DRAFT
prEN 13892-3

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

April 2000

ICS

English version

Methods of test for sreed materials - Part 3: Determination of wear resistance-Böhme

Méthodes d'essai des matériaux pour chapes - Partie 3: Détermination de la résistance à l'usure Böhme

Prüfverfahren für Estrichmörtel und Estrichmassen - Teil 3: Bestimmung des Verschleißwiderstandes nach Böhme

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 303.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Ref. No. prEN 13892-3:2000 E

Contents List

Foreword

This draft European Standard has been prepared by TC 303 „Floor screeds and insitu floorings in buildings“ and was approved by CEN/TC 303/WG2 for submission to TC 303 for consideration for circulation for formal voting.

It was prepared by Working Group 2 „Screed materials and floor screeds -Test-methods“ taking into account the proposals submitted by Working Group 1 „Screed materials and floor screeds - Definitions, properties and requirements“.

No existing European Standard is superseded.

1 Scope

This European Standard specifies a method for determining the wear resistance of moulded mortar specimens made from cementitious screed material, primarily for hard aggregate wearing screed materials or optionally for other than cementitious screed materials. The method is also suitable for specimens of set mortar cut from floor screed.

2 Normative references

This European Standard incorporates, by dated or undated references, 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.

(Unnecessary drafts will be deleted later)

EN 104-841	Determination of chemical resistance
ENV 196	Methods of testing cement - Part 1 - Determination of strength - Part 7 - Method of taking and preparing samples of cement
prEN 197	Cement composition, specification and conformity criteria - Part 1 - Common Cements (prepared by CEN/TC 51)
EN 222	Bitumen
EN 459-2	Building lime - Test methods
prEN 933-1	Sieve analysis of aggregates
EN 934-2	Admixtures for concrete, mortar and grout, concrete admixtures, definitions, specifications and conformity
EN 1008	Mixing water for concrete
EN 12614	Determination of glass transition temperature
prEN 13139	Aggregates for mortar
prEN 13318	Screed materials and floor screeds - Definitions
EN 13454	Binders, composite binders and factory made mixtures for floor screeds based on calcium sulfate - Part 1 - Definitions, requirements - Part 2 - Test methods
prEN 13813	Screed materials and floor screeds Screed materials - Properties and requirements
EN TTT	Additives for mortar

WI 00303005	Screed materials and floor screeds Floor screeds - Properties and requirements
WI 00303006	Method of test for screed materials - Sampling, making and curing specimens for test
WI 00303007	Method of test for screed materials - Determination of flexural and compressive strength
WI 00303008	Method of test for screed materials - Determination of wear resistance (Böhme)
WI 00303009	Method of test for screed materials - Determination of surface hardness
WI 00303012a	Method of test for screed materials - Determination of resistance to rolling wheel - Method for screed material with floor coverings
WI 00303012b	Method of test for screed materials - Determination of resistance to rolling wheel - Method for screed material for wearing surface
WI 00303013	Method of test for screed materials - Determination of bond- and surface tensile strength
WI 00303014	Method of test for screed materials - Determination of electrical Resistance
WI 00303015	Method of test for screed materials - Determination of wear resistance BCA
WI 00303019	Binders for magnesite screeds - caustic magnesia and magnesium chloride - Part 1 - Definitions, requirements
WI 00303020	Binders for magnesite screeds - caustic magnesia and magnesium chloride - Part 2 - Test methods
ISO 178	Plastics - determination of flexural properties
ISO 468	Surface roughness - Parameters, their values and general rules for specifying requirements

3 Principle

Cast specimens are placed on the Böhme abrader, on the test track of which standard abrasive is strewn, the disk then being rotated and the specimens subjected to an abrasive load of 294 N for a given number of cycles.

The wear resistance-Böhme is the loss in specimen volume. It can also be determined as the reduction in specimen thickness.

4 Symbols

$A=\Delta V$	is the wear resistance-Böhme or the loss in volume after 16 cycles
a	is the test area of 50 cm^2
Δl	is the mean reduction after 16 cycles
l_{om}	is the average thickness of the specimen from the measurements made at all nine measuring points prior to testing
l_{16m}	is the average thickness of the specimen from the measurements made at all nine measuring points after completion of the test
Δm	is the reduction in mass after 16 cycles
ρ_R	is the density of the specimen or, in the case of multi-layer specimens, the density of the wearing layer

5 Apparatus

To establish the reduction in thickness, the plunger of which shall have a spherical bearing and an annular contact face of 8 mm outside and 5 mm inside diameter, and a measuring table, shall be used.

The Böhme abrader as shown in figure 1 consists essentially of a rotating table with a defined test track to receive the abrasive, a specimen holder and a loading device.

The rotating table shall have a diameter of approximately 750 mm and be flat and positioned horizontally. When loaded, its speed shall be (30 $\pm$ 1) r pm.
The table shall be provided with a revolution counter and a device that switches off the rotating table automatically after 22 revolutions.

The test track shall be annular, with an inside diameter of 120 mm and an outside diameter of 320 mm (i.e. by 200 mm wide), and be replaceable.

The track shall be made of cast iron with a perlitic structure, a phosphorus content not exceeding, 0,35 % and a carbon content of more than 3 %. The track shall have a Brinell hardness of 190 to 220 HB 2,5/187,5 determined as the mean from measurements taken at not less than ten points along the edge of the track.

The face of the track in contact with the specimen shall be fine finished. It is recommended that the track be designed to permit both sides to be used.
The track surface is subject to wear in service; the resulting reduction in thickness shall not exceed 0,3 mm and any grooves not be deeper than 0,2 mm. If these values are exceeded, the track shall be replaced or refinished. When the track has been refinished three times, its hardness shall be determined anew.

The specimen holder shall consist of a U frame approximately 40 mm thick, with a clear distance of (5 $\pm$ 1) mm from the test track. The frame shall be positioned so that the centre-line distance between specimen and rotating table is 200 mm and the angle bead of the specimen holder, which supports the specimen, is located at a distance of (4 $\pm$ 1) mm above the rotating table. The mounting of the specimen holder shall ensure that, during testing, no vibration occurs.

The loading device shall consist of a lever of two arms of different length, a loading weight and a counterweight, the lever being pivoted with as little friction as possible and positioned almost horizontally during the test. The system shall be designed to ensure that the load is transferred vertically via the plunger to the centre of the specimen. The self-weight of the lever is balanced by the counter-weight and the scale to receive the loading weight. The force acting on the specimen results from the loading weight multiplied by the leverage ratio, the mass of the weight being selected to produce a test force of (294 $\pm$ 3) N (corresponding to about 0,06 N/mm^2 compressive stress), which shall be verified by calculation.

6 Abrasive material

The standard abrasive material used shall be an artificial corundum[1)] designed to produce an abrasive wear of 1,10 mm to 1,30 mm when testing standard granite[2)] specimens and of 4,30 mm to 4,80 mm when testing standard limestone[2)] specimens. The tolerances of the chemical composition of the abrasive material is given in table 1. Compliance with these requirements, the homogeneity of the material and the uniformity of bulk density and grading of the abrasive shall be checked by an impartial testing laboratory[1)].

Tabel 1: Standard requirements of the chemical composition

constituent	content [mass percentage]
corundum (crystallized aluminiumoxid Al_2O_3)	from 70 to 80
silica (SiO_2)	≤ 5
alkali- and earth alkalioxide ($Na_2O + K_2O + CaO + MgO$)	≤ 2
iron-III-oxide (Fe_2O_3)	residue

The loose density of the standard abrasive grit shall be between 1,60 and 1,70 kg/dm^3. The loose density is determined according to the test method described in EN 459-2 whereby the filling container of the apparatus is to be filled with 2 kg of the grit.

The mass percentage of material on each sieve shall correspond the particle size destribution of tabele 2. The portion of the grading passing $<$ 0,071 mm shall not amount more than 3 % by mass.

[1]) Information on sources of supply of standard abrasives and on impartial testing laboratories is obtainable from the Normenausschuß Materialprüfung (Materials Testing Standards Committee) of DIN, Burggrafenstr. 6, 10787 Berlin.
[2]) The standard material is stocked by the laboratory responsible for the inspection of standard abrasives.

Tabelle 2: Sieve analysis

test sieve according to ISO 565	residue [M.-%]	
0,20	0	
0,16	≤ 10	
0,125	≥ 40 ± 10	≥ 80
0,1	≥ 40 ± 10	
0,071	≤ 10	

7 Preparation of specimens

The wear resistance Böhme is measured on 3 specimens made in accordance with WI 0030306 or cut from floor screed.

Square sheets, or cubes with an edge length of (71 ± 1,5) mm shall be used as specimens.

The contact face and the opposite face of the specimen shall be parallel and flat. For determining the reduction in thickness the opposite face shall, if appropriate, be ground parallel or otherwise machined so as to be parallel.

8 Procedure

The wear resistance Böhme shall be determined as loss in volume. In some cases, it can also be useful to determine the wear resistance as a reduction in thickness. In case of the chosen determination, one of the following preparations shall be undertaken.

To determine the loss in volume, prior to testing, the density of the specimen, ρ_R, shall be determined by measurements, to the nearest 0,1 mm, and by weighing, to the nearest 0,1 g.
In the case of multi-layer specimens, the density shall be determined for specimens taken separately from the wearing layer, such specimens also being ground prior to testing where necessary.

To determine the reduction in thickness, prior to testing and after every four cycles, the specimen after careful cleaning, shall be placed contact face up on a measuring table, and readings taken from the dial gauge at a total of nine measuring points arranged as shown in figure 2, the results being given to the nearest 0,01 mm.

Prior to the abrasion test and after every four cycles the specimen shall be weighed to an accuracy of 0,1 g.

20 g of standard abrasive to be strewn evenly on the test track and the specimen, clamped into the holder and with the test contact face facing the track, loaded centrically with (294 ± 3) N.

The rotating table shall then be rotated, taking care that the abrasive on the track remains evenly distributed over an area traversed by the specimen.

The specimen shall undergo testing for 16 cycles, each consisting of 22 revolutions.

After each cycle, both rotating table and contact face shall be cleaned, and the specimen turned progressively through 90° and new abrasive strewn on the track.

9 Expression of results

The wear resistance Böhme A after 16 cycles shall be determined as the loss in specimen volume ΔV, using equation (1). In some cases, it can also be usefull to determine the wear resistance as the mean reduction in specimen thickness Δl, using equation (2). Δl may also be calculated from ΔV using equation (3).

$$A = \Delta V = \frac{\Delta m}{\rho_R} \qquad \text{cm}^3/50\ \text{cm}^2 \qquad (1)$$

$$\Delta l = l_{0m} - l_{16m} \qquad \text{mm} \qquad (2)$$

$$\Delta l = \frac{\Delta m}{\rho_R \cdot a} = \frac{\Delta V}{a} \qquad \text{mm} \qquad (3)$$

10 Test report

The test report shall include the following information:

a) the number, title and date of issue of this European Standard;

b) the place, date and time of sampling;

c) the method of sampling (by reference to EN WI 00303006) and by which organisation;

d) identification of the samples, including type, origin and designation of the screed material or of the floor screed by reference to the relevant product standard ;

e) preparation (mixing, casting) and storage (curing) or cutting conditions by reference to WI 00303006;

f) the date and time of preparing specimens for test (i.e. date and time of any mixing, casting, moulding, or demoulding procedure or date of cutting the specimens of the floor screed, if appropriate);

g) age of specimens when tested;

h) total mass of each individual test specimen;

i) test results (individual values to the nearest 0,05 $cm^3/50\ cm^2$ and corresponding mean value stated to the nearest 0,1 $cm^3/50\ cm^2$)

j) density, ρ_R, to the nearest 0,01 g/cm^3, if the abrasive wear is given as loss in volume.

k) remarks

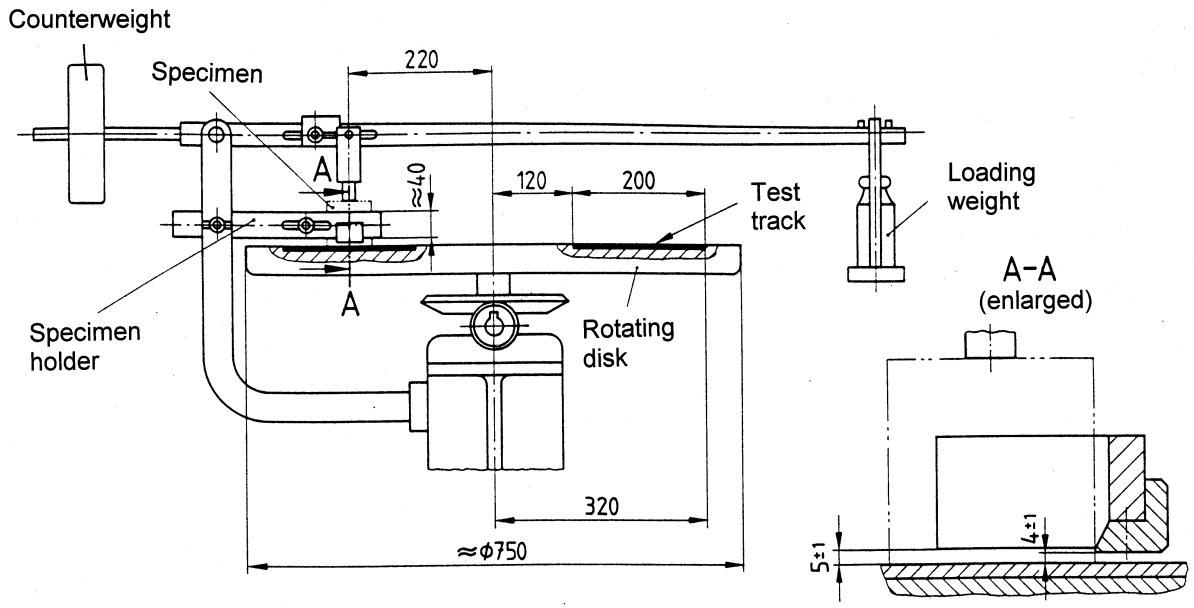

Figure 1: Principle of Böhme disk abrader

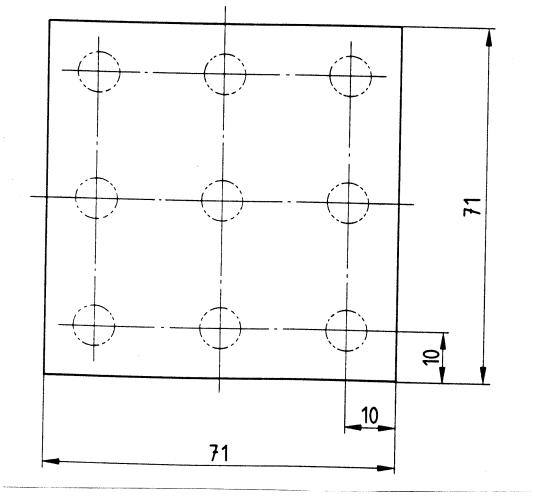

Figure 2: Principle of arrangement of measuring points