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ISO 1288-2

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Glass in building — Determination of the bending strength of glass —

Part 2: Coaxial double-ring test on flat specimens with large test surface areas

Verre dans la construction — Détermination de la résistance du verre à la flexion —

Partie 2: Essais avec doubles anneaux concentriques sur éprouvettes planes, avec de grandes surfaces de sollicitation

Reference number
ISO 1288-2:2016(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 160, *Glass in building*, Subcommittee SC 2, *Use considerations*

ISO 1288 consists of the following parts, under the general title *Glass in building — Determination of the bending strength of glass*:

— *Part 1: Fundamentals of testing glass*

— *Part 2: Coaxial double ring test on flat specimens with large test surface areas*

— *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*

Glass in building — Determination of the bending strength of glass —

Part 2:
Coaxial double-ring test on flat specimens with large test surface areas

1 Scope

This part of ISO 1288 specifies a method for determining the bending strength of glass for use in buildings, excluding the effects of the edges.

The limitations of this part of ISO 1288 are described in ISO 1288-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 1288-1, *Glass in building - Determination of the bending strength of glass - Part 1: Fundamentals of testing glass*

3 Terms and definitions

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

3.1
bending stress
tensile bending stress induced in the surface of a specimen

Note 1 to entry: For testing purposes, the bending stress should be uniform over a specified part of the surface.

3.2
effective bending stress
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
tensile bending stress or effective bending stress which leads to breakage of the specimen

3.4
equivalent bending strength
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	m^2
E	modulus of elasticity (Young's modulus) of the specimen NOTE For soda lime silicate glass (see ISO 16293-1), a value of 70 GPa is used.	Pa
F	piston force	N
F_{max}	piston force upon breakage, "breaking force"	N
F_{ring}	force transmitted by the loading ring to the specimen, "ring load"	N
h	thickness or average thickness of specimen	m
L	side length of the square specimens	m
μ	Poisson number of specimen NOTE For soda lime silicate glass (see ISO 16293-1), a value of 0,23 is used.	
p	gas pressure on the surface area defined by the loading ring	Pa
$p(F)$	nominal gas pressure as a function of the piston force	Pa
$p_{max}(F_{max})$	nominal gas pressure upon breakage	Pa
r	location coordinate	m
r_1	radius of loading ring	m
r_2	radius of supporting ring	m
r_{3m}	average specimen radius (for evaluation)	m
σ	stress	Pa
σ_{bB}	bending strength	Pa
σ_{beqB}	equivalent bending strength	Pa
t	time	s
$\Delta F/\Delta t$	rate at which piston force rises	N/s
F^*, p^*, σ^*	non-dimensional quantities corresponding to F, p and σ [see Formulae (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 References [2], [3], [4]). 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 ISO 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 (6.1 b)] 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.

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

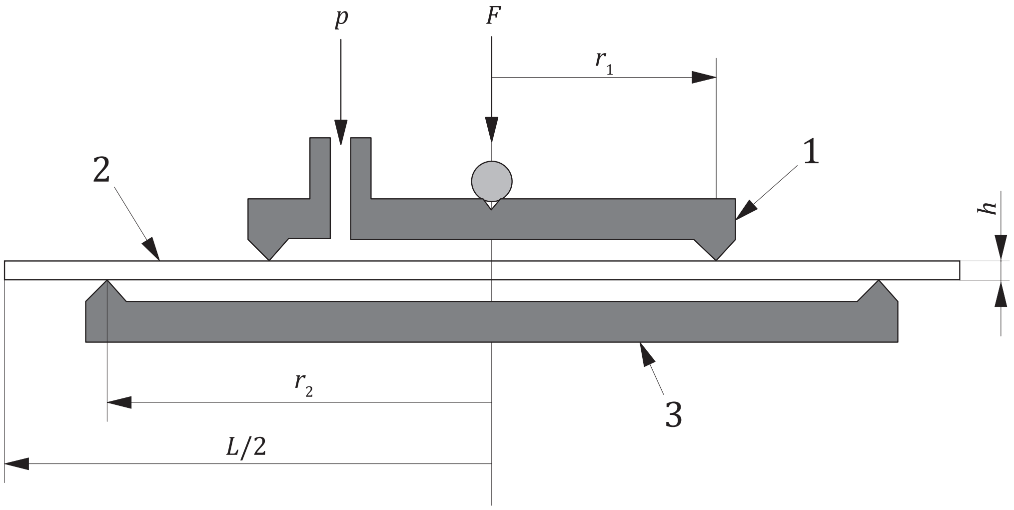
6.1 Testing machine

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.



Key

1 loading ring

2 specimen

3 supporting ring

Figure 1 — Basic diagram of test apparatus

