INTERNATIONAL STANDARD

ISO 12844

First edition
1999-12-15

Raw optical glass — Grindability with diamond pellets — Test method and classification

Verre d'optique brut — Résistance à l'abrasion par palets diamantés — Méthode d'essai et classification

Reference number
ISO 12844:1999(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 12844 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 3, *Optical materials and components*.

Raw optical glass — Grindability with diamond pellets — Test method and classification

1 Scope

This International Standard specifies a test method for determining the grindability of raw optical glass with diamond pellets, and defines a classification of optical glasses according to the grindability determined by this method.

2 Terms and definitions

For the purposes of this International Standard, the following term and definition applies.

2.1
grindability
volume removed from a glass specimen when it is ground with a diamond pellet tool for a fixed period of time, relative to that removed from a standard reference glass

3 Principle

The grindability of any glass type is compared to a standard reference glass type and classified. Twenty samples of the unclassified glass and twenty samples of the standard reference dense barium crown glass are first prepared using aluminium oxide and then ground using a standard diamond pellet tool and water coolant for a period of 30 s.

The samples are weighed to determine the mean mass of material removed, taking into account the density of the glass to determine the volume reduction. The grindability class of the unknown glass is established according to the classification table given in this International Standard.

4 Reagents and materials

4.1 Standard diamond pellet, 10 mm in diameter and 3 mm thick.

The pellet shall be produced by the hot pressing technique using diamond of particle size 5 μm to 12 μm and a copper-tin alloy consisting of 80 % copper (Cu) and 20 % tin (Sn). The concentration shall be 15, corresponding to 0,66 carat/cm^3 (= 0,132 g/cm^3).

In order to obtain reproducible grindability test results, it is considered necessary that all laboratories use only standard diamond pellets from the same producer. [1)]

4.2 Dressing tool, of cast iron, about 280 mm in diameter.

4.3 Abrasion blocking tool as used in 6.3, of flat cast iron, about 250 mm in diameter.

4.4 Abrasive grains, of fused aluminium oxide with a mean grain size of 11,5 μm to 14,5 μm. [2)]

1) The name and address of the present supplier can be obtained from ISO/TC 172 or national standardization bodies.

2) This mean grain size corresponds to grain size P 1200 complying with the FEPA-Standard 43-GB-1984.

4.5 Abrasive grains, of fused aluminium oxide with a mean grain size of 52,5 µm to 62,0 µm. [3)]

4.6 Reference material, consisting of fine annealed dense barium crown glass, whose composition by mass is :

— barium oxide (BaO) 49,9 %;

— silicon dioxide (SiO_2) 31,1 %;

— boric oxide (B_2O_3) 17,3 %;

— aluminium oxide (Al_2O_3) 1,4 %;

— sodium oxide (Na_2O) 0,3 %.

The international reference number of this glass is 620603, density 3,58 g/cm^3.

For the shape, number and preparation of reference specimens, see clause 6.

4.7 Propan-2-ol (C_3H_7OH)

5 Apparatus

Usual laboratory equipment, together with the following.

5.1 Grinding test apparatus (see Figure 1), consisting essentially of:

5.1.1 Diamond pellet tool (see Figure 2)**,** having a diameter of 115 mm and constructed of cast iron.

The tool shall rotate horizontally at a constant speed. The flat tool surface shall contain diamond pellets (4.1) in the approximate pattern shown in Figure 2.

After adhering the diamond pellets to the cast iron plate, apply the following abrading procedure for finishing the diamond pellet tool:

a) rotate the dressing tool (4.2) with a rotational frequency of 60 r/min to 100 r/min;

b) keep the centre of the diamond pellet tool at a distance of 80 mm from that of the dressing tool without any swing;

c) apply a load of approximately 69 N to the diamond pellet tool;

d) dress the pellet tool for as long as needed to obtain a flatness across annulus, as measured with a spherometer, of $< 0{,}005$ mm.

5.1.2 Supporting rod, to maintain the specimen at a fixed position and apply a constant load F. The specimen holder shall have an inside diameter of $(35{,}8\ ^{+\,0{,}05}_{0})$ mm.

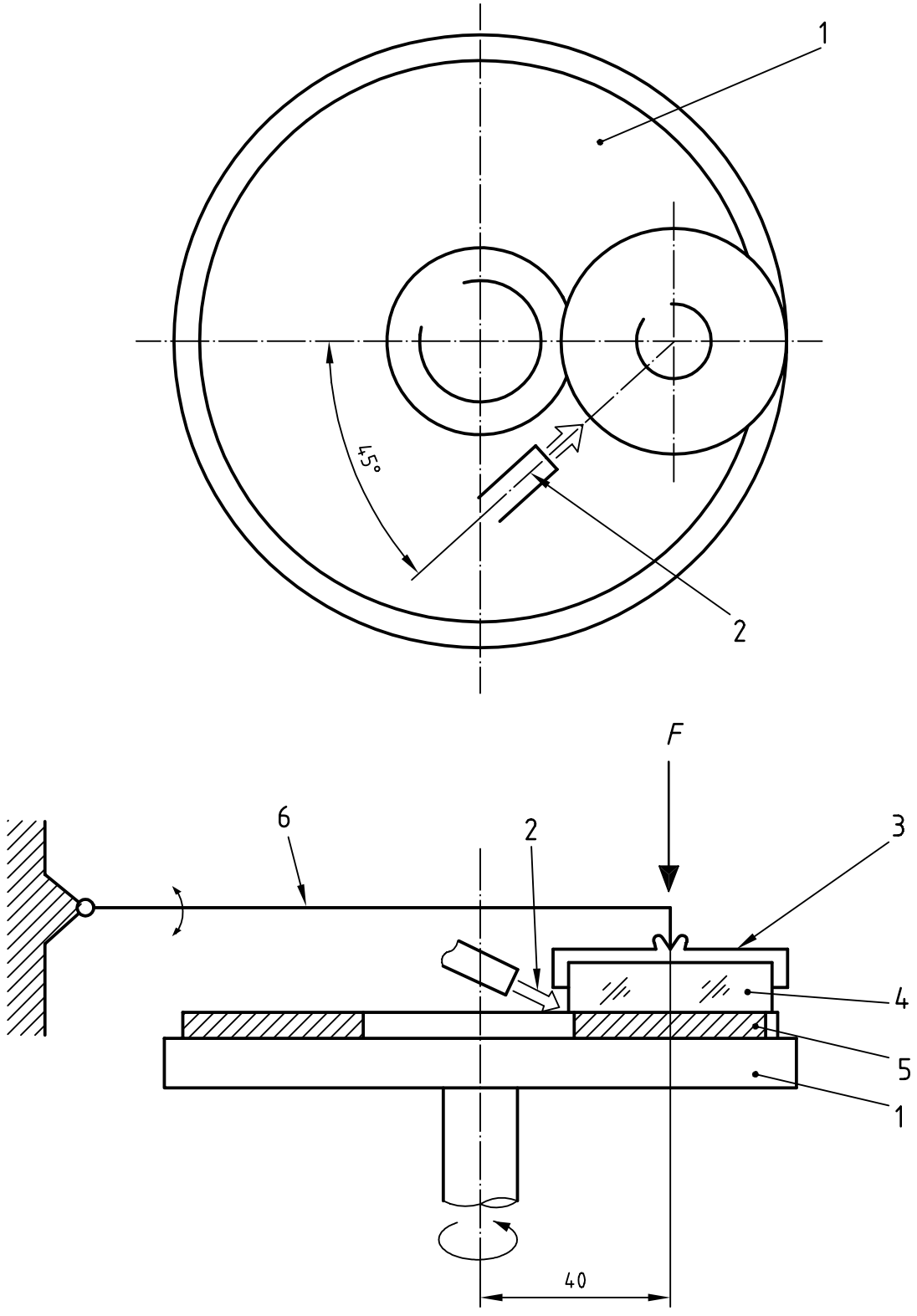
5.1.3 Device for supplying coolant.

5.2 Balance, capable of weighing to an accuracy of $\pm$ 1 mg.

5.3 Desiccator, containing a 2:1 mixture of silica gel (for H_2O absorption) and soda-lime (a mixture of CaO and Na_2O, for CO_2 absorption, with indicator for regeneration).

3) This mean grain size corresponds to grain size P 360, complying with the FEPA-Standard 43-GB-1984.

Dimensions in millimetres



Key

1	Diamond pellet tool	4	Specimen
2	Coolant	5	Surface with diamond pellets
3	Specimen holder	6	Supporting rod

Figure 1 — Grinding test apparatus (schematic)

Dimensions in millimetres

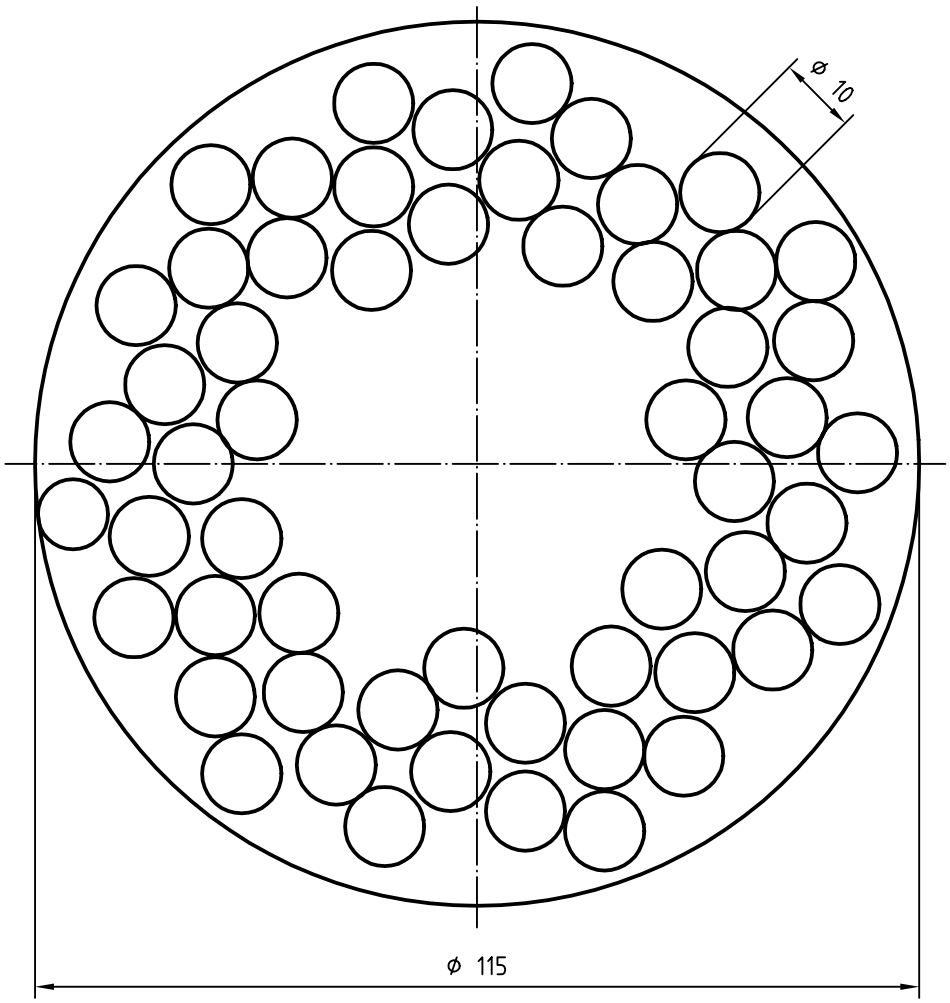


Figure 2 — Diamond pellet tool

6 Specimens

6.1 Shape

The reference specimens and the test specimens shall be discs of diameter 35,7 mm ± 0,05 mm with a thickness of 4 mm to 8 mm. All specimens shall be prepared without chamfering.

6.2 Number

For a test, a set of 20 reference specimens and a set of 20 test specimens are required. A test quantity of 20 pieces is used to establish consistent process performance.

6.3 Preparation

Using wax, cement onto the abrasion blocking tool (4.3) the 20 specimens to be used in one test. Repeat the same procedure for the 20 reference specimens. Carry out the abrasion by applying first the coarser abrasive and then the finer abrasive (4.4 and 4.5) to the specimens with a rotational frequency of about 50 r/min and a load of approximately 29 N. Stop the grinding when the roughness is between 6 µm to 8 µm for at least 98 % of the surface.

6.4 Cleaning

Clean the surfaces of each specimen by slightly wiping with a tissue or smooth cloth moistened with propan-2-ol. Complete the cleaning by immersing the specimens in propan-2-ol contained in a beaker of appropriate size.

Dry the specimens by moving them in air and store immediately in the desiccator (5.3) for at least 1 h before testing.

NOTE For drying, an oven at (115 ± 5) °C for 30 min may also be used.

7 Procedure

7.1 Mark the 20 cleaned reference specimens by a number and determine the mass m_1 of the reference specimens having the numbers 16 through 20 using the balance (5.2). Discard sample Nos. 1 to 15.

7.2 Mark the 20 cleaned test specimens by a number and determine the mass m_1 of the test specimens having the numbers 16 through 20. Discard sample Nos. 1 to 15.

Then grind all reference specimens as described in 7.3.

After the grinding process, clean the surfaces of the five reference specimens No. 16 through 20 and determine their mass m_2 using the balance (5.2).

7.3 Just before each grindability test, dress the diamond pellet tool for 2 min according to the abrading procedure specified in 5.1.1. Then apply the following steps for grinding the specimens:

a) rotate the diamond pellet tool at a speed of 1 200 r/min;

b) supply water as a coolant at a flowrate of 2,5 l/min from a fixed direction (see Figure 1);

c) keep the centre of the specimen at a distance of 40 mm from that of the diamond pellet tool;

d) load the specimen with approximately 49 N;

e) maintain constant rotation of the specimen to ensure a constant rate of stock removal;

f) remove the specimen from the diamond pellet tool after 30 s ± 1 s.

8 Expression of results

8.1 Calculate, for each reference specimen No. 16 through No. 20 and each test specimen No. 16 through No. 20, the mass reduction $w = m_1 - m_2$.

8.2 Calculate the mean mass reduction $\overline{w}_0$ of the five reference specimens and the mean mass reduction $\overline{w}_X$ of the five test specimens.

8.3 Calculate the grindability of the optical glass tested, using the following formula:

$$HG = \frac{\overline{w}_X / \rho}{\overline{w}_0 / \rho_0} \times 100 \qquad (1)$$

where

HG is the grindability, rounded to the nearest integer;

$\overline{w}_X$ is the mean mass reduction of the five test specimens, in grams;

$\overline{w}_0$ is the mean mass reduction of the five reference specimens, in grams;

ρ is the density of the glass tested, in grams per cubic centimetre;

ρ_0 is the density of the reference material, in grams per cubic centimetre.

9 Classification and designation

9.1 Classification

Optical glasses shall be classified as shown in Table 1 according to their grindability as determined by the method specified in this International Standard.

Table 1 — Classification of grindability

Grindability class	**Grindability** [see eqn. (1)]
HG 1	$\leqslant 30$
HG 2	> 30 and $\leqslant 60$
HG 3	> 60 and $\leqslant 90$
HG 4	> 90 and $\leqslant 120$
HG 5	> 120 and $\leqslant 150$
HG 6	> 150

9.2 Designation

Optical glass of grindability in accordance with the classification defined in this International Standard shall be designated with the descriptor block "optical glass, grindability class", followed by a reference to this International Standard, followed by the grindability class.

EXAMPLE For a glass having a grindability of 70 (class HG 3):

Optical glass, grindability class ISO 12844 - HG 3

10 Test report

The test report shall include the following information:

a) a reference to this International Standard;

b) identification of the test specimens, including density ρ;

c) identification of the reference material, including density ρ_0;

d) the mean mass reductions $\overline{w}_0$ and $\overline{w}_x$ of the reference specimens and the test specimens, respectively;

e) the grindability of the glass;

f) the designation of the grindability class HG;

g) any unusual features noted during the determination.

Bibliography

[1] ISO 6508-1:1999, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

[2] ISO 7438:1985, *Metallic materials — Bend test.*

[3] FEPA-Standard 43-GB-1984[4)], *Coated abrasive grains of fused alumina and silicon carbide.*

4) Federation of European Producers of Abrasive Products (FEPA).

ICS 81.040.10

Price based on 7 pages