.

Calculate the bulk density, ρ, of the test piece, in kg/m³, using the equation:

$$\rho = \frac{m}{V_b}$$

where

m is the dry mass in kg determined in 5.4

V_b is the bulk volume in m³

5.6 Test report

Report the data required by clause 11, the mass and dimensions of each test piece, reference to the method for thickness, and the individual values for each test piece and a mean for each item.

6 Determination of resilience

6.1 Definition

Resilience is the ability of AES wools to spring back after compression to 50 % of thickness. It is the ratio of the thickness of a product (after the application and relaxation of a compressive force, which reduces the original thickness to 50 % of its original value), to its original thickness.

6.2 Principle

Calculation of the ratio, expressed in %, of the thickness of a product to its initial thickness, after application of a compressive stress sufficient to reduce the initial thickness to 50 % for a given time.

6.3 Apparatus

6.3.1 thickness gauge;

6.3.2 compression testing machine, capable of applying the compressive stress at a given rate and provided with means for measuring the test piece deformation;

6.3.3 balance, capable to measuring to the nearest ± 0,01 g;

6.3.4 ventilated oven, set at (110 ± 5) °C.

6.4 Test pieces

6.4.1 Dimensions

Cut out test pieces of dimensions 100 mm × 100 mm × (nominal thickness). Do not compress the test pieces when cutting out.

6.4.2 Drying

See 5.3.

6.5 Procedure

Determine the thickness according to clause 4. Set the compression testing machine to give a constant deformation rate of 2 mm/min. Place the test piece in the compression tester and compress at the given rate until the test piece thickness has been reduced by 50 %.

NOTE If a record of compressive stress versus thickness is required, record the compressive stress at regular % reductions of the original thickness.

Keep the test piece at 50 % of its initial thickness for 5 min and then remove the majority of the pressure applied by the testing machine but just maintaining a nominal pressure, of either 350 Pa for products with a bulk density less than 96 kg/m³ or 725 Pa for products with a bulk density equal to or higher than 96 kg/m³. After 5 min, determine the thickness according to clause 4.

NOTE Other values for reduction of the thickness can be chosen by agreement between the parties. The same procedure shall be used.

6.6 Expression of the results

Calculate the resilience, R, in %, using the equation

$$R = \left(\frac{t_t}{t_i} \right) \times 100$$

where

t_t is the thickness after testing, in mm;

t_i is the initial thickness, in mm;

Calculate permanent deformation, D_P, in %, using the equation:

$$D_P = 100 \left(1 - \frac{t_t}{t_i} \right)$$

6.7 Test report

Report the data required by clause 11, the dimensions of the test pieces and the thickness method, also any value for reduction of the thickness, if different from 50 %, individual values of permanent deformation/resilience, and the mean values of permanent deformation/resilience.

7 Determination of the permanent linear change on heating

7.1 Principle

Determination of the permanent linear change of the dimensions of test pieces held at a prescribed temperature and for a prescribed time interval. The permanent linear change is expressed as the ratio of the difference between the initial dimension and the dimension after testing measured between platinum wire markers inserted into the test piece surface on the initial dimension.

7.2 Apparatus

7.2.1 Furnace

Electric furnace, the homogeneity of which shall be such as not to allow the temperature difference between any two points of the furnace to exceed 10 K. The dimensions of the furnace shall be such as to ensure that test pieces are at least 50 mm away from heating elements and that the test piece and the thermocouple junction are 10 mm to 20 mm apart.

7.2.2 Measuring devices

Measurements shall be by means of an optical method.

7.2.3 Thermocouples

One thermocouple should be used to measure the temperature and temperature distribution over the space occupied by the test pieces in at least 3 positions.

7.3 Test pieces

7.3.1 Dimensions

The dimensions of the test pieces shall be 100 mm x 100 mm x (nominal thickness), care being taken to record the direction of rolling of the product.

7.3.2 Drying

See 5.3.

7.4 Procedure

7.4.1 Test-piece preparation

On the diagonals of the upper 100 mm × 100 mm surface of each test-piece, and 10 mm to 15 mm away from the edges, insert four platinum wire markers so that they are approximately 75 mm apart. These markers shall be 0.5 mm in diameter, their length being such as to leave 1 mm or 2 mm protruding above the surface when they are inserted at a depth corresponding to at least 3/4 of the test piece thickness. For calculation, take into account the distance (approximately 75 mm) between two markers, measured parallel to the edge of the test piece.

NOTE For very hard preformed shapes, platinum wire markers may be replaced by painted marks.

7.4.2 Sample Measurement

The centre-to-centre distance between each pair of platinum pins is measured. This is achieved by measuring the distance between the left hand sides of both pins and the right hand sides of both pins. These 2 distances are summed and the value divided by 2. This gives the centre-to-centre value. It is usual practice to place a platinum pin in one of the corners of the sample as a reference marker for the orientation of the sample after firing. The pins' placement is indicated on the measurement sheet used to record the above data.

7.4.3 Accuracy of measurements

The optical measurement shall be accurate to ± 0.05 mm.