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**TNO report**

**2005-CVB-R0288[Rev.1]**

**Determination of the resistance to fire of a glazed  
partition of Glaverbel with a PYROBELITE  
EW60/12 type 2 in IGU fixed in a Jansen frame  
following NEN-EN 1364-1**

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Project name Fire resistance glazed partition construction  
Project number 006.45152/01.01

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## 1 SUBJECT

Non-loadbearing glazed partition construction of Glaverbel with a PYROBELITE EW60/12 type 2 in IGU fixed in a Jansen Janisol 2 steel frame.

## 2 TEST PERFORMED

Fire resistance according to NEN-EN 1364-1:2001.

## 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 May 25, 2005.  
The test was performed on May 27, 2005.

## 5 DATE AND NUMBER OF REPORT

Date of report: August 2005  
Number of report: 2005-CVB-R0288

## 6 TEST CONSTRUCTION

### 6.1 General

The test was performed on a glazed partition construction in a concrete testing frame with internal dimensions (w x h) 4000 x 3000 mm. The frame was reduced in size by a cellular concrete pier, thickness 150 mm, to accommodate the 3000 mm wide steel frame. The partition was constructed from a steel frame (Jansen Janisol 2) with glass panes, type Glaverbel Pyrobeitel EW60/12 type 2 insulated fire protective double glass units.

## 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) 3000 x 3000 mm. The frame was constructed (by De Rollecate B.V.) from steel Jansen Janisol 2 shaft profiles. The frame was divided into 6 separate panels, see figure 1, of the following inside dimensions (w x h): 1635 x 1010 mm; 795 x 1830 mm; 795 x 1245 mm; 795 x 535 mm; 1215 x 535 mm; 1215 x 2305 mm. The frame members consisted of 2 separate steel profiles, joined by special polyamide-based insulating material, and filled with 8.5 mm thick strips of gypsum-based cooling material placed over the full length and width of the profiles. The width of the frame beams was 52.5 mm, with a raised edge of 20 mm. Steel thickness was 2 mm.
- Double-glazed units from Glaverbel, consisting of fire resisting glass type Pyrobelite EW60/12 type 2, a gap of 15 mm, and thermoplus ENERGY 6mm. The test was performed with the Pyrobelite glass towards the fire. The pane dimensions were (w x h) 1620 x 1000 mm; 778 x 1820 mm; 778 x 1235 mm; 778 x 520 mm; 1200 x 520 mm; and 1200 x 2300 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<sup>3</sup>, 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, ceramic fibre glazing tape, 5 x 20 mm and 3 x 20mm, 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 R402.1127. The beads were mounted by clicking over steel screws, type 450.009, 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  $\varnothing 7.5$  x 120 mm window screws ('*kozijnschroeven*'). These screws were positioned at centre-to-centre distance of approximately 500 mm, starting at 150 mm from the edge. The gaps between the test frame and the test specimen were filled with rockwool and sealed with Dow Corning sealant.

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 rockwool.
- 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

The samples of the panes were identified by the supplier as follows:

- sample #1	1200x2300	BX04507-04-501	2421053707/1/1/1
- sample #2	1200x520	BX04507-05-501	2421053707/1/2/1
- sample #3	1620x1000	BX04507-06-501	2421053707/1/3/1
- sample #4	778x1820	BX04507-02-501	2421053707/1/4/1
- sample #5	778x520	BX04507-03-501	2421053707/1/5/1
- sample #6	778x1235	BX04507-01-501	2421053707/1/6/1

## 8 MODE OF TESTING

### 8.1 Verification of test sample

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

TNO Centre of Fire Research has not been involved in the sampling procedure of the test specimen components.

### 8.2 Conditioning

In the period between assembling and testing the construction was stored in ambient conditions of temperature ( $20 \pm 5$  °C) and relative humidity ( $50 \pm 10$  %) in the testing laboratory of the Centre for Fire Research.

### 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

The initial ambient temperature was 21 °C.

#### 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 2.7 m height from the floor;
- surface temperatures on the non-directly heated side of the test sample with 27 thermocouples;
- radiation at 1 m from the centre 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 B3.

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

## 9 OBSERVATIONS DURING HEATING

After heating for 31 minutes, thermocouple 29 indicated the frame temperature had increased  $>180\text{ }^{\circ}\text{C}$  (**end of thermal insulation**).

After heating for 58 minutes the inner pane of the largest window fell away, leaving an opening between the outer glass pane and the frame, through which the furnace could be directly accessed; continuous flaming occurred around the edge of the glass (**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 C6 of annexe C.

### Uncertainty of measurement

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

## 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
Insulation regarding temperature	
-average temperature rise $>140\text{ }^{\circ}\text{C}$	50 minutes
-maximum temperature rise $>180\text{ }^{\circ}\text{C}$ (glass)	48 minutes
-maximum temperature rise $>180\text{ }^{\circ}\text{C}$ (frame)	31 minutes
Insulation regarding radiation	$> 65$ minutes
Integrity	
- continuous flaming	58 minutes
- gap gauges	58 minutes
- ignition of cotton pad	not determined

The test was discontinued after 65 minutes.

## 12 CONCLUSIONS

**The fire resistance** of the tested glazed partition construction following NEN 6069:2001, with respect to its separation function is as follows: **58 minutes**.

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

## 13 FIELD OF APPLICATION AND CONDITIONS

The conclusions are only valid for glazed partition 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



Dr. Ir. G. van den Berg

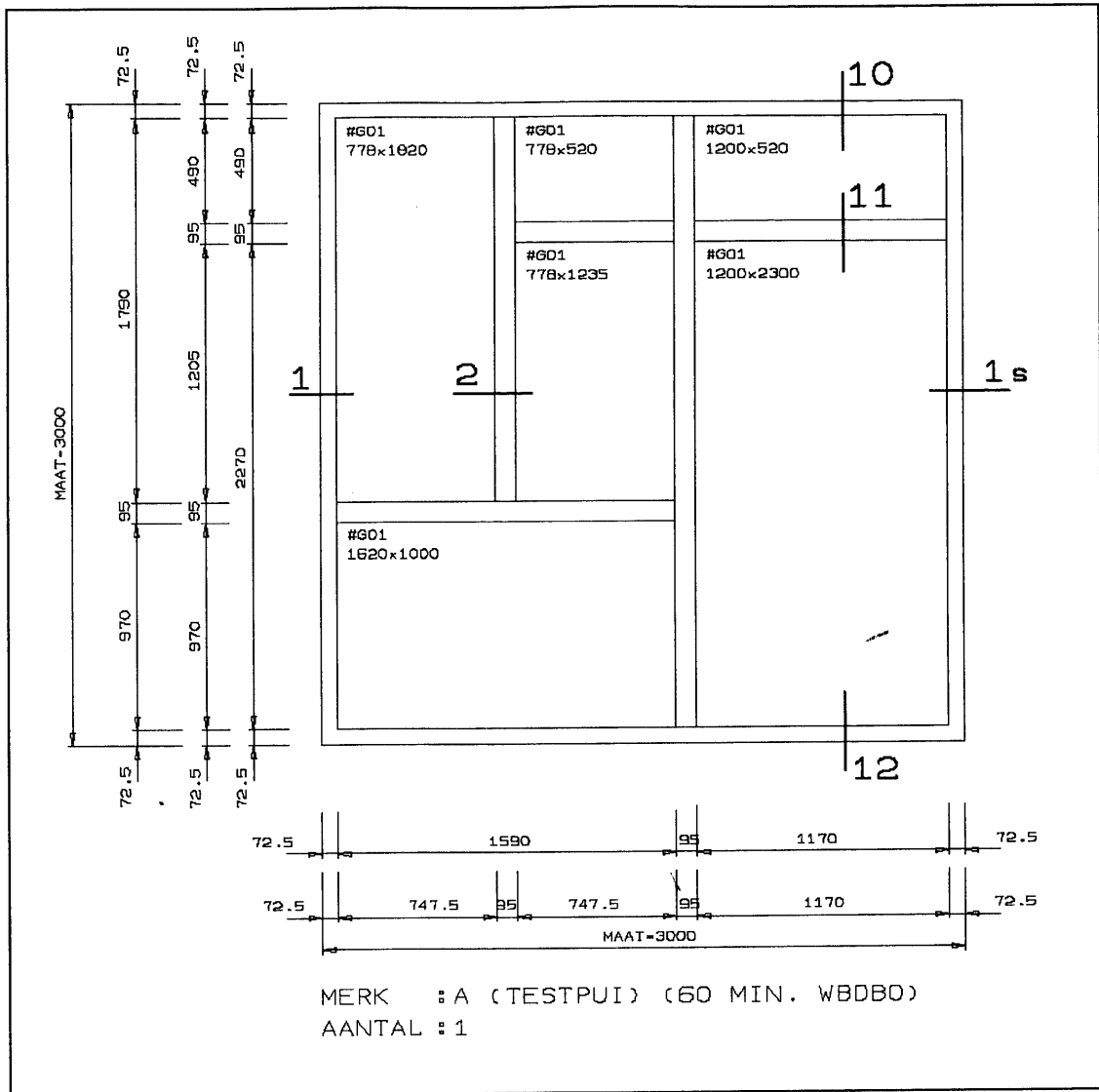


Figure 1, test specimen overview

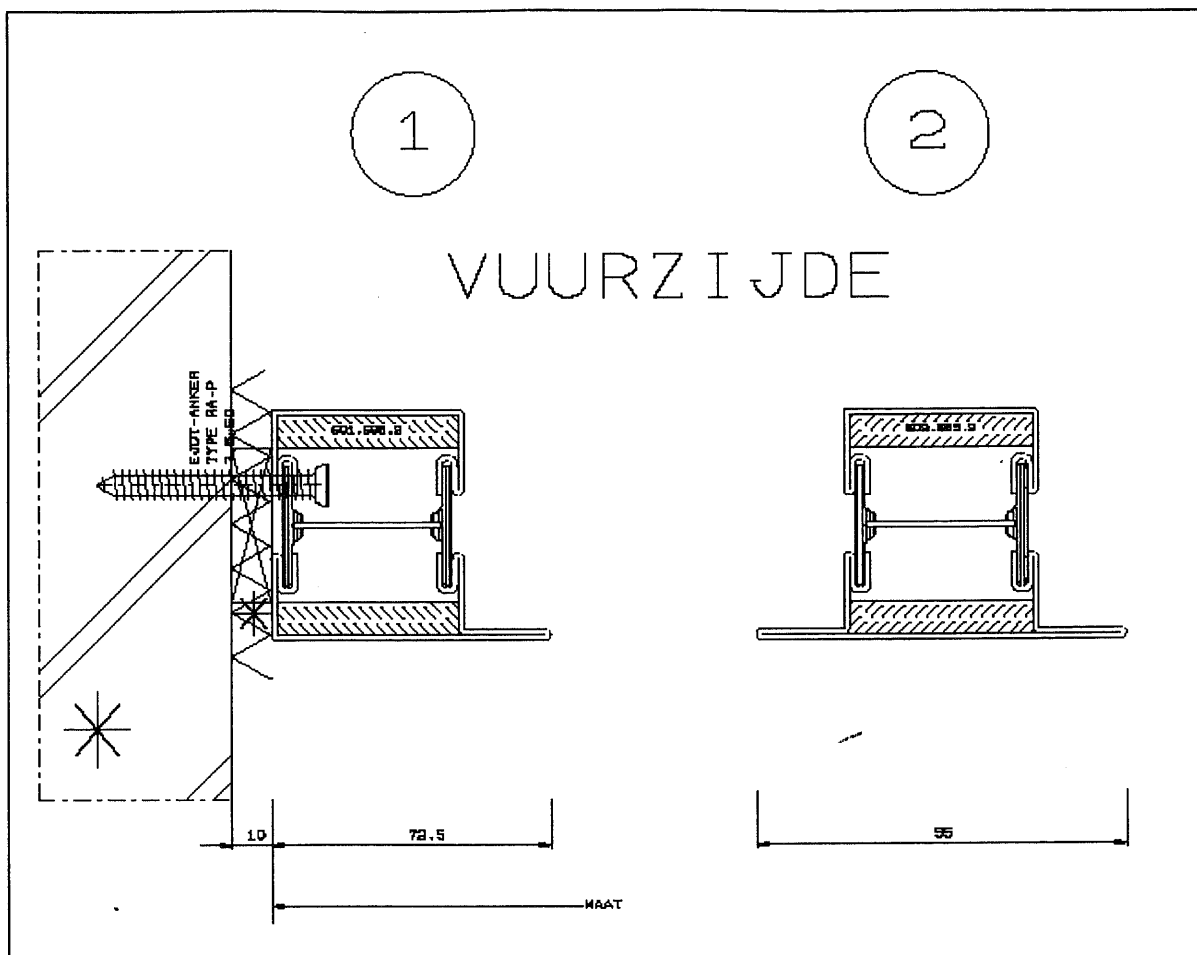


Figure 2, details of frame members and connections.

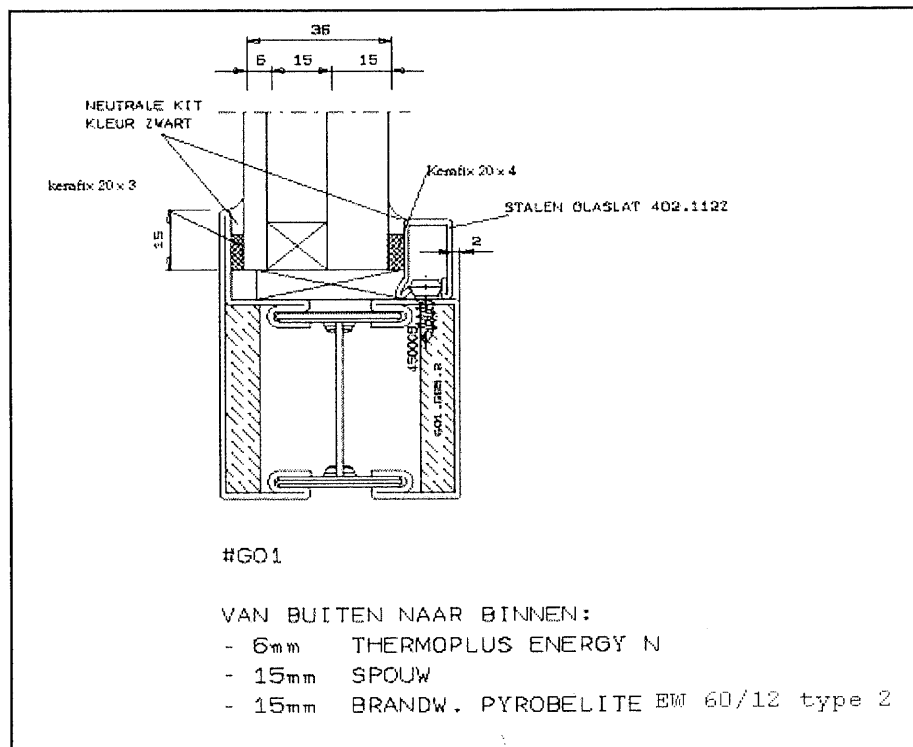


Figure 3, details of glass setting.



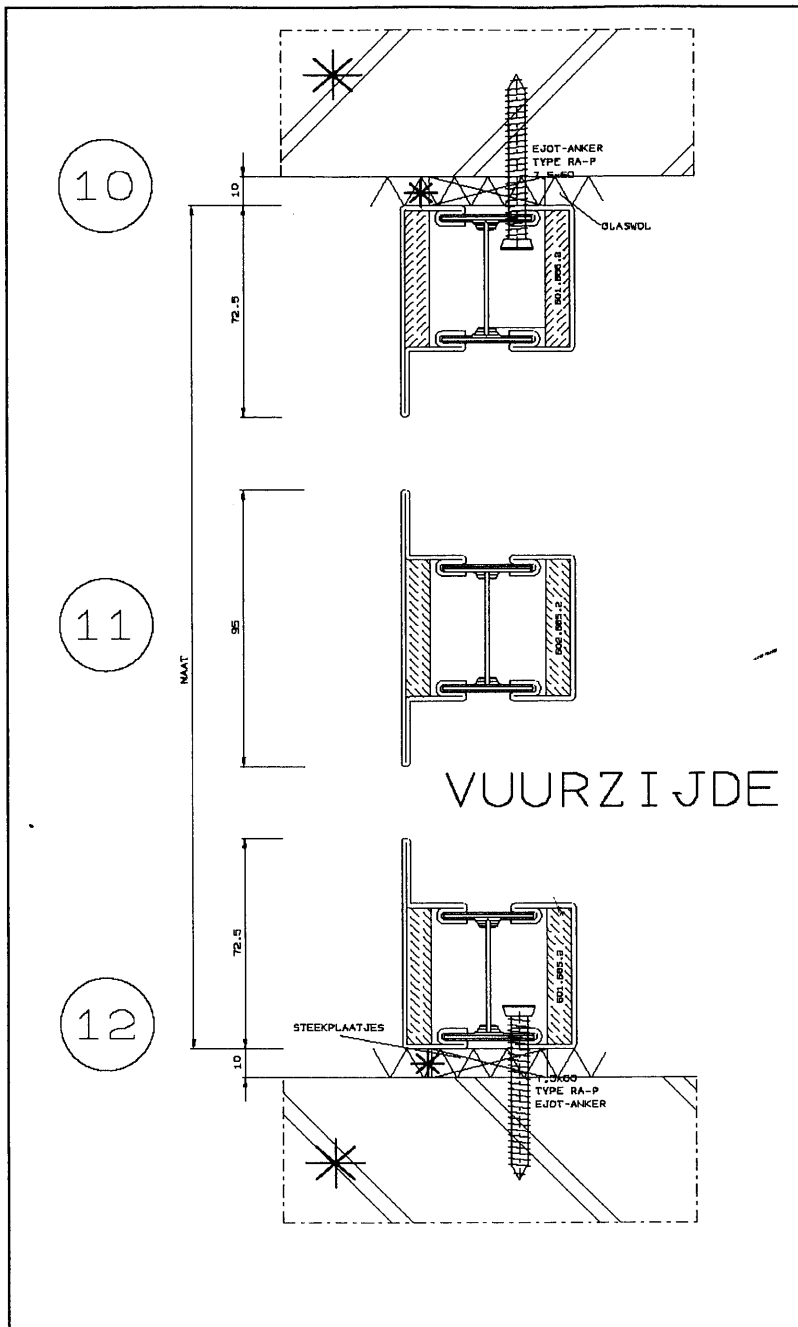


Figure 4, details of frame members and connections.

**Annex A: Observations during the test.**

0	start of heating
2	first cracks appear in the (inner) panes
2½	panes start to discolour
5	all panes are white
14	crack in outside glass of largest pane
16	all outside glass panes are cracked
23	the white protective layer starts to become brown
27	PVB film starts to melt
33	a hole in the protective layer in the largest pane is visible
40	smoke escapes through the joint glass - frame
42	pieces of glass fall away from the inner glass of the largest pane
54	the inner glass of the largest pane falls away
58	the outside glass of the largest pane becomes loose in the frame; continuous flaming is observed around the edges; the 6 mm gap gauge can pass through the gap– <b>end of integrity</b>
65	test stopped after consultation with contractor

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

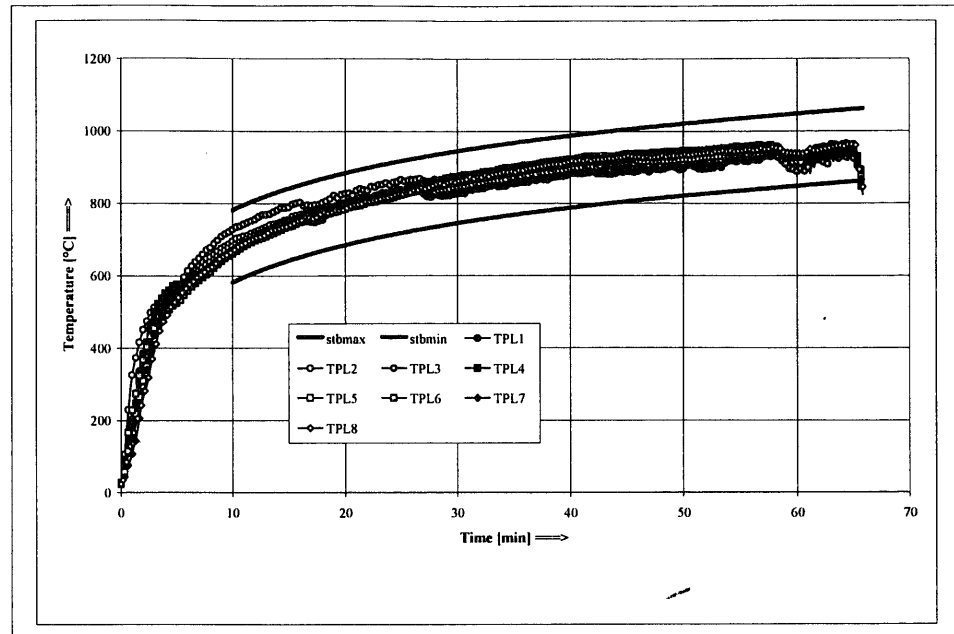


Figure B1: Furnace temperatures with standard fire temperatures

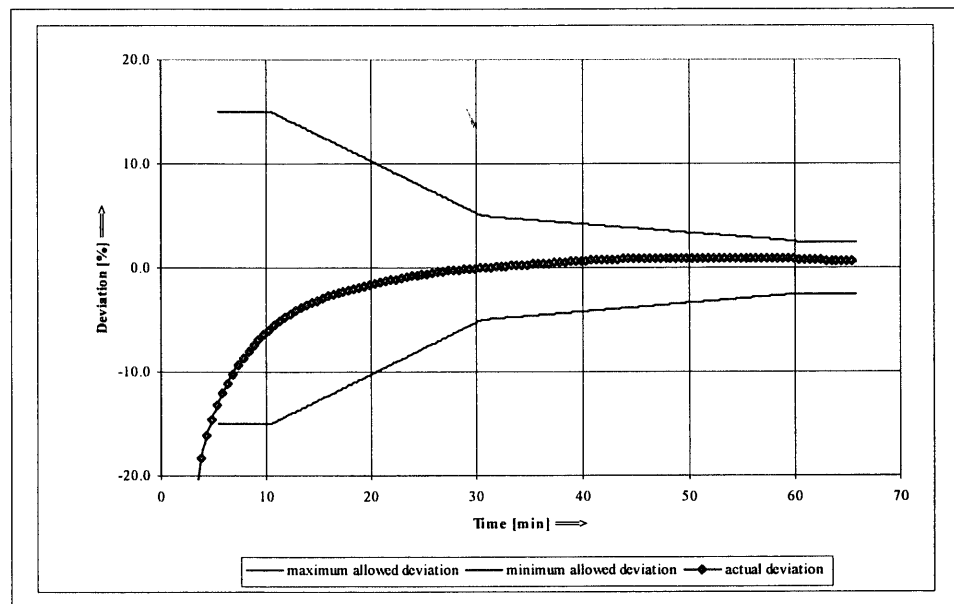


Figure B2: Deviation from NEN-EN

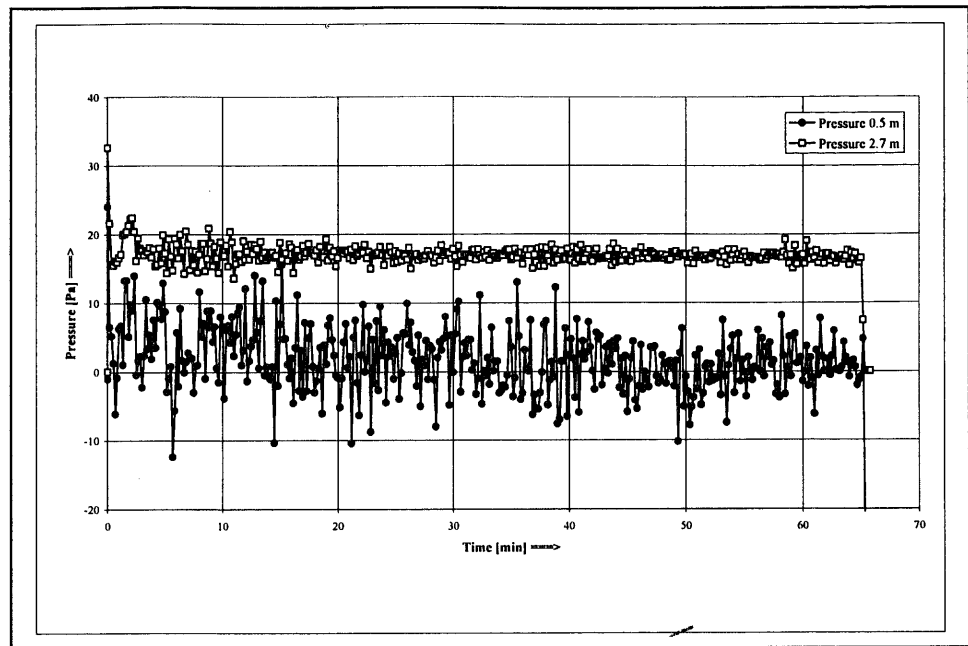
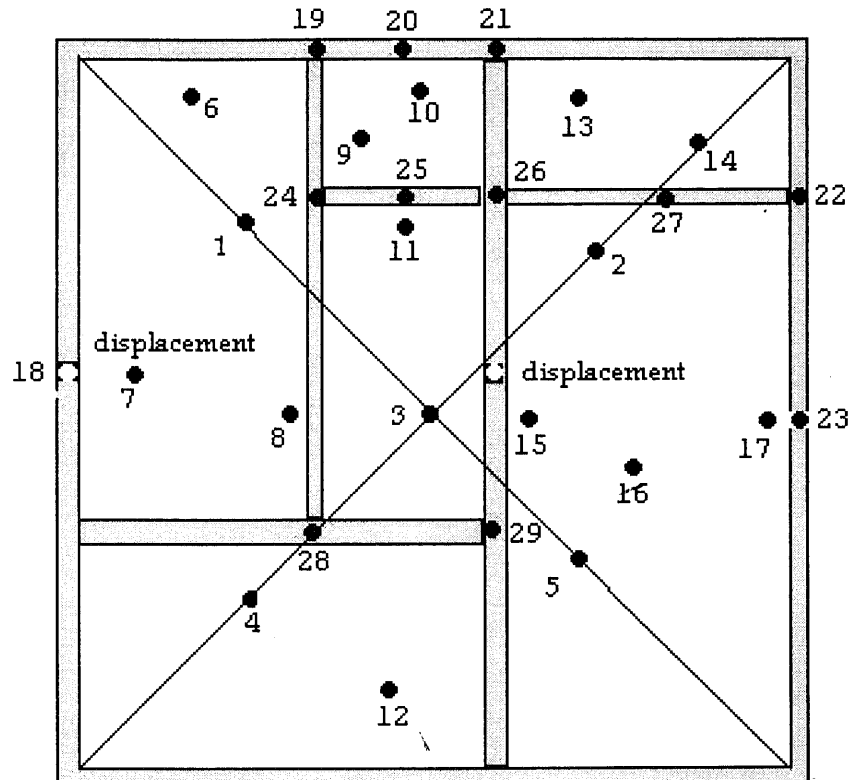


Figure B4: Furnace pressure at 0.50 and 2.70 m above floor level.

**Annex C: measured test specimen temperatures, radiation and displacement**

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



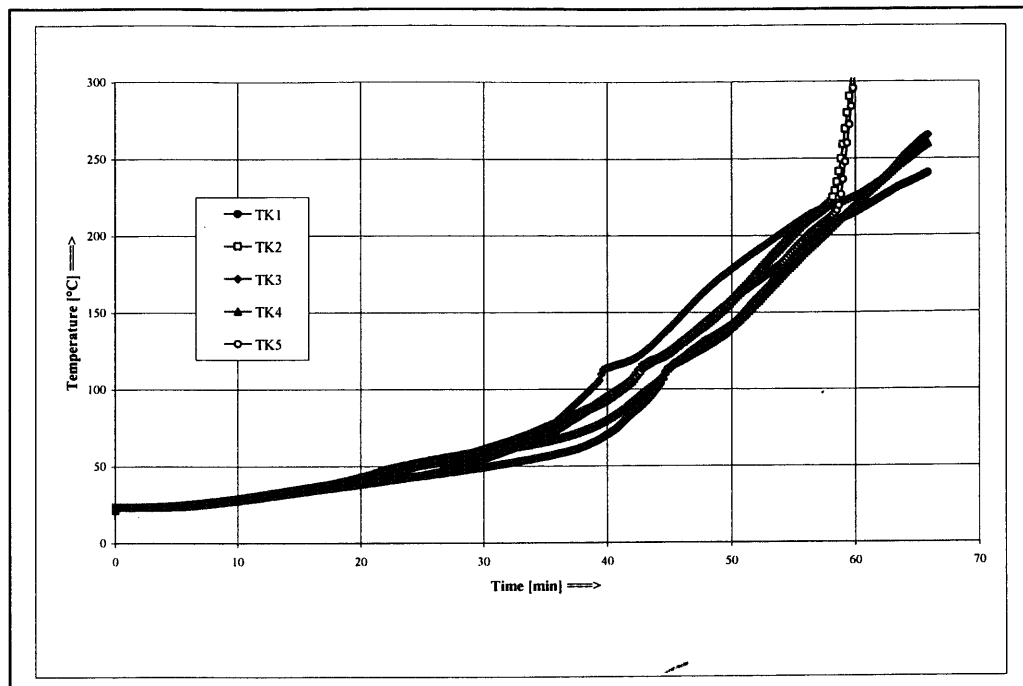


Figure C3: Surface temperature readings for determining average temperature.

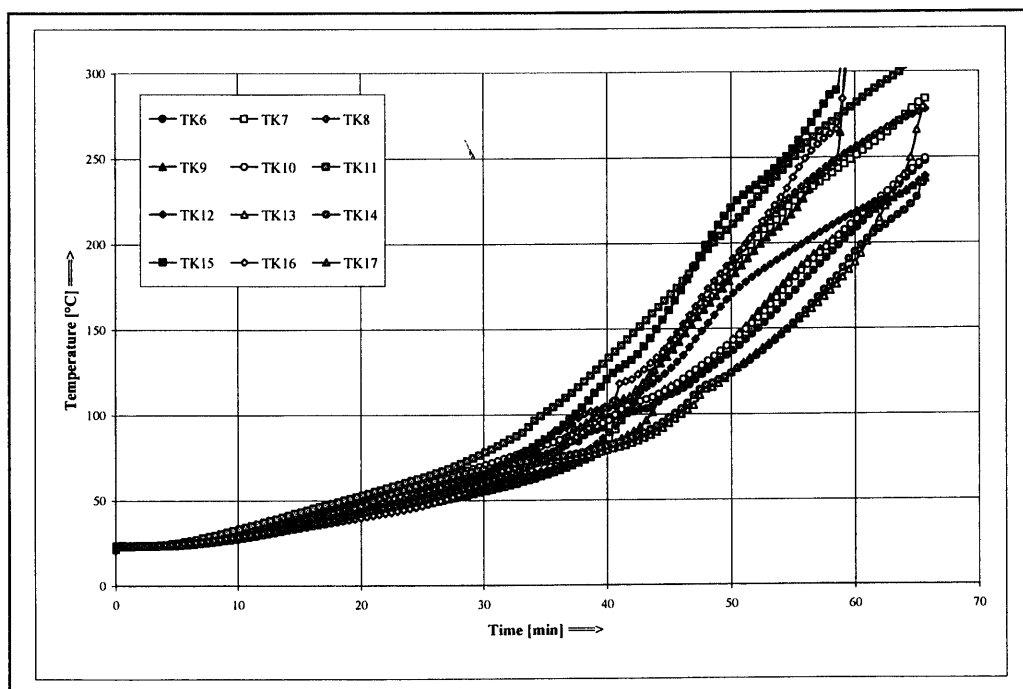


Figure C4: Surface temperature readings on the glass.

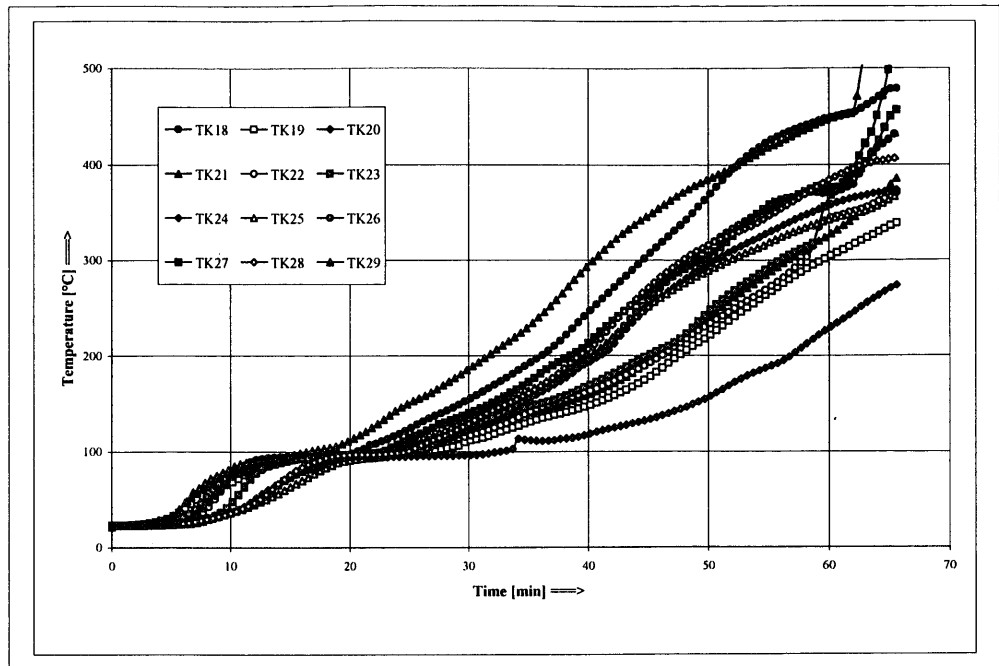


Figure C4: Temperatures on steel profiles.

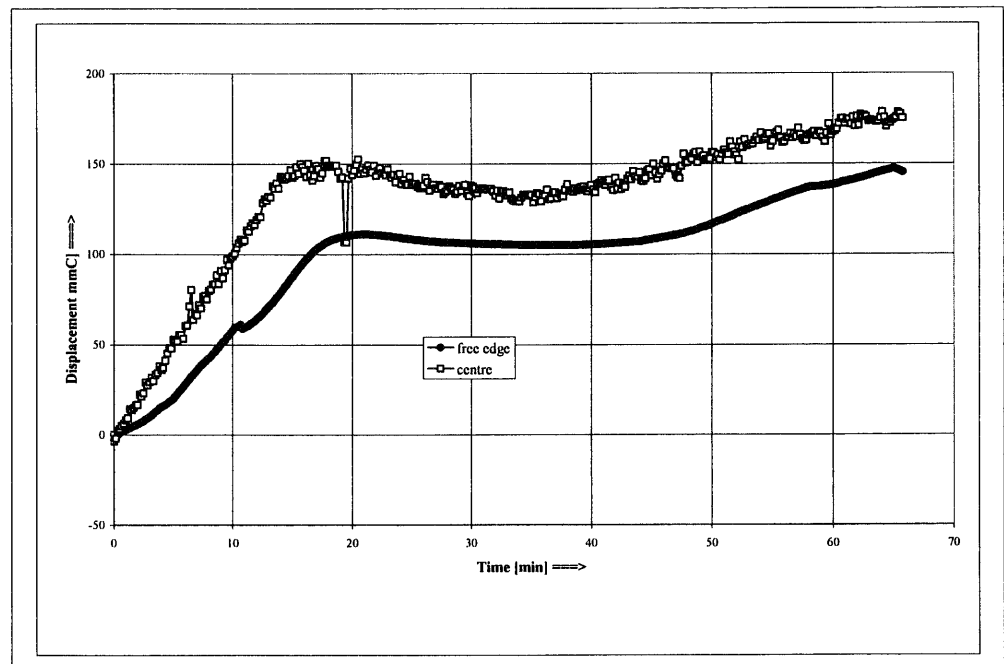


Figure C5: Wall displacement.

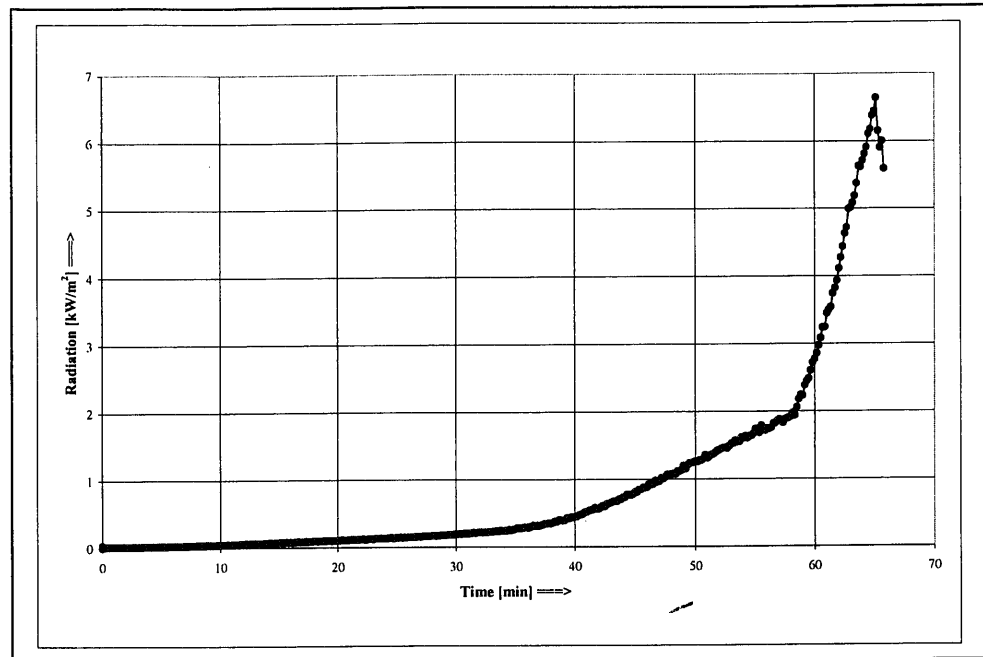
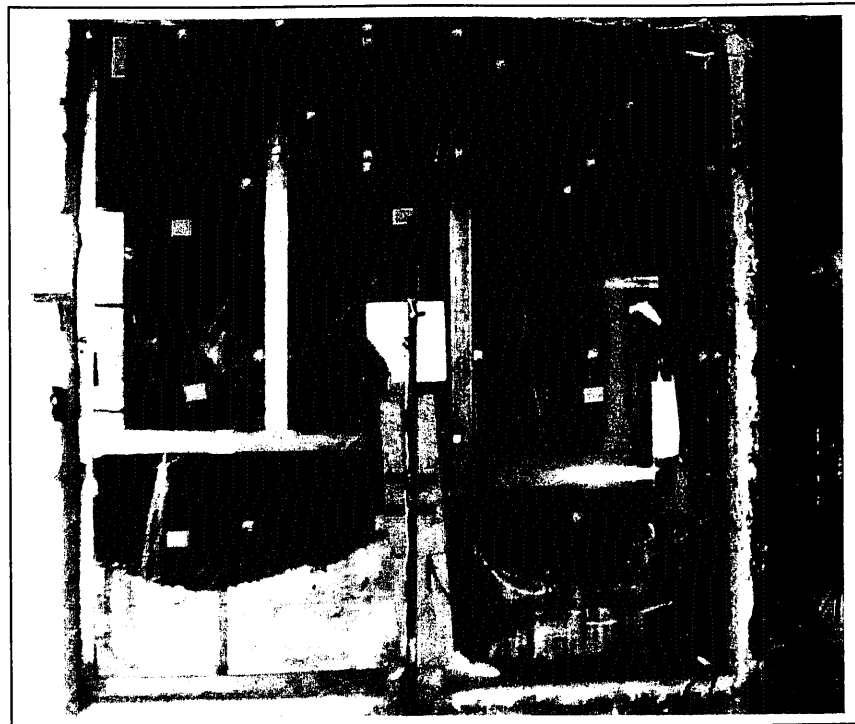


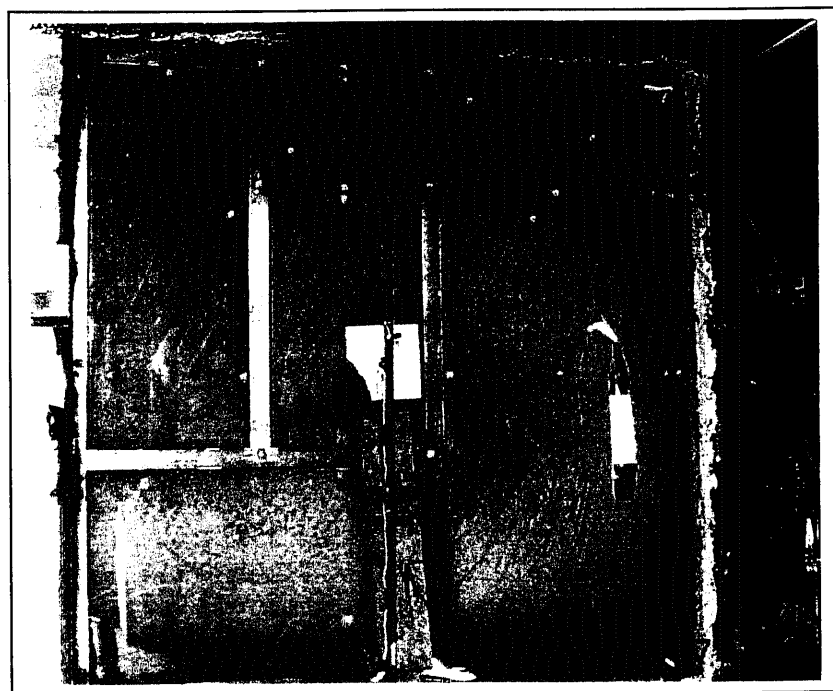
Figure C6: Radiation at 1 m distance from centre of test specimen.



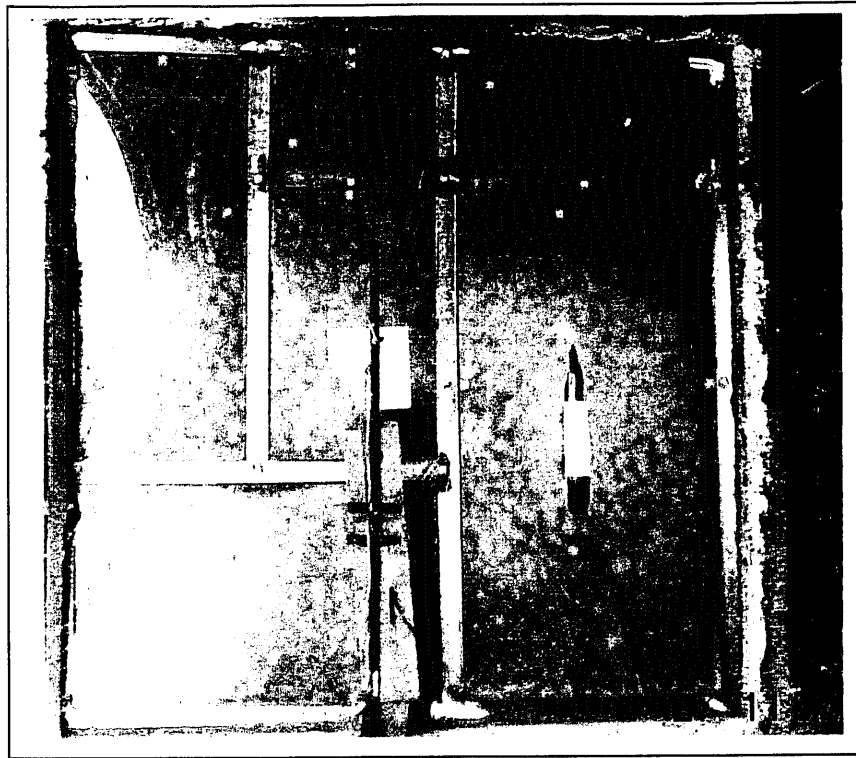
**Annexe D: pictures**



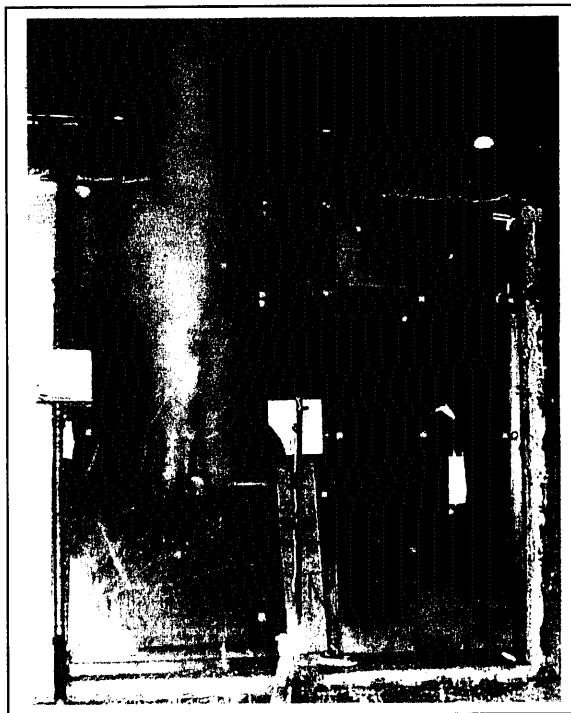
Picture 1. Test specimen at start of test (after 1 minute).



Picture 2. Test specimen after 5 minutes.



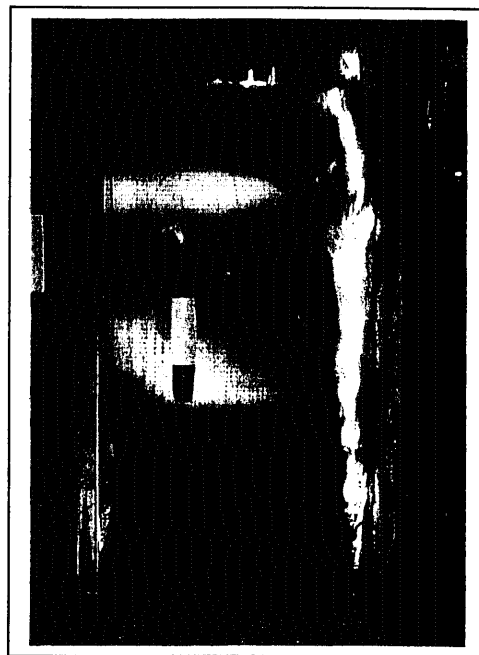
Picture 3, test specimen after 30 minutes.



Picture 4, test specimen after 43 minutes



Picture 5, test specimen after 57 minutes, inner glass has fallen away, outer glass becomes loose.



Picture 6, 58 minutes, end of integrity