

### BS EN 1288-3:2000

Glass in building - Determination of the bending strength of glass -  
Part 3: Test with specimen supported at two points (four point bending)

#### Technical Report

**Report No:** R13693-2  
**Author:** M Swanborough  
**Date:** 18-11-13

#### Customer

iGLASS (UK) Ltd  
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#### Details

**Project Name:** Four point bend test  
**Product Name:** iClad Safety Glass coated and aluminium laminated safety glass  
**Size:** 6mm iClad Safety Glass bonded to 15mm MDF board  
**Test standards:** In accordance with BS EN 1288-3:2000

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Testing Conducted by: Wintech Engineering Ltd  
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Test Conducted at: Address as above

Test Conducted for: iGLASS (UK) Ltd

Standard Specified: BS EN 1288-3:2000

Project No: 13693

Product to be tested: iClad Safety Glass coated and aluminium laminated safety glass

Type of glass: Coated and aluminium laminated glass

Pre-treatment and surface condition of test specimen: N/A

Description of edge finish: Polished symmetrical edge

Orientation of glass under test: 50% tested Glass face down

Number of test specimens: 10

Date testing completed: 18 November 2013

Testing Conducted by: Anthony Price

Report Compiled by: M Swanborough

Technical Approval:  
(Authorising Signatory) M Wass  
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## **1. INTRODUCTION**

*This report describes the tests conducted at the testing laboratory of Wintech Engineering Ltd to a selection of glass samples on behalf of iGLASS (UK) Ltd.*

*The test methods were in accordance with BS EN 1288-3:2000 - Glass in building - Determination of the bending strength of glass - Part 3: Test with specimen supported at two points (four point bending) as specified in BS EN 12150-2:2004 - Glass in building - Thermally toughened soda lime silicate safety glass - Part 2: Evaluation of conformity/product standard.*

*Wintech Engineering Ltd is accredited by the United Kingdom Accreditation Service as UKAS Testing Laboratory No. 2223.*

## **2. TEST ARRANGEMENT**

### **2.1 TEST RIG**

*Test specimens, supplied for testing in accordance with the relevant European Standard, were mounted into the 4 Point bend testing machine.*

*A uniformly increasing bending stress was applied at a rate of  $(2.0 \pm 0.4) \text{N/mm}^2 \cdot \text{s}$  until breakage occurred. The maximum load was recorded together with the time taken to reach the load.*

### **2.2 INSTRUMENTATION**

#### **2.2.1 FOUR POINT BEND TESTING MACHINE**

*The testing machine load measuring device is within the error limits of to  $\pm 2.0\%$ . The supporting rollers and bending rollers have a diameter of 50mm and a length of 365mm, all of the rollers are free to rotate.*

#### **2.2.2 MEASUREMENT**

*The thickness of the samples were measured using a digital calliper accurate to 0.01mm. The width and length of the sample was measured with a tape measure accurate to the nearest 1.0mm*

#### **2.2.3 TEMPERATURE & HUMIDITY**

*A data logger capable of measuring temperature with accuracy of  $\pm 1^\circ\text{C}$  and humidity with accuracy of  $\pm 5\% \text{Rh}$  was used. The sample was stored and tested in the laboratory in the permitted range of  $23 \pm 5^\circ\text{C}$  and 40-70% humidity. During the test the temperature did not vary by more than  $1^\circ\text{C}$  in order to avoid the development of thermal stresses.*

### 3. TEST PROCEDURES

#### 3.1 SEQUENCE OF TESTING

##### PRIOR TO TEST

1. The width of the sample was determined by the arithmetic mean of at least 3 individual measurements
2. The thickness of the test sample was determined by the arithmetic mean of at least 4 individual measurements to the nearest 0.05mm

- a) The measured positions lie outside to bending rollers, to avoid damage to sample
- b) The measurements were taken from both ends of the test sample.

3. The test specimen was mounted as per Figure 1 below. Strips of rubber 3mm thick and of hardness  $(40 \pm 10)$  IRHD were placed between the sample and the supporting and bending rollers. An adhesive film was applied to the side of the specimens facing the bending rollers in order to facilitate the location of the fracture origin.

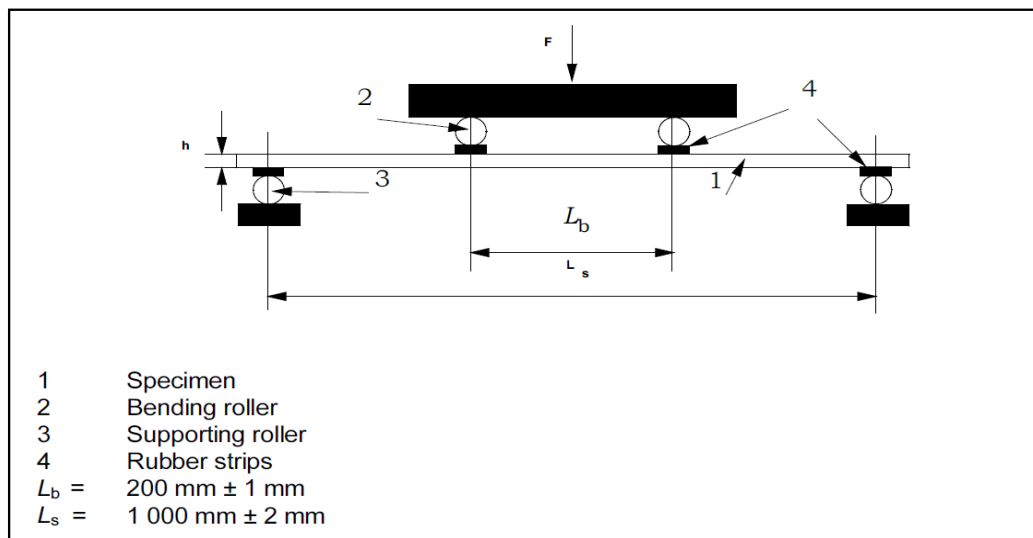
##### MAIN TEST

4. The test samples were bent with a uniformly increasing bending stress at a rate of  $(2 \pm 0.4) \text{ N/mm}^2 \cdot \text{s}$  until breakage occurred. The maximum load was recorded together with the time taken to reach the load.

##### END OF TEST

5. After completion of the bending test the following information was recorded and calculated
  - a) The origin of the break
  - b) The maximum load to break
  - c) The time to break
  - d) The bending strength

**FIGURE 1 (Mounting of specimen as described in BS EN 1288-3:2000)**



#### 4. ACTUAL TEST RESULTS

The results as calculated in accordance with BS EN 1288-3:2000. Note the bending strength is below is calculated using the sample measured average thickness of 22mm

Sample Description and Orientation	Average specimen width mm	Specimen Length mm [L]	Average thickness mm [h]	Maximum force - N [Fmax]	Bending Strength - N/mm <sup>2</sup> [σ <sub>bb</sub> ]	Equivalent Pass	Breakage on edge of glass	Breakage within bending rollers
Glass face up	361.00	1100.00	22.54	2250.0	15.6	N/A	Yes	Yes
Glass face up	361.00	1100.00	22.02	2224.0	16.1	N/A	Yes	Yes
Glass face up	361.00	1100.00	22.64	2340.0	16.0	N/A	Yes	Yes
Glass face up	361.00	1099.00	22.10	2212.0	15.9	N/A	Yes	Yes
Glass face up	361.00	1100.00	22.33	2526.0	17.7	N/A	Yes	Yes
Glass face down	361.00	1100.00	22.46	1832.0	12.9	N/A	Yes	Yes
Glass face down	361.00	1100.00	22.09	1836.0	13.4	N/A	Yes	Yes
Glass face down	361.00	1100.00	22.61	1926.0	13.4	N/A	Yes	Yes
Glass face down	361.00	1100.00	22.53	1839.0	12.9	N/A	Yes	Yes
Glass face down	361.00	1100.00	22.14	2270.0	16.3	N/A	Yes	Yes

#### 4.1 COMPARISON AGAINST 6mm TOUGHENED GLASS

The comparison below gives an indication of the iClad Safety Glass bending strength when compared to standard 6mm toughened glass calculated in accordance with BS EN 1288-3:2000

Sample Description and Orientation	Average specimen width mm	Specimen Length mm [L]	Comparative thickness mm	Maximum force - N [Fmax]	Bending Strength - N/mm <sup>2</sup> [σ <sub>bb</sub> ]	Equivalent Pass	Breakage on edge of glass	Breakage within bending rollers
Glass face up	361.00	1100.00	6.00	2250.0	223.6	Yes	Yes	Yes
Glass face up	361.00	1100.00	6.00	2224.0	221.1	Yes	Yes	Yes
Glass face up	361.00	1100.00	6.00	2340.0	232.4	Yes	Yes	Yes
Glass face up	361.00	1099.00	6.00	2212.0	219.9	Yes	Yes	Yes
Glass face up	361.00	1100.00	6.00	2526.0	250.6	Yes	Yes	Yes
Glass face down	361.00	1100.00	6.00	1832.0	182.7	Yes	Yes	Yes
Glass face down	361.00	1100.00	6.00	1836.0	183.1	Yes	Yes	Yes
Glass face down	361.00	1100.00	6.00	1926.0	191.9	Yes	Yes	Yes
Glass face down	361.00	1100.00	6.00	1839.0	183.4	Yes	Yes	Yes
Glass face down	361.00	1100.00	6.00	2170.0	215.8	Yes	Yes	Yes

#### 4.2 COMPARISON AGAINST 8mm TOUGHENED GLASS

The comparison below gives an indication of the iClad Safety Glass bending strength when compared to standard 8mm toughened glass calculated in accordance with BS EN 1288-3:2000

Sample Description and Orientation	Average specimen width mm	Specimen Length mm [L]	Comparative thickness mm	Maximum force - N [Fmax]	Bending Strength - N/mm <sup>2</sup> [σ <sub>bb</sub> ]	Equivalent Pass	Breakage on edge of glass	Breakage within bending rollers
Glass face up	361.00	1100.00	8.00	2250.0	126.4	Yes	Yes	Yes
Glass face up	361.00	1100.00	8.00	2224.0	125.0	Yes	Yes	Yes
Glass face up	361.00	1100.00	8.00	2340.0	131.4	Yes	Yes	Yes
Glass face up	361.00	1099.00	8.00	2212.0	124.3	Yes	Yes	Yes
Glass face up	361.00	1100.00	8.00	2526.0	141.6	Yes	Yes	Yes
Glass face down	361.00	1100.00	8.00	1832.0	107.3	No	Yes	Yes
Glass face down	361.00	1100.00	8.00	1836.0	107.5	No	Yes	Yes
Glass face down	361.00	1100.00	8.00	1926.0	112.7	No	Yes	Yes
Glass face down	361.00	1100.00	8.00	1839.0	107.7	No	Yes	Yes
Glass face down	361.00	1100.00	8.00	2170.0	126.6	Yes	Yes	Yes

**Table 1 - Values for the mechanical strength of thermally toughened soda lime silicate safety glass (BS EN 12150-1:2000)**

Type of glass	Values for mechanical strength (N/mm <sup>2</sup> )
Float: Clear Tinted Coated	120
Enamelled Float (Enamelled surface in tension)	75
Patterned glass and drawn sheet	90

**5. SUMMARY**

The Results in table 4.1 show that the iClad Safety Glass samples tested are comparable in terms of bending strength to 6mm toughened glass when the surface of the glass is in both tension and compression.

The Results in table 4.2 show that the iClad Safety Glass samples tested are comparable in terms of bending strength to 8mm toughened glass when the surface of the glass is in compression only.

The iClad Safety Glass samples were able to accommodate a significant amount of deflection under load of a magnitude similar to 4mm toughened glass. This characteristic should make the glass more durable in service with a much lower chance of failure than standard 6mm toughened glass.