



SINTEF

TEST REPORT

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TITLE / TEST METHOD

Fire test of glazed elements according to NS-EN 1364-1:1999

PRODUCT NAME

FKN Fire window E 30

CLIENT

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

CLIENT REF.

Bernard Deloge

PROJECT NO.

103010.80

ELEKTRONIC FILE CODE

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Glaverbel\REPORT.doc

PROJECT MANAGER (NAME, SIGN.)

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TEST DATE

2006-03-28

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ABSTRACT

Test of two glazed elements for 30 minutes fire resistance according to EN 1364-1 Annex A. The frames were made of Pine. One element, containing 2 glass panes, had insulating glass of type Pyrobelite 12EG 16-15-6 mm. This element was exposed towards the glazing beads made of aluminium and the 6 mm float glass was on the unexposed face. The second element, containing 2 glass panes, had glazing beads made of Pine on the unexposed side. This element had 12 mm Pyrobelite glass.

TEST RESULTS

Test duration:	34 minutes
	Time in completed minutes without criteria failure:
- Integrity:	- Sustained flaming: 33 minutes
	- Gap gauge: 34 minutes
	- Cotton pad*: 34 minutes
- Insulation:	31 minutes for Pyrobelite 12EG 16-15-6 (element A)
	30 minutes for Pyrobelite 12 (element B)
- Radiation:	34 minutes

*No cotton pad test was conducted between 31 and 34 minutes.

REMARKS / DEVIATIONS:

The two tested elements contained different types of glass and glazing beads, and they were tested with glazing beads on both exposed and unexposed sides. This specimen was designed to obtain wide applicability for the test result in connection with further documentation.

The results presented in this test report may only be quoted in full.
Excerpts may be quoted only with the written permission of SINTEF NBL.
The test results referred to in this report relate only to the items tested.
Test reports from SINTEF NBL form the basis of fire technical classifications, certifications and approvals.

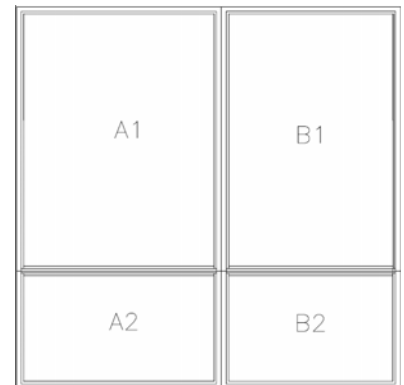
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TEST RESULTS

The test results are documented as:

- Visual observations during and after the test.
- Measurements in furnace and on the test specimen, as graphic presentations.
- Photos taken before, during and after the test.
- Video taken during the test.



Visual observations during the test

The following observations are made on unexposed side of the specimen, if otherwise is not given.

TIME min:sec	OBSERVATIONS
01:40	The float glass on exposed side in A1 cracks.
01:50	The glass in B1 starts to turn white and cracks.
02:30	The left glazing bead of aluminium in A1 is loose on exposed side. Small amount of smoke from the top of A1.
03:15	B2 starts to turn white.
05:00	A1 starts to turn white. B1 and B2 are now white. Small amount of smoke from right side of A1.
06:30	The float glasses on exposed side in A1 and A2 have fallen into the furnace.
07:30	Decrease in smoke emission from A1.
08:50	Pieces of glass pops out from B1 and B2.
09:50	The glass in A2 starts to turn white.
15:00	Cotton pad test performed in half width on the top of A1. No criteria failure. The glass in B1 and B2 bends into furnace.
18:10	The glass in A1 is loose and bends into furnace. Between the angle profiles (detail 16 on drawing 1003) along the vertical edges, the glass has a displacement on about 2 cm. See photo 9.
20:40	Small amount of smoke from bottom of B1.
22:00	Small amount of smoke from B2.
25:30	Smoke emission from the top of A1 increase and the frame is discoloured.
29:30	Cotton pad test performed on the top of B1. No criteria failure.
31:00	Cotton pad test performed on the top of A1. No criteria failure.
33:40	Sustained flaming from bottom of A1 which causes criteria failure.
34:00	The test is discontinued.

Visual observations after the test

After termination of the test, the restraint frame with the test specimen was removed from the furnace, for cooling and inspection.

SIDE	OBSERVATIONS
Unexposed	<p>A1: The glass is partly discoloured and along some of the edges it bends into the furnace. The Lorient strip has expanded and is visible between frame and glass. The glass bends into furnace between the angle profiles and has a displacement along the vertical edges that varies from 1,5 to 3 cm. The surface of the glass is plain. The rubber moulding looks undamaged. See photo 9.</p> <p>A2: The glass bends into the furnace along the vertical edges and cause until 1 cm displacement of the glass. The surface of the glass is plain.</p> <p>B1: The frame is carbonized at the top and there is a gap through the specimen between glass and frame. The glass is cracked. The rubber moulding looks undamaged. The Lorient strip seems to have expanded.</p> <p>B2: The same as B1 without carbonization of the frame.</p>
Exposed	<p>A1: Parts of the aluminium glazing bead is remaining at the top. The frame contains the screws for the glazing beads. The Lorient strip has expanded. The non-carbonized depth of the frame varies from 5,4 to 6,9 cm.</p> <p>A2: Aluminium glazing bead is situated at the bottom of the test specimen.</p> <p>B1: The laminated Pine divides easily. Expanded Lorient strip is visible between glass and frame.</p> <p>B2: The same as B1. The non-carbonized depth of the frame varies from 6,3 to 6,9 cm.</p> <p>Fixed edges of test specimen: The screws are in carbonized part of frame, and the fittings (drawing 569) keep the specimen in position.</p>

Temperature in furnace hall

Test start	Stop	Average
15 °C	16 °C	15 °C

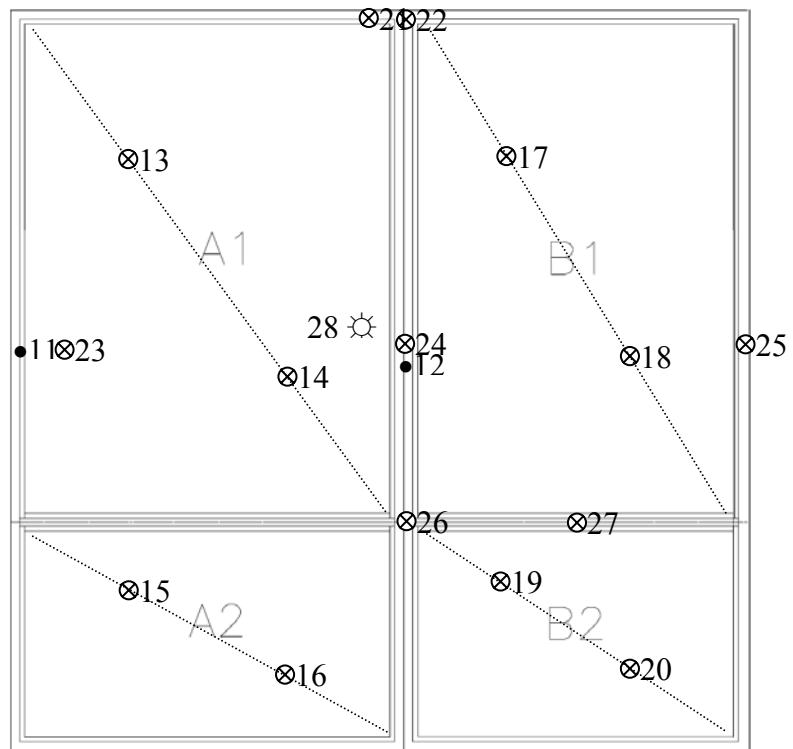
Instrumentation of the test specimen

The test specimen was instrumented in accordance with test method:

- Thermocouples on unexposed side for registration of temperature.
- Deflection measurements approximately in centre of test specimen and in half height at free edge.
- Radiation measurements in centre of test specimen.

The sketch shown in figure 1 shows the location of the measurements on unexposed side.

Positions for instrumentation:
 -TC 13-20 located in center of 1/4-part of each glass
 -TC 23-25 and deflection 11 and 12 located in half height of specimen
 -Radiation located 1 meter from center of specimen



⊗ Thermocouples • Deflection measurements ☼ Radiation measurement

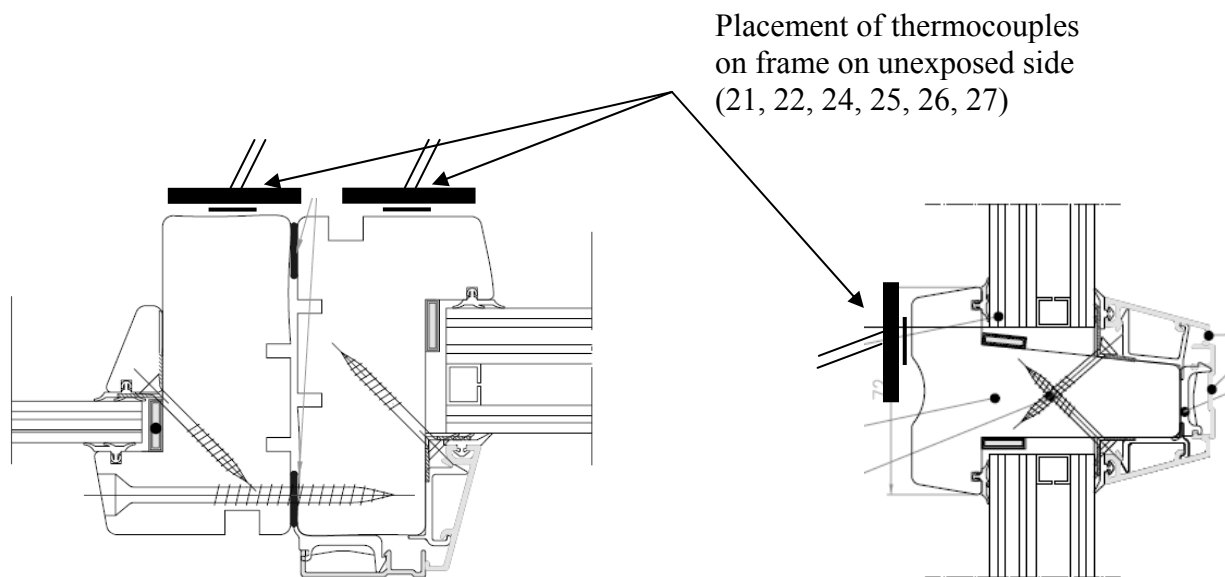


Figure 1 Sketch (not in scale) of instrumentation on the specimen.

Presentation of test results

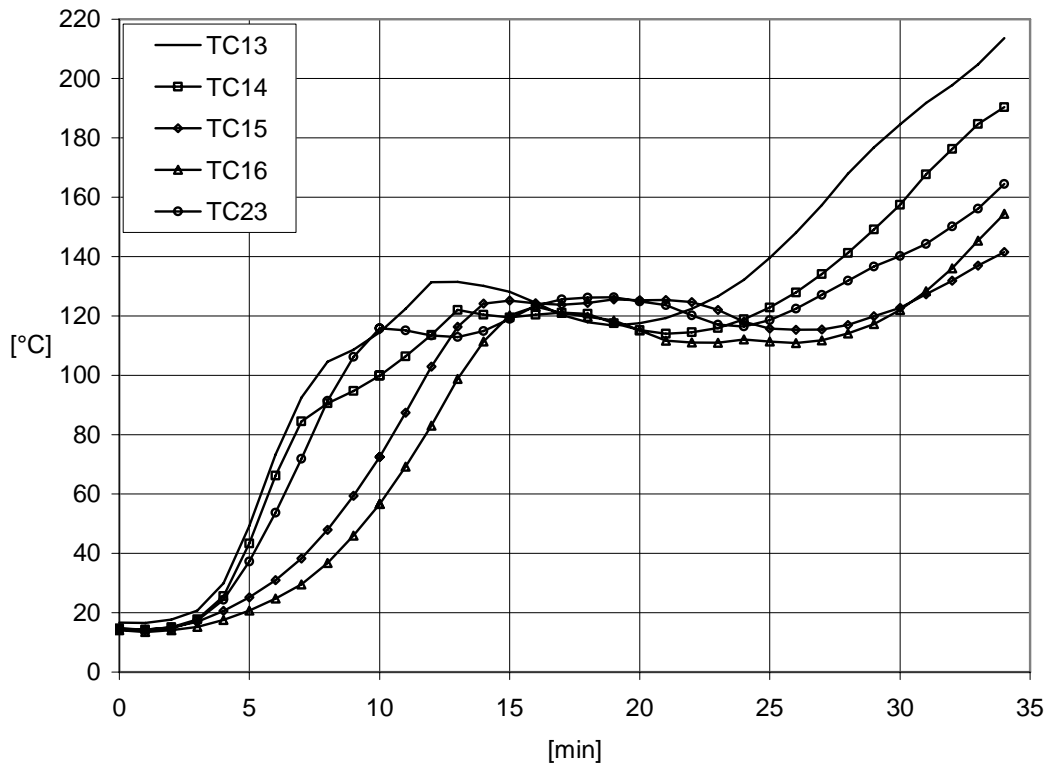


Figure 2 Temperature measurements on unexposed side of glass pane A1 and A2.

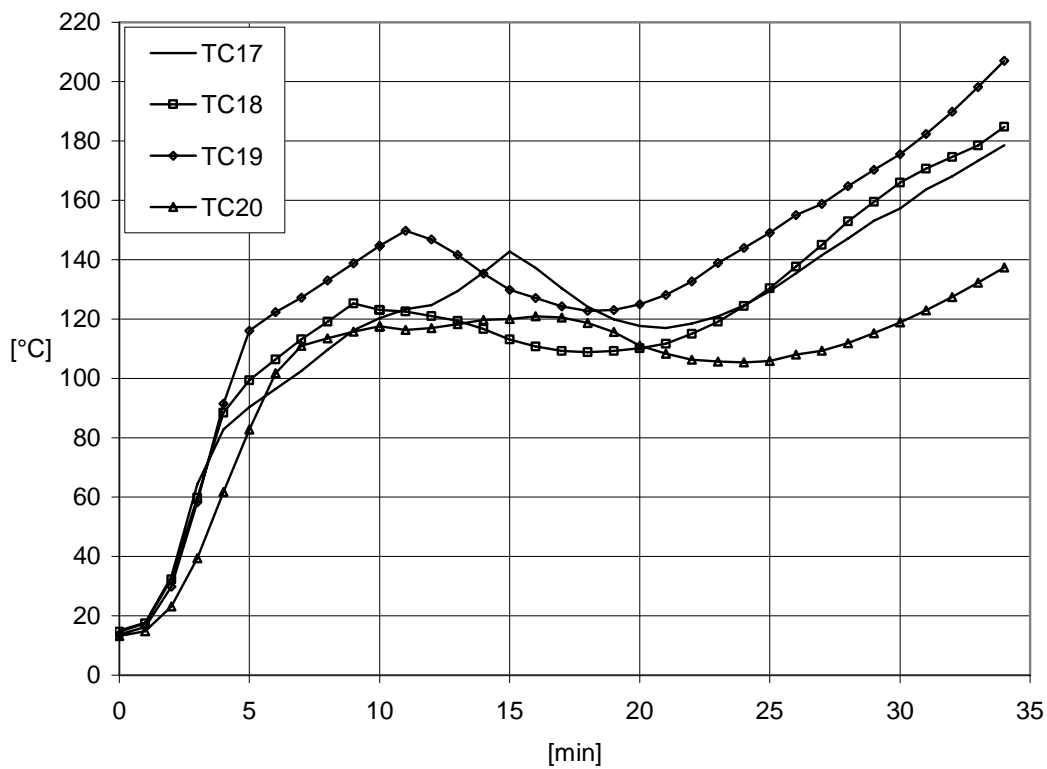


Figure 3 Temperature measurements on unexposed side of glass pane B1 and B2.

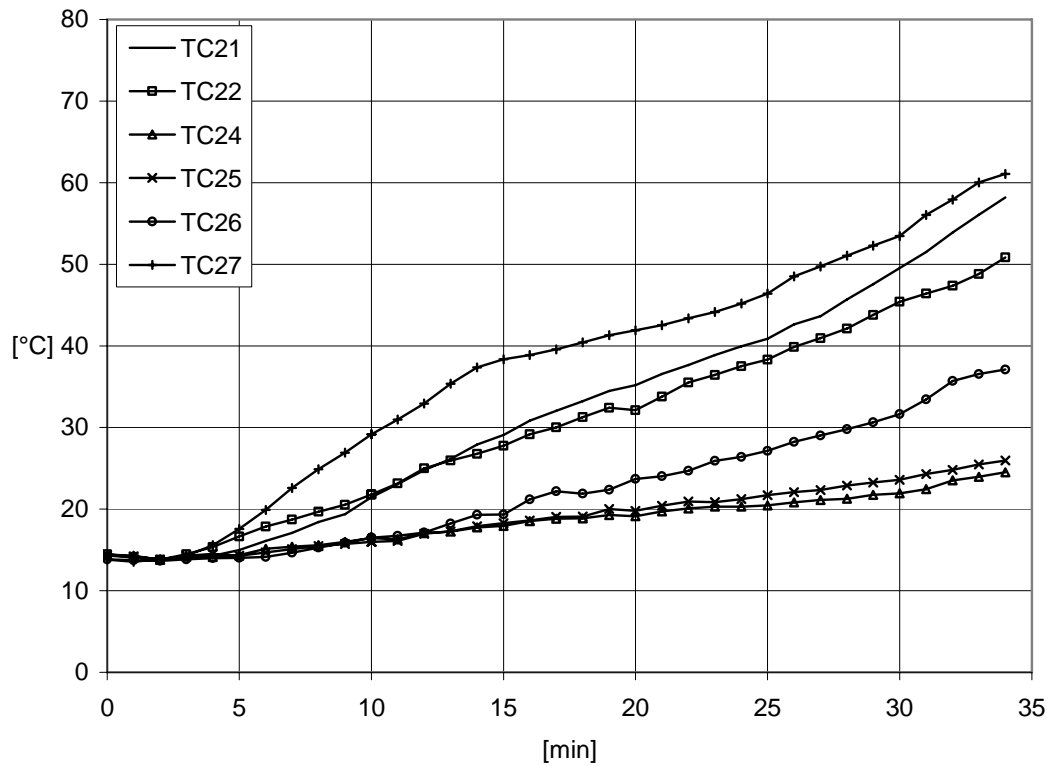


Figure 4 Temperature measurements on unexposed side of the framework.

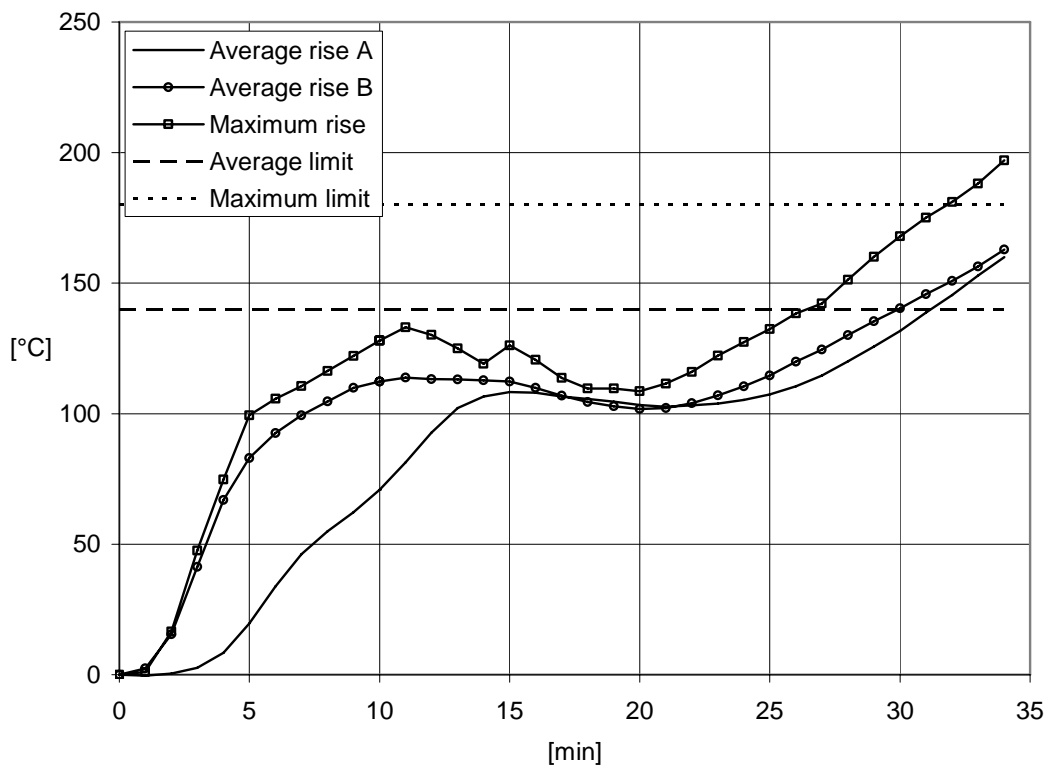


Figure 5 Average- (TC 13-16 for A and TC 17-20 for B) and maximum (TC 13-27) temperature rise on unexposed side of the test specimen.

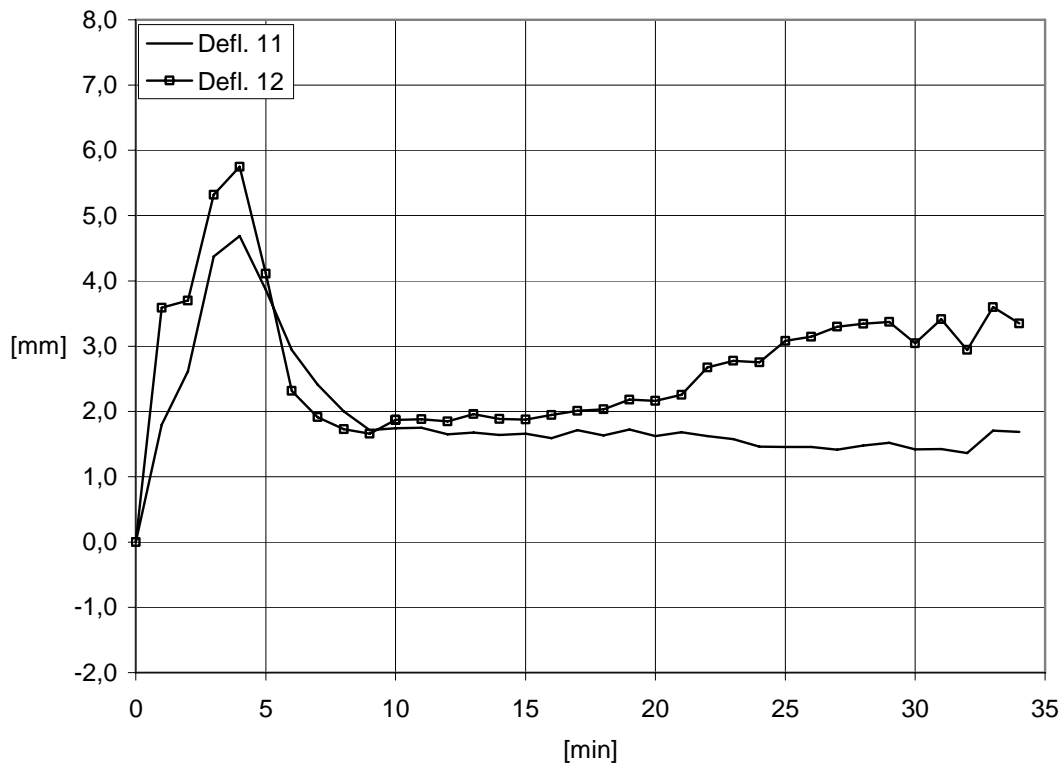


Figure 6 Deflection of the construction, measured in approximately centre of the specimen and in half height on the free edge. Positive values indicate deflections towards the furnace.

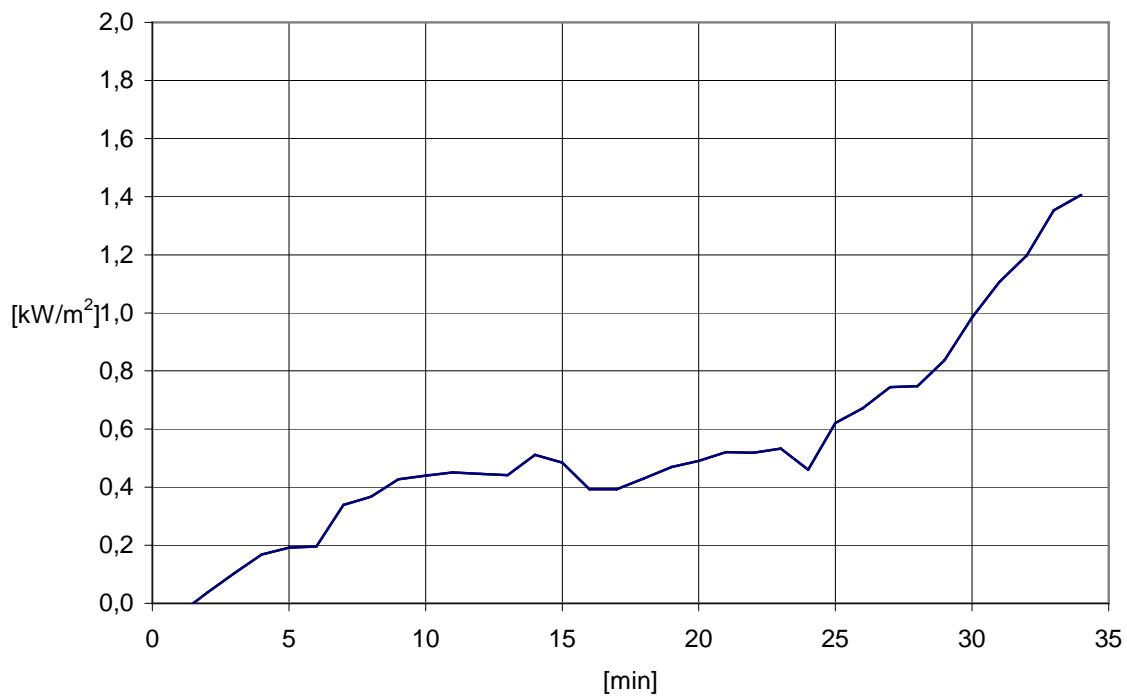


Figure 7 Radiation from the unexposed side of the test specimen, measured approximately 1 meter from the centre of the specimen.

Photos before, during and after the test



Photo 1: Exposed side of the test specimen before the fire test.



Photo 2: Unexposed side of the test specimen before the fire test.

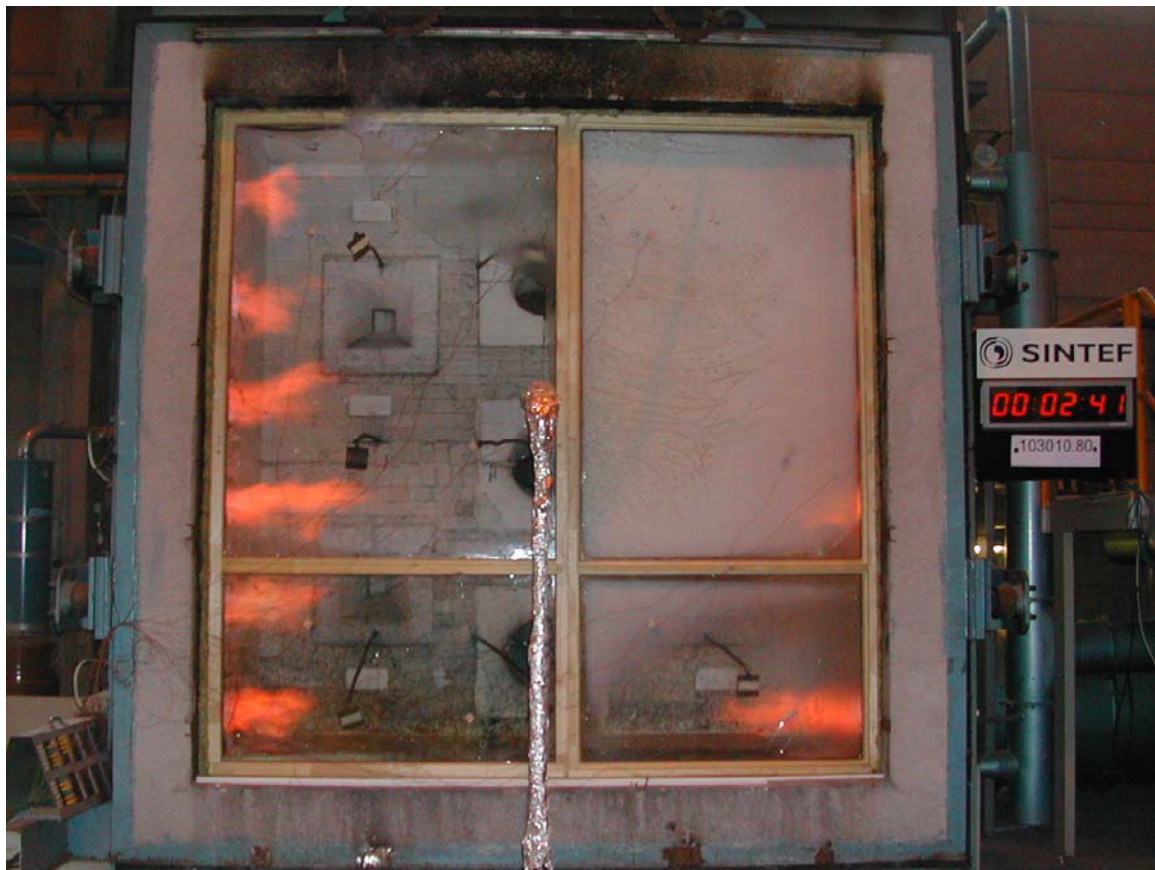


Photo 3: *Unexposed side of the test specimen after 2 minutes and 41 seconds of fire testing.*



Photo 4: *Unexposed side of the test specimen after 12 minutes of fire testing.*

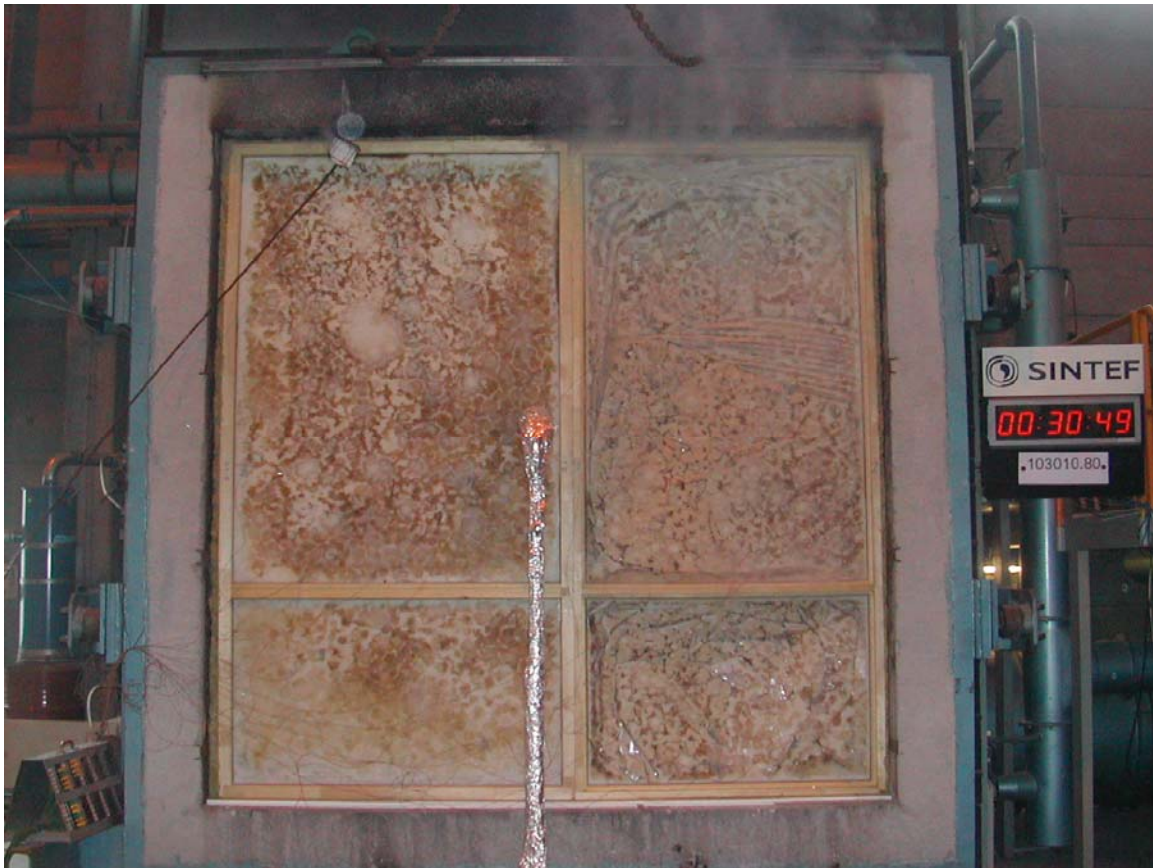


Photo 5: Unexposed side of the test specimen after 30 minutes and 49 seconds of fire testing.



Photo 6: Unexposed side of the test specimen after failure due to sustained flaming.



Photo 7: Unexposed side of the test specimen after test.



Photo 8: Exposed side of the test specimen after test.



Photo 9: Unexposed side of the test specimen. The glass bends into furnace and have a displacement from flange.

PREPARATION OF THE TEST SPECIMEN

Constructional details

The test specimen consisted of two glazed elements. Each element consisted of two glass panes. The frames were made of Pine. Element A had glazing beads made of aluminium, and element B had glazing beads made of Pine. Element A was exposed towards the glazing beads, and element B had the glazing beads on the unexposed side.

The glasses in element B were Pyrobelite 12. This glass had a total thickness of 12 mm and consisted of three 3 mm float glass separated by two 1,5 mm fire resistant interlayer.

The glasses in element A were Pyrobelite 12 EG 16-15-6. This glass had a total thickness of 37 mm and consisted of a Pyrobelite 12 on the unexposed side, a 0,76 mm PVB film, a 3 mm float glass (EG), a 15 mm aluminium spacer (air) and a 6 mm float glass (towards the exposed side).

The glasses were fixed into the frame by using angle profiles and glazing beads. Each glass was fixed by four angle profiles. For the upper glasses the angle profiles were placed along the vertical edges, and for the lower glasses the angle profiles were placed along the horizontal edges. In pane A1 the angle profiles were placed 20 cm from the inner corner. In field A2, B1 and B2 the angle profiles were placed in 1/3 points of width or height.

Glazing beads of Pine were fixed to the frame with 31 mm nails with c/c 20 cm. Clips for glazing beads of aluminium were screwed to the frame with 3 x 20 mm screws with c/c 20 cm.

Between glass and frame in line with surface of the glass on the side without glazing beads, the construction contained a Lorient expanding list. See drawings on pages 15-20 for more details.

OVERALL DIMENSIONS:	2970 x 2985 mm (wxh)		
GLASS DIMENSIONS A1:	1499 x 1999 mm (wxh) (prod.ref. BX05781-01-501)	DAYLIGHT OPENING A1:	1472 x 1970 mm (wxh)
GLASS DIMENSIONS A2:	1499 x 856 mm (wxh) (prod.ref. BX05781-02-502)	DAYLIGHT OPENING A2:	1472 x 828 mm (wxh)
GLASS DIMENSIONS B1:	1299 x 1999 mm (wxh) (prod.ref. BX05780-01-501)	DAYLIGHT OPENING B1:	1272 x 1970 mm (wxh)
GLASS DIMENSIONS B2:	1299 x 856 mm (wxh) (prod.ref. BX05781-02-501)	DAYLIGHT OPENING B2:	1272 x 828 mm (wxh)
GLAZING A1 AND A2:	Pyrobelite 12 EG 16-15-6mm	GLAZING B1 AND B2:	Pyrobelite 12mm

Authentication

NBL has controlled the drawings supplied by the client, and found these to be, as far as possible to control, in accordance with the test specimen.

Manufacturer (-s) and place of production

1. SPECIMEN:

Glazed elements

PLACE OF PRODUCTION:

Norgesvinduet, Norway

2. COMPONENTS/FITTINGS:

- Frame, painted Pine
- Glazing beads, Pine
- Aluminium glazing bead with plastic clips
- Lorient expanding list, 4 x 15 mm
- Angle profile
- Glass, Pyrobelite 12 and 12 EG 16-15-6
- Fittings for fixing the specimen to the test frame

MANUFACTURER AND PLACE OF PRODUCTION:

- Norgesvinduet, Norway
- Norgesvinduet, Norway
- SAPA, Sweden
- B. Sørbo AS, Norway
- Norgesvinduet, Norway
- Glaverbel, Czech Republic
- Norgesvinduet, Norway

Support and restraint conditions

The two elements were screwed together with three 7,5 x 112 mm screws placed respectively 12 cm below upper frame, in half height and 12 cm above bottom frame. The screws were placed on the exposed side of the connection. On the unexposed side of the connection a joint of silicon was used. Se drawing 1052 for details.

The specimen was mounted in the test frame with seven 10 x 120 mm expanding screws. One at top and bottom of each section and three at fixed edge of the wall. At top and bottom of each element the screws were placed in half width, and at the fixed edge the screws were placed in same positions as in the section connection. All screws were placed on the exposed side of the glass. The last edge of the specimen was free. Below the bottom frame on exposed side a joint of Dow Corning 700 Fire Stop silicon was used.

The screws in the connection between the elements and between the specimen and test frame were secured by fittings. The fittings were 50 x 50 mm and were made of 1,9 mm thick steel. In addition to the fastening screw, the fittings were screwed on the frame with three 4,5 x 40 mm screws. Se drawing 569 for details.

The gaps between the specimen and the test frame (sides and top) were insulated with pressed Rockwool Flexi A-plate (31 kg/m³). The specimen was placed on top of two plaster boards.

Pre-test conditioning

The test specimen arrived NBL on 2006-03-27. The test specimen was mounted the same day and stored in the laboratory until the date of testing, 2006-03-28.

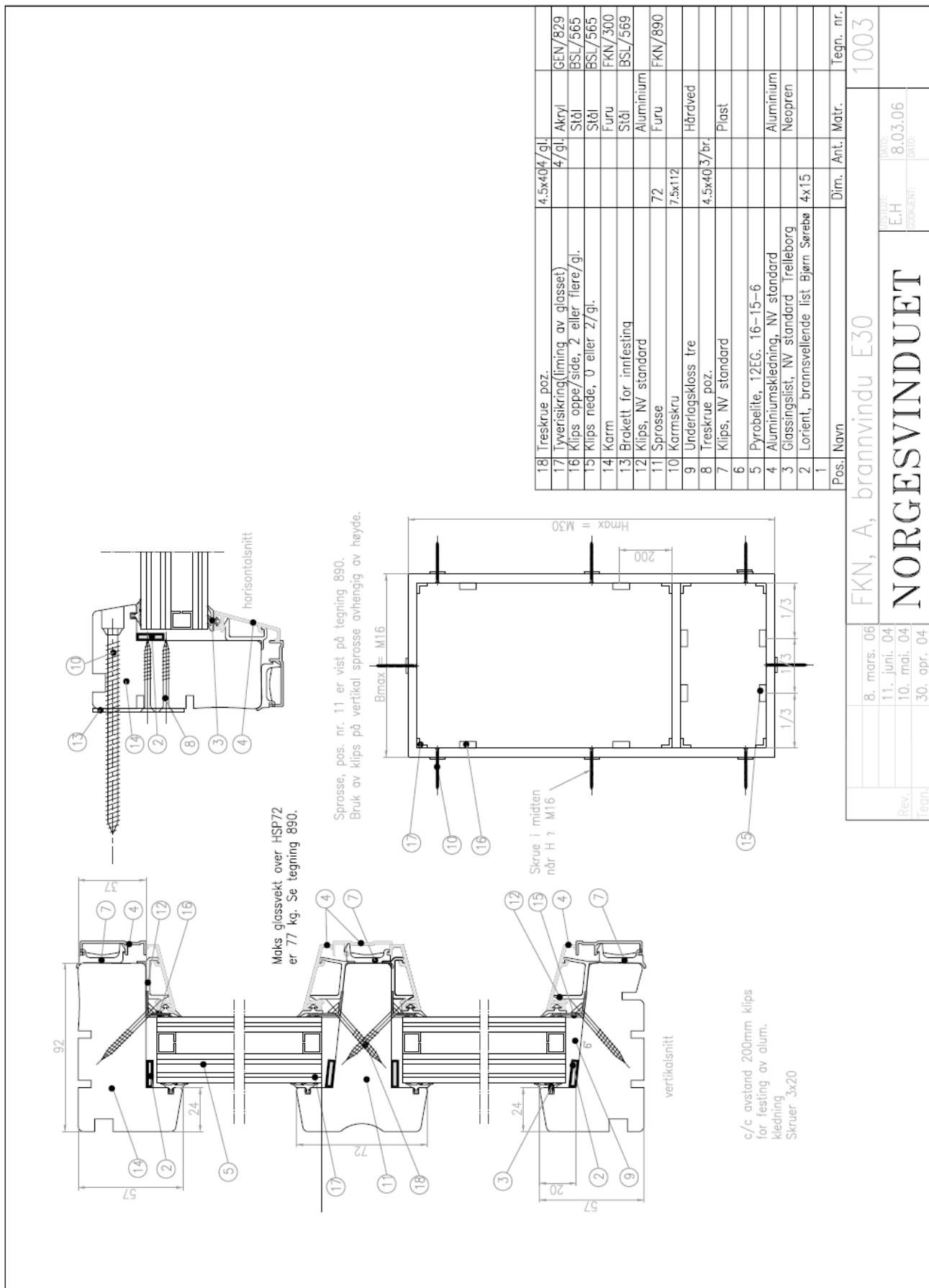
Selection of the test specimen

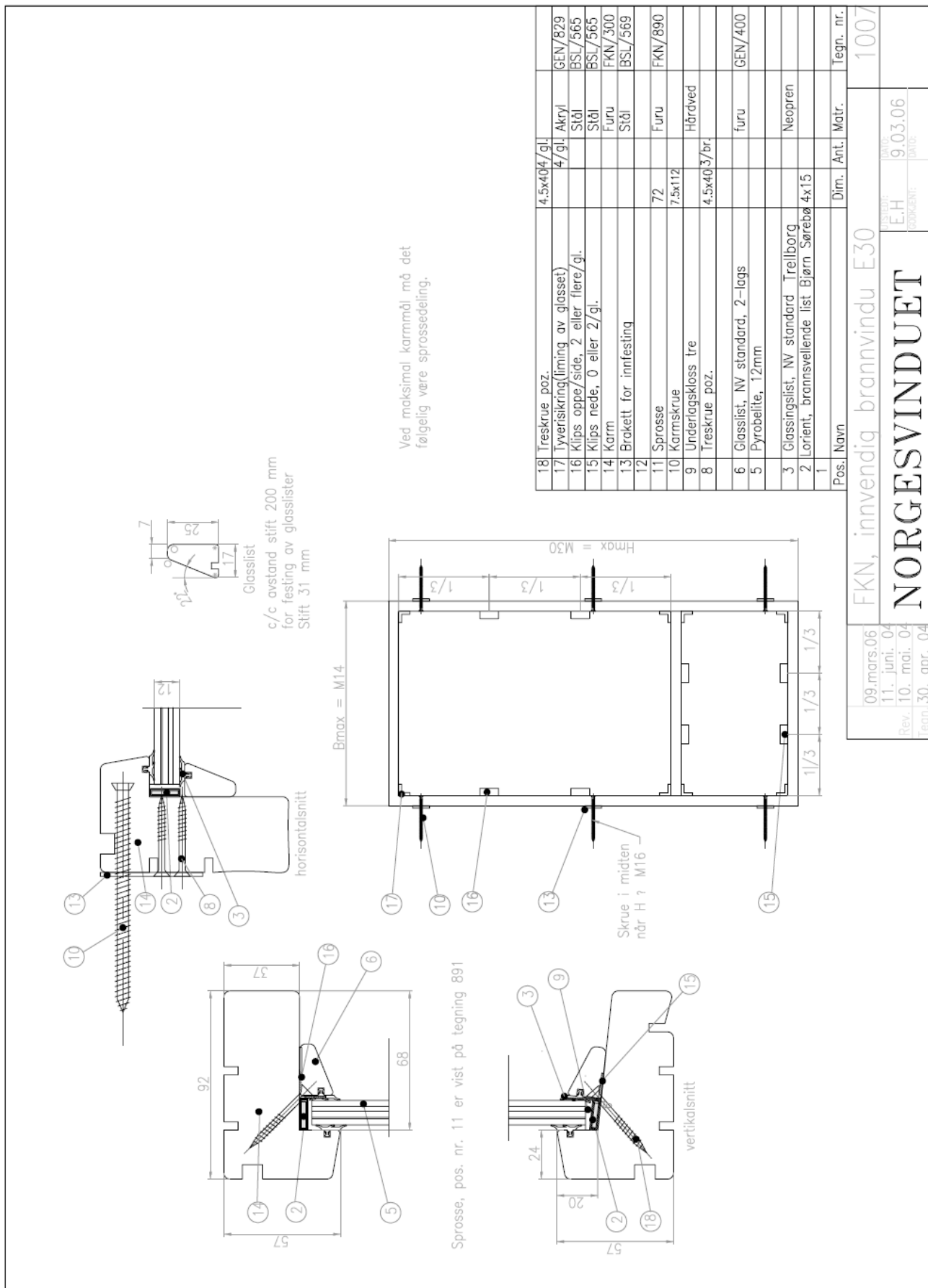
NBL was not involved in the selection of the materials for the fire test.

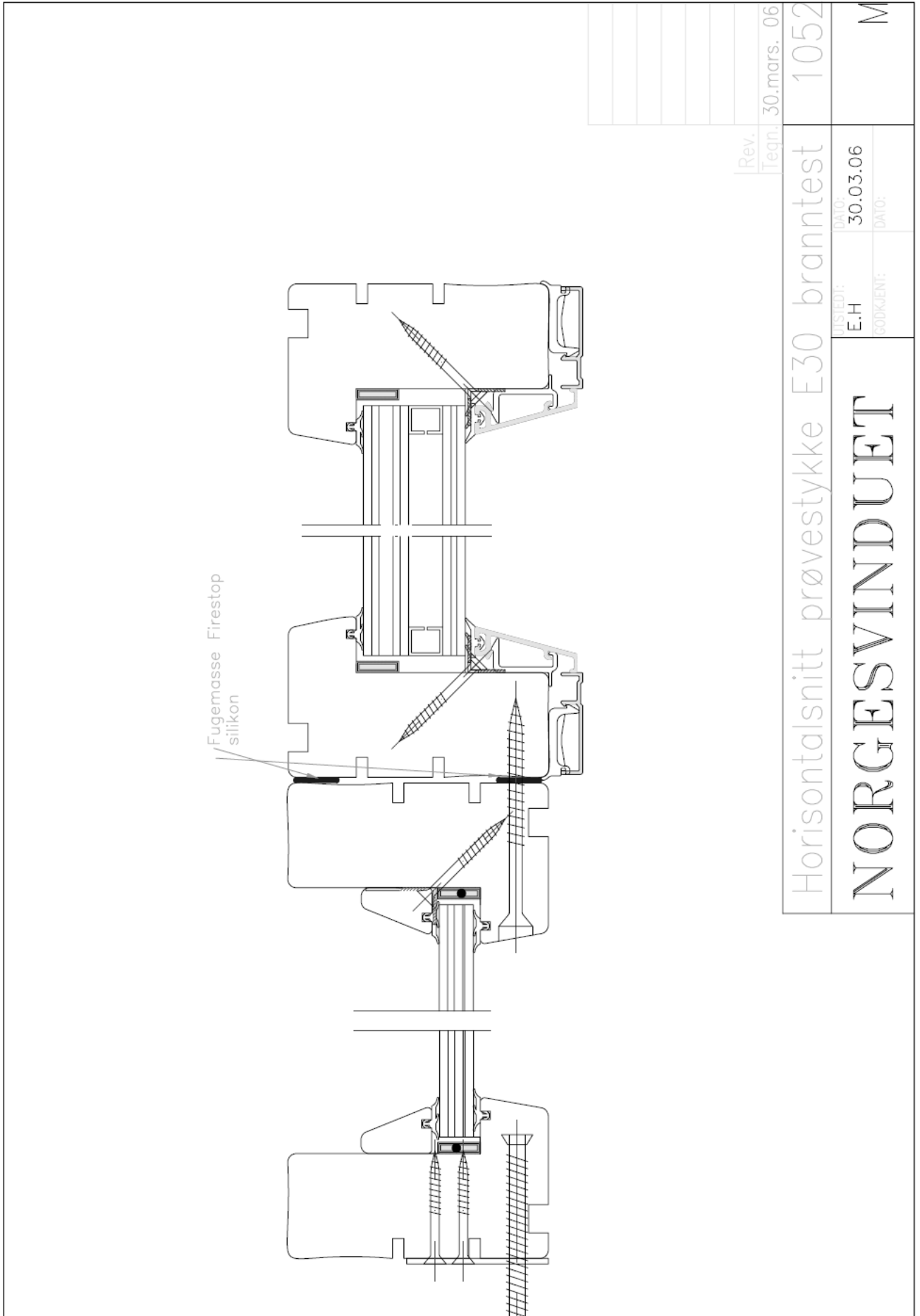
Drawings

Drawings provided by the clients are presented on the following pages.

<i>Page:</i>	<i>Drawing no., version</i>	<i>Description:</i>
15	2004-06-16	Front elevation
16	1003, 2006-03-08	FKN, A, fire window
17	1007, 2006-03-09	FKN, Indoor fire window
18	1052, 2006-03-30	Horizontal cross-section
19	569, 2004-05-10	Fittings for fastening points
20		Pyrobelite 12, Product description





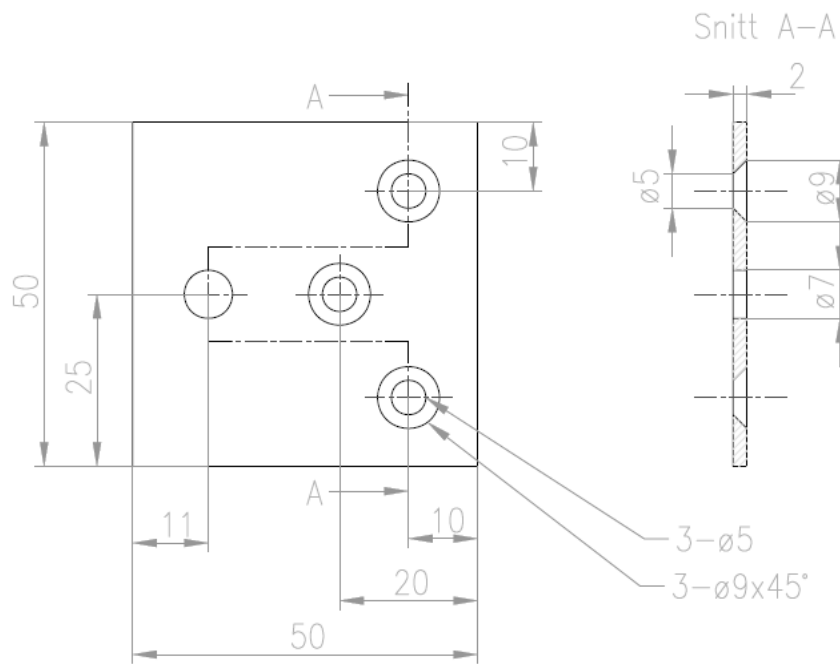


Rev.
Tegn. 30.mars. 06

Horisontalsnitt prøvestykke E30 branntest 1052

LISTEDT: E:H	DATO: 30.03.06	M
ODKJENF:	DATO:	

NORGESVINDUET



Matr. : Stål ubehandlet.

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Tegn.	18. nov. 02

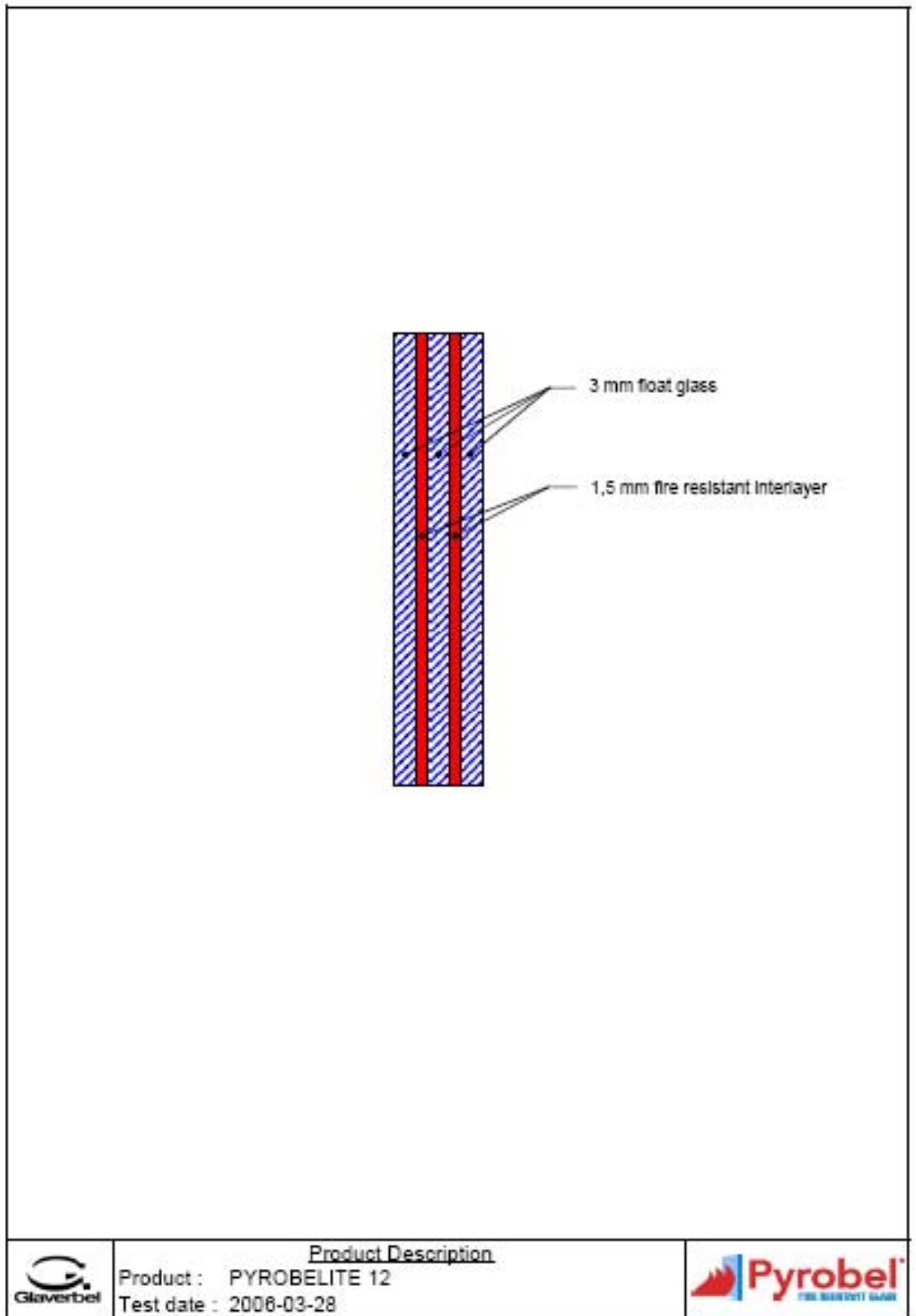
BSL, brakett for innfesting FKN brannvindu

569

NORGESVINDUET

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Appendix I - CARRYING OUT THE TEST

Test method

The test was carried out in accordance with NS-EN 1363-1:1999, Fire resistance tests – Part 1: General requirement, and NS-EN 1364-1, Fire resistance test for non-loadbearing elements – Part 1: Walls.

Carrying out the test

The test was carried out in the laboratory's gas-heated wall furnace. The furnace has inner dimensions 3060 x 3060 x 1200 mm. See Figure I.1.

The support construction was installed into a restraint frame made of steel with concrete lining. This restraint frame has an inner dimension of 3030 x 3030mm. The specimen was screwed to the frame on 3 sides with one edge free.

The furnace was heated in accordance with the standard time- temperature curve given in NS-EN 1363-1:1999.

Persons witnessing the test

Representative:

Bernard Deloge
Egil Hundeide
Ståle Granås
Roy Rakvåg

Organisation:

Glaverbel
Norgesvinduet Bjørlo AS
Norgesvinduet Svenningdal AS
O.M. Rakvåg AS

TEST FURNACE

Pressure and temperature in the furnace was registered during the test, and is given in this Appendix. Results and deviation limits are given according to NS-EN 1363-1:1999.

Dimensions

The furnace has inner dimensions of 3060 x 3060 x 1200 mm (w x h x d).

Thermocouples

The temperature was measured with 9 plate thermocouples, located 100 mm from the exposed side of the specimen, evenly distributed as shown in figure I.1.

The thermocouples were of the plate thermocouple type, as described in NS-EN 1363-1, 1999. Section 4.5.1.1.

Pressure

The pressure in the furnace was measured by means of a pressure sensor of Type 1 ("T"-shaped sensors). The pressure sensor was located 2500 mm from the test furnace floor. The calculation of the furnace pressure is in accordance with NS-EN 1363-1, section 5.2.

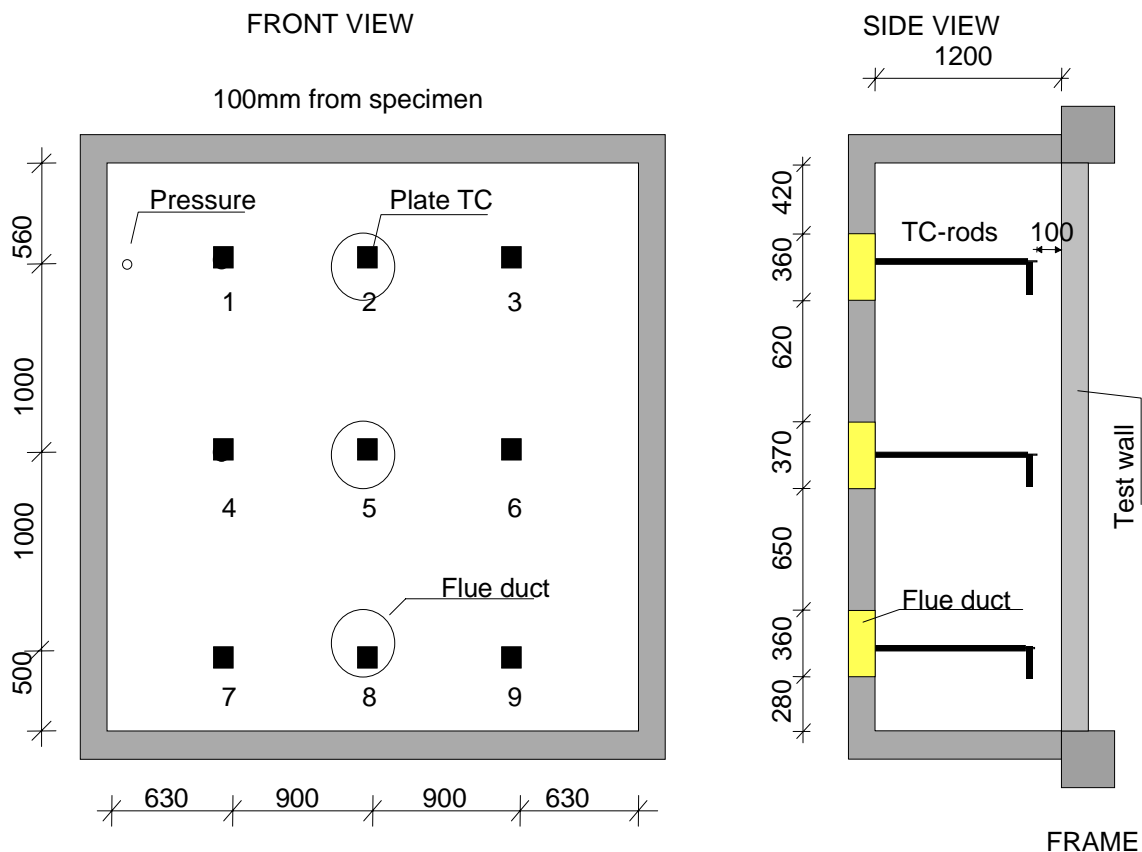


Figure I.1 Location of thermocouples and pressure gauge inside the furnace, 100 mm from the exposed side of the test specimen.

PRESENTATION OF PRESSURE AND TEMPERATURE IN FURNACE

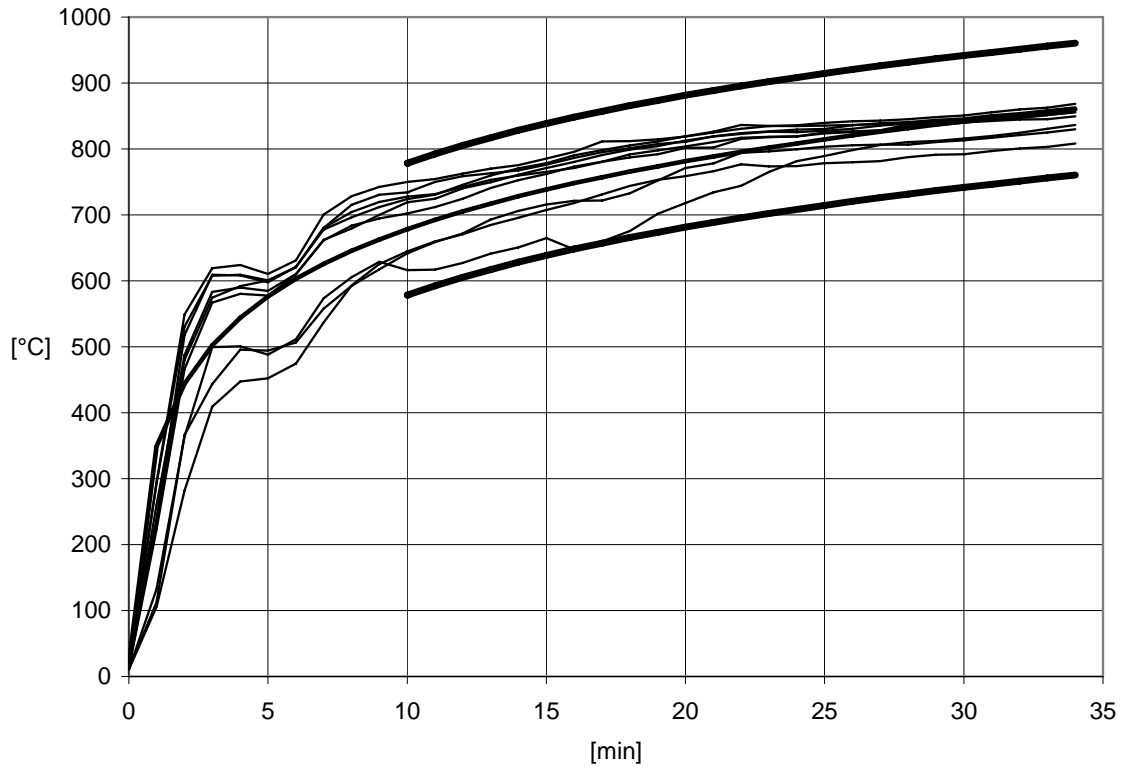


Figure I.2 Furnace temperature and the standard time- temperature curve. Deviation limits after 10 minutes.

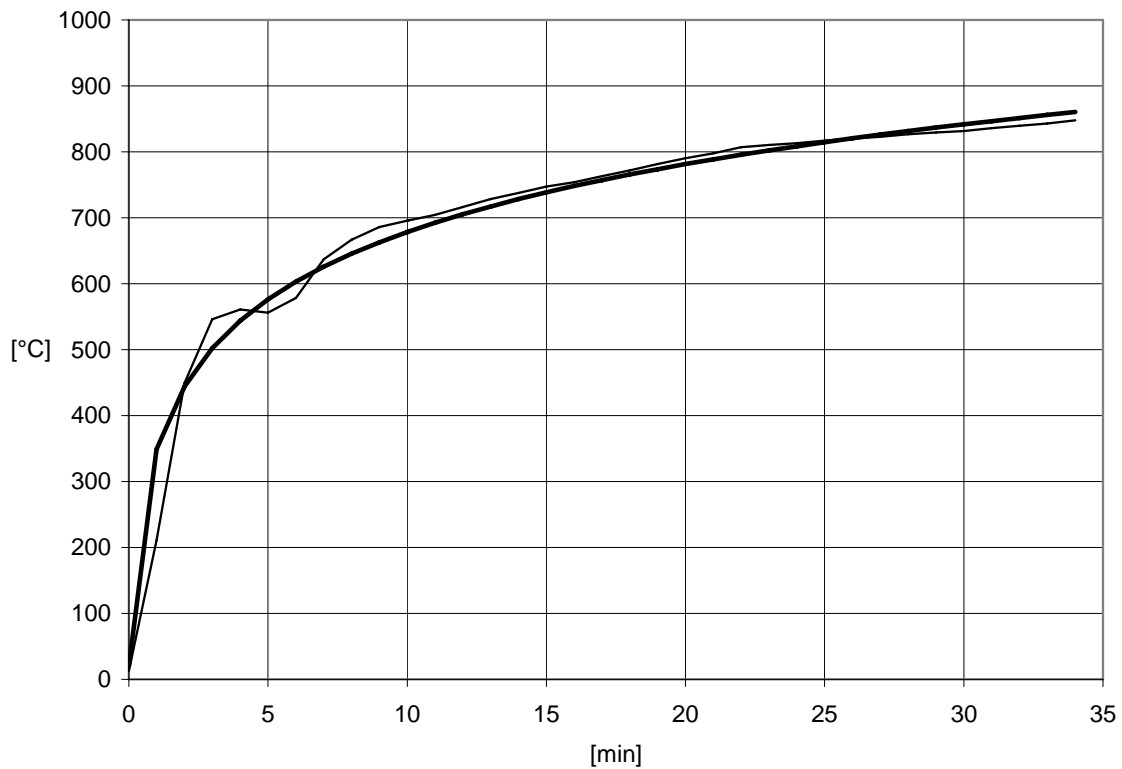


Figure I.3 Average temperature in furnace, and the standard time- temperature curve.

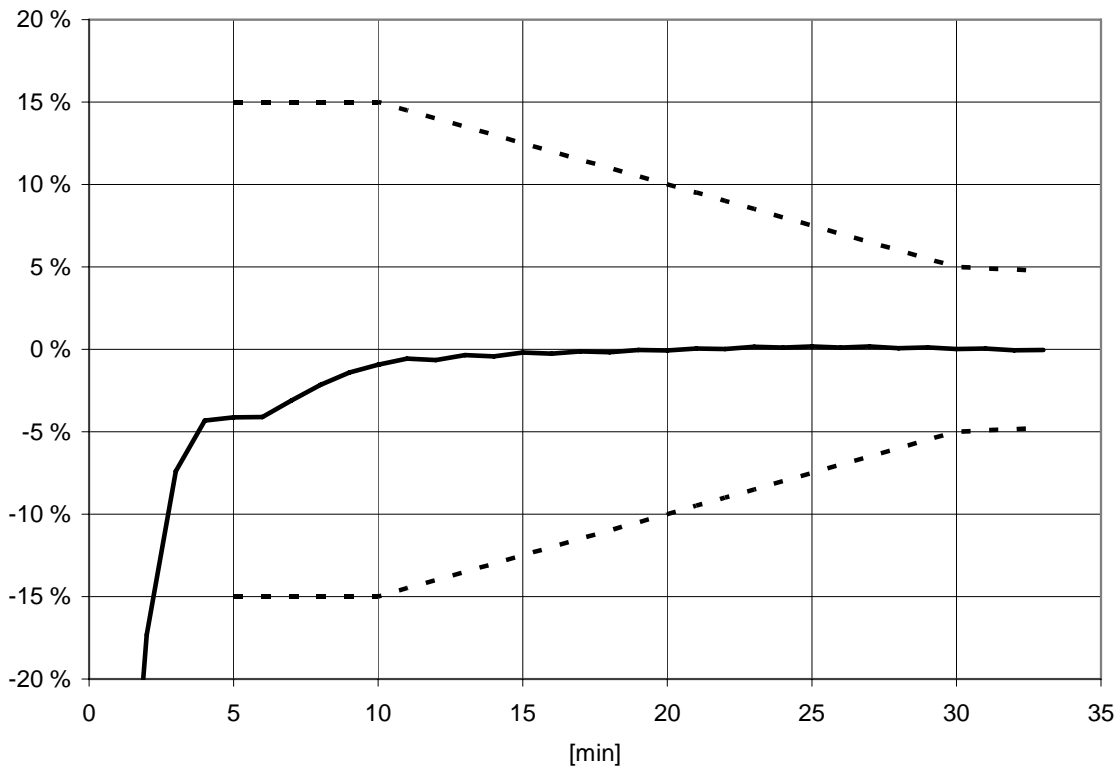


Figure I.4 Percentage deviation between average furnace temperature and standard time-temperature curve. Deviation limits after 5 minutes.

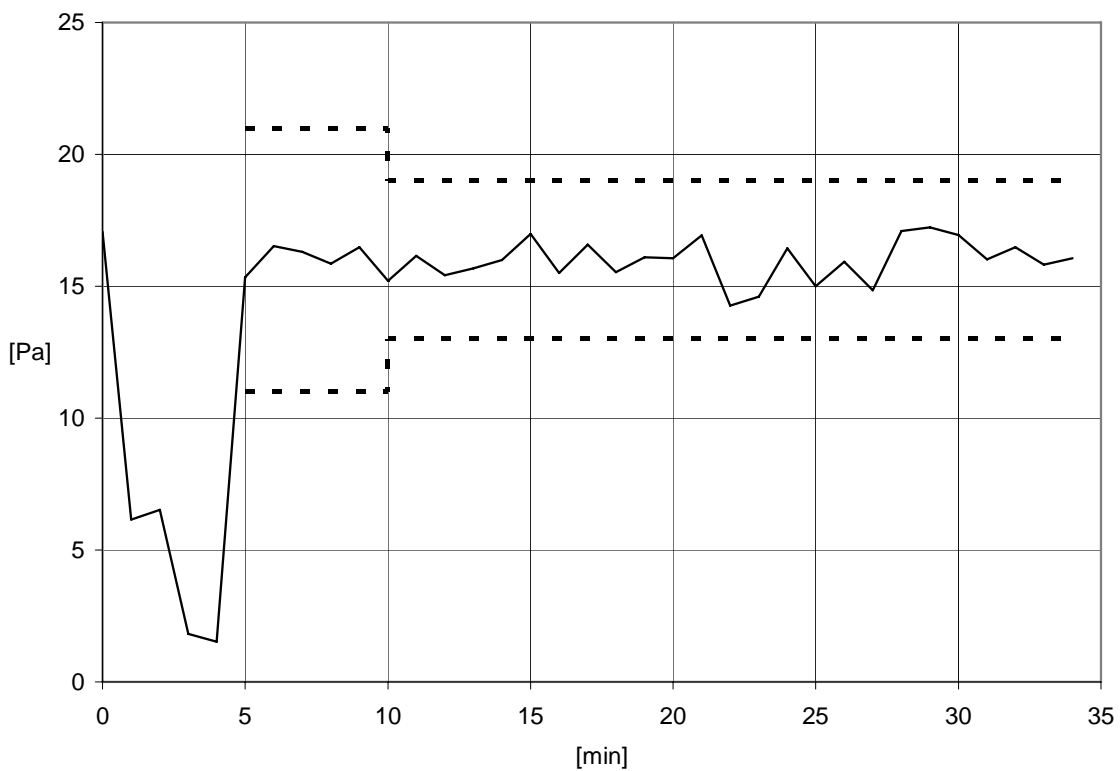


Figure I.5 Pressure in the furnace, measured at 2,5 m above furnace floor. Deviation limits after 5 minutes. Intended furnace pressure: 16 Pa.

Appendix II

STATEMENT IN ACCORDANCE WITH NS EN-1363-1

“This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in EN 1363-1, and where appropriate EN 1363-2.”

“Any significant deviation with respect to size, constructional details, loads, stresses, edge or end conditions other than those allowed under the field of direct application in the relevant test method is not covered by this report.”

“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”

PERFORMANCE CRITERIA IN ACCORDANCE WITH NS EN 13501-2

Relevant performance criteria in NS-EN 13501-2 are given under:

Integrity:

The assessment of integrity shall be made on the basis of the following three aspects:

- a) cracks or openings in excess of given dimensions;*
- b) ignition of a cotton pad;*
- c) sustained flaming on the non-exposed side.*

Insulation:

The performance level, used to define insulation, shall be the average temperature rise on the unexposed face, limited to 140°C above the initial average temperature, with the maximum temperature at any point limited to 180°C above the initial average temperature.

Radiation:

The classification shall be given by the time which the maximum value of radiation does not exceed a value of 15kW/m².

APPENDIX III

FIELD OF DIRECT APPLICATION.

The field of direct application is described in NS-EN 1363-1 Annex A

“...The field of direct application clause in each specific test method may relate to the more common forms of construction for which experience of testing has provided the knowledge that such variations can be safely accepted. The extents of the permitted variations are generally conservative as they are based on the minimum level of common agreement that can be achieved.”

“...The variations that are permitted under direct application can be introduced automatically to manufactured products without additional assessment.”

The field of direct application is described in NS EN 1364-1

The results of the fire test are directly applicable to similar constructions where one or more of the changes listed below are made and the construction continues to comply with the appropriate design code for its stiffness and stability. Other changes are not permitted. The rules for the changes that can be performed on the construction described in this report are defined in NS EN 1364-1 Sec. A.5, pages 15 and 16. A copy of this section is repeated on the next page in this appendix.

A.5 Field of direct application of test results

A.5.1 General

The results of the fire test are directly applicable to similar constructions where one or more of the changes listed below are made and the construction continues to comply with the appropriate design code for its stiffness and stability. Other changes are not permitted.

- a) Decrease in the linear dimensions of panes.
- b) Change in the aspect ratio of panes provided that the largest dimension of the pane and its area are not increased.
- c) Decrease in the distance between mullions and/or transoms.
- d) Decrease in distance between fixing centres.
- e) Increase in the dimensions of framing members.
- f) Screwed-on glazing beads, if `clip-on` beads were incorporated in the test specimen.
- g) Allowances for expansion if none were incorporated in the test specimen.
- h) Change in the angle of installation of up to 10° from the vertical.

A.5.2 Extension of height

No extension in height is allowed above that tested.

A.5.3 Extension of width

The width of an identical construction may be increased if the specimen was tested at a minimum of normally 3m wide width one vertical edge without restraint.

A.5.4 Supporting constructions

A.5.4.1 Standard supporting constructions

The result of a test of fire resistant glazing tested in one of the standard supporting construction given in EN 1363-1 is applicable to any other supporting construction, or the test frame, within the same type (high density rigid, low density rigid or flexible) that has a greater fire resistance.

A.5.4.2 Non-standard supporting constructions

The result of a test of fire resistant glazing tested in non-standard supporting constructions is only applicable to that construction.