

BRE Global Test Report

Fire resistance test in accordance with BS 476: Part 22: 1987 on a single action, single-leaf timber doorset with one vision panel, mounted in a block-wall supporting construction.

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SUMMARY

A single action, single leaf timber doorset incorporating one glazed vision panel, was submitted to a fire resistance test of 30 minutes duration on 5th February 2018, in accordance with BS 476: Part 22: 1987.

The doorset was installed within a nominal 215mm-deep block-wall supporting construction and orientated so that the door leaf opened away from the furnace.

In the orientation tested, the doorset was found to achieve the following fire resistance:

Integrity: 16 minutes

Insulation: 3 minutes.



1 OBJECTIVE

To determine at the request of BRE Fire Investigation, the fire resistance of a single action, single leaf timber doorset (including one vision panel) when subjected to a fire resistance test in accordance with BS 476: Part 22: 1987.

2 CONSTRUCTION

2.1 General

The doorset was fitted into an aperture, nominally 900mm-wide x 1990mm-high, constructed within a block work wall supporting construction, built within a concrete lined furnace test frame of aperture size 3050mm x 3050mm.

Prior to the test, a threshold was fitted in accordance with Fire Test Study Group Resolution 51.

The doorset was orientated so that the leaf opened away from the furnace.

There was no latch or lock mechanism fitted to the door leaf.

Drawings of the type of doorset supplied for test were not supplied by the sponsor.

The specimen is shown before, during and after testing in Photographs.

2.2 Supporting construction

The doorset was installed in a 215mm-deep blockwork wall, with the doorframe anchored into the blockwork surrounding the door-set.

The aperture for the doorset (nominally 900mm-wide x 2100mm-high, was set centrally within the wall, with the door sill located at a nominal height of 550mm above the base of the wall.

2.3 Door Frame

Details of the door frame construction were not available/not provided by the sponsor.

The frame comprised of vertical and horizontal formed timber members of overall dimensions 40mm-deep x 79mm wide.

The frame was screw fixed through and into the brickwork surround using 7.5mm-diameter x 110mm-long screw fixings, with four fixings noted per jamb and two fixings per horizontal head section.

A bead of white coloured general-purpose silicone sealant (supplied in 310ml cartridges) was gunned around the perimeter edges of the door frame, sealing the gap between frame and supporting construction (both specimen faces).



2.3.1 Damage to door frame

It was noted after installation of the doorset that the top horizontal frame member was damaged near the left-hand side (as viewed from the exposed face). The damage was repaired by the sponsor using a shaped wooden infill and some alkaline earth silicate blanket. A photo of the repaired area of frame is given in the Photographs.

2.4 Door Leaf

Details of the door leaf construction were not available/not provided by the sponsor.

The door leaf was of overall nominal dimensions 825mm x 2035mm x 44mm-thick, painted a blue colour on the exposed face and a dark green colour on the unexposed face.

Incorporated within the leaf was one glazed vision panel (nominally 135mm-wide x 285mm-high located towards the top right-hand side of the leaf, as viewed from the unexposed face).

There were no visible markings on the leaf to identify the fire rating of the doorset.

The door leaf away from the furnace.

There was no latch or locking mechanism fitted to the leaf. The leaf was held in the closed position using a door-closer, fitted to the unexposed face of the door-set.

2.5 Door Fittings

Although no details were provided, a visual examination showed the doorset being fitted with the following furniture:

Three steel hinges, one located nominally 150mm from the bottom, one located nominally 1080mm from the bottom and one located nominally 200mm from the top of the door leaf.

A door closer was fitted to the unexposed face of the door-set, nominally 240mm from the hinged edge of the leaf.

A steel kick-plate, 150mm high x 750mm-wide was fitted 10mm up from the bottom of the door leaf on the exposed face of the leaf.

A steel push-plate was fitted near the moving edge of the leaf on the exposed face, and a handle was fitted on the corresponding opposite side of the leaf.

A nylon bristle-type smoke strip was fitted to the perimeter of the door leaf on both side edges and the top, but not to the bottom edge of the leaf.

2.6 Opening/closing forces

The opening and closing forces applied to the leaf from the door closer were measured in accordance with FTSG Resolution 63 and found to be as follows:

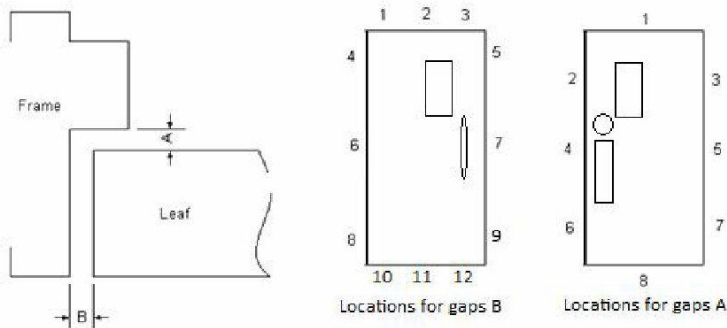
Closing moment: 42.8Nm

Opening moment: 29Nm



2.7 Door leaf / frame gaps

The gaps between the door leaf and frame were measured (in mm) and found to be as given in the sketch and table below.



Location B	1	2	3	4	5	6	7	8	9	10	11	12
Gap - mm	2	2.5	2.5	2.5	2	1	2.5	2	3	5	7	5

Location A	1	2	3	4	5	6	7	8
Gap - mm	8	8	5	7	2	5	5	10



3 TEST PROCEDURE

3.1 General

The test was carried out on 5th February 2018 and was witnessed on behalf of BRE Fire Investigation by Dr David Crowder & Ms Ciara Holland.

The ambient temperature at the start of the test was 11°C.

3.2 Furnace control

The furnace temperature was measured by means of fourteen bare wire thermocouples arranged in rows in the furnace with their measuring junctions 100mm from the exposed face of the specimen. The furnace was controlled so that the average temperature followed the time/temperature relationship specified in BS 476-20: 1987.

The furnace pressure was monitored at a point 2.5m above the threshold of the doorset. The pressure was maintained in accordance with BS 476: Part 20: 1987, taking the threshold of the doorset as the notional floor level.

3.3 Specimen temperature measurements

The unexposed face temperature of the specimen was measured using fourteen chromel / alumel (K-type) thermocouples each soldered to a copper disk and covered with an insulating pad attached to the leaf and frame of the doorset.

The locations of the unexposed face thermocouples are given in the following table and shown in the Photographs.

Thermocouple	Location
1	On the top frame member, at mid-width of the door-set.
2	Near the top left corner of the door leaf.
3	Near the top right corner of the door leaf.
4	On the glass in the door leaf, at the top and at mid-width of the glass.
5*	Near the centre of the top left quarter area of the door leaf
6	On the timber reveal around the glass, at mid-height of the glass panel.
7	At the centre of the glass in the door leaf.
8*	At ¾ height of the door leaf, at mid-width between the edge of the vision panel and the edge of the door leaf.



Thermocouple	Location
9	On the left-hand side frame member, at mid-height.
10*	At the centre of the door leaf.
11	At mid-height of the door leaf, near the right hand side edge of the leaf, and below the handle location.
12	On the right-hand side frame member at mid height.
13*	Near the centre of the bottom left quarter area of the door leaf
14*	Near the centre of the bottom right quarter area of the door leaf.

* These five thermocouples were used to determine the mean unexposed face temperature of the doorset with all thermocouples (including those on the frame) being used to determine the maximum temperature.

3.4 Deflection

Two linear displacement transducers were connected via taut fine steel wires to the top right-hand side corner of the door leaf and the right-hand side of the door leaf at mid-height (which were considered to be the locations of maximum deflection) to continuously monitor the horizontal deflection during the test. Positive and negative values denote the deflection of the leaf toward and away from the furnace respectively.



4 RESULTS

4.1 Observations

Observations made during the test are given in the following table and unless stated are of the unexposed face.

Time minutes	Observation
0	Start test.
1½	Some smoke is coming from between the door leaf and frame over the top (approximately) third height of the doorset.
2	The smoke observed at 1 ½ minutes is increasing from the left-hand side edge.
3	The glass in the vision panel has cracked. Increasing smoke is now coming from the top edge of the door leaf, and from near the top hinge location.
5	Considerable smoke is coming from the left-hand side edge of the door leaf, over the top half height of the doorset.
8	The door has charred black and is flaming on the exposed face. A moderate amount of smoke is now coming from both sides of the door leaf, from the top down to approximately mid-height of the leaf.
15	A red glow (and hot gases) were observed at the top left-hand side corner of the door leaf.
16¾	Failure of integrity using the cotton pad at the top left-hand side corner of the door leaf.
18	Intermittent flaming from the top left-hand side corner of the door leaf.
20	Sustained flaming from the top left-hand side corner of the door leaf.
21	Flames are spreading across the top edge of the leaf.
24	Flaming from the door leaf perimeter is increasing in intensity.
24½	Flaming from the top edge of the vision panel opening.
25	The paint on the unexposed face is blistering as it heats up.
26	Flaming from the sides and bottom of the vision panel opening.



Time minutes	Observation
26½	The glass fell out from the door leaf vision panel.
31½	Test stopped.

The doorset is shown at the end of the test in the Photographs.

4.2 Furnace temperature

The mean furnace temperature, together with the specified curve for comparison is given in the Graphs.

4.3 Unexposed face temperatures

The individual, mean and maximum temperatures recorded on the unexposed face of the specimen during the test are plotted against time in Graphs.

The maximum temperature of the door leaf exceeded the 180°C temperature-rise limit after 3 minutes of the test.

The mean unexposed face temperature of the door leaf did not exceed the 140°C temperature-rise limit during the test.

4.4 Deflection

The deflection recorded by the transducers is plotted against time in Graphs, where positive values indicate deflection towards the furnace and negative values indicate deflection away from the furnace.

The maximum deflection measured by the transducer attached to the top right-hand side corner of the door leaf was 0.8mm towards the furnace, recorded after 25 minutes of the test. The maximum deflection measured by the transducer attached to the right-hand side of the door leaf at mid-height was 14.5mm away from the furnace, recorded at the end of the test.



5 PERFORMANCE CRITERIA

The standards state that a doorset is regarded as having a fire resistance (expressed in minutes) that is equal to the elapsed time (to the nearest completed minute) between the commencement of heating and either the termination of heating, or the time of failure with respect to the relevant criteria for integrity.

Integrity: Failure is deemed to occur:

- a) When collapse or sustained flaming for not less than 10s on the unexposed face occurs;
- b) When ignition (defined as glowing or flaming) of a cotton fibre pad, when applied against the surface of the test specimen, for a maximum of 15s. (Charring of the cotton pad without flaming or glowing shall be ignored).
- c) When a 6mm-diameter gap gauge can penetrate through a gap into the furnace, the sill level being discounted, and be moved in the gap for a distance of at least 150mm;
- d) When a 25mm-diameter gap gauge can penetrate through a gap into the furnace

Insulation: Failure is deemed to occur:

- a) When the mean unexposed face temperature increases by more than 140°C above its initial value;
- b) When the temperature recorded at any position (including the roving thermocouple) on the unexposed face is in excess of 180°C above the initial mean unexposed face temperature;
- c) When integrity failure occurs.



6 CONCLUSION

A single action, single leaf timber doorset incorporating one vision panel, when submitted to a fire resistance test in accordance with BS 476: Part 22: 1987 on 05 February 2018 at BRE laboratories, Garston, Watford, for the duration of 30 minutes, achieved the following fire resistance:

Integrity: 16 minutes

Insulation: 3 minutes.

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 BS 476: Part 22: 1987.

Any significant deviation with respect to size, construction 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.

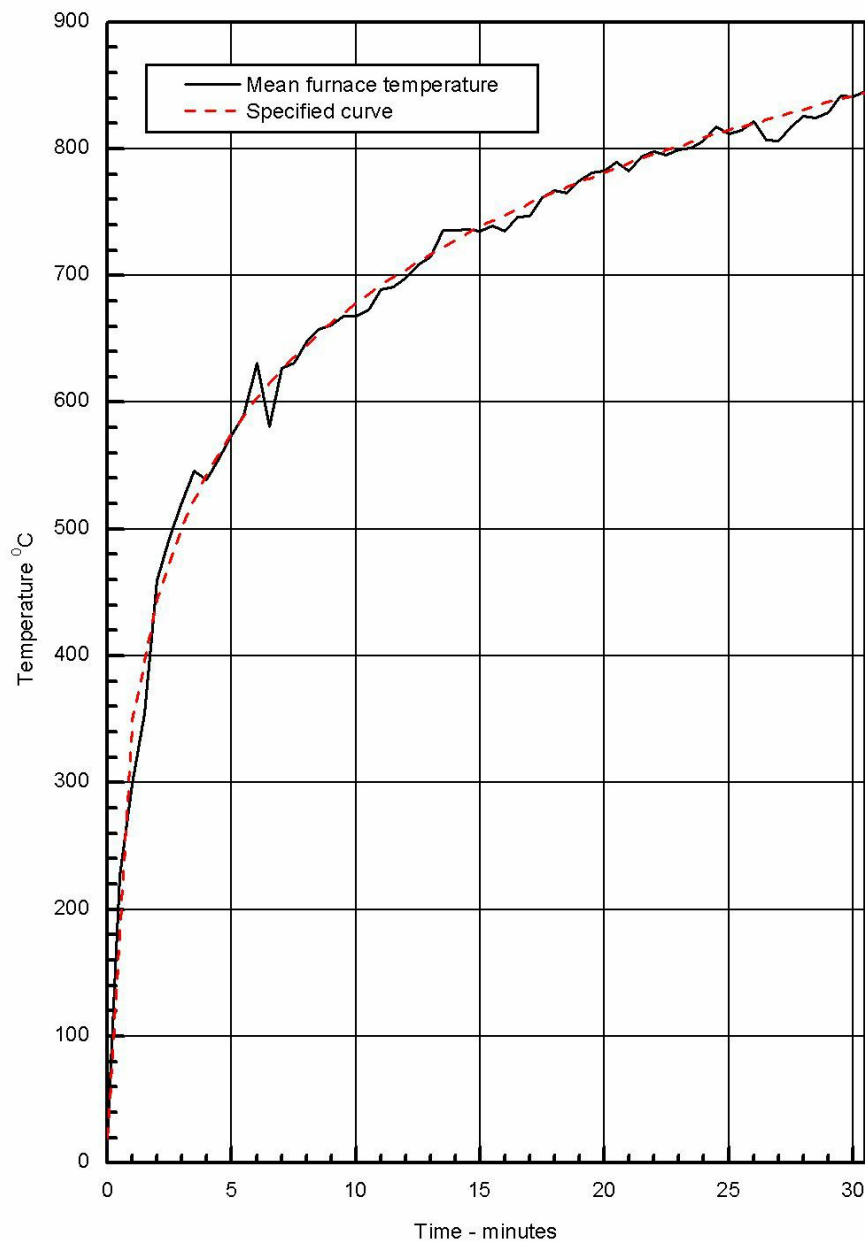
The specification and interpretation of fire test methods is the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons, it is recommended that the relevance of test reports over 5 years old should be considered by the user. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

7 REFERENCES

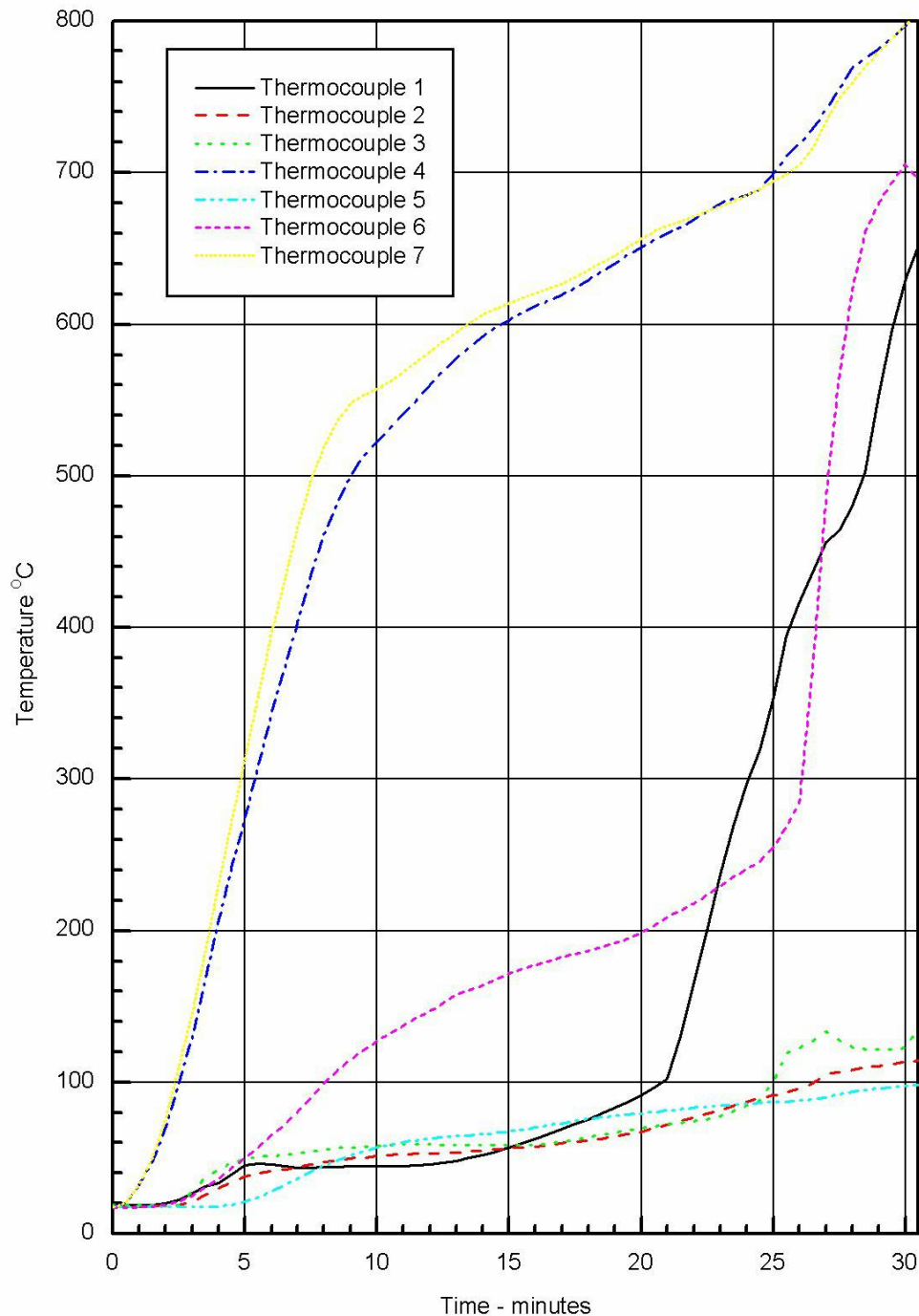
- Fire tests on building materials and structures. Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction. (British Standard 476: Part 20:1987. British Standards Institution, London, 1987.
- Fire Test Study Group Resolutions 26/11/03: Resolution 51 – Door Threshold Details
- Fire Test Study Group Resolutions 26/11/03: Resolution 63 – Door closer forces.
- Fire tests on building materials and structures. Part 20: Method for determination of the fire resistance of elements of construction (general principles). British Standard 476: Part 20:1987. British Standards Institution, London, 1987.



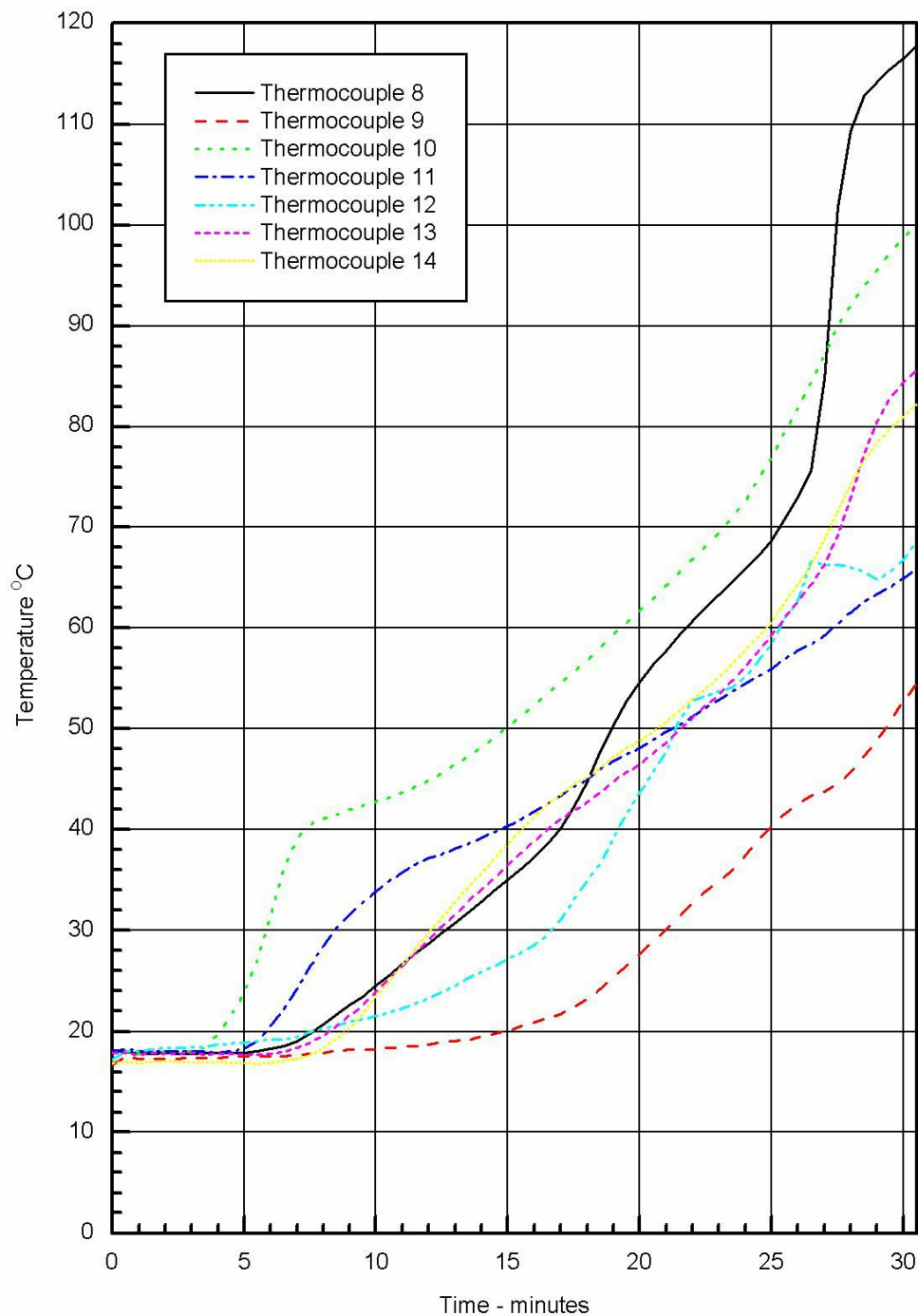
8 GRAPHS



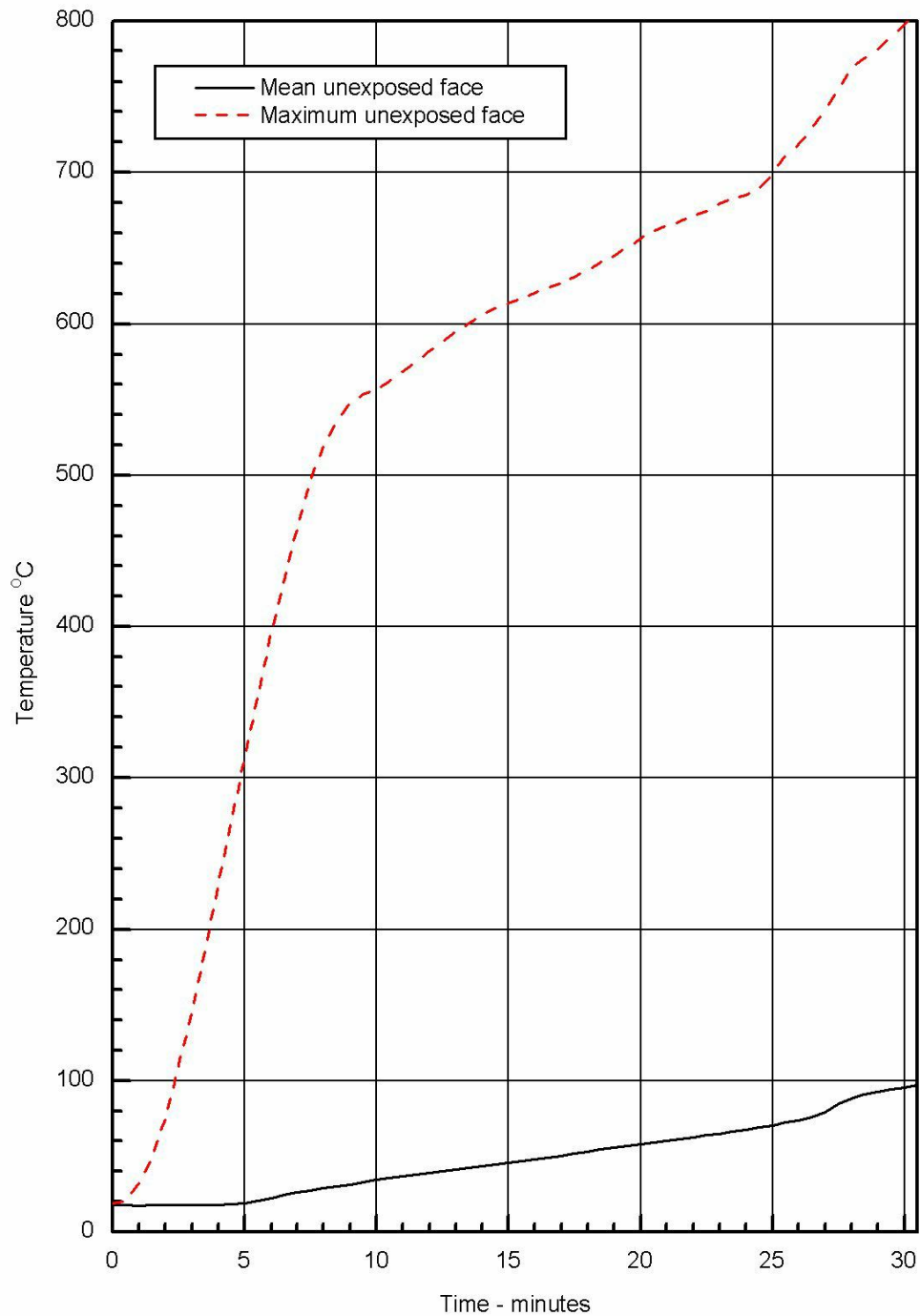
Mean furnace temperature with specified curve for comparison.



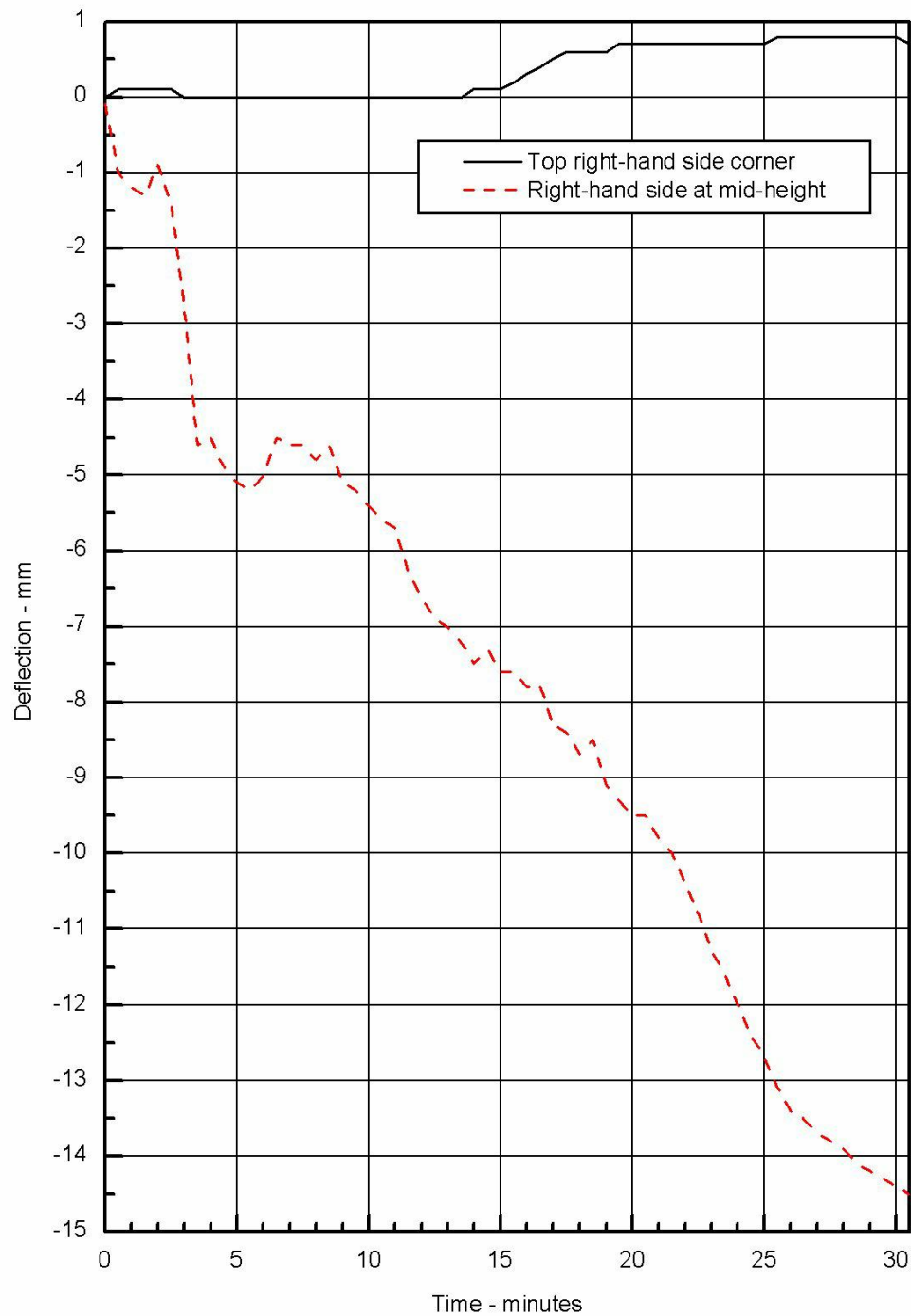
Temperatures recorded on the unexposed face by thermocouples 1 to 7.



Temperatures recorded on the unexposed face by thermocouples 8 to 14.



Mean and maximum temperatures recorded on the unexposed face.



Horizontal deflection recorded during the test.



9 PHOTOGRAPHS



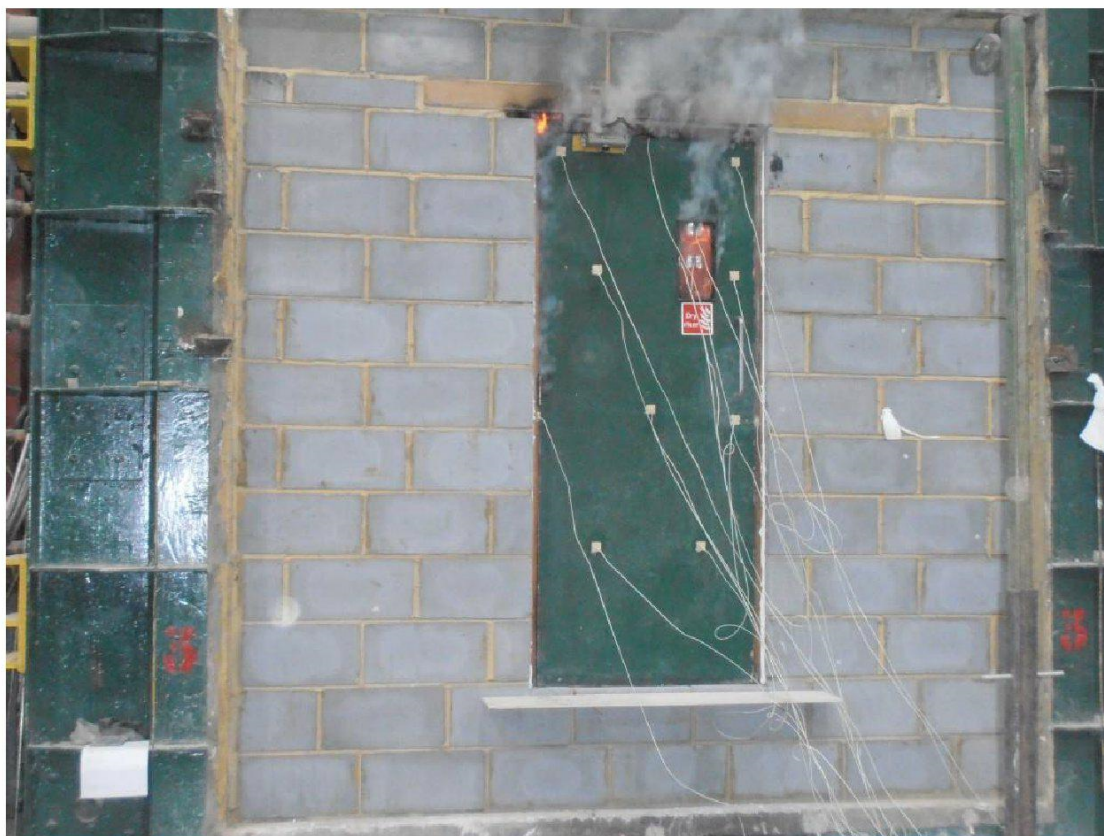
Exposed face of specimen before test.



Location of repaired damage on the door frame (before the test).



Unexposed face of specimen before test.



Unexposed face of specimen after 16 minutes.



Unexposed face of specimen at the end of the test.

REPORT ENDS