SIST

SLOVENSKI STANDARD
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Steklo v stavbah - Ugotavljanje upogibne trdnosti stekla - 2. del: Metoda soosnega dvojnega obroļ a na ravnem steklu z velikimi povrģinami

Glass in building - Determination of bending strength of glass - Part 2: Coaxial double ring test on flat specimens with large test surface areas

Glas im Bauwesen - Bestimmung der Biegefestigkeit von Glas - Teil 2: Doppelring-Biegeversuch an plattenförmigen Proben mit großen Prüfflächen

Verre dans la construction - Détermination de la résistance du verre a la flexion - Partie 2: Essais avec doubles anneaux concentriques sur éprouvettes planes, avec de grandes surfaces de sollicitation

Ta slovenski standard je istoveten z: **EN 1288-2:2000**

ICS:

81.040.20	Steklo v gradbeništvu	Glass in building

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English version

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This European Standard was approved by CEN on 5 September 1999.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists 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.

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

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Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 129 "Glass in building", the secretariat of which is held by IBN.

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of an identical text or by endorsement, at the latest by December 2000, and conflicting national standards shall be withdrawn at the latest by December 2000.

CEN/TC 129/WG8 "Mechanical Strength" prepared the draft "Glass in building - Determination of the bending strength of glass - Part 2 : Coaxial double ring test on flat specimens with large test surface areas".

There are four other parts to this standard:

- Part 1 : Fundamentals of testing glass
- Part 3 : Test with specimen supported at two points (four point bending)
- Part 4 : Testing of channel shaped glass
- Part 5 : Coaxial double ring test on flat specimens with small test surface areas

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

1 Scope

This European standard specifies a method for determining the bending strength of glass for use in buildings, excluding the effects of the edges.

The limitations of this standard are described in EN 1288-1.

EN 1288-1 should be read in conjunction with this standard.

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.

EN 1288-1	Glass in building - Determination of the bending strength of glass - Part 1 : Fundamentals of testing glass
EN 572-1	Glass in building - Basic soda lime silicate glass products - Part 1 : Definitions and general physical and mechanical properties
ISO 48	Rubber, vulcanised or thermoplastic - Determination of hardness (hardness between 10 IRHD and 100 IRHD)

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 bending stress: The tensile bending stress induced in the surface of a specimen.

NOTE: For testing purposes, the bending stress should be uniform over a specified part of the surface.

3.2 effective bending stress: A weighted average of the tensile bending stresses, calculated by applying a factor to take into account non-uniformity of the stress field.

3.3 bending strength: The bending stress or effective bending stress which leads to breakage of the specimen.

3.4 equivalent bending strength: The apparent bending strength of patterned glass, for which the irregularities in the thickness do not allow precise calculation of the bending stress.

4 Symbols

A	Effective surface area of quasi-uniform stress
E	Modulus of elasticity (Young's modulus) of the specimen.
	NOTE: for soda lime silicate glass (see EN 572-1) a value of 70 x 10^3 N/mm^2 is used.
F	Piston force
F_{max}	Piston force upon breakage, "breaking force"
F_{ring}	Force transmitted by the loading ring to the specimen, "ring load"
h	Thickness or average thickness of specimen
L	Side length of the square specimens
μ	Poisson number of specimen
	NOTE: for soda lime silicate glass (see EN 572-1) a value of 0,23 is used.
p	Gas pressure on the surface area defined by the loading ring
$p(F)$	Nominal gas pressure as a function of the piston force
$p_{max}(F_{max})$	Nominal gas pressure upon breakage
r	Location co-ordinate
r_1	Radius of loading ring
r_2	Radius of supporting ring
r_{3m}	Average specimen radius (for evaluation)
σ	Stress
σ_{bB}	Bending strength
σ_{beqB}	Equivalent bending strength
t	Time
$\Delta F/\Delta t$	Rate at which piston force rises

F^*, p^*, σ^* Non-dimensional quantities corresponding to F, p and σ (see equations (1) to (5))

5 Principle of test method

The square specimen, of side length, L, and having virtually plain parallel surfaces, is placed loosely on a supporting ring (a circular ring with a radius r_2). The specimen is subjected to a load, F_{ring}, by means of a loading ring (radius r_1), which is arranged concentrically to the supporting ring. In addition, the area, A, defined by the loading ring $0 < r < r_1$ is placed under gas pressure, p, which has a specific relationship with the ring load, F_{ring} (see figure 1).

When the specimen is subjected to the ring load and the associated gas pressure, depending upon the dimensions r_1, r_2, L, and h, a radial tensile stress field, which is sufficiently homogeneous for the test purpose, is developed on the convexly bent surface over the area defined by the loading ring (see [1], [2], [3] of annex B). The tangential tensile stress is equal to the radial tensile stress at the central point (r=0) of the specimen, but decreases as the radius, r, increases.

Outside the loading ring, the radial and tangential stresses fall sharply towards the edge of the specimen, so that the risk of breakage outside the loading ring is low. On the edge of the specimen itself, the radial stress is zero and the tangential stress is a compressive stress, this being the case on both the concavely and the convexly bent sides of the specimen. The edge of the specimen is thus always under tangential compressive stress (see EN 1288-1).

By increasing the force, F, and the gas pressure, p, the tensile stress in the central part of the specimen is increased at a constant rate (see (6.1b)) until breakage, so the origin of the break can be expected to occur in the surface area subjected to maximum tensile stress within the loading ring.

NOTE: With the test apparatus as shown in figure 1, a force, pA, acts against the piston force, F, due to the gas pressure, p. The force transferred by the loading ring is $F_{ring} = F - pA$. Thus a distinction should be made between the piston force and the ring load.

The bending strength, σ_{bB}, or equivalent bending strength, σ_{beqB}, is calculated from the maximum value, F_{max}, of the piston force, measured at the time of breakage, and the thickness, h, of the specimen, taking into account the prescribed dimensions of the specimen and various characteristic material values. This assumes that the gas pressure, p, follows the piston force, F, according to the nominal function $p(F)$, (see figure 3).

6 Apparatus

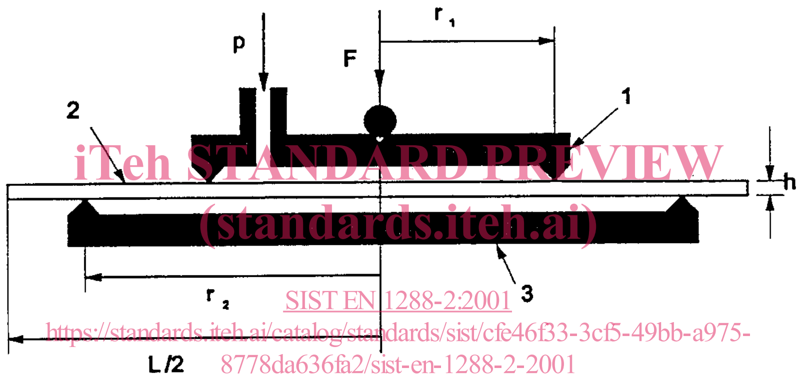
6.1 Testing machine

The bending test shall be carried out using a suitable bending testing machine, which shall incorporate the following features:

a) The stressing of the specimen shall be capable of being applied from zero up to a maximum value in a manner which minimizes shock and is stepless;

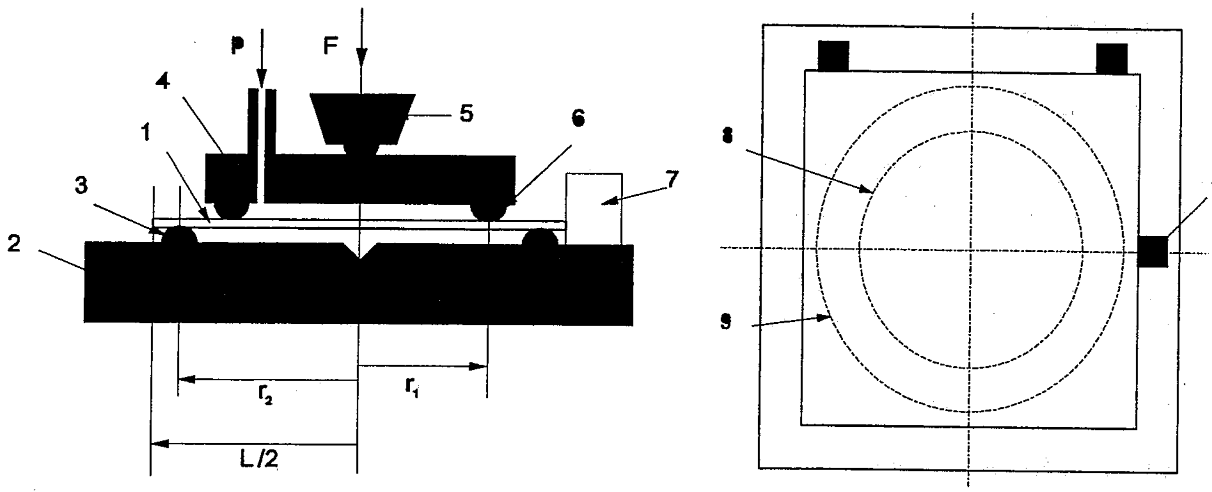
b) The stressing device shall be capable of the specified rate of stressing;

c) The testing machine shall incorporate a load measuring device with a limit of error of ± 2,0 % within the measuring range.



1: Loading ring
2: Specimen
3: Supporting ring

Figure 1: Basic diagram of test apparatus



1 Specimen
2 Rigid base plate, preferably made of steel, with supporting ring (radius r_2).(1)
3 Rubber profile, adapted to the supporting ring, 3 mm thick, with a hardness (40 ± 10) IRHD (in accordance with ISO 48).
4 Rigid loading ring (radius r_1), preferably made of steel.(1)
5 Force transmitting component, with a ball mechanism to ensure the force is centred in the loading ring.
6 Rubber profile, adapted to the loading ring, 3 mm thick with a hardness (40 ± 10) IRHD (in accordance with ISO 48).(2)
7 Adjustment jaws for centring the specimen.(3)
8 Contact circle of the loading ring
9 Contact circle of the supporting ring

NOTE:
(1) The radius of curvature of the bearing surface of the ring is 5 mm.
(2) In the case of specimens which are patterned on the loading ring side, a sponge rubber profile approximately 5 mm thick should also be used to ensure an adequate seal for the gas pressure.
(3) The jaws are removed before the bending test is started, in order that the edge of the specimen is not clamped.

Figure 2: Loading device

6.2 Loading device

6.2.1 Ring load

The ring load shall be applied using a loading device as shown in figure 2. The dimensions of the loading device are given in table 1.

Table 1 : Dimensions for the loading ring and supporting ring

Loading ring r_1 mm	Supporting ring r_2 mm	Effective surface area A mm^2
300 ± 1	400 ± 1	240 000

6.2.2 Surface pressure regulator

The loading device for the surface pressure is shown in figure 2.

The regulator shall be chosen with regard to accuracy and flow rate in such a way that the nominal function, $p(F)$, as shown in figure 3 or table 3, can be met (see annex A).

6.3 Measuring instruments

The following measuring instruments are required:

- a measuring instrument enabling the width of the specimen to be measured to the nearest millimetre;

- a measuring instrument allowing the thickness of the specimen to be measured to the nearest 0,01 mm.

7 Sample

7.1 Shape and dimensions of the specimens

Square specimens of the dimensions shown in table 2 shall be used.

The minimum thickness given for the specimens has been calculated in such a way that the effect of the self-weight of the specimen upon the stress distribution can be ignored.