TNO Building and Construction Research

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TNO report

2002-CVB-R06277

Fire resistance of a Glaverbel glazed partition construction following NEN 6069:1997 and NEN-EN 1364-1

Date	October 2002
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Number of appendices	A t/m D
Sponsor	Glaverbel S.A. B 7180 Seneffe Belgique
Project name	Fire resistance glazed partition construction
Project number	006.10141/01.04.04

1 SUBJECT

Glazed separation construction in a steel frame.

2 TEST PERFORMED

Fire resistance according to NEN 6069:1997 and NEN-EN 1364-1.

3 CONTRACTOR

Glaverbel S.A.
Parc Industriel – Zone C
B 7180 Seneffe
Belgium

4 PLACE AND DATE OF TEST

4.1 Place of test

The test was performed at the Centre for Fire Research of TNO Building and Construction Research, in Rijswijk, The Netherlands.

4.2 Dates regarding the test

The construction was assembled on March 28 and April 8, 2002.
The test was performed on April 22, 2002.

5 DATE AND NUMBER OF REPORT

Date of report: October 2002
Number of report: 2002-CVB-R06277

6 TEST CONSTRUCTION

6.1 General

The test was performed on a window construction mounted in a supporting construction consisting of a steel testing frame with a fire-proof concrete lining with internal dimensions (w x h) 4000 x 3000 mm. The frame was reduced in size by 2 cellular concrete piers, thickness 150 mm, to accommodate the 3010 mm wide window frame. The window was constructed from a steel frame (make : Jansen) with glass panes, type Pyrobelite EW30/7 and Pyrobelite EW30/11 fire protective glass.

6.2 Window construction

For the window construction, see figures 1 – 5.
The window was constructed from:

- A steel frame, outside dimensions (w x h) 3010 x 2950 mm. The frame was constructed (by De Rollecate B.V.) from steel Jansen RJE60 shaft profiles. The frame divided the construction into 6 separate panels. The upper part was divided into two large frames, inside dimensions (w x h) 1213 x 2015 mm, and two smaller frames, inside dimensions (w x h) 165 x 2015 mm; the lower part was divided into two frames, inside dimensions (w x h) of 1429 x 788 mm. The width of the frame beams was 55 mm, with a raised edge of 20 mm. Steel thickness was 2 mm.
- Glass panes from Glaverbel, fire resisting glass types Pyrobelite EW30/7 and Pyrobelite EW30/11, thickness respectively 7 and 11 mm. Pyrobelite EW30/11 is identical to Pyrobelite EW30/7, with an additional layer of glass with UV-protective coating. Two of the panes were fixed with the coating oriented towards the fire. The panes were produced by Glaverbel OLOVI (Czech Republic). For more information regarding the placement of the panes, please refer to the drawings (fig. 6). The pane dimensions were (w x h) 1205 x 2005, 157 x 2005 and 1421 x 777 mm. Between the panes and the frame a distance of about 5 mm was kept. Supporting blocks of compressed mineral fibre, dimensions (l x w x t) 80 x 15 x 5 mm, density 990 kg/m^3, were placed below the panes, 4 below each large pane, a single block below the two small panes.
- In order to mount the panes in the frame, Fiberfrax glazing tape, 5 x 15 mm, was put on the edges of the panes and on the glass beads. The panes were fixed in the frame with steel glass beads, type R402.135z in combination with the Pyrobelite 7, and type R402.130z in combination with the Pyrobelite 11. The beads were mounted by clicking over steel screws, type 450.008, in-between distance approximately 175 mm. The joints between glass and frame were sealed with Dow Corning 815 sealing compound.

6.3 Connection to the testing frame

One vertical side of the test specimen was not attached to the test frame, to allow free movement of the test specimen. The other vertical side, as well as both horizontal sides of the specimen, were attached to the concrete testing frame by means of ø7.5 x 72 window screws (‘*kozijnschroeven*’). Placement of the screws is indicated in the drawing. The specimen was oriented with the glass beads towards the fire. The gaps between the test frame and the test specimen were filled with ‘Superwool 607’, mineral wool of density 128 kg/m^3.

For more information regarding the construction, please refer to the drawings.

6.4 Assembly of the construction

The glazed separation construction was mounted as follows:

- Placement of the pre-fabricated frame in the testing frame, fastening the window frame with window screws.
- Filling the gaps between the frame and the supporting construction with ‘Superwool’.
- Placement of the window panes in the frame. Glazing tape was placed against the edges of the panes.
- Fixing of the panes with glass beads, clicking the beads over the screw heads.
- Applying Dow Corning sealing compound to the joints of the panes.

7 SAMPLING AND PREPARATION OF TEST SPECIMEN

Centre for Fire Research TNO Building and Construction Research Rijswijk, the Netherlands	Test frame
De Rollecate B.V. Staphorst, the Netherlands	Manufacturing of the window frame
Glaverbel S.A. Seneffe, Belgium	Assembly of the test specimen

8 MODE OF TESTING

8.1 Verification of test sample

During the assembly the parts and materials were verified from the supplied drawings.

8.2 Conditioning

In the period between assembling and testing the construction was stored in ambient conditions of temperature (20 ± 5 °C) and relative humidity (50 ± 10 %) in the testing laboratory of the Centre for Fire Research, until April 12. From April 12 until April 19, the construction was stored at 35 °C and 10 % relative humidity, to ascertain curing of the silicone sealing compound. From April 19 until the test on April 22nd, the construction was again placed in the testing laboratory in ambient conditions.

8.3 Fire test

8.3.1 Test conditions

The test was performed under the conditions as specified in NEN-EN 1363-1 and NEN-EN 1364-4

8.3.2 Measurements

During the heating the following data were measured and registered:

- temperatures inside the furnace with 8 plate thermometers, regularly spread over the directly heated surface;
- the pressure inside the furnace at 0.5 m and 3.0 m height from the floor;
- surface temperatures on the non-directly heated side of the test sample with 20 thermocouples;
- radiation at 1 m from the centre of either half of the test specimen;
- displacement of the test specimen at the centre of the test specimen and at mid height at the free edge;
- temperature and air velocity outside the furnace.

Furnace temperatures and pressure are given in graphs B1 to B4.

The placement of the thermocouples on the test specimen is given in fig. C1.

9 OBSERVATIONS DURING HEATING

After heating for 8½ minutes, the average temperature of the large Pyrobelite 7 pane exceeded 160 °C (**end of thermal insulation**).
After heating for 37 minutes the furnace could be directly accessed through a crack on the top side of the large centre pane (**end of integrity criterion**).

For a more detailed description of the observations please refer to Annexe A.

10 TEST RESULTS OF THE MEASUREMENTS OF THE FIRE TESTS

Test results are given in graphs C2 to C5 of annexe C.

11 SUMMARY

Table 1 summarises the most important results of the test.

Table 1. Test results.

	Time from the start of the heating, during which the criterion was just fulfilled.	
Criterion	NEN-EN 1364-1	NEN 6069
Insulation regarding temperature	8 minutes	9 minutes
Insulation regarding radiation	>39 minutes	>39 minutes
Integrity	37 minutes	37 minutes

The test was discontinued after 39 minutes.

12 CONCLUSIONS

The fire resistance of the tested glazed separation construction following NEN 6069:1997, with respect to its separation function is as follows: **37 minutes.**

A classification following NEN-EN 1364-1 can be given in the classification document as described in prEN 13501-2.

13 FIELD OF APPLICATION AND CONDITIONS

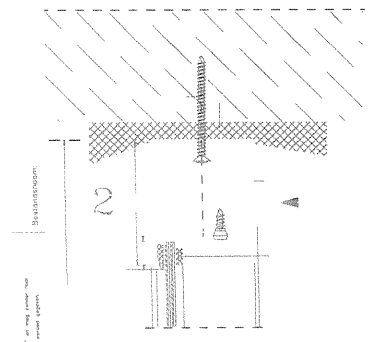
The conclusions are only valid for glazed separation constructions which are in detail the same as the construction tested;

- with connections and joints as described in this report;
- for walls with a maximum height of 3.00 m; the width is not limited.

Regarding these conclusions it is also required that the construction elements to which these are connected have a fire resistance which is at least equal to that of the glazed partition.

Dr. F. Paap

P.W.M. Kortekaas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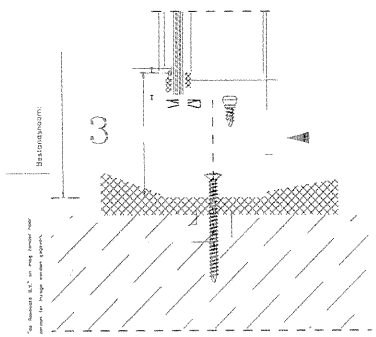
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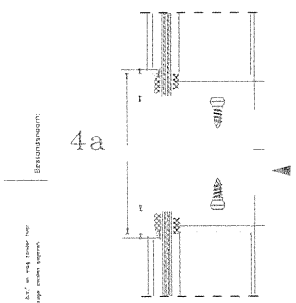
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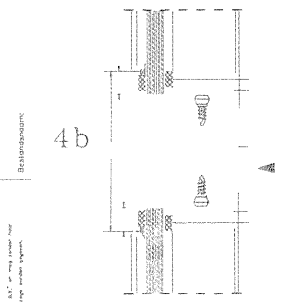
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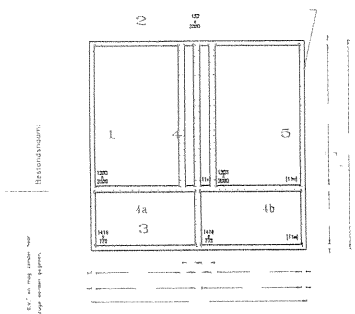
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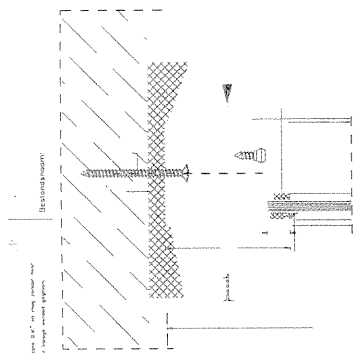

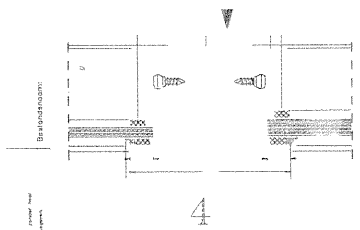
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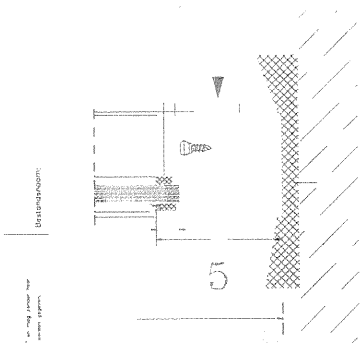
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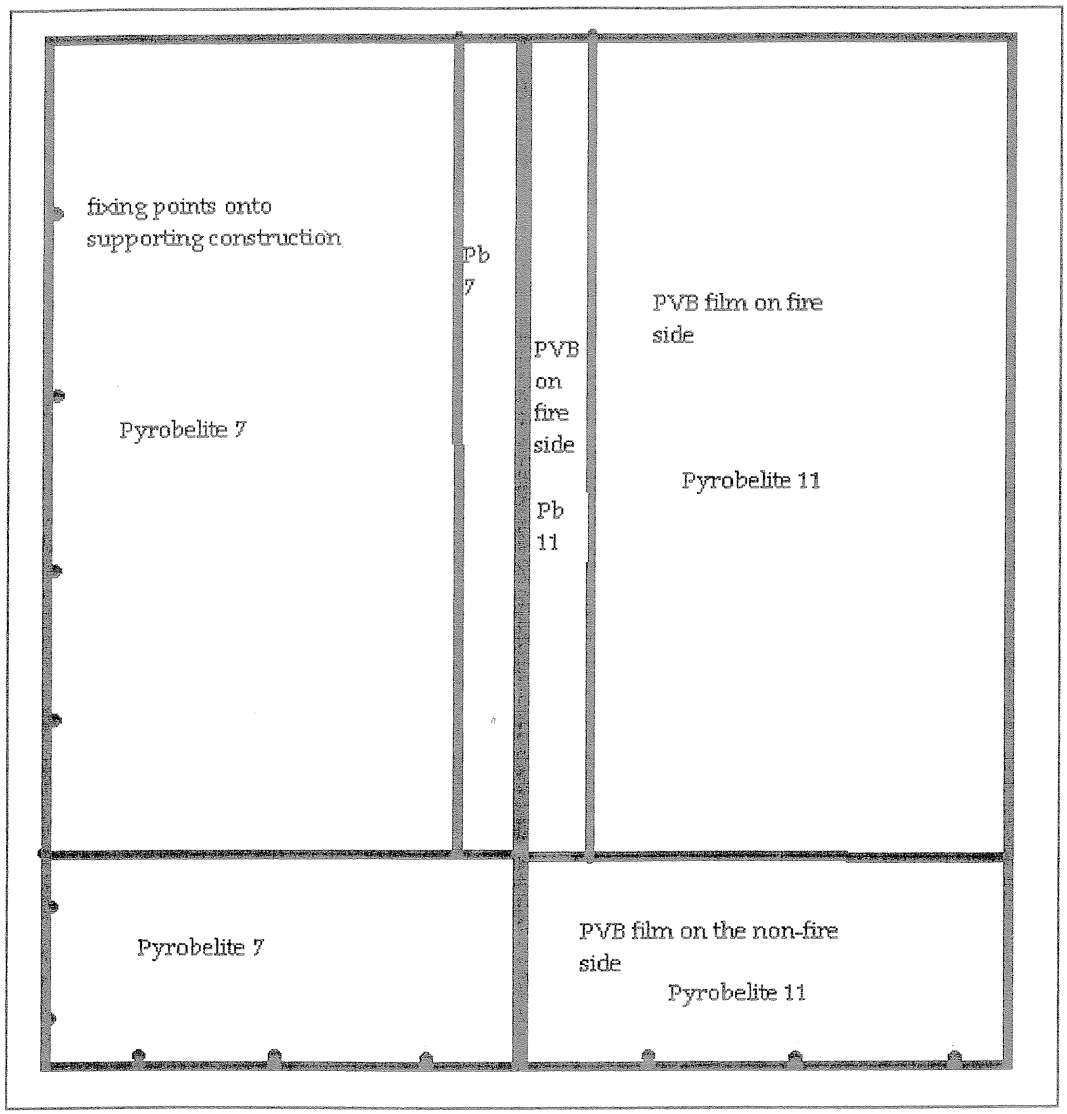
Figure 2, positioning of fixing points of window frame onto test frame, and placement of glass types.



Annex B: Measured gas temperatures and pressure in the furnace.

Figure B1: Furnace temperatures with standard fire temperatures

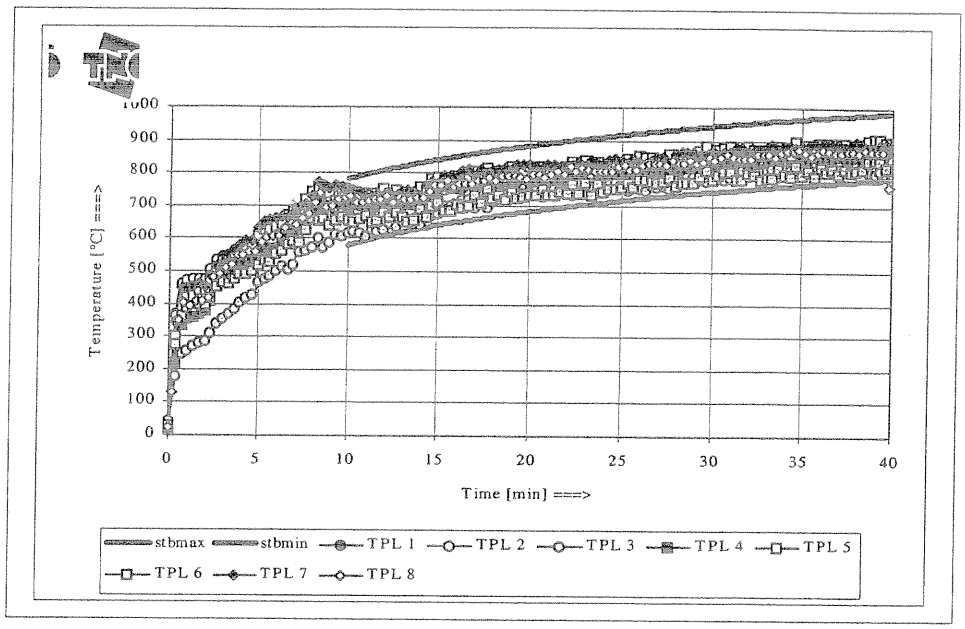


Figure B2: Deviation from NEN

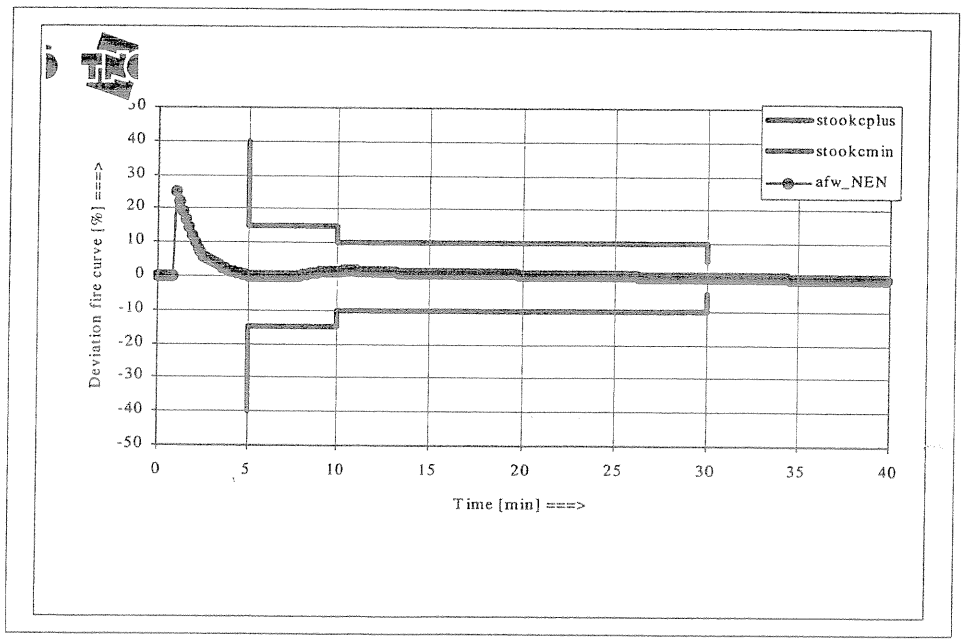


Figure B3: Deviation from NEN-EN

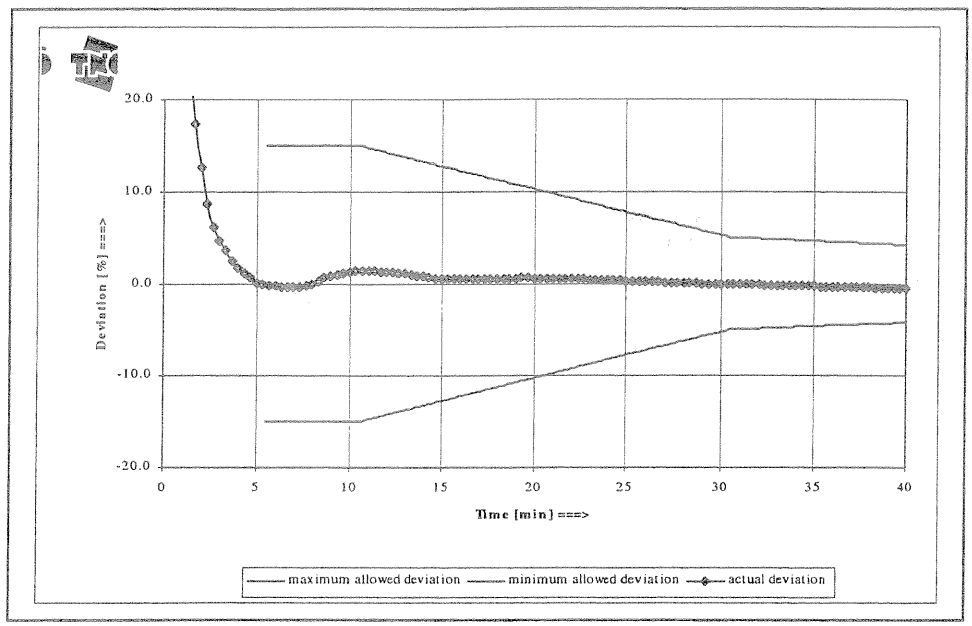
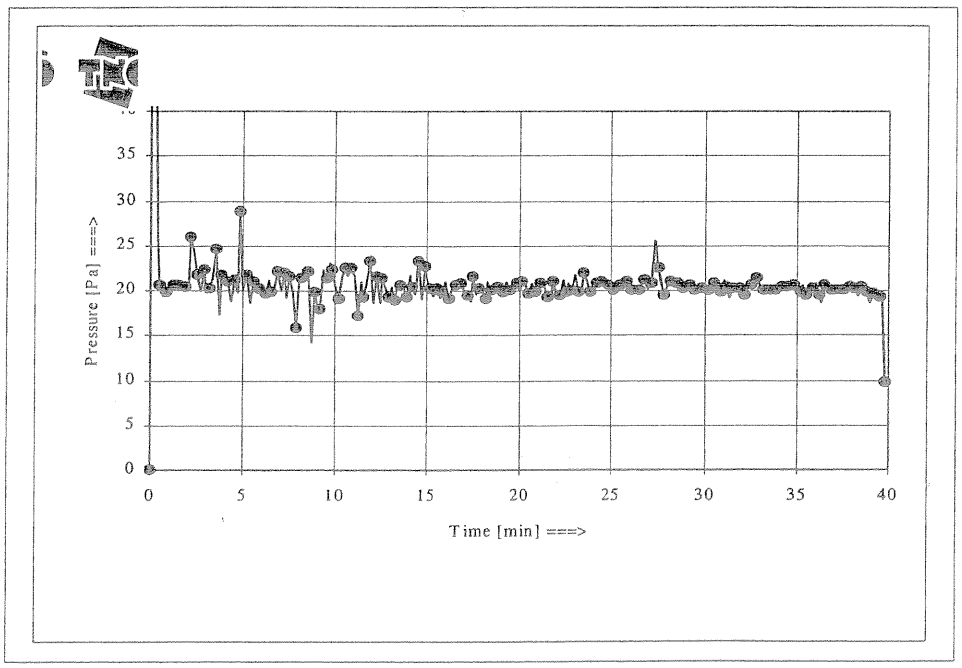


Figure B4: Furnace pressure at 2.70 m



Annexe C: measured test specimen temperatures, radiation and displacement

Figure C1:Schematic drawing of placing of thermocouples and displacement measurements.

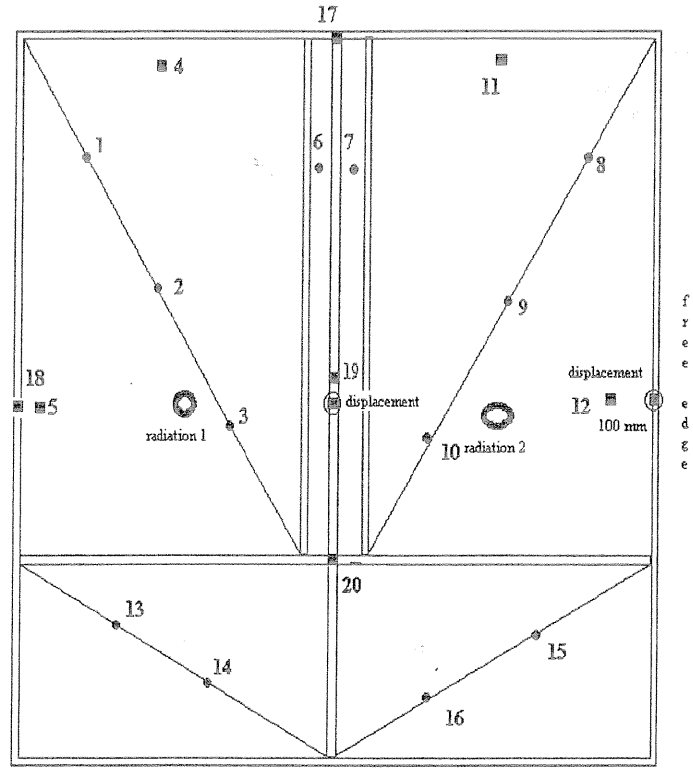


Figure C2: Surface temperature readings on the glass.

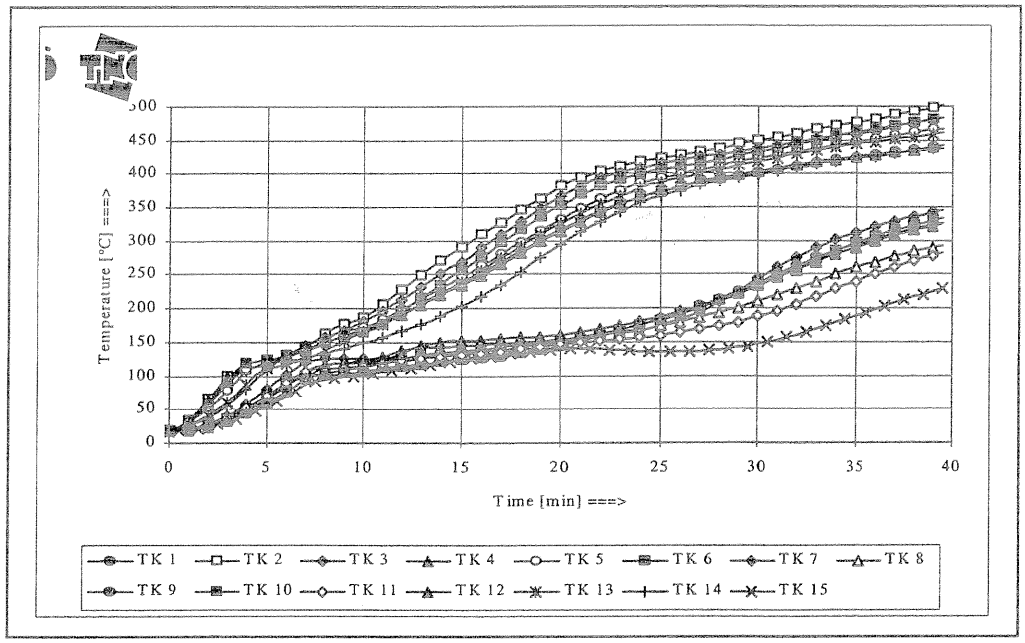


Figure C3: Temperatures on steel profiles.

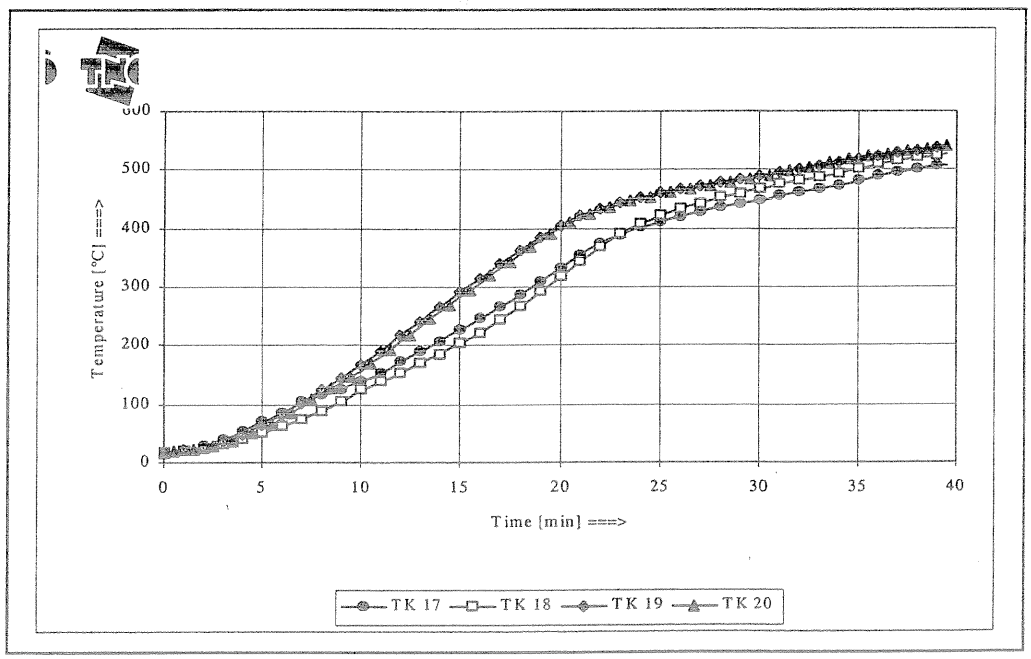


Figure C4: Wall displacement.

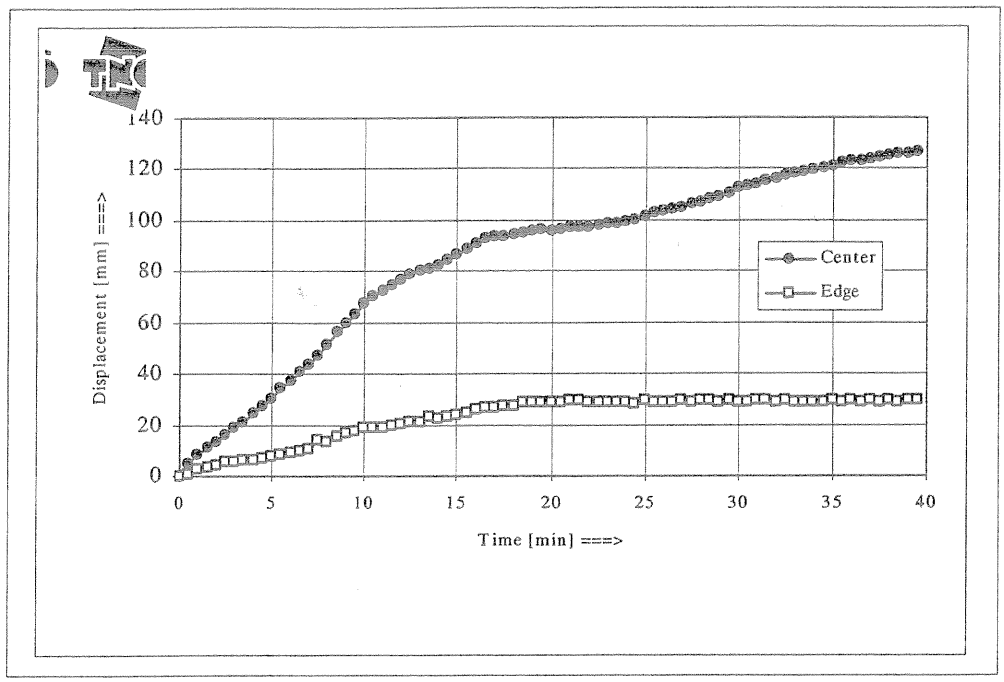
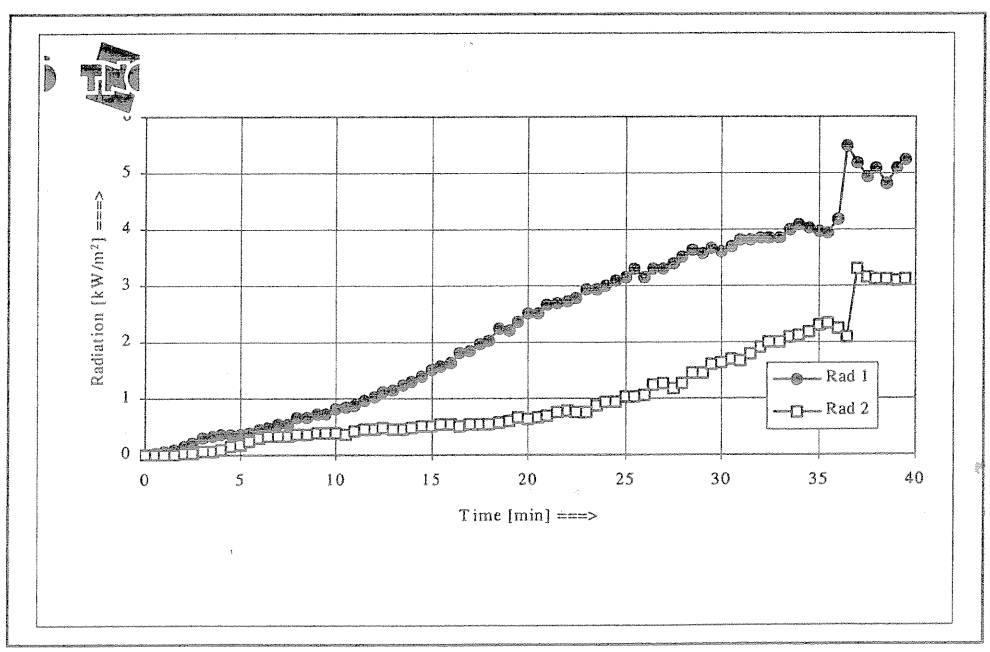
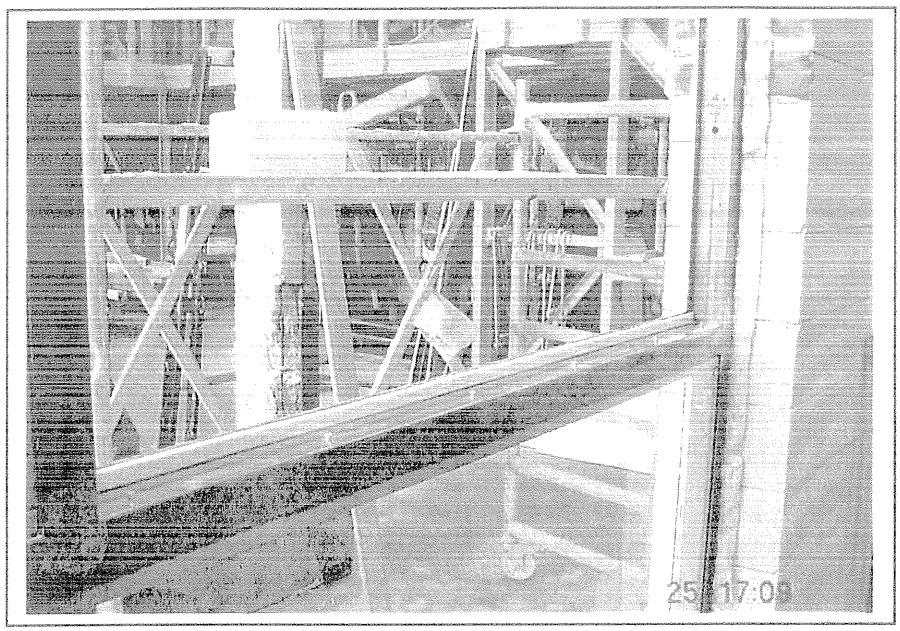


Figure C5: Radiation at 1 m distance from centre of test specimen.

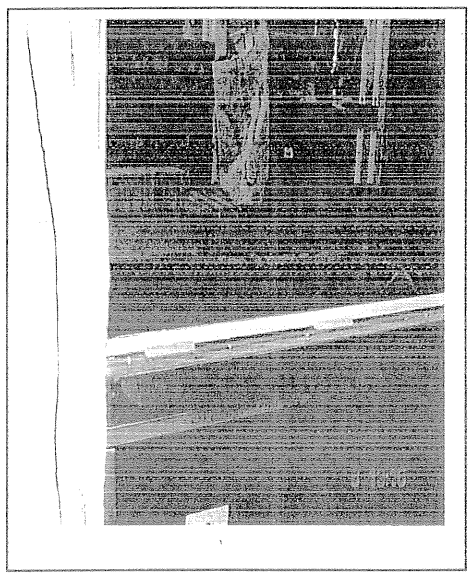


Annexe D: pictures

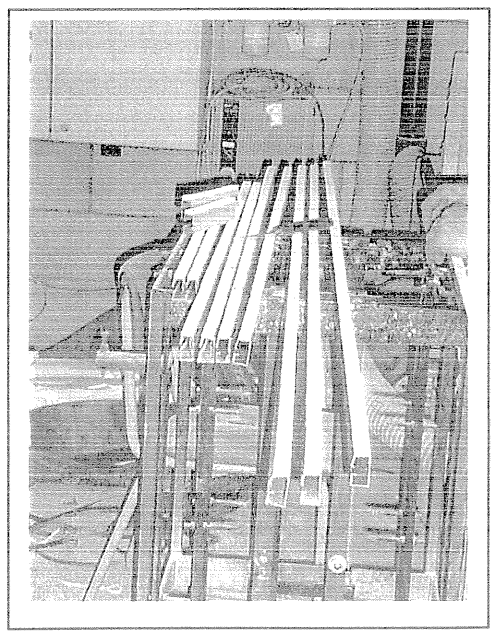
Picture 1. Assembly of test specimen.



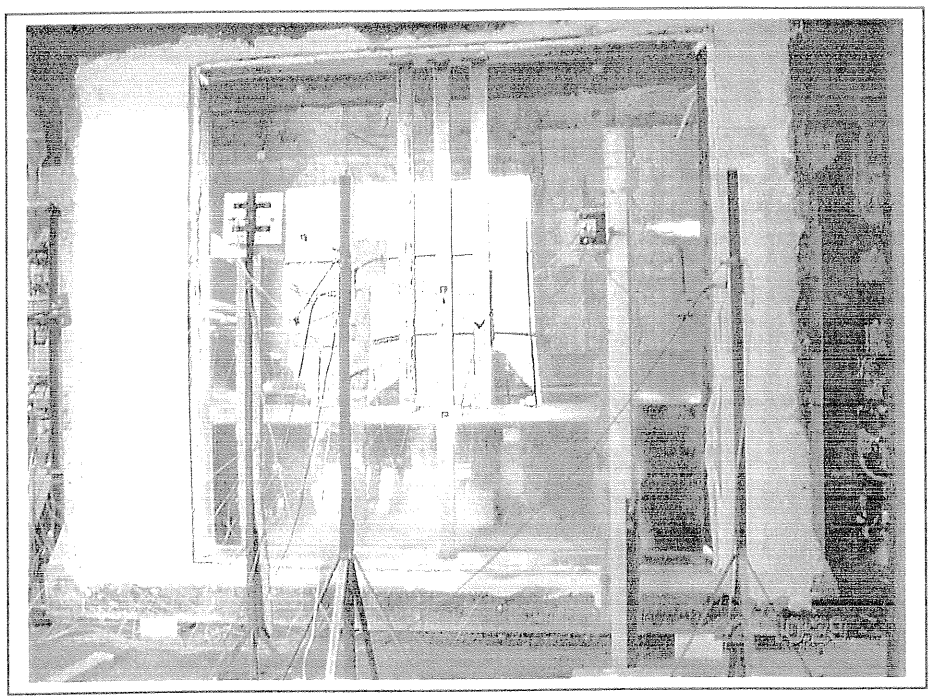
Picture 2. Setting blocks in frame.



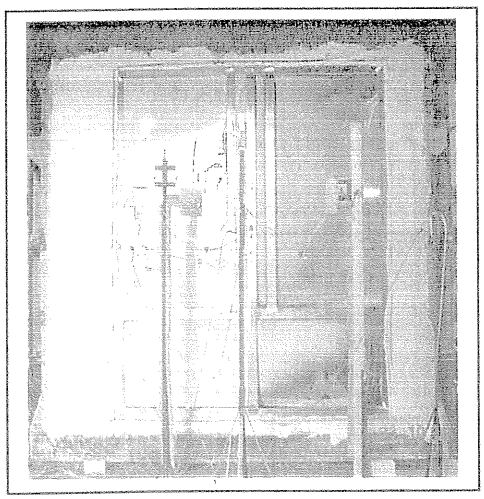
Picture 3. Glass beads with glazing tape.



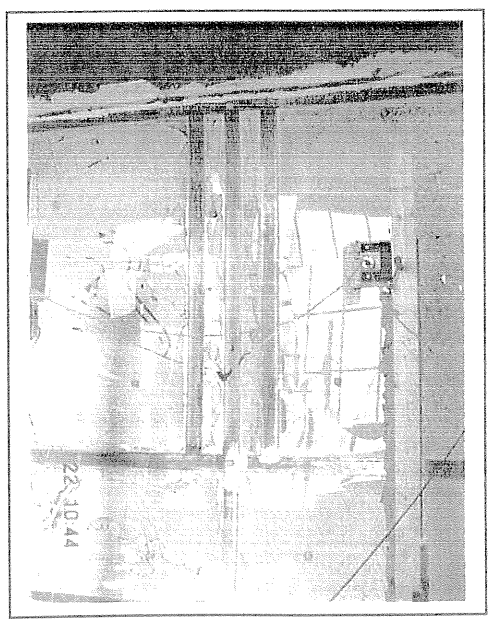
Picture 4. Start of test, t = 0 mins.



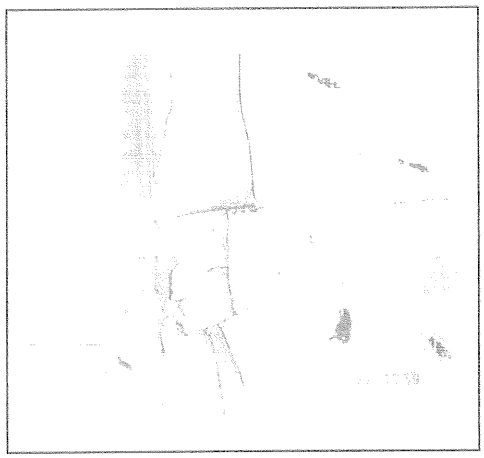
Picture 5. Left panes are opaque, right panes start to react, t = 5 mins.



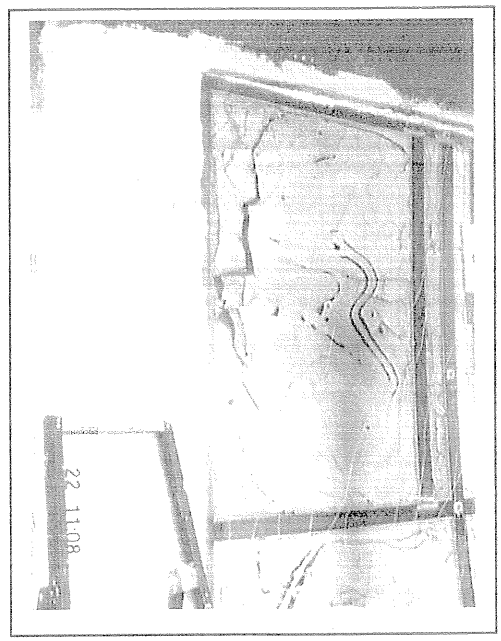
Picture 6. Steel frame discolours by heat, t = 15 mins.



Picture 7. A crack starts to form in the left pane, t = 31 mins.



Picture 8. The crack has grown; end of integrity, t = 39 mins.



Picture 10. The specimen after the test.