

FIRE TYPE TEST REPORT

FR12837-001

FIRE RESISTANCE TEST OF A LOADBEARING STEEL JOIST FLOOR AND 36 MM METRA PANEL CEILING CONSTRUCTION IN ACCORDANCE WITH AS 1530.4:2014

CLIENT
Metra Panel Systems Limited
15 Tregowerth Lane
Huntly
New Zealand

All tests and procedures reported herein, unless indicated, have been performed in accordance with the laboratory's scope of accreditation

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TEST SUMMARY

Objective

To determine the fire resistance of a loadbearing floor/ceiling system when tested in accordance with AS 1530.4:2014 *"Methods for fire tests on building materials, components and structures, Part 4: Fire–resistance test of elements of construction.*

Test Sponsor

Metra Panel Systems Limited
15 Tregowerth Lane
Huntly
New Zealand

Description of Test Specimen

The test specimen consisted of a loadbearing floor/ceiling system nominally 3,000 mm wide and with a 4,000 mm span. The floor/ceiling system was constructed with 190 mm x 45 mm x 1.5 mm thick steel joists. The underside of the joists was lined with a single layer of 36 mm thick Metra Panel panels. The top of the joists was lined with 20 mm thick Strandboard flooring sheets.

Date of Test

4 August 2020

Test Results

The test results in accordance with AS 1530.4:2014, "Methods for fire tests on building materials, components and structures – Part 4: Fire – resistance test of elements of construction are as follows:

Structural Adequacy	61 minutes	No failure
Integrity	61 minutes	No failure
Insulation	61 minutes	No failure
Resistance to Incipient Spread of Fire	54 minutes	

The tested specimen is deemed to have achieved an FRL of 60/60/60.

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The test standard requires the following statements to be included:

"The results of these fire tests may be used to directly assess fire hazard, but it should be recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions."

"This report details methods of construction, the test conditions and results obtained when the specific element of construction described herein was tested following the procedure outlined in this standard. Any significant variations 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."

LIMITATIONS

The results reported here relate only to the item/s tested.

TERMS AND CONDITIONS

This report is issued in accordance with the Terms and Conditions as detailed and agreed in the BRANZ Services Agreement for this work.

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1. TEST PROCEDURE

The test was conducted in accordance with AS 1530.4:2014 “Methods for fire tests on building materials, components and structures, Part 4 Fire-resistance tests of elements of construction, Section 4, for which the fire resistance of the specimen is the time, expressed in minutes, to failure under one or more of the following criteria:

1.1 Structural Adequacy Failure Criteria

Failure in relation to structural adequacy shall be deemed to have occurred when collapse occurs, or when the deflection exceeds $L^2/400d$ mm, or when the rate of deflection exceeds $L^2/9000d$ mm/minute after a deflection of L/30 is exceeded, where “L is the 4,000 mm clear span and “d is 190 mm the depth of the structural member.

For the test specimen the depth of the structural member was taken as the height of the joists. This gave a maximum allowable deflection of 210.5 mm and a maximum allowable rate of deflection of 9.4 mm per minute to be applicable after a deflection of 133 mm.

1.2 Integrity Failure Criteria

Failure shall be deemed to occur when;

a) when flames and/or hot gases cause flaming or glowing of the cotton fibre pad; or

b) a 6 mm gap gauge can be passed through an unobstructed gap in the specimen and project into the furnace and move a distance of 150 mm along the gap; or

c) a 25 mm gap gauge can be passed through an unobstructed gap in the specimen and project into the furnace; or

d) Sustained flaming on the surface of the unexposed face for 10 seconds or longer.

1.3 Insulation Failure Criteria

Failure in relation to insulation shall be deemed to have occurred if;

a) The average temperature on the unexposed face of the floor exceeds the initial temperature by 140 K: or

b) The maximum temperature at any point on the unexposed face of the floor exceeds the initial temperature by 180 K.

1.4 Incipient Fire Spread Criteria

Failure shall be deemed to have occurred when the maximum temperature at any point within the plenum of the ceiling/floor exceeds 250 C.

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2. DESCRIPTION OF TEST SPECIMEN

2.1 General

The test specimen consisted of a loadbearing floor/ceiling system nominally 3,000 mm wide and with a 4,000 mm span. The floor/ceiling system was constructed with 190 mm x 45 mm x 1.5 mm thick steel joists. The underside of the joists was lined with a single layer of 36 mm thick Metra Panel panels. The top of the joists was lined with 20 mm thick Strandboard flooring sheets.

All dimensions are nominal unless otherwise stated.

2.1.1 Conditioning

Framing of the floor/ceiling began on 29 July 2020 with the ceiling linings applied on 29 July 2020, the floor lining was applied on 30 July 2020. The floor/ceiling was left under ambient laboratory conditions throughout its construction until testing on 4 August 2020.

2.1.2 Specimen Selection

BRANZ assisted with the construction of the specimen, to the customers' specification, but was not involved in the selection of the joists, ceiling lining or floor lining.

2.2 Plans and Specification

Details of the construction of the various components are included in this report as Figure 1. Further details of the tested specimens are held on file by BRANZ.

Where discrepancies between the dimensions in the report text and those shown in the attached drawings exist, the text takes precedence.

2.3 Specimen Construction

2.3.1 Steel Joists

The floor was formed from eight 4,300 mm long, 190 mm x 45 mm x 1.5 mm thick G250 galvanised steel joists. The six intermediate joists were spaced at nominally 450 mm centres (one at nominally 220 mm). At each end, the joists were inserted into a 190 mm x 56 mm x 1.5 mm thick galvanised steel channel section. The joists were attached to foldable tabs on the end channel sections using 40 mm x 80 mm steel corner brackets with eight 16 mm long x 10-16 Tek screws, five screws from bracket to joist and three screws from bracket to end channel.

2.3.2 Ceiling Lining

The ceiling comprised a single layer of 36 mm thick Metra Panel panels. The panels were orientated in the direction of the joists and secured at 600 mm centres along the joists using 40 mm x 60 mm steel corner brackets with two 16 mm long x 10-16 Tek screws from bracket to joist and two 25 mm long x 8g chipboard screws from bracket to panel. A longitudinal panel joint was included which was positioned mid-way between two of the intermediate joists. On the cavity side of the joint, two 2,100 mm long x 300 mm wide x 36 mm thick Metra Panel 'splice plates' were glued and fixed across the joint.

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A thin bead of H.B. Fuller Sturdi Bond heavy duty adhesive was applied between the panels and the 'splice plates'. The 'splice plates' were then mechanically fixed using 65 mm long x 8g screws. The screws were spaced at nominally 200 mm centres at four positions nominally 25 mm from the edges of the 'splice plate' and 25 mm from both sides of the panel joint. A thin bead of Hilti Firestop Acrylic sealant was applied into gaps between the butt joint between the 'splice plates'.

On the exposed face of the ceiling, the panel joint was taped with 48 mm wide Adfors Fiba Tape® Classic and stopped with GIB® Plus 4® jointing compound.

The measured properties of the 36 mm thick Metra Panel panels were as follows:

Measured thickness	35.4 mm
Measure weight per unit area	24.13 kg/m^2
Measured density	681.8 kg/m^3
Measured moisture content by weight	8.83 %

2.3.3 Floor Lining

The flooring comprised a single layer of 20 mm thick Laminex tongue and groove Strandboard flooring sheets. The three 1,200 mm wide and one 700 mm wide sheets were orientated to be perpendicular to the joists and secured along the joists and end channels with 40 mm long x 10-16 metal screws. The screws were spaced at nominally 150 mm centres on the edge joists and end channels and nominally 250 mm centres on the intermediate joists. A thin bead of H.B. Fuller Strudi Bond heavy duty adhesive was applied into the tongue and groove as the floor was assembled.

The measured properties of the 20 mm thick strandboard were as follows:

Measured thickness	20.3 mm
Measure weight per unit area	14.21 kg/m^2
Measured density	699.9 kg/m^3
Measured moisture content by weight	10.97 %

2.3.4 Installation of the Floor/Ceiling

The 4,300 mm long floor/ceiling assembly was placed above a concrete lined test frame with a clear opening of 4,000 mm x 3,020 mm. The 150 mm long bearing surfaces at each end of the assembly were placed above a layer of Superwool insulation. A layer of Superwool insulation was inserted between the edges of the assembly and the test frame. The ceiling was fixed to the concrete lined test frame at ¼, ½ and ¾ width with 100 mm long masonry screws at both ends.

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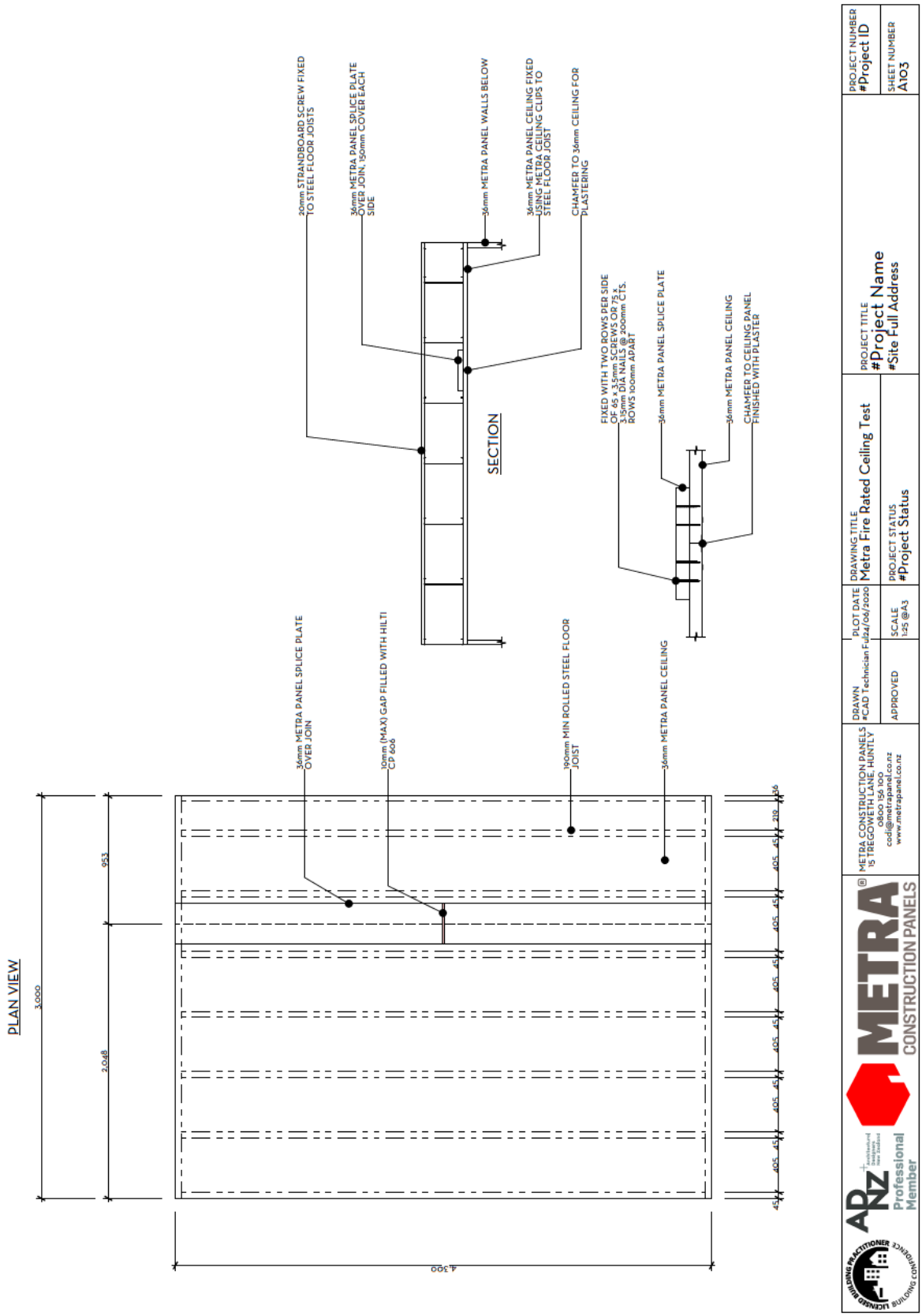
Figure 1: Client Supplied Plan and Section View of the Floor/Ceiling Assembly



3. TEST CONDITIONS AND RESULTS

3.1 General

The specimen was tested on 4 August 2020, at the BRANZ laboratories at Judgeford, New Zealand in the presence of the client.

The ambient temperature at the beginning of the test was 12°C.

The frame containing the test specimen was placed on top of the horizontal furnace, and the temperature and pressure conditions were controlled as specified in AS 1530.4:2014.

The test was terminated after the specimen had been exposed to the standard fire resistance conditions for 63 minutes.

3.2 Furnace Conditions

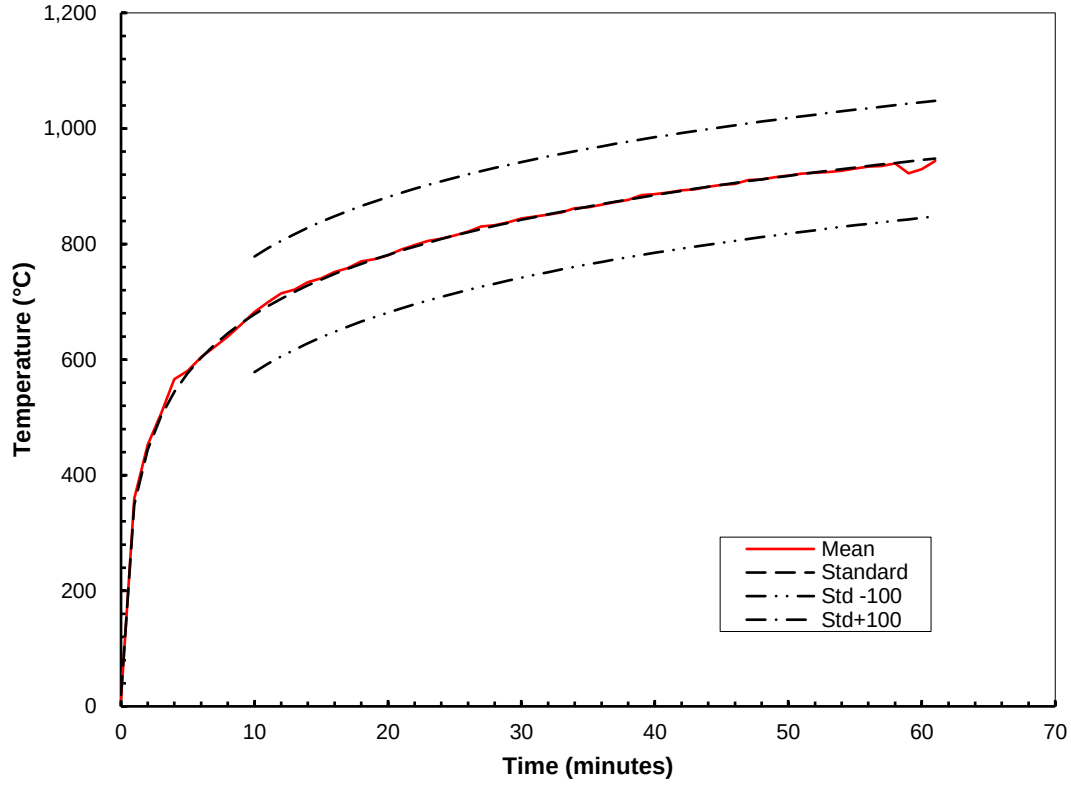
3.2.1 Furnace Temperature Measurement

Temperature measurement within the furnace was made using twelve mineral insulated metal sheathed (MIMS) chromel-alumel thermocouples uniformly distributed in a horizontal plane approximately 100 mm from the exposed face of the specimen.

The furnace thermocouples were connected to a computer controlled data logging system which recorded the temperatures at 15 second intervals.

Figure 2 shows the mean furnace temperature curve and the permitted upper and lower limits in accordance with AS 1530.4:2014.

Figure 2: Furnace Temperature



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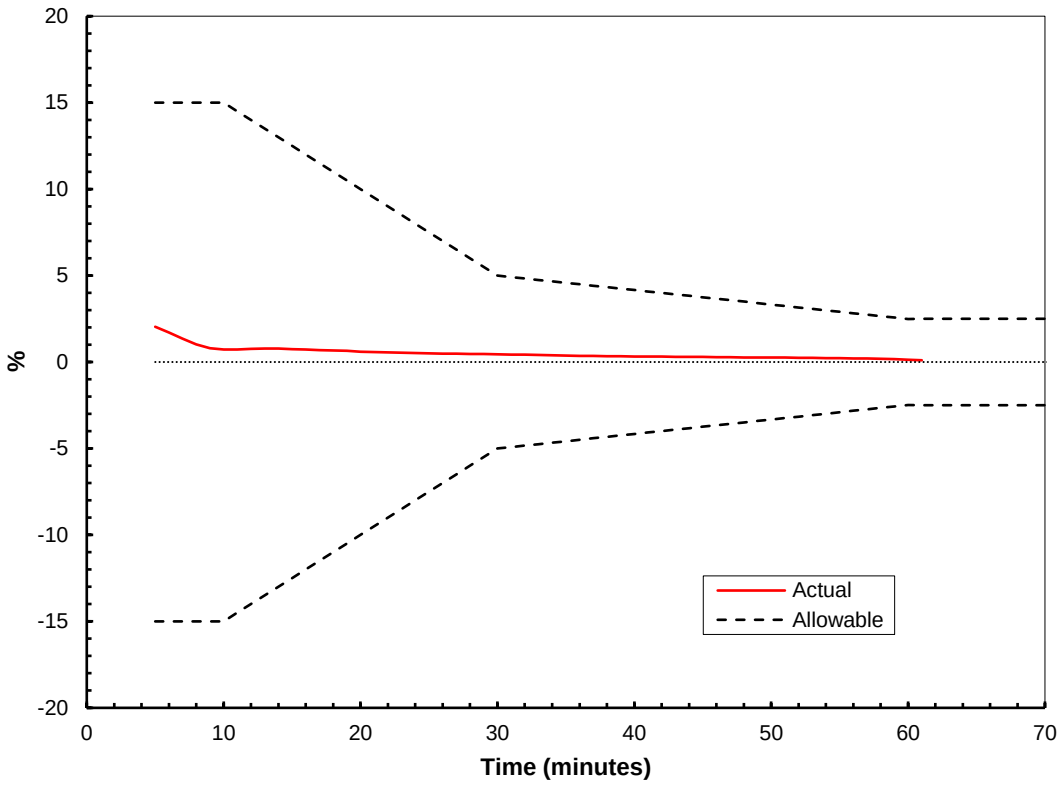
3.2.2 Furnace Control

The percentage deviation of the area of the furnace mean temperature from the standard time temperature curve is shown in Figure 3. In summary the furnace conditions complied with the test standard.

Figure 3: Percentage Deviation of the Furnace Drive



3.2.3 Pressure Measurements

The differential pressure of the furnace above the laboratory atmosphere was controlled to be 20 Pa at 100 mm below the ceiling which corresponds to 18 Pa at the pressure probe in the furnace. The differential pressure was monitored using a micromanometer connected to a computer controlled data logging system which recorded the pressure at 15 second intervals.

The furnace pressure was monitored and controlled during the test so that by 5 minutes after the commencement of the test the furnace pressure was ± 5 Pa of the target pressure at the pressure sensor and after 10 minutes the pressure was within ± 3 Pa of the target pressure. The pressure sensor was located 100 mm below the underside of the ceiling. Figure 4 shows the furnace pressure variation with time.

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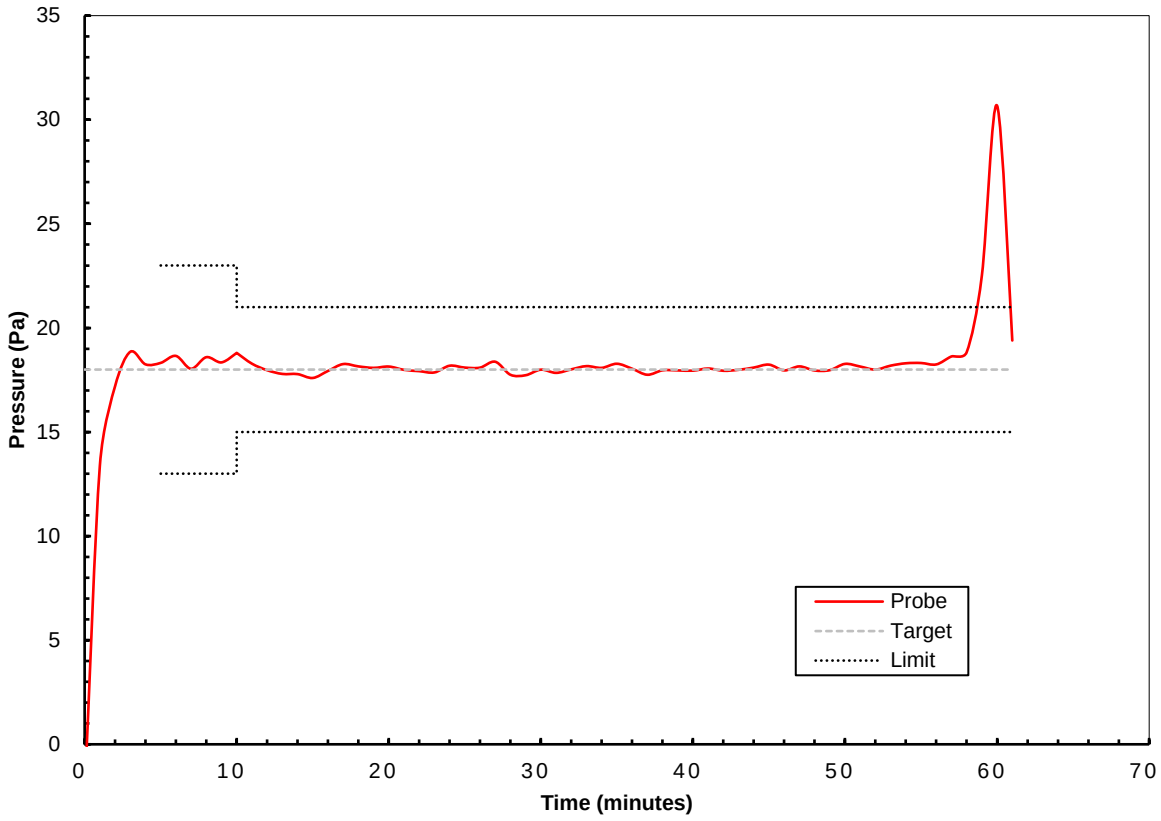
Figure 4: Furnace Pressure



The furnace pressure met the requirements of the standard for the majority of the test except for one brief period where the recorded furnace pressure exceeded the upper limits. It is considered the pressure variation outside the standard would not have influenced the tested results.

3.3 Specimen Temperature Measurement

The temperature on the unexposed face of the test specimen was measured using chromel-alumel thermocouples mounted on copper discs and covered with insulating pads, in accordance with clause 2.2.3 of the test standard. The thermocouples were placed on the floor as shown in Figure 5.

The Incipient Spread of Fire temperatures were measured using chromel-alumel thermocouples mounted on copper discs and covered with insulating pads, in accordance with clause 2.2.3 of the test standard. The thermocouples were placed on the upper face of the ceiling within the plenum as shown in Figure 5.

Additional thermocouples were included on the test specimen for information purposes.

All the thermocouples described above were connected to a computer controlled data logging system which recorded the temperatures at 15 second intervals.

A roving thermocouple was available for measuring temperatures elsewhere on the specimen.

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3.4 Loading

At the request of the client a uniformly distributed load of 3.0 kPa was placed on the specimen. The load was applied using 20 drums partially filled with water and approximately uniformly distributed over the top of the specimen. Each drum had three swivel feet, each with a contact surface consisting of a 100 mm x 100 mm square of particleboard. The load was applied to the specimen at least 30 minutes before the commencement of the test.

3.5 Deflection Measurements

The deflection on the unexposed face of the floor at the positions shown in Figure 5 were measured using linear variable differential transducers (LVDT's) connected to a computer controlled data acquisition system which recorded the deflections at 15 second intervals.

3.6 Structural Adequacy

The maximum measured deflection of the floor was 52 mm downwards towards the furnace at 61 minutes into the test. This deflection was measured at Deflection Point B which was located at mid-span and mid-width of the floor. The floor did not deflect past the maximum allowable deflection limit of 210.5 mm for the duration of the test. Figure 8 shows the deflections over the duration of the test. The negative numbers indicate that the specimen was deflecting downwards towards the furnace.

The measured rate of deflection exceeded the 9.4 mm/min failure criteria after 59 minutes at deflection points A and B but as this occurred before the 133 mm deflection limit this did not constitute a failure. The maximum measured rate of deflection was 23.5 mm/min and occurred at 61 minutes at Deflection Point B. Figure 9 shows the rate of deflection over the duration of the test.

3.7 Integrity

The floor/ceiling did not fail the integrity criteria of the test for the 61 minute test duration.

3.8 Insulation

The average temperature measured on the unexposed face of the floor did not exceed the 140 K average temperature rise criteria for the 61 minute duration of the test. The highest average temperature rise was 21 K at 61 minutes.

The temperature measured on the unexposed face of the floor did not exceed the 180 K maximum criteria for the duration of the test. The maximum temperature on the unexposed face was 25.7 K at 61 minutes. Graphs of the mean and maximum temperature rise of the floor are shown in Figure 6 and Figure 7.

3.9 Incipient Spread of Fire

The maximum temperature measured within the plenum between the ceiling and floor exceeded 250 °C after a test duration of 54 minutes. A graph of the maximum temperature recorded within the plenum of the ceiling and floor is shown in Figure 10.

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Figure 5: Thermocouple Locations and Deflection Points

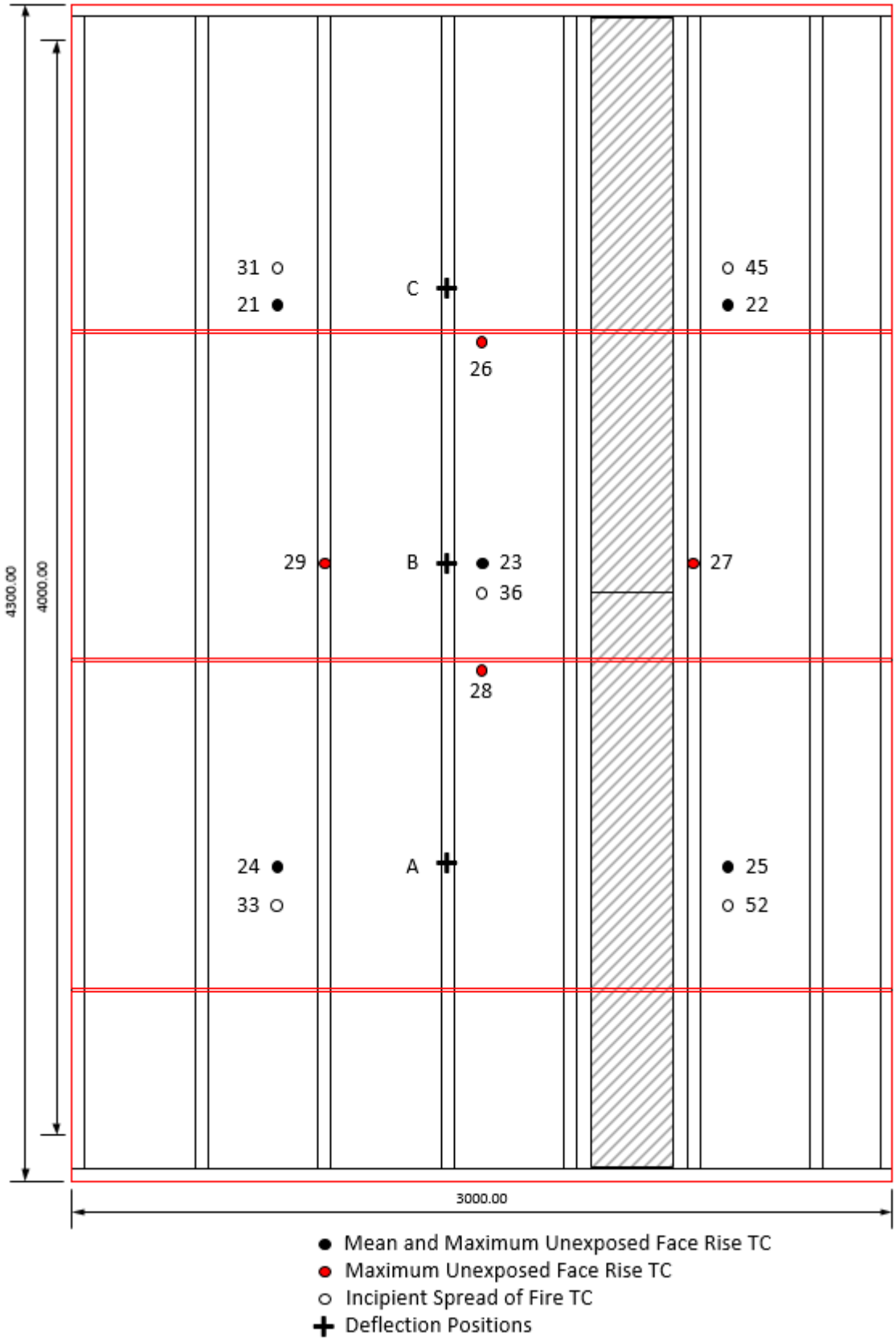

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Figure 6: Unexposed Average and Maximum Temperature Rise

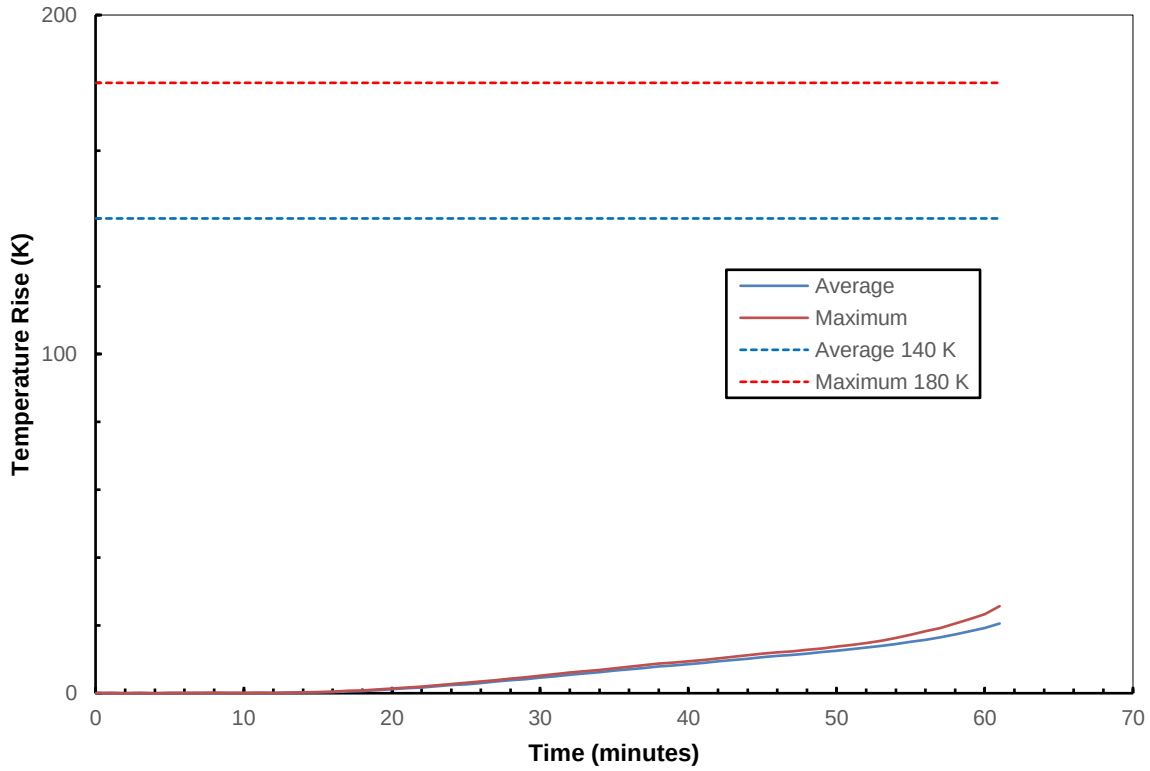

Figure 7: Unexposed Additional Maximum Temperature Rise

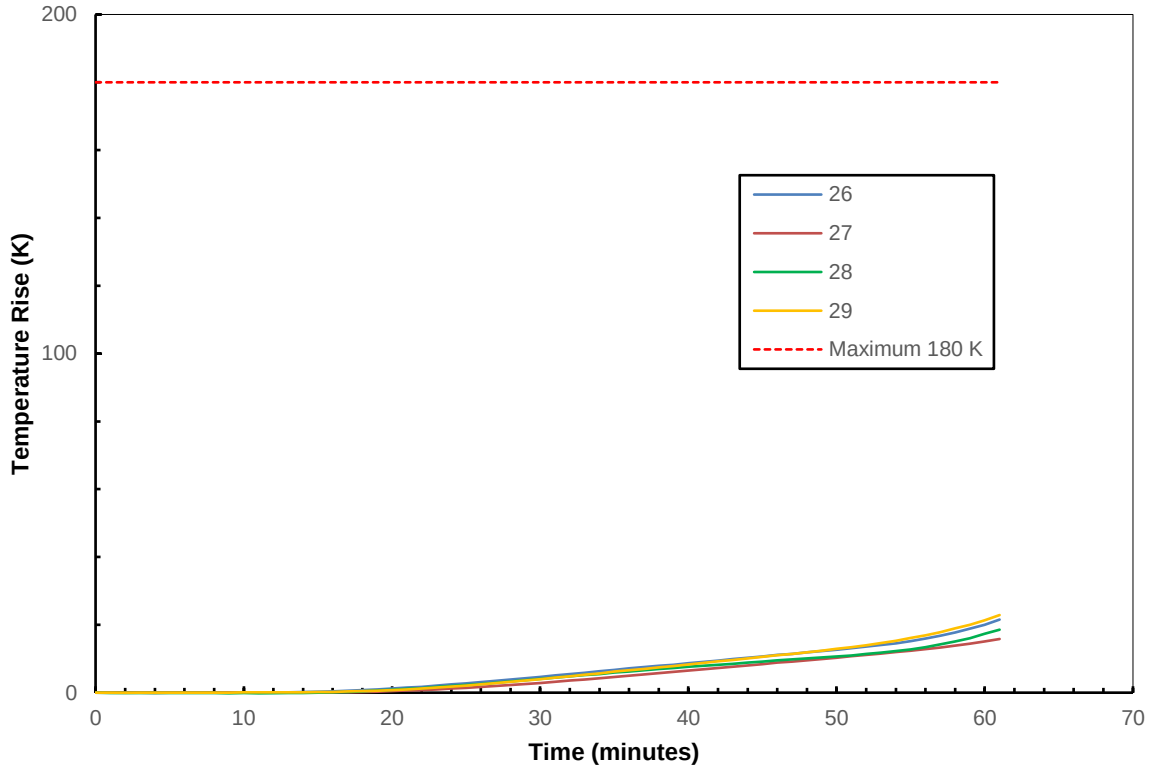

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Figure 8: Deflection of the Floor

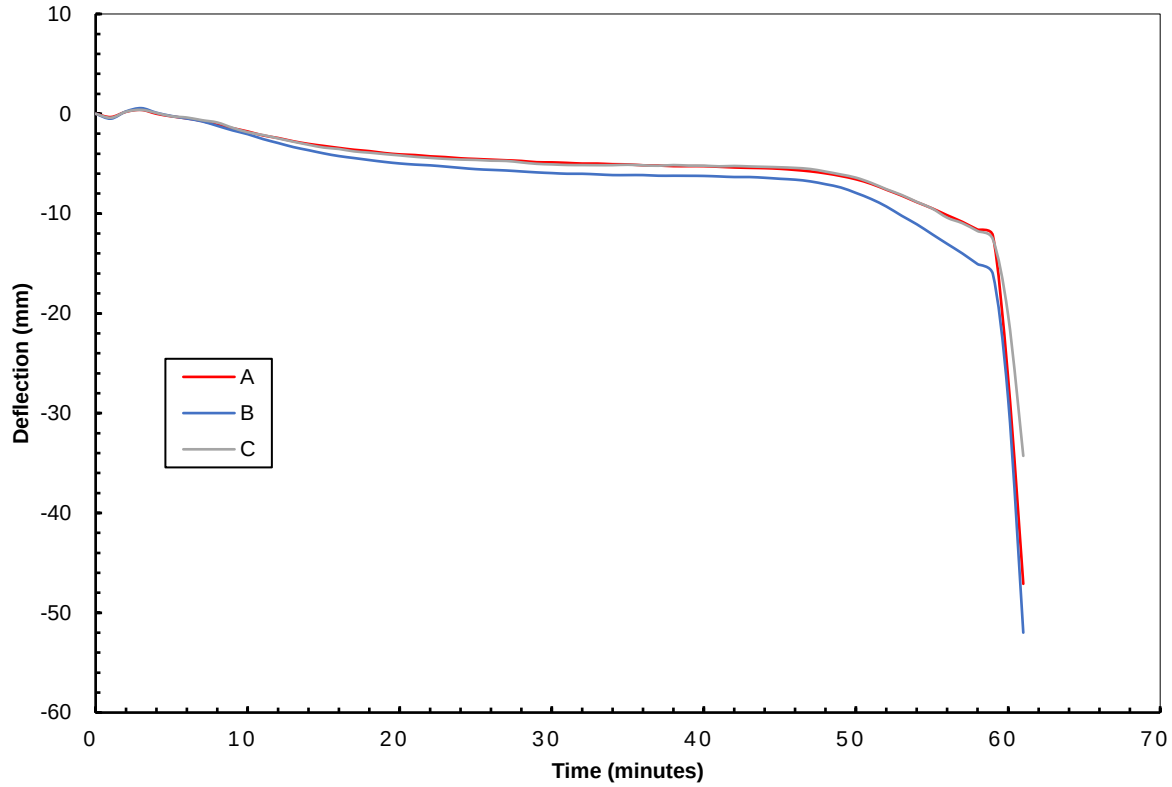

Figure 9: Rate of Deflection of the Floor

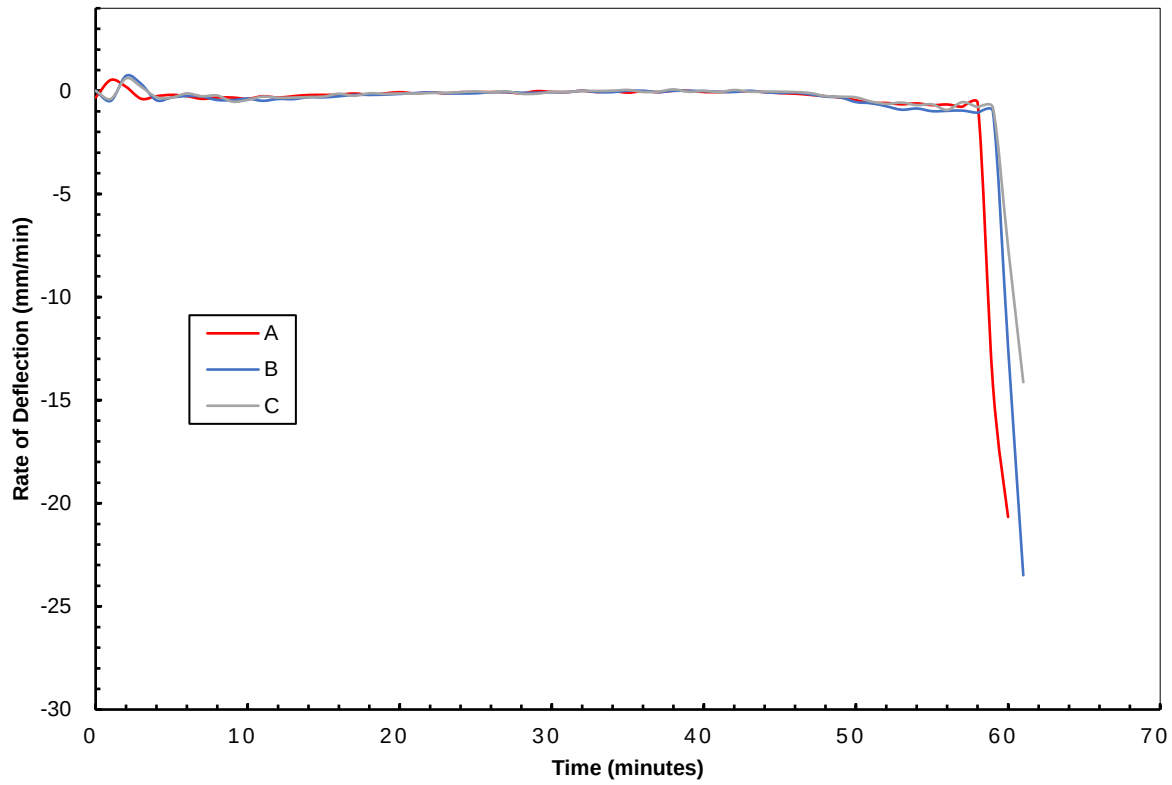

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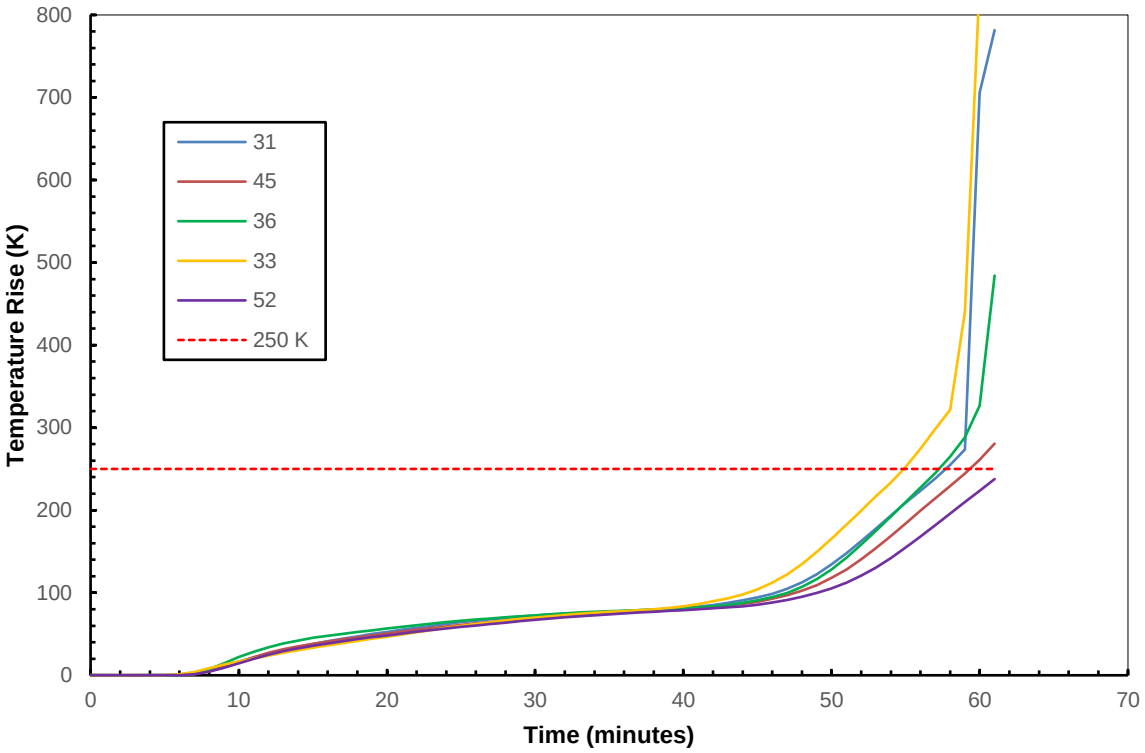
Figure 10: Incipient Fire Spread Maximum Temperature Rise



3.10 Test Observations

Observations related to the performance of the specimen were at the times stated in minutes and seconds are shown in Table 1.

U = Observations from the unexposed face.
E = Observations from the exposed face.

Table 1: Test Observations

Time (Min:Sec)	Test Face	Observations
00:00	-	The test commences.
05:00	U	Smoke issue commences from around the perimeter of the specimen.
12:00	E	Large volume of flaming within the furnace chamber.
20:00	E	The panel joint gap is beginning to increase in size, approximately 5 mm.
30:00	-	The specimen continues to maintain Structural Adequacy and Integrity.
32:00	E	The panel joint gap is continuing to increase in size, approximately 10 mm.
50:00	E	The volume of flaming within the furnace chamber is increasing.
55:00	U	The vertical deflection of the specimen is clearly visible.
59:00	E	The ceiling lining is detaching.
60:00	-	The specimen continues to maintain Structural Adequacy and Integrity.
61:15	-	Test is discontinued.

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4. SUMMARY

The test results in accordance with AS 1530.4:2014, “Methods for fire tests on building materials, components and structures – Part 4: Fire – resistance test of elements of construction are as follows:

Structural Adequacy	61 minutes	No failure
Integrity	61 minutes	No failure
Insulation	61 minutes	No failure
Resistance to Incipient Spread of Fire	54 minutes	

The tested specimen is deemed to have achieved an FRL of 60/60/60.

The test standard requires the following statements to be included:

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"This report details methods of construction, the test conditions and results obtained when the specific element of construction described herein was tested following the procedure outlined in this standard. Any significant variations 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.”

5. PERMITTED VARIATION

5.1 General

The results of the fire resistance test contained in the test report are directly applicable, without reference to the testing authority, to similar constructions where one or more of the changes permitted below have been made provided no individual component is removed or reduced:

(a) The stress level is reduced and the location and distribution of the load is unchanged.
(b) The rotational and longitudinal restraint is increased.
(c) Thermal insulation is not reduced at any point over the whole area.
(d) The plenum depth in assemblies containing a horizontal protective membrane is increased.

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PHOTOS

Photo 1: The Construction Including Loading Apparatus Prior to Testing

Photo 2: The Test Construction After a Duration of 20 Minutes

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Photo 3: The Test Construction After a Duration of 40 Minutes

Photo 4: The Test Construction After a Duration of 60 Minutes

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FR12837-001
Type Test Summary

This is to certify that the specimen described below has been tested by BRANZ on behalf of the sponsor.

Sponsor: Metra Panel Systems Limited
15 Tregowerth Lane
Huntly
New Zealand

Referenced Standard: AS 1530.4:2014

Specimen Name: 36 mm Metra Panel Ceiling

Specimen Description: The test specimen consisted of a loadbearing floor/ceiling system nominally 3,000 mm wide and with a 4,000 mm span. The floor/ceiling system was constructed with 190 mm x 45 mm x 1.5 mm thick steel joists. The underside of the joists was lined with a single layer of 36 mm thick Metra Panel panels. The top of the joists was lined with 20 mm thick Strandboard flooring sheets.

At the request of the client, a uniformly distributed load of 3.0 kPa was placed on the specimen and was maintained for the entire test duration.

A full description of the test specimen and the test results are given in BRANZ Type Test report: FR12837-001

Orientation: Exposure from below

The assessed results were as follows:

FRL (FRR) = 60/60/60

Issued by

Stephen Whatham
Fire Testing Engineer
IANZ Approved Signatory

Reviewed by

Merv Godkin
Senior Fire Testing Engineer
BRANZ

Regulatory authorities are advised to examine test reports before approving any product.

Issue Date
8 September 2020

Expiry Date
8 September 2025