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Additional Test Report

Fire Resistance test in accordance with BS EN 1365-2:2000 on a loaded softwood timber joist floor incorporating fifteen Halers H2 downlights.

This test report is additional to that issued as number 260284 and dated 8 April 2010. The original test report shall remain valid and is not replaced by this additional test report.

Prepared for:
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Northamptonshire,
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19 December 2011

Test report number 260284A

UKAS TESTING

0578

Protecting People, Property and the Planet

Fire Resistance test in accordance with BS EN 1365-2:2000 on a loaded softwood timber joist floor incorporating fifteen Halers H2 downlights.

Prepared on behalf of BRE Global by

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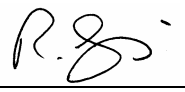
Signature 

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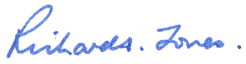
Signature 

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Summary

A floor and ceiling assembly was subjected to a fire resistance test conducted in accordance with BS EN 1365-2:2000 on 17 February 2010. The test was conducted at the BRE Laboratories, Watford for a duration of 31min. with an imposed load of 1.5 kN/m^2 applied to the floor.

The test specimen was installed within the aperture of a BRE concrete lined furnace test frame and was constructed from seven softwood timber joists spaced evenly across the test frame and spanning the length of the aperture. Each end of the timber joists were seated on concrete ledges within the test frame, with an unsupported specimen span of 4150mm long x 3500mm wide (nominal internal aperture dimensions of the furnace test frame) directly exposed to the furnace throughout the full test duration.

The unexposed side of the timber joists were clad with a single layer of 22mm-thick tongue and grooved chipboard.

The exposed side of the joists were covered with a single layer of 15mm-thick Knauf standard wallboard. Fifteen Halers H2 downlights were installed through apertures made in the plasterboard ceiling.

The floor achieved the following fire resistance:

Loadbearing capacity:		31min*
Integrity:	Sustained flaming :	29min
	Gap gauge :	31min*
	Cotton Pad :	29min
Insulation:		29min

* No failure, the test having been discontinued at the request of the sponsor.

The product has not been retested. This Additional Test Report does not involve technical change or technical review of the original test report. The original and alternative name of the product are documented by the laboratory and maintained in company records. Halers Lighting Ltd. state that the product has not changed and is the same as that identified in the original report (260284).

1 Objective

To determine the fire resistance of a loaded floor constructed from softwood timber joists, protected by a single layer of 15mm-thick Knauf standard wallboard and incorporating fifteen Halers H2 downlights, when tested in accordance with BS EN 1365-2EN 1365-2:2000(1).

2 Construction

2.1 General

The floor, nominally 4500mm long x 3500mm wide, was constructed between 10th and Wednesday 11th February 2010 within the aperture of a reinforced concrete test frame of internal exposed dimensions nominally 4150mm long x 3500mm wide. The 4150mm opening in the test frame had a 55mm wide chamfered shoulder at either end; the joists set over this aperture therefore had an unsupported span of 4270mm.

BRE was not involved in the selection of the test specimen in any way.

The arrangement of the floor is shown in Figures 1 and 2; the downlights were as shown in Figure 3. The downlights and floor before test are shown in Plates 1 to 4.

2.2 Materials

2.2.1 Floor joists and noggins

Softwood timber joists cut to 4500mm lengths, nominally 45mm thick x 195mm deep were used in the specimen construction. A joist in the specimen construction was marked “SODRA PEFC/05-32-20 5003V EW/ER BS 4978 KO GS C16”.

A representative sample of timber joist was taken and found to have a density of 495 kg/m^3 and a mean thickness of 43.1mm.

During construction, the moisture content of the timber was measured using a hand held portable Protimeter Timber Master measuring device. The moisture content recorded ranged between 18% and 22% with an average value of 20%.

Softwood timber noggins (195mm deep x 45mm thick) were made from a spare joist. The noggins were cut to size and fixed between each joist at either end of the joist assembly using.5mm-diameter x 80mm-long screws with two screws per joint.

The arrangement of the joists within the floor can be seen in Figure 1.

2.2.2 Chipboard flooring.

Tongue and grooved chipboard, 22mm-thick, supplied in sheets of nominal dimensions 2400mm long x 600mm wide was used for the floor. A representative sample of the chipboard was taken and found to weigh 13.8kg/m² and to have a mean thickness of 21.9mm.

2.2.3 Plasterboard

Knauf standard wall board was used for the ceiling. The plasterboard was 15mm thick, delivered in tapered edged sheets, 1200mm wide x 2400 long, pink with a pale grey paper facing on the exposed face. The rear face of one sheet was marked " Knauf Standard Wallboard 1200 x 15 TE 220210 Standard Wallboard Type A EN 520 20/11/09 102-56 220210". A sample of the plasterboard was taken and found to weigh 10.4kg/m^2 with a mean thickness of 15.02mm.

2.2.4 Joint finish

Plasterboard jointing tape, 50mm wide, was used to cover all joints between the plasterboard sections.

An air-drying pre-mixed jointing compound was used to cover plasterboard jointing tape / joints and screw fixings

2.2.5 Fixings

The screws used to fix the joists to the noggins were 5mm-diameter x 80mm-long screws.

The screws used to fix the chipboard flooring to the joists were 4mm-diameter x 60mm-long drywall screws.

The screws used to fix the plasterboard to the joists were 50mm-long coarse-thread "Easydrive" drywall screws.

2.2.6 Halers H2 Downlights

Each downlight contained an integrated 700mA LED driver and carried 3 LEDs within a mild steel housing. Each downlight had a front face with a diameter of approximately 80mm and was installed through a hole, nominally, 65mm diameter made in the ceiling. A gasket made from a 1.2mm-thick silicone-based closed-cell foam material was set around the casing on the upper surface of the lip projecting from the steel housing and served to seal the contact of the lip with the underside of the ceiling when the unit was installed; another gasket made from the same material was set around the casing under the lip projecting from the steel housing and served to seal the contact of the lip with a fascia. The fascia was made from flame-retardant ABS and had an outside diameter of 90mm.

The unit was retained in place by steel spring clips which were attached, prior to installing the downlight, to the lowest position on the spring carrier.

Details of the fittings, which had a white finish, are shown in Figure 3. The fittings, before test are shown in Plates 2 and 3.

2.3 Assembly

2.3.1 Assembly of floor and ceiling.

Seven timber joists, 4500mm long, were placed onto the test frame ledges and spaced at 600mm centres, the last spaced at nominally 410mm centres as shown in Figure 1 The ends of the joists were simply supported on the test frame ledges. The ends of each joist were screw fixed, using two 80mm fixings per joint, to spacer noggins, 45mm thick x 195mm deep, to provide vertical stability to the joists, whilst providing the required spacing distance of 600mm.

A single layer of 22mm-thick chipboard floorboards was screw fixed perpendicular across the top of the joists with 60mm-long drywall screws located at 300mm nominal centres with two fixings per joist location. The chipboard was cut to ensure the ends of the board coincided with the joists.

The exposed face of the timber joists was protected by a single layer of 15mm-thick Knauf Standard Wallboard secured to the exposed face of the timber frame using 50mm-long drywall screws at nominal 230mm centres.

All the exposed face plasterboard joints were covered with a 50mm wide paper jointing tape and a coat of ready mix joint cement applied to cover all jointing tape and the heads of all board fixings.

Finally, all perimeter edges of the specimen (exposed and unexposed) were sealed with gypsum plaster and an imposed load of 1.5kN/m^2 applied evenly across the surface of the chipboard.

2.3.2 Installation of downlighters.

The downlights were positioned as shown in Figures 1 and 2. Their arrangement along the length of the floor was with a spacing of nominally 830mm centres, except for one downlight which was offset with a nominal separation of 500mm from an adjacent fitting. Their arrangement across the width of the floor was nominally at the mid-span of the separation of the five central joists apart from one downlight which was offset with a nominal separation from a joist.

BRE installed the downlights through 65mm-diameter holes made in the ceiling. The downlighters were inserted through the apertures and retained in place by their integral retaining springs. The downlighters were not connected to any electrical cables.

The position of the individual downlighters is shown in Figures 1 and 2.

3 Conditioning

A representative sample of the chipboard flooring, joists and plasterboard were taken during construction. On the day of the test the chipboard and timber joist samples were placed into an oven at 105°C whilst the samples of plasterboard were placed in an oven at 50°C, to determine free moisture content by weight loss technique. The samples were found to have a free moisture contents, shown as a percentage of the dry weight, as follows:

Chipboard:	6.97%

Knauf wallboard:	0.54%
Timber joist	17.30%

The moisture content of the timber flanges of the joists was also measured prior to the test using a hand held Protimeter and the average % moisture content was found to be 20%

4 Test procedure

4.1 General

The test was carried out on the Wednesday 17th February 2010 at the BRE Garston laboratories using the large-scale horizontal furnace. The ambient temperature at the start of the test was 14°C. The test was witnessed by Mr Tony Allison representing the sponsor.

4.2 Loading

The total imposed load applied to the floor was 1.5kN/m^2, as requested by the sponsor. The load was achieved using cast-iron weights distributed evenly over the area of the floor. Details of the loading are given in the Appendix.

4.3 Furnace control

4.3.1 Furnace temperature

The furnace temperature was measured by means of ten plate thermometers arranged symmetrically in the furnace, suspended through the floor assembly (with the holes sealed) such that the measuring junctions were set 100mm below the soffit of the floor. The arrangement of the furnace thermometers was as shown in Figure 2.

The furnace was controlled so that the mean temperature recorded followed the time/temperature relationship specified in EN 1363-1:1999[2].

4.3.2 Furnace pressure

The pressure in the furnace was measured using a micromanometer connected to a probe installed below the floor and was controlled such that the pressure at a level 600mm below the floor was maintained as closely as possible to 15.7 Pa and did not exceed the maximum allowable of 20Pa at a level 100mm below the floor.

4.4 Specimen temperature

4.4.1 Unexposed face temperature

The temperature on the unexposed face of the floor was monitored by fourteen K-type thermocouples, each soldered to a copper disk and secured using an insulating pad to the upper side of the chipboard. The positions of the thermocouples are detailed in Table 1 below (described when viewed from above) and are also shown in Figure 2:

Table 1 Thermocouple positions on unexposed face

Thermocouple	Location
1	At top right quarter section of the floor above downlight location.
2*	At the centre of the top right quarter section of the floor
3	Adjacent to a long joint, at mid width.
4*	At top left quarter section of the floor.
5	Adjacent to a corner joint.
6	Adjacent to a long joint and above a downlight.
7	Adjacent to a width joint.
8*	At the centre of the floor.
9	Adjacent to a long joint in area above underlying join in plasterboard. .
10	Adjacent to a long joint in area above underlying join in plasterboard and in vicinity of downlight location. .
11	Near mid-width of floor above downlight location.
12	Above position of downlight located 100mm from joist.
13*	At the centre of the bottom left quarter section of the floor.
14*	At the centre of the bottom right quarter section of the floor.

*Used to determine mean surface temperature on the unexposed face of the floor. (Tcs2, 4, 8, 13 and 14)

4.4.2 Cavity temperature

Seven K-Type thermocouples, referenced Int1 to Int7 were placed internally within the voids formed between joists at the locations detailed in Table 3 below (described as viewed from above) and shown in Figure 3.

The temperature recorded by the internal thermocouples was for the sponsor's information only.

Table 3 Internal thermocouple positions

Thermocouple number	Location
Int1	Air temperature above downlight in top right-hand quarter section.
Int2	Air temperature above downlight located under join in chipboard.
Int3	Air temperature on left-hand side of specimen remote from fittings.
Int4	Air temperature near centre of floor remote from fittings.
Int5	Air temperature above downlight located 100mm from joist.
Int6	Attached to joist 100mm from fitting.
Int7	Air temperature above downlight.

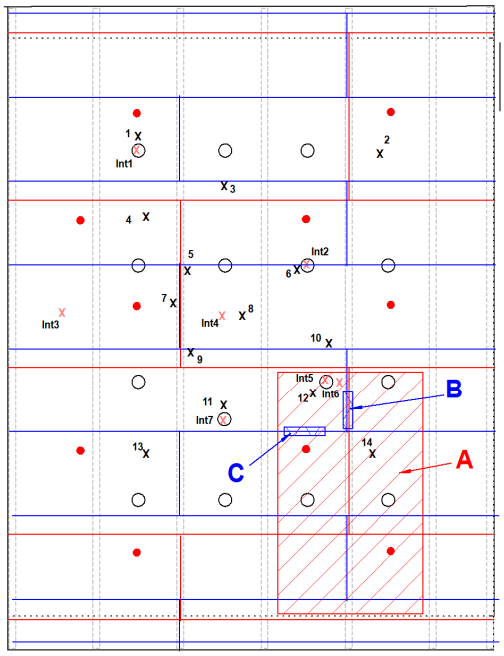
4.5 Deflection

The vertical deflection at the centre of the floor was continuously measured during the test by a linear deflection transducer attached via a taut fine steel wire to the centre of the floor.

5 Results

5.1 Observations

The observations made during the test are given in Table 4. All observations are of the exposed face unless stated otherwise. In Table 4 reference is made to the following diagram showing the arrangement as viewed from above.



X 1-14 Unexposed face thermocouples X Int1- Int7 Internal thermocouples
● Furnace thermocouples ○ Downlighter

Table 4 Observations during test

Time Min:s	Observation (Relate to exposed face unless otherwise stated)
0:.00	Test started.
1:45	Paper facing on plasterboard is flaming.
4:00	Joint filler still in place

Time Min:s	Observation (Relate to exposed face unless otherwise stated)
5:30	Plasterboard joint filler is falling away.
6:30	Fascia of some downlighters fall away, rims of fittings remain in place.
10:00	All of plasterboard joint filler has fallen away; gap at plasterboard join is approx. 2mm – 3mm wide.
15:00	No change in appearance of exposed face of ceiling apart from brighter glow from surface.
15:30	No change in appearance of unexposed face of floor, photographs taken.
17:00	Widening of gaps at plasterboard joins running perpendicular to joists; gaps are up to approx. 5mm wide, no cracking around screws at edges of plasterboard sections. Fittings remain in place.
19:00	Widening of gaps at plasterboard joins running perpendicular to joists, gaps are up to approx. 15mm wide. Some sagging at edges of plasterboard sections between fixings.
22:00	On unexposed face very slight unevenness in surface of floor. Plate 5.
22:30	Large section of plasterboard ceiling falls away from area under location of thermocouples 12 and 14 (See A in diagram above); flames issuing from voids between joists.
24:00	Other pieces of plasterboard ceiling fall away, copious flames issuing from void prevent a view of the exposed face of the test construction.
26:00	On unexposed face slight quantities of smoke issuing from join between chipboard flooring in vicinity of thermocouple 12 (See B in diagram above).
26:30	Plate 6.
27:00	On unexposed face increase in quantity of smoke issuing from join between chipboard flooring in vicinity of thermocouple 12 (See B in diagram above).
29:00	On unexposed face roving thermocouple applied adjacent to join between chipboard flooring in vicinity of thermocouple 12 (See B in diagram above) measures a temperature of approx. 60^{o}C.
29:39	On unexposed face sustained flaming from join between chipboard flooring in vicinity of thermocouple 12 (See C in diagram above) - Failure of integrity.
30:00	Plates 7, 8..
31:00	Test terminated at sponsor's request

5.2 Furnace control.

The mean furnace temperature is shown plotted against time in Graph 1 together with the specified time/temperature curve for comparison. The furnace pressure, measured 100mm below the ceiling, is shown plotted against time in Graph 2.

5.3 Temperatures on unexposed face

The mean and maximum temperature recorded on the unexposed face of the floor is shown plotted against time in Graph 3.

The temperature recorded by individual temperatures on the unexposed face of the floor is plotted against time in Graphs 4, 5 and 6.

The specimen satisfied the insulation criteria for the mean temperature rise (140°C rise) throughout the course of the test but failed the insulation criteria for the maximum temperature rise (180°C rise) after 29 minutes from the start of the test.

5.4 Temperatures recorded by internal thermocouples.

The temperature recorded by thermocouples Int1 to Int7, for the sponsor's information only, is shown plotted against time in Graphs 8 and 9.

5.5 Deflection recorded

The deflection at the centre of the floor recorded by the transducer is plotted against time in Graph 10. The maximum deflection measured during the course of the test was 62mm towards the furnace, recorded after 31 min., at the conclusion of the test. The rate of deflection is shown plotted against time in Graph 11.

Neither the limiting deflection, 234mm (D), nor the limiting deflection rate, 10.4mm/min (dD/dt), for loadbearing capacity were exceeded during the course of the test.

6 Performance criteria

The standards[1,2] state the fire resistance of a loadbearing floor shall be expressed in terms of the elapsed time (in completed minutes) between the commencement of heating and the termination of heating, or until failure to meet the loadbearing capacity, integrity (sustained flaming, gap gauges and cotton pad) and insulation criteria occurs, whichever is the sooner.

Loadbearing capacity: Failure arises when the specimen is no longer able to support the test load. This is deemed to occur when both of the following are exceeded:

a) a limiting deflection $D = L^2/400d$

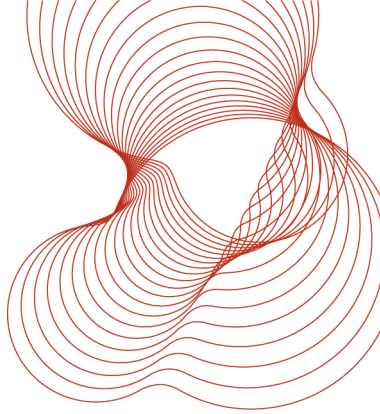
$D = (4270)^2/(400 \times 195) = 233.8\text{mm}$

b) a limiting rate of deflection $dD/dt = L^2/9000d$

$dD/dt = (4270)^2/(9000 \times 195) = 10.39\ \text{mm/min}$

where

L is the clear span of specimen (in mm);



d is the full depth of the structural section (in mm).

the rate of deflection limit shall not apply before a deflection of L/30 (142mm) is exceeded.

Integrity : Failure is deemed to occur when:

a) ignition of a cotton test pad applied to the specimen occurs;

b) a 6mm-diameter gap gauge can penetrate through a gap into the furnace and be moved in the gap for a distance of at least 150mm;

c) a 25mm-diameter gap gauge can penetrate through a gap into the furnace;

d) sustained flaming for not less than 10s on the unexposed face occurs;

e) loadbearing capacity failure occurs.

Insulation : Failure is deemed to occur when:

a) the mean unexposed face temperature increases by more than 140°C above its initial value;

b) the temperature recorded at any position on the unexposed face is in excess of 180°C above the initial mean unexposed face temperature;

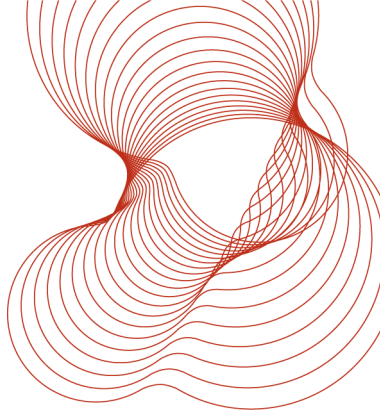
c) integrity failure occurs.

7 Conclusions

A floor comprising 195mm timber joists covered with a single layer of 22mm-thick chipboard with the exposed underside covered with a single layer of 15mm-thick Knauf standard wallboard and carrying Fifteen Halers H2 downlights; as described in this report, was submitted to a fire resistance test in accordance with EN 1365-2:2000(1), for a duration of 31 minutes whilst supporting an imposed load of 1.5kN/m^2.

The floor achieved the following fire resistance:

Loadbearing capacity:		31min*
Integrity:	Sustained flaming :	29min
	Gap gauge :	31min*
	Cotton Pad :	29min
Insulation:		29min



* No failure, the test having been discontinued at the request of the sponsor.

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 -1:1999[(2)], and where appropriate EN 1363 -2:2000[(1)]. 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.

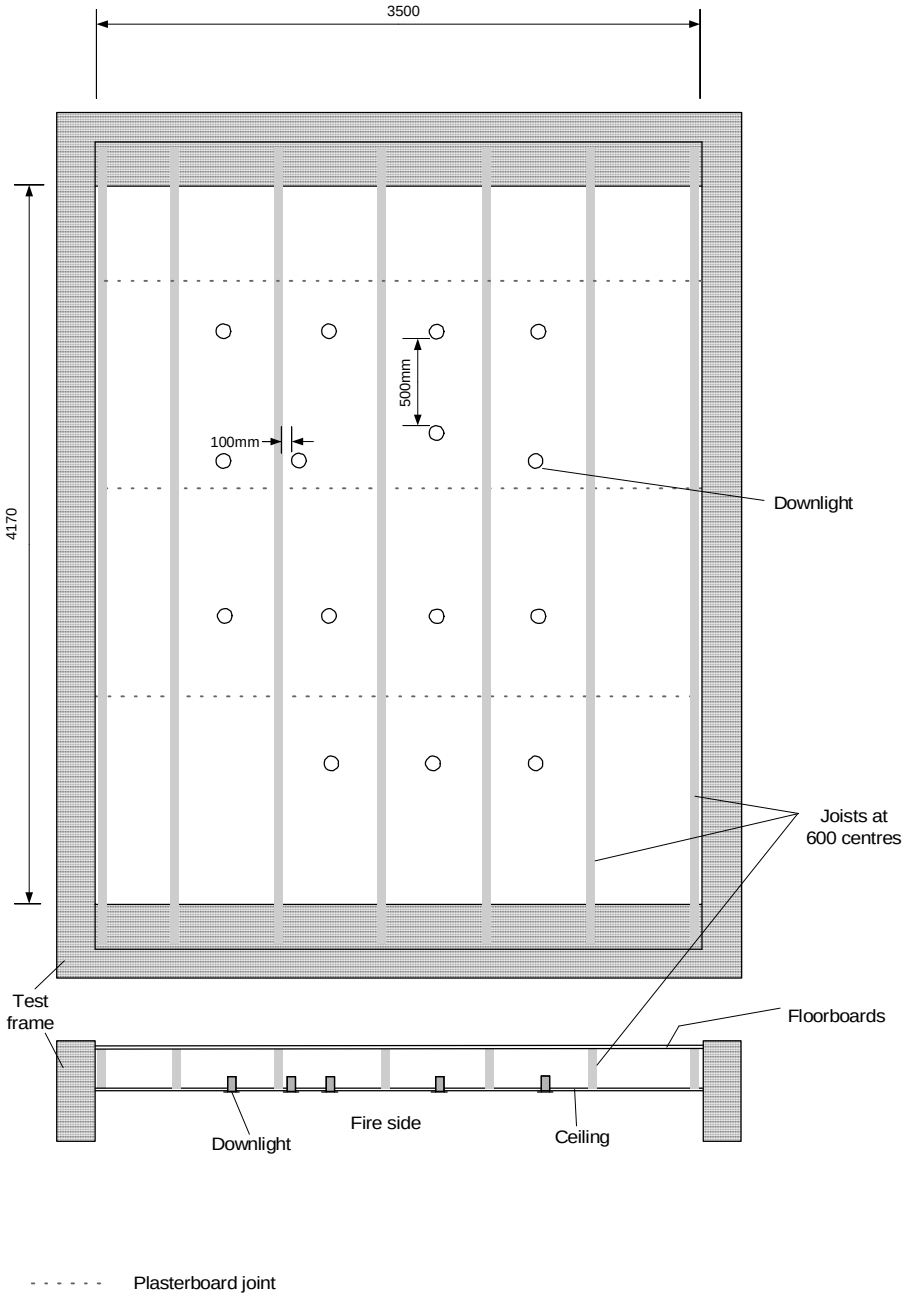
The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over 5 years old should be considered by the user. The laboratory that 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.

8 References

1 Fire resistance tests for loadbearing elements. Part 2. Floors and roofs. BS EN 1365-2:2000. British Standards Institution, London, 2000.

2 Fire resistance tests. Part 1. General requirements. BS EN 1363-1:1999. British Standards Institution, London, 1999.

9 Figures



Not to scale

Figure 1 Schematic showing the arrangement of joists and downlights when viewed from above.

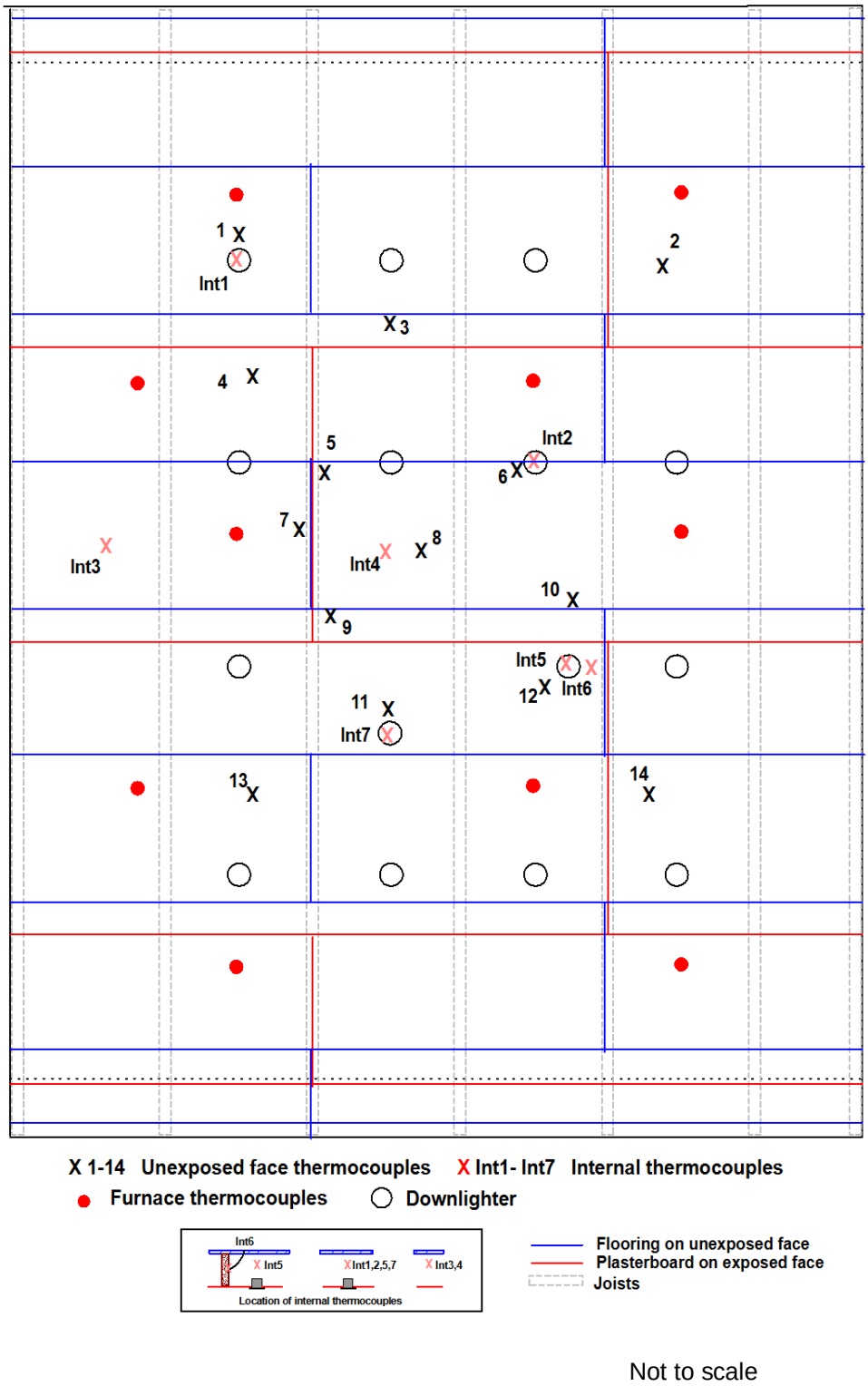


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Figure 2 Schematic showing arrangement of specimen and thermocouples.

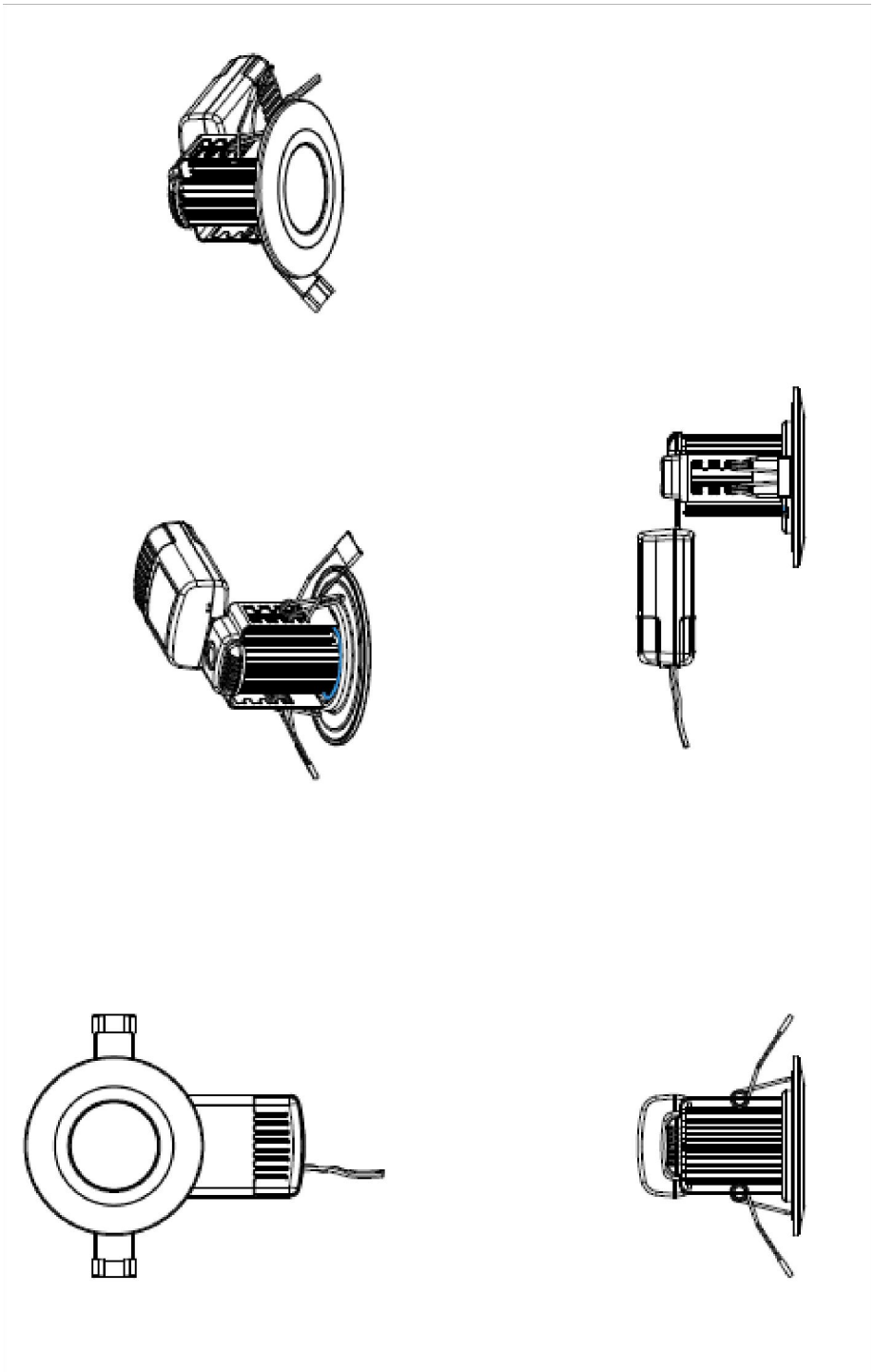

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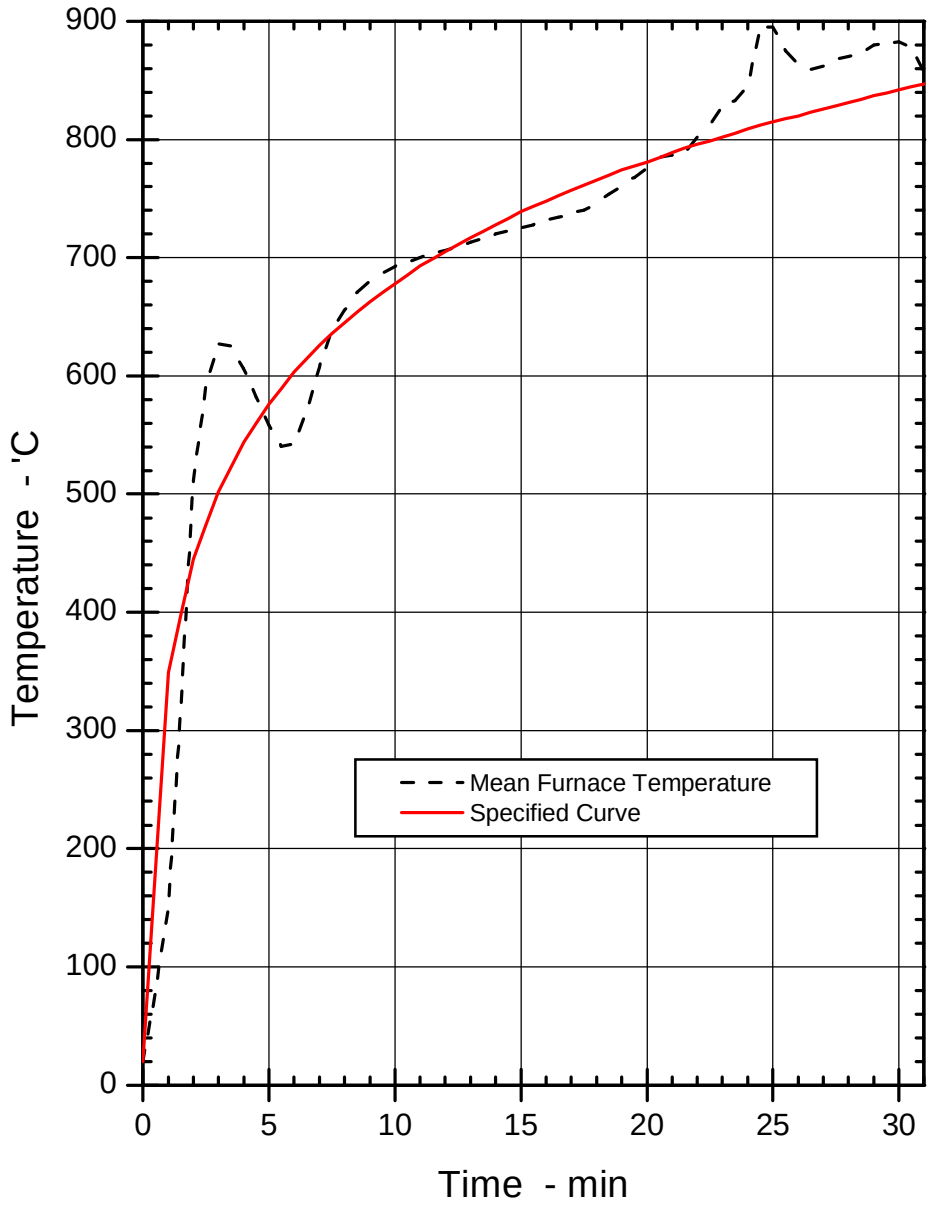
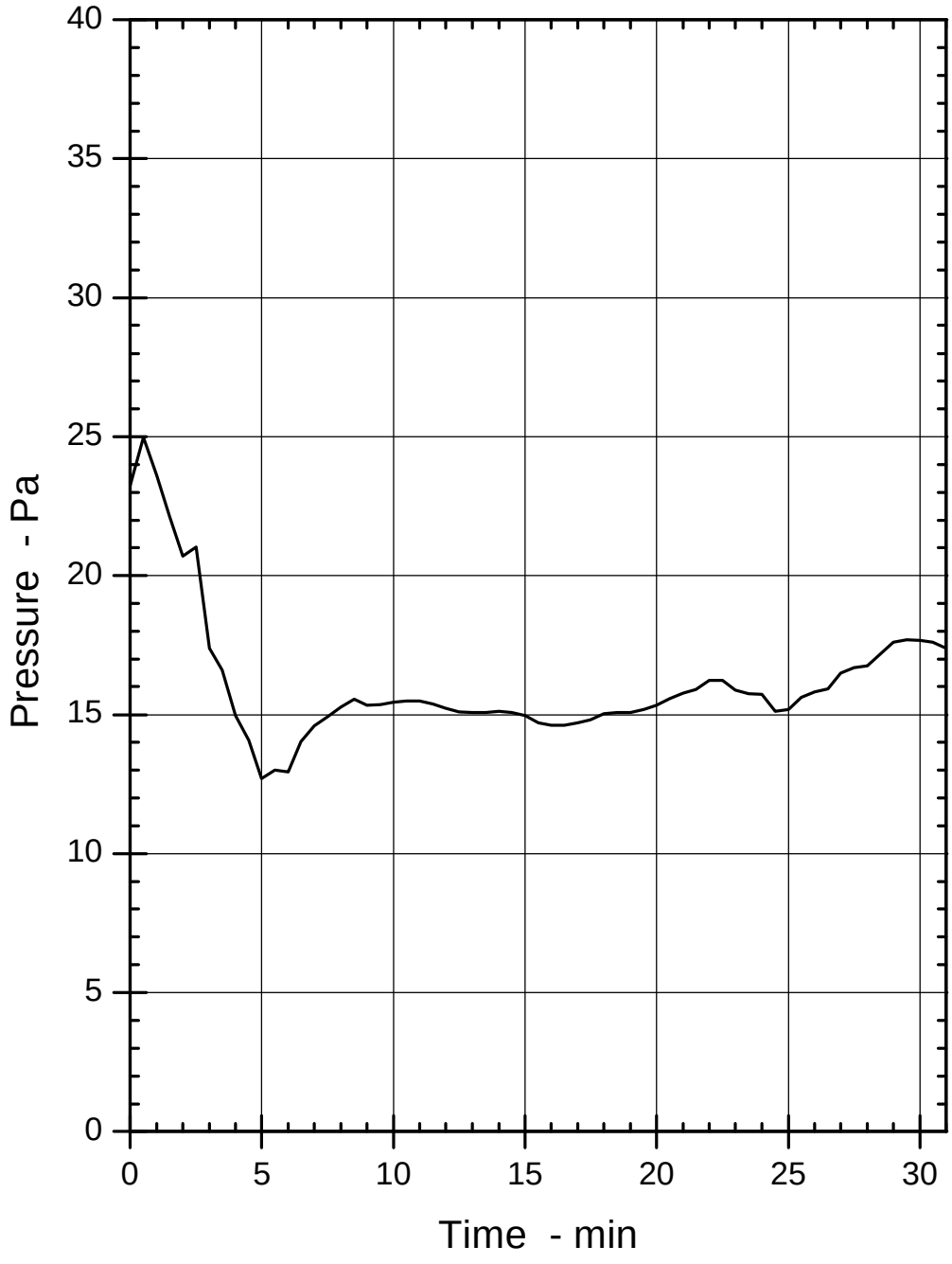
Figure 3 Halers H2 downlighter.

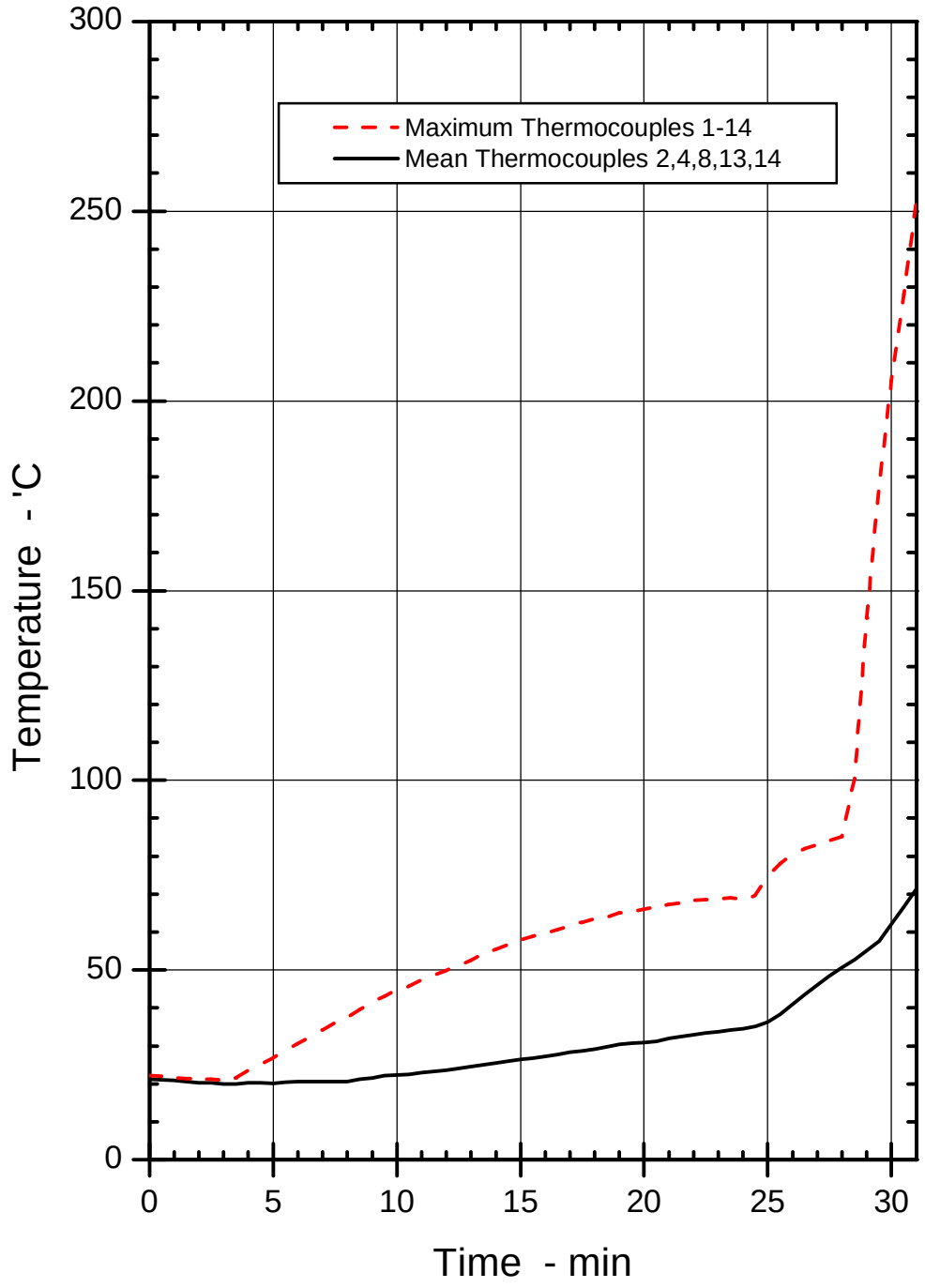
10 Graphs



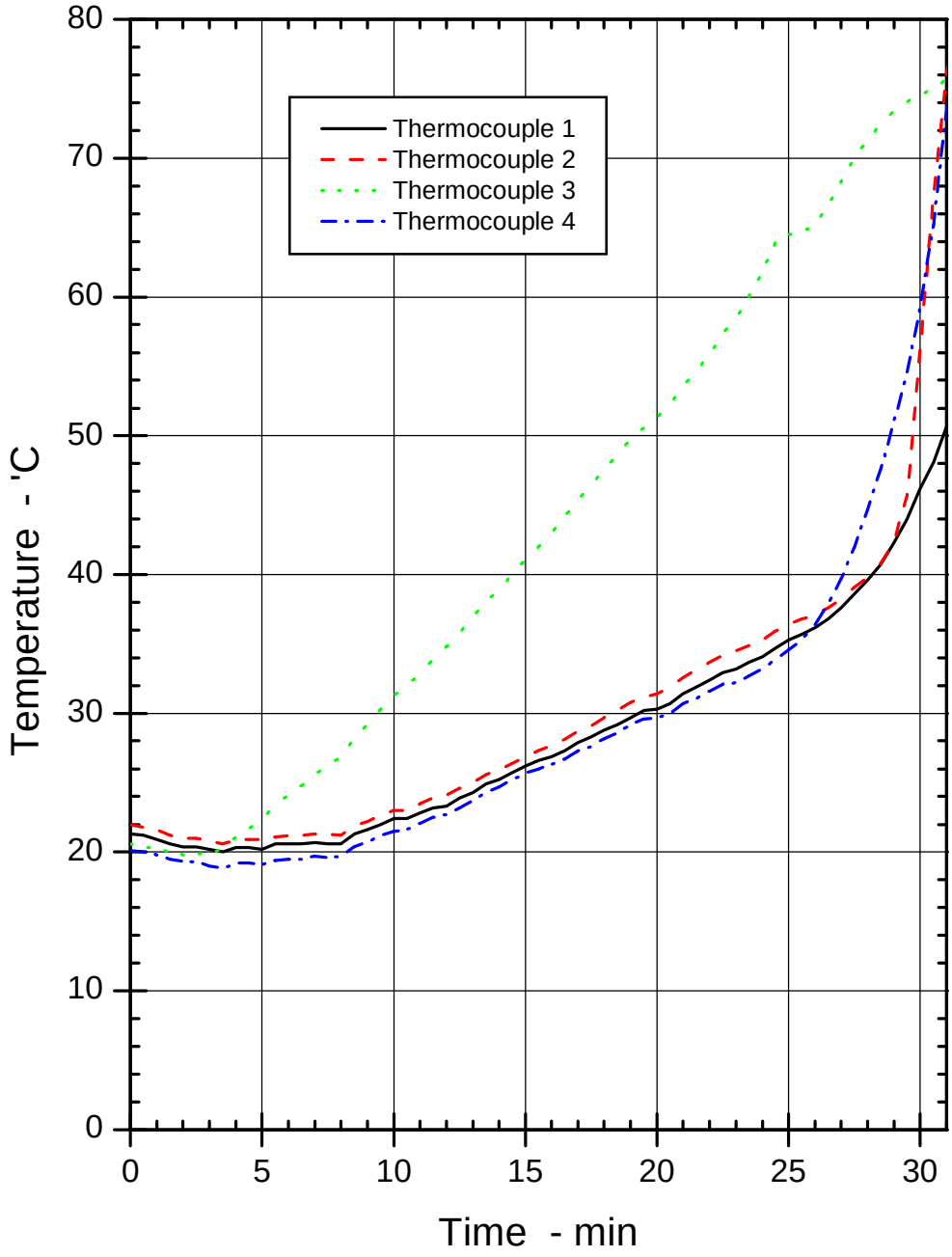
Graph 1 Furnace temperature.



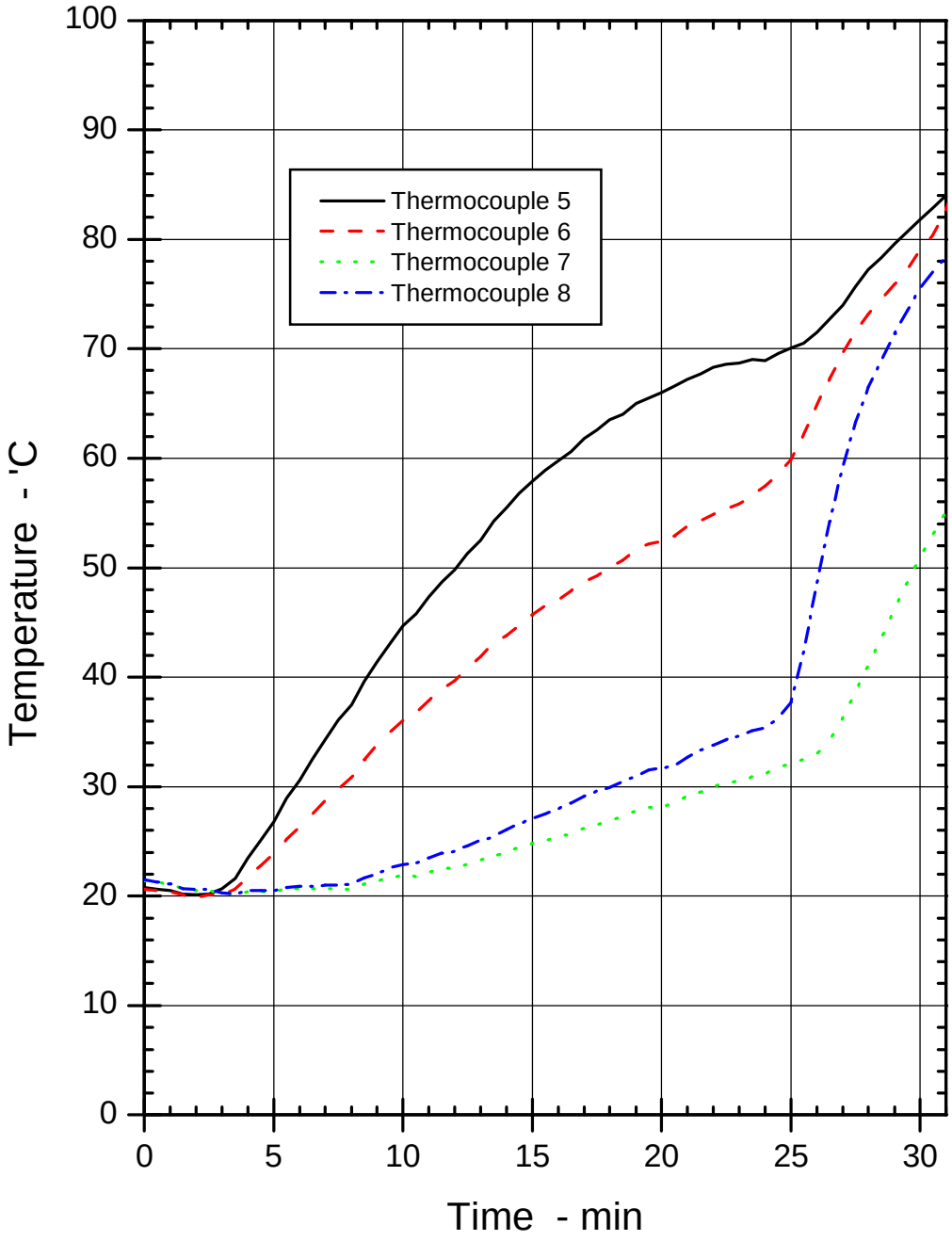
Graph 2 Furnace pressure.



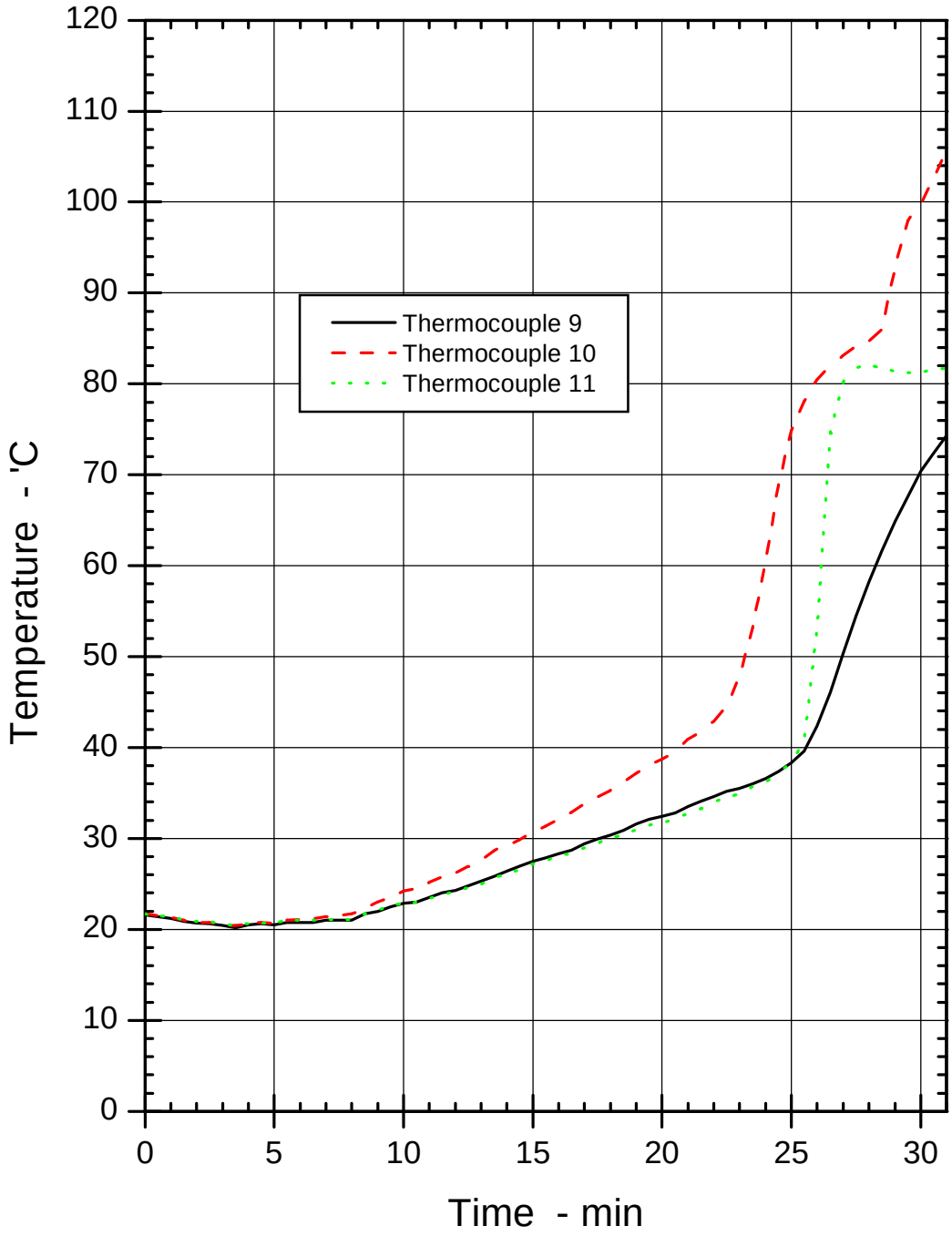
Graph 3 Mean and maximum temperature recorded on unexposed face of floor.



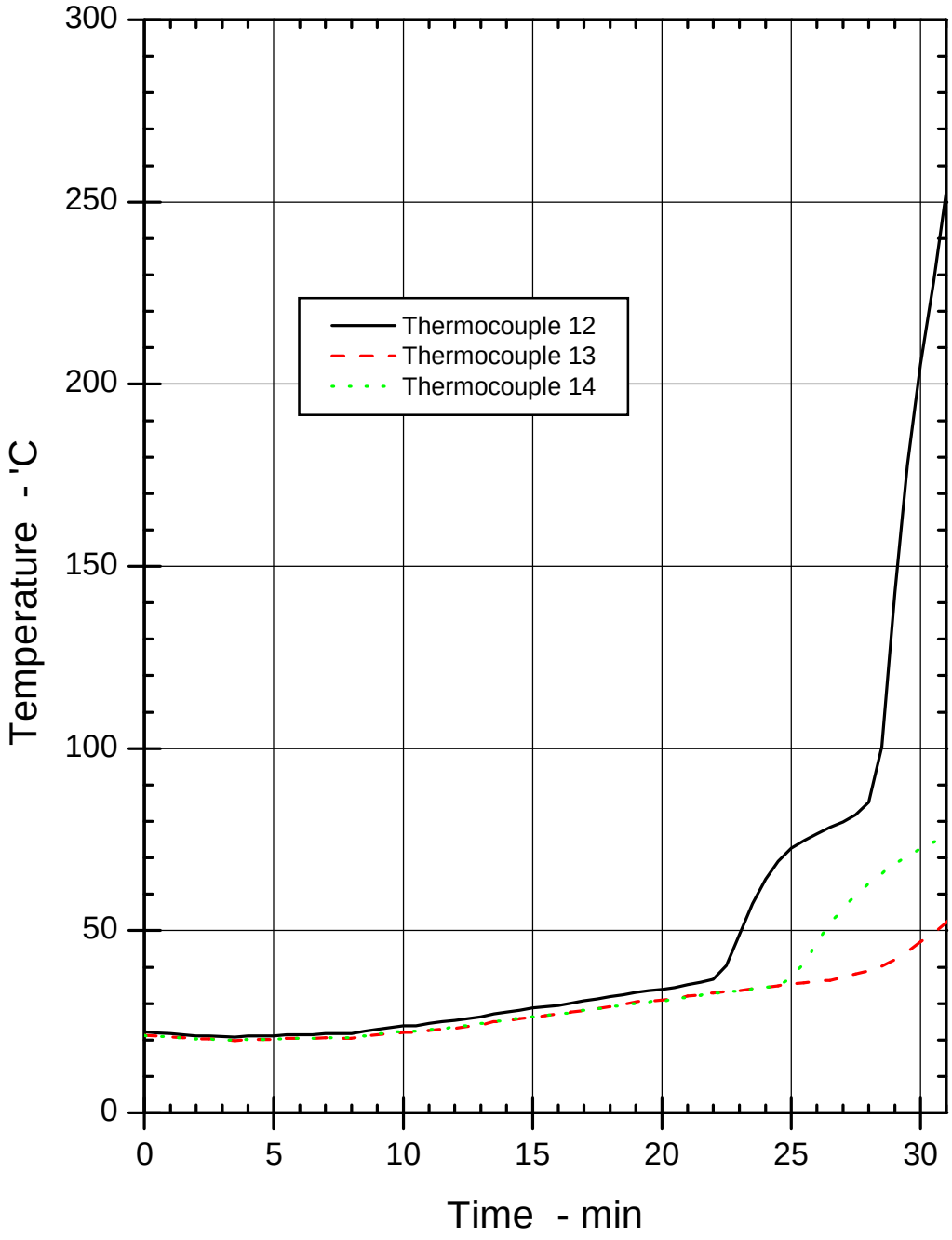
Graph 4 Temperature recorded by thermocouples 1 to 4 on unexposed face of floor.



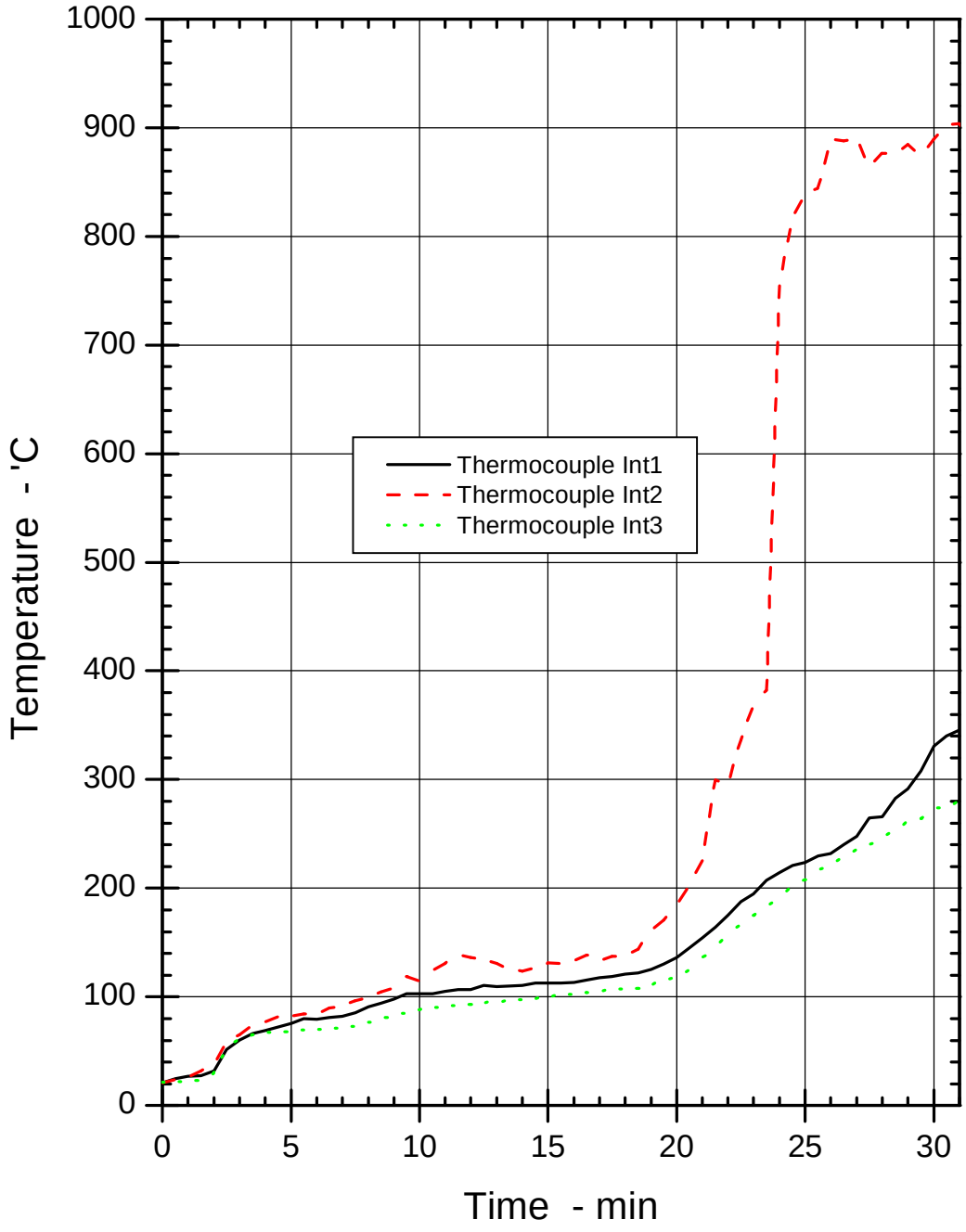
Graph 5 Temperature recorded by thermocouples 5 to 8 on unexposed face of floor.



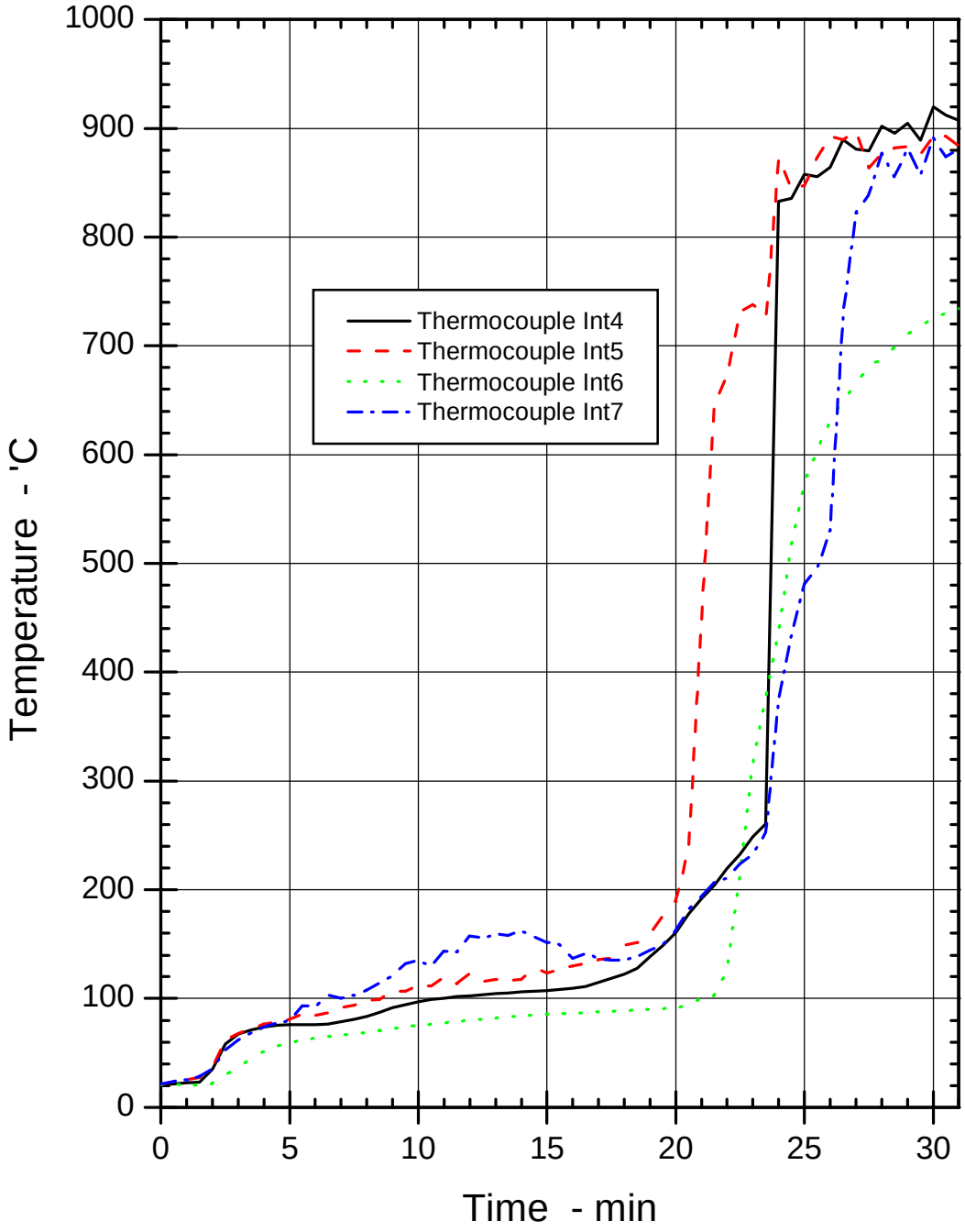
Graph 6 Temperature recorded by thermocouples 9 to 11 on unexposed face of floor.



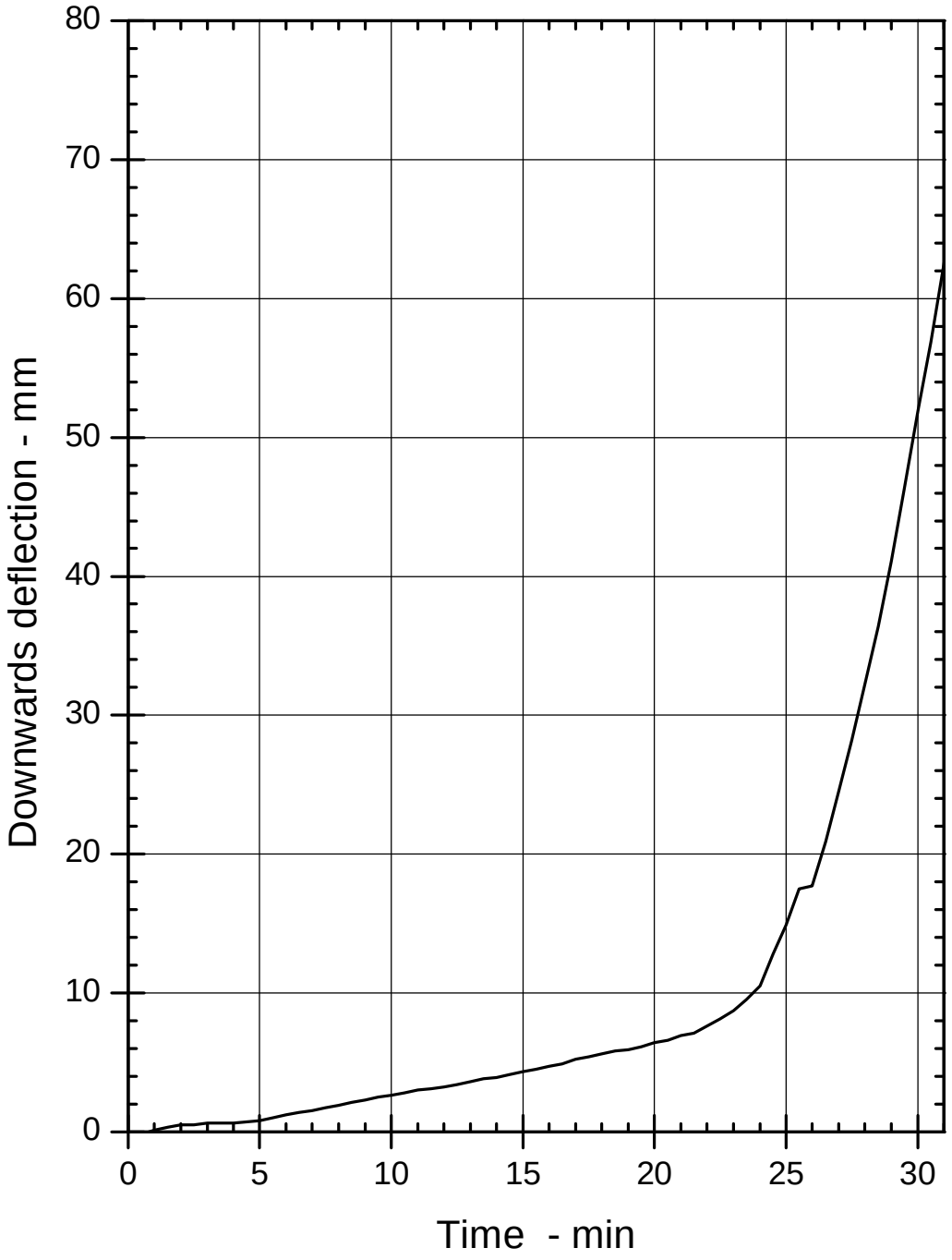
Graph 7 Temperature recorded by thermocouples 12 to 14 on unexposed face of floor.



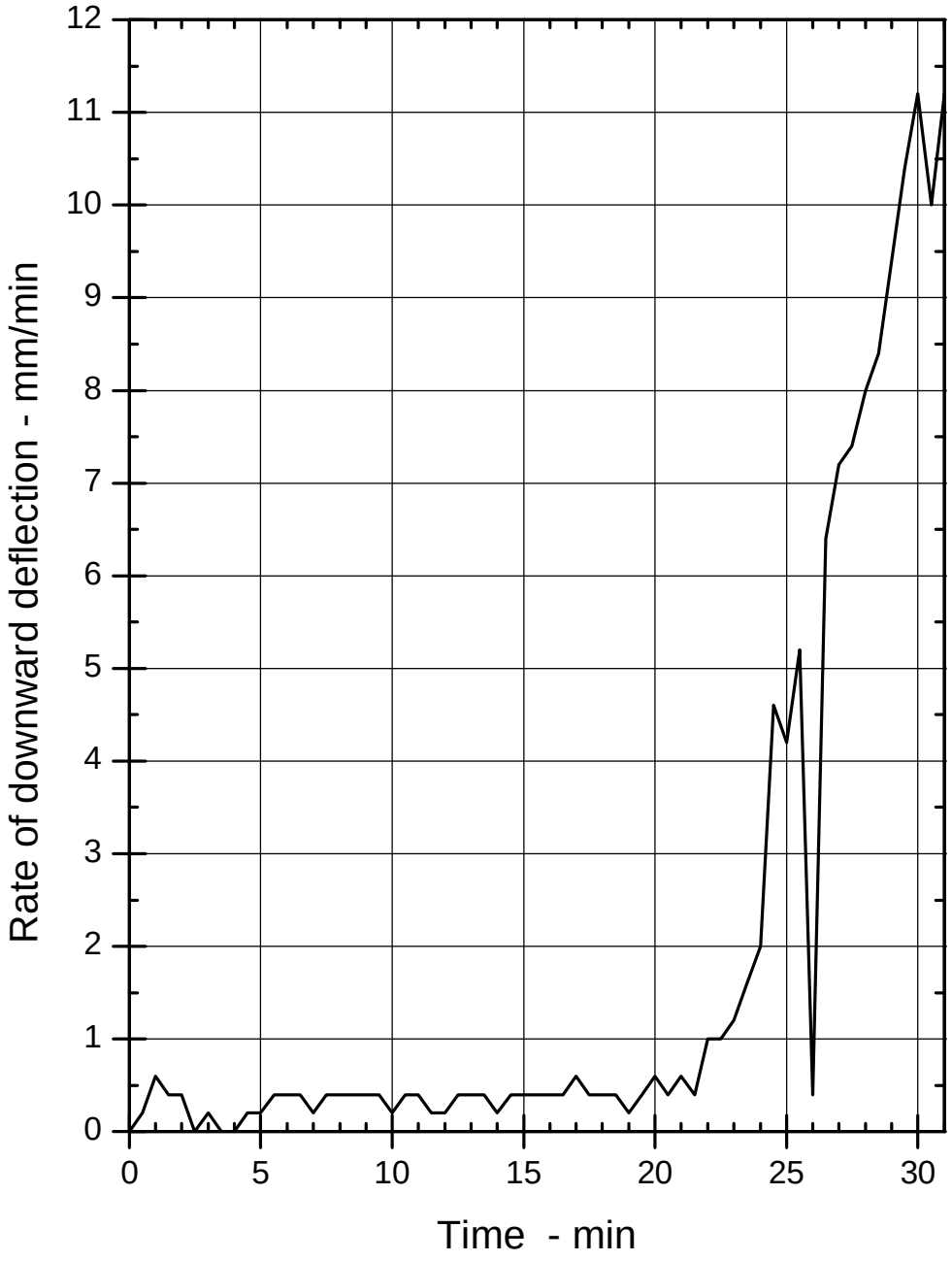
Graph 8 Temperature recorded by thermocouple Int1 to Int3 in cavity of floor assembly.



Graph 9 Temperature recorded by thermocouple Int4 to Int7 in cavity of floor assembly.



Graph 10 Downwards deflection recorded at centre of floor.



Graph 11 Rate of downwards deflection recorded at centre of floor.

11 Photographs

Plate 1 Test construction being lifted onto furnace before test, showing holes drilled in ceiling prior to installation of downlights.

Plate 2 Exposed face of test construction before test showing downlights installed.

Plate 3 Halers H2 downlight as used in test construction.

Plate 4 Unexposed face of test construction before test.

Plate 5 Unexposed face of test construction after approx. 22 minutes from start of test.

Plate 6 Unexposed face of test construction after approx. 26 minutes from start of test.

Plate 7 Unexposed face of test construction after approx. 30 min from start of test.

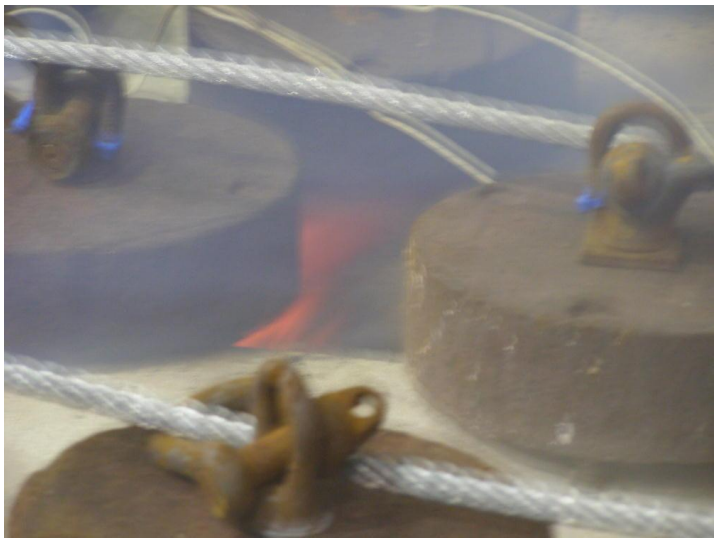


Plate 8 Unexposed face of test construction after approx. 30 min showing flaming in vicinity of thermocouple 12.

Appendix

Loading details

Total imposed load required : 1.5kN/m^2

Area of floor to be loaded : 4.27m x 3.50m = 14.95m^2

Therefore applied load required = 14.95m^2 x 1.5kN/m^2

= 22.425kN

= 2286kg

The cast-iron weights were laid on the floor uniformly in a 9 (across the length) x 11 (across the width) grid with one 23.2kg (weight plus threaded rod holding device) weight on each of the 99 grid locations giving a total actual weight of 2297kg. Therefore the actual load applied exceeded the load required by 0.5%.

==========REPORT ENDS==========