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Page: 1/6**LABORATORY :**

CAR

TEST REPORT

N°. DE, ATA, RE.: DE 651 XI 271

N°. Labo : CAR 10236

N°. Sample : N 2010-049-007

REQUESTED BY : AGC GLASS EUROPE
 Chaussée de La Hulpe, 166
 1170-BRUXELLES
 Tel. : 02/674 31 11 Fax : 02/672 44 62

Invoice : AGC FLAT GLASS EUROPE
 Rue Jules Bordet
 7180-SENEFFE

Contact persons :

- Demander -
 Mrs. C. Matean

- BBRI -
 Mr. V. Detremmerie

Test carried out : Pendulum impact test

References : EN 12600 : Glass in building – Pendulum test – Impact test method and classification for flat glass

Date and reference of the request : 2010.09.07
Date of receipt of the sample(s) : 2010.10.20
Test date : 2010.10.29
Drafting date of the report : 2010.12.06

This report contains **6** pages and no appendix; it may only be reproduced in its entirety.

Each page of the original report has been stamped (in red) by the laboratory and initialled by the head of laboratory.

The results and findings are only valid for the tested samples.

- No sample
- Sample(s) submitted to a destructive test
- Sample(s) to be removed from our laboratories 60 calendar days after sending of the report, unless a written request is received by the demander of the test

The Deputy Head of Laboratory

The Head of Laboratory

Ir. V. Detremmerie

Ir. B. Michaux

In charge of the test

VDT/KCA



1. INTRODUCTION

On request of AGC Glass Europe, represented by Mrs C. Matean, the BBRI carried out tests in order to determine the resistance of samples made of Pyrobel glass according to the pendulum body impact test.

The results of these tests are given in the report with reference “CAR 10236”.

2. DESCRIPTION OF TEST PIECES

The test pieces were issued and registered in the register of receipts for test pieces under section N-2010-049-007 at the testing station of the BBRI in Limelette by the laboratory “Roof and Façade elements”. This relates to Pyrobel glass samples for which the composition and dimensions are stated below.

The delivered samples are described in Table 1 and in Table 2 here below.

| Commercial name of the product | Sample reference | Sample configuration | Dimensions (mm x mm) | Thickness (mm) | Weight (kg/m ²) | Number of samples |
|--------------------------------|--|--------------------------------|----------------------|----------------|-----------------------------|-------------------|
| Pyrobel 30 | BX14010-01-501 BX14010-01-502 BX14010-01-503 BX14010-01-504 | Symmetric sample (cfr Table 2) | 1938 x 876 | 30 ± 2 | 69 | 4 |
| Pyrobel 53 N | BX14009-05-501 BX14009-05-502 BX14009-05-601 BX14009-05-602 | Symmetric sample (cfr Table 2) | 1938 x 876 | 52.5 ± 3 | 122 | 4 |

Table 1 : Description of the samples

| Components | Type | Nominal thickness | Treatment | |
|-------------------|-----------------|-------------------|-----------|----------|
| | | | Physical | Chemical |
| Pyrobel 30 | | | | |
| 1 | Clear glass | 3 | | |
| 2 | Pyrobel coating | 1.6 | | |
| 3 | Clear glass | 3 | | |
| 4 | Pyrobel coating | 1.6 | | |
| 5 | Clear glass | 3 | | |
| 6 | Pyrobel coating | 1.6 | | |
| 7 | Clear glass | 3 | | |
| 8 | Pyrobel coating | 1.6 | | |
| 9 | Clear glass | 3 | | |
| 10 | Pyrobel coating | 1.6 | | |
| 11 | Clear glass | 3 | | |
| 12 | Pyrobel coating | 1.6 | | |
| 13 | Clear glass | 3 | | |



| Components | Type | Nominal thickness (mm) | Treatment | |
|--------------------|-----------------|------------------------|-----------|----------|
| | | | Physical | Chemical |
| Pyrobel 53N | | | | |
| 1 | Clear glass | 3 | - | - |
| 2 | Pyrobel coating | 1.6 | - | - |
| 3 | Clear glass | 3 | - | - |
| 4 | Pyrobel coating | 1.6 | - | - |
| 5 | Clear glass | 8 | - | - |
| 6 | Pyrobel coating | 1.6 | - | - |
| 7 | Clear glass | 3 | - | - |
| 8 | Pyrobel coating | 1.6 | - | - |
| 9 | Clear glass | 3 | - | - |
| 10 | PVB | 0.76 | - | - |
| 11 | Clear glass | 3 | - | - |
| 12 | Pyrobel coating | 1.6 | - | - |
| 13 | Clear glass | 3 | - | - |
| 14 | Pyrobel coating | 1.6 | - | - |
| 15 | Clear glass | 8 | - | - |
| 16 | Pyrobel coating | 1.6 | - | - |
| 17 | Clear glass | 3 | - | - |
| 18 | Pyrobel coating | 1.6 | - | - |
| 19 | Clear glass | 3 | - | - |

Integration of an electronic system or alarm component: none

Table 2 : Structural composition of the samples

3. DESCRIPTION OF THE TESTS

The pendulum impact test is performed according to the EN 12600. This test is intended to classify flat glass products in 3 principal classes by performance under impact and by mode of breakage.

The test apparatus comprises:

- A stable main frame
- A clamping frame (internal width: 847 ± 5 mm, internal height: 1910 ± 5 mm) which is fitted onto the main frame and is used to hold the test piece in position for the duration of the test. Each part of the clamping frame is fitted with a strip of rubber. This is 20 ± 2 mm wide and 10 ± 1 mm thick and has a hardness of 60 ± 5 IRHD
- A dual tyre impactor (total mass of 50 ± 0.1 kg, inflate pressure of 0.35 ± 0.02 MPa) with a suspension device and release mechanism

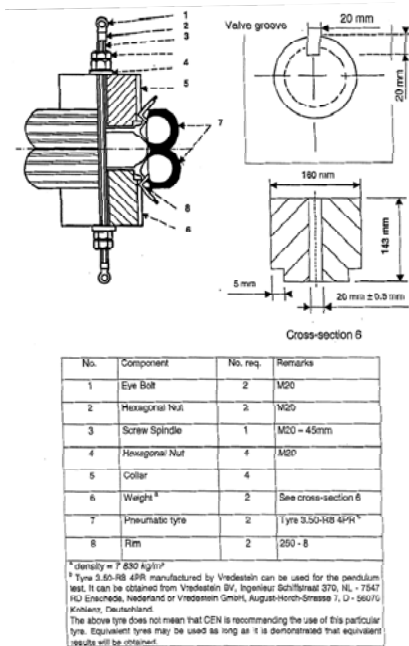


Figure 1 : Impactor

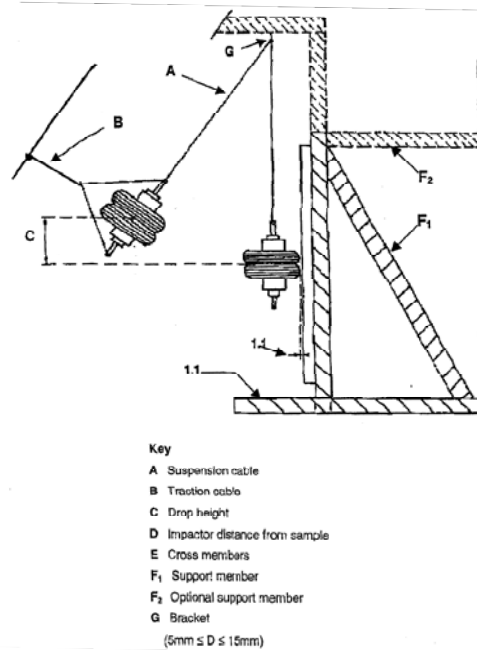


Figure 2 : Side elevation of the main frame with impactor

The test piece is placed in the clamping frame so that its edges are encased in the rubber to a minimum depth of 10 mm. When clamped, the rubber shall be compressed by no more than 20% of its thickness. The test is carried out at $20 \pm 5^\circ\text{C}$. Testing starts at the lowest drop height (see Table 3) up to the drop height appropriate to the class for which the material is intended.

| Classification | Drop height (mm) |
|----------------|------------------|
| 3 | 190 |
| 2 | 450 |
| 1 | 1200 |

Table 3: Impact levels

The impactor is released so that it falls with a pendulum movement and without initial velocity. The direction of impact on the centre of the test piece shall be normal to the surface. If the impactor strikes the test piece more than once the test shall be deemed to be invalid.

After impact, the test piece is inspected i.e.:

- It remains unbroken or
- It broke in accordance with either the requirements a) or b) hereunder
 - a) Numerous cracks appear, but no shear or opening is allowed within the test piece through which a 76 mm diameter sphere can pass when a maximum force of 25 N is applied. Additionally, if particles are detached from the test piece up to 3 minutes after impact, they shall, in total, weigh no more than a mass equivalent to 10000 mm² of the original test piece. The largest single particle shall weigh less than the mass equivalent to 4400 mm² of the original test piece
 - b) Disintegration occurs and the 10 largest crack-free particles collected within 3 minutes after impact and weighed, all together within 5 minutes of impact shall weigh no more than the mass equivalent to 6500 mm² of the original test piece. The particles shall be selected only from the portion of the original test piece exposed in the test frame. Only the exposed area of any particle retained in the test frame shall be taken into account in determining the mass equivalent.
- It broke and failed to conform to the requirements a) and b) here above



If any of the initial 4 test pieces breaks and fails to conform to the requirements a) and b) here above, the procedure has to be stopped. If all 4 test pieces either do not break or else break according to the criteria a) or b) here above, the drop height has to be increased to the next level if it is required to test the material to a higher impact level. The test has to be repeated on 4 more samples of the same material. If the material remains unbroken, the same sample may be used.

The performance classification of a glass product shall be given as follows: $\alpha\beta\Phi$ where

- α is the highest drop height class (see Table 3) at which the product either did not break or broke in accordance with a) or b) here above
- β is the mode of breakage
 - a) type A : numerous cracks appear forming separate fragments with sharp edges, some of which are large (typical of annealed glass)
 - b) type B : numerous cracks appear, but the fragments hold together and do not separate (typical of laminated glass)
 - c) type C : disintegration occurs, leading to a large number of small particles that are relatively harmless (typical of toughened glass)
- Φ is the highest drop height class (see Table 3) at which the product either did not break or broke in accordance with a) here above

4. RESULTS OF THE TESTS

The results of the pendulum impact tests are given in Table 4.

Temperature in the laboratory: 20.1°C

Relative humidity: 52.3%

Conditioning time: 9 days

| Sample | | Drop height (mm) | Test results |
|------------|----------------|---------------------|--------------|
| Type | Reference | | |
| Pyrobel 30 | BX14010-01-501 | 190 | No breakage |
| | BX14010-01-502 | | No breakage |
| | BX14010-01-503 | | No breakage |
| | BX14010-01-504 | | No breakage |
| | BX14010-01-501 | 450 | No breakage |
| | BX14010-01-502 | | No breakage |
| | BX14010-01-503 | | No breakage |
| | BX14010-01-504 | | No breakage |
| | BX14010-01-501 | 1200 | No breakage |
| | BX14010-01-502 | | No breakage |
| | BX14010-01-503 | | No breakage |
| | BX14010-01-504 | | No breakage |



| | | | |
|-------------|----------------|------|-------------|
| Pyrobel 53N | BX14009-05-501 | 190 | No breakage |
| | BX14009-05-502 | | No breakage |
| | BX14009-05-601 | | No breakage |
| | BX14009-05-602 | | No breakage |
| | BX14009-05-501 | 450 | No breakage |
| | BX14009-05-502 | | No breakage |
| | BX14009-05-601 | | No breakage |
| | BX14009-05-602 | | No breakage |
| | BX14009-05-501 | 1200 | No breakage |
| | BX14009-05-502 | | No breakage |
| | BX14009-05-601 | | No breakage |
| | BX14009-05-602 | | No breakage |

Table 4 : Results of the pendulum impact test

The Pyrobel 30 and Pyrobel 53N are both classified 1B1 according to the EN 12600.