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Fire assessment report

Assessment of FyreFLOOR systems

Sponsor: Trafalgar Group

Report number: FAS220367 Revision: R1.0

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Quality management

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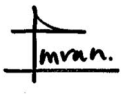
		Signature			

Executive summary

This report documents the findings of the assessment undertaken to determine the expected fire resistance level (FRL) of Trafalgar FyreFLOOR systems in accordance with AS 1530.4:2014.

The analysis in section 5 and 6 of this report found that the proposed systems, together with the described variations, are expected to achieve the FRL as shown in Table 1 – in accordance with AS 1530.4:2014.

The variations and outcome of this assessment are subject to the limitations and requirements described in sections 2, 3 and 7 of this report. The results of this report are valid until 30 April 2028.

Table 1 Assessment outcome

Ceiling lining	Floor lining	Referenced figures	Fire resistance level (FRL)
2 × 12.5 mm A1 COREX boards	NA	Figure 1, Figure 3, Figure 4, Figure 5, Figure 6, Figure 7	-/45/45
2 × 15 mm A1 COREX boards			-/60/60
2 × 25 mm A1 COREX boards			-/120/120
2 × 12.5 mm A1 COREX boards	Any non-combustible floor lining.	Figure 2, Figure 4, Figure 5, Figure 6, Figure 7	-/45/45
2 × 15 mm A1 COREX boards			-/60/60
2 × 25 mm A1 COREX boards			-/120/120

Contents

1. Introduction

This report documents the findings of the assessment undertaken to determine the expected fire resistance level (FRL) of Trafalgar FyreFLOOR systems in accordance with AS 1530.4:2014[1].

This report may be used as evidence of suitability in accordance with the requirements of the relevant National Construction Code (NCC) to support the use of the material, product, form of construction or design as given within the scope of this assessment report. It also references test evidence for meeting deemed to satisfy (DTS) provisions of the NCC that apply to the assessed systems.

This assessment was carried out at the request of Trafalgar Group. The sponsor details are included in Table 2.

Table 2 Sponsor details

Sponsor	Address
Trafalgar Group	26 Ferndell St, South Granville NSW 2142 Australia

2. Framework for the assessment

2.1 Assessment approach

An assessment is an opinion about the expected performance of a component or element of structure subjected to a fire test.

No specific framework, methodology, standard or guidance documents exists in Australia for undertaking these assessments. We have therefore followed the 'Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence' prepared by the Passive Fire Protection Forum (PFPF) in the UK in 2021[2].

This guide provides a framework for undertaking assessments in the absence of specific fire test results. Some areas where assessments may be offered are:

- Where a modification is made to a construction which has already been tested
- The interpolation or extrapolation of results of a series of fire resistance tests, or utilisation of a series of fire test results to evaluate a range of variables in a construction design or a product
- Where, for various reasons – eg size or configuration – it is not possible to subject a construction or a product to a fire test.

Assessments can vary from relatively simple judgements on small changes to a product or construction through to detailed and often complex engineering assessments of large or sophisticated constructions.

This assessment uses established empirical methods and our experience of fire testing similar products to extend the scope of application by determining the limits for the design based on the tested constructions and performances obtained. The assessment is an evaluation of the potential fire resistance performance of the elements in accordance with AS 1530.4:2014.

This assessment has been written in accordance with the general principles outlined in EN 15725:2010[3] for extended application reports on the fire performance of construction products and building elements.

1 Standards Australia, 2014, Methods for fire tests on building materials, components and structures – Part 4: Fire-resistance tests for elements of construction, AS 1530.4:2014, Standards Australia, NSW.
2 Passive Fire Protection Forum (PFPF), 2021, Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence, Passive Fire Protection Forum (PFPF), UK.
3 European Committee for Standardization, 2010, Extended application reports on the fire performance of construction products and building elements, EN 15725:2010, European Committee for Standardization, Brussels, Belgium.

This assessment has been written using appropriate test evidence generated at accredited laboratories to the relevant test standard. The supporting test evidence has been deemed appropriate to support the manufacturer's stated design.

2.2 Compliance with the National Construction Code

This assessment report has been prepared to meet the evidence of suitability requirements of the NCC 2022[4] under A5G3 (1) (d). It references test evidence for meeting deemed to satisfy (DTS) provisions of the NCC under A5G5 for fire resistance level that apply to the assessed systems based on Specifications 1 and 2 for fire resistance for building elements.

This assessment report may also be used to demonstrate compliance with the requirements for evidence of suitability under the relevant sections of previous versions of the NCC.

2.3 Declaration

The 'Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence' prepared by the PFPF in the UK requires a declaration from the client. By accepting our fee proposal on 11 January 2023, Trafalgar Group confirmed that:

- To their knowledge, the variations to the component or element of structure, which is the subject of this assessment, have not been subjected to a fire test to the standard against which this assessment is being made.
- They agree to withdraw this assessment from circulation if the component or element of structure is the subject of a fire test by a test authority in accordance with the standard against which this assessment is being made and the results are not in agreement with this assessment.
- They are not aware of any information that could adversely affect the conclusions of this assessment and – if they subsequently become aware of any such information – they agree to ask the assessing authority to withdraw the assessment.

3. Limitations of this assessment

- The scope of this report is limited to an assessment of the variations to the tested systems described in section 4.3.
- This report details the methods of construction, test conditions and assessed results expected in accordance with AS 1530.4:2014.
- This assessment applies to floor/ceiling systems exposed to fire from below in accordance with the requirements of AS 1530.4:2014 where horizontal elements must be exposed to heat from the underside only.
- The floor/ceiling joists must be designed by the project structural engineer to support the system ensuring the joists would not structurally collapse in an event of a fire.
- This report is only valid for the assessed system/s and must not be used for any other purpose. Any changes with respect to size, construction details, loads, stresses, edge or end conditions – other than those identified in this report – may invalidate the findings of this assessment. If there are changes to the system, a reassessment will need to be done by an Accredited Testing Laboratory (ATL) that is accredited to the same nominated standards of this report.
- The documentation that forms the basis for this report is listed in Appendix A and Appendix B.
- This report has been prepared based on information provided by others. Warringtonfire has not verified the accuracy and/or completeness of that information and will not be responsible for any errors or omissions that may be incorporated into this report as a result.

[4] National Construction Code Volumes One and Two - Building Code of Australia 2022, Australian Building Codes Board, Australia

- This assessment is based on the proposed systems being constructed under comprehensive quality control practices and following appropriate industry regulations and Australian Standards on quality of materials, design of structures, guidance on workmanship and expert handling, placing and finishing of the products on site. These variables are beyond the control and consideration of this report.

4. Description of the specimen and variations

4.1 Description of assessed systems

The proposed FyreFLOOR systems consist of two layers of Trafalgar A1 COREX boards as ceiling lining, which are supported by various types of frameworks. The types of frameworks include suspended systems, solid timber joists, steel joists and truss, as shown in Figure 3. For the suspended system, the ceiling linings are fixed to the furring channels connected to the floor or timber/steel joists by hanger bars. For other types of frameworks, the ceiling linings are directly fixed to the ceiling/floor joists.

For system that require a layer of floor lining, the floor lining is to be fixed to the top side of the joists, as shown in Figure 2.

4.2 Referenced test data

The assessment of the variation to the tested systems and the determination of the expected performance is based on the results of the fire tests documented in the reports summarised in Table 3. Further details of the tested systems are included in Appendix B. The test report sponsor has granted permission to refer their reports in this assessment.

Table 3 Referenced test data

Report number	Test sponsor	Test date	Testing authority
RFTR22056	DALSAN AICI SAN. VER TIC. A.S.	12 May 2022	Efectis Era Avrasya Test Ve Belgelendirme A.S
RFTR22118		20 July 2022	
RFTR22164		5 October 2022	

4.3 Variations to the tested systems

The tested systems and variations to those tested systems – together with the referenced standard fire tests – are described in Table 4.

Table 4 Variations to tested systems

Item	Reference test	Description	Variations
Ceiling systems without floor lining	RFTR22056 RFTR22118 RFTR22164	Test RFTR22056 consisted of a ceiling system clad with two layers of 15 mm thick A1 COREX lining fixed on the fire exposed side of the framework. Test RFTR22118 consisted of a ceiling system clad with two layers of 25 mm thick A1 COREX lining fixed on the fire exposed side of the framework. Test RFTR22164 consisted of a ceiling system clad with two layers of 12.5 mm thick A1 COREX lining fixed on the fire exposed side of the framework. All three systems were tested in accordance with EN 1364-2:2018[5] for various period.	The proposed ceiling systems are identical to the specimen tested in the referenced test reports. The proposed systems are assessed in accordance with AS 1530.4:2014.
Ceiling systems with floor lining			The proposed ceiling/floor systems are identical to the specimen tested in the referenced test reports, except with an additional floor lining fixed to unexposed side of the floor joists.

[5] European Committee for Standardization, 2018, Fire resistance tests for non-loadbearing elements Part 2: Ceilings, BS EN 1364-2:2018, European Committee for Standardization, Brussels, Belgium.

Item	Reference test	Description	Variations
			The systems are assessed in accordance with AS 1530.4:2014.
Framework		The framework of the tested systems was a suspended system. The ceiling linings were fixed to the galvanised quick hangers (furring channels) with 400 mm long hanger bars at 600 mm to 650 mm centres, connected to the structural beams above the suspended ceiling system.	The proposed systems consist of various framework, including suspended timber joists, suspended steel joists, steel joists, solid timber joist and truss – as shown in Figure 3.
Edge details		The perimeter frame of the tested systems was formed by U-shaped (TU) and C-shaped (TC) galvanised steel profiles. The U-shaped steel profiles were fixed to the supporting construction. The C-shaped steel profiles were fitted inside the U-shape steel profile. The distance between each ceiling C-shape stud is 600 mm. The tested U-tracks had a dimension of 28 mm wide × 27 mm deep × 0.5 mm thick, whereas the tested C-tracks had a dimension of 60 mm wide × 27 mm high × 0.6 mm thick. The ceiling linings of the tested systems were installed hard-up against the supporting wall without any fire rated sealant.	The proposed systems consist of a bead of 15 mm wide FyreFLEX sealant applied to the edge to full depth of the ceiling lining – as shown in Figure 4. The framework of the proposed systems is minimum 28 × 0.5 mm BMT J or U track. The ceiling support frame located at board joints are 28 mm × 38 mm furring channel.

4.4 Schedule of components

Table 5 outlines the schedule of components for the assessed systems. Figure 1 to Figure 6 show the assessed systems.

Table 5 Schedule of components of assessed systems

Item	Description	
Floor and ceiling lining		
1.	Item name	Ceiling lining
	Product name	Trafalgar A1 COREX board
	Thickness	12.5 mm, 15 mm or 25 mm
	Installation	The ceiling linings are to be fixed the ceiling framework (item 7 and item 8) with self-tapping steel screws. For the system with two layers of 12.5 mm thick ceiling lining, the first (inner) layer must be fixed with 6g × 25 mm long screws (item 12) at 300 mm centres, where the second (outer) layer must be fixed with 6g × 38 mm long screws (item 12) at 150 mm centres. For the system with two layers of 15 mm thick ceiling lining, the first (inner) layer must be fixed with 6g × 38 mm long screws (item 12) at 300 mm centres, where the second (outer) layer must be fixed with 6g × 45 mm long screws (item 12) at 150 mm centres. For the system with two layers of 25 mm thick ceiling lining, the first (inner) layer must be fixed with 6g × 45 mm long screws (item 12) at 300 mm centres, where the second (outer) layer must be fixed with 8g × 70 mm long screws (item 12) at 150 mm centres. The linings should be fixed to the edge framing as shown in Figure 4. The joints of the lining should be installed as shown in Figure 5.

Item	Description	
		The linings should be overlap between layers for minimum of 300 mm – as shown in Figure 6.
2.	Item name	Floor lining
	Description	The non-combustible floor lining is to be installed on the top side of the structural joist (item 9).
3.	Item name	Resilient tape
	Description	Polyethylene foam sound insulating tape – is used between supporting construction and U-shape profiles for the suspended systems.
4.	Item name	Coating
	Description	Both faces of the ceiling lining must be covered with fiberglass mattress. Unit area weight of the fibreglass mattress on face of the lining must be nominally 205 g/m^2.
5.	Item name	Joint compound
	Description	The joint compounds must be used at the joints of the plasterboard at the second layer.
6.	Item name	Self-adhesive fibre glass joint table
	Description	Joint tape is applied on the joints of the boards before the joint compound (item 1).
Framework		
7.	Item name	J or U track
	Dimensions	Minimum 28 mm wide × 0.5 mm BMT
	Description	The J or U-Track is fixed to the perimeter fire rated wall with appropriate fixing as shown in Figure 4.
8.	Item name	Furring channel
	Dimensions	38 mm wide × 28 mm high × 0.6 mm thick
	Description	For suspended ceiling systems, furring channels must be used to fix the ceiling linings. These furring channels must be supported by structural joists via hanger at maximum 600 mm centres – as shown in Figure 3. The furring channels must be spaced at maximum 600 mm centres and the ceiling lining must be fixed to these as shown in Figure 5.
9.	Item name	Floor joist
	Dimensions	Designed by the project structural engineer
	Description	Suspended solid timber joist, suspended steel joist, steel joist, solid timber joist and truss are applicable to the proposed floor-ceiling system – as shown in Figure 1 to Figure 3. The floor joists must be spaced at maximum 600 mm centres.
10.	Item name	Hanger bar
	Description	Hanger bars must be used to connect the furring channel and structural joists – as shown in Figure 3.
Sealant		
11.	Item name	Fire rated sealant
	Product	Trafalgar FyreFLEX Sealant
	Depth	Up to 15 mm at full depth of the ceiling linings – as shown in Figure 4.
Fixing		
12.	Item name	Ceiling lining fixing
	Product and size	6g × 25 mm screw

Item	Description	
		6g × 38 mm screw 6g × 45 mm screw 8g × 70 mm screw

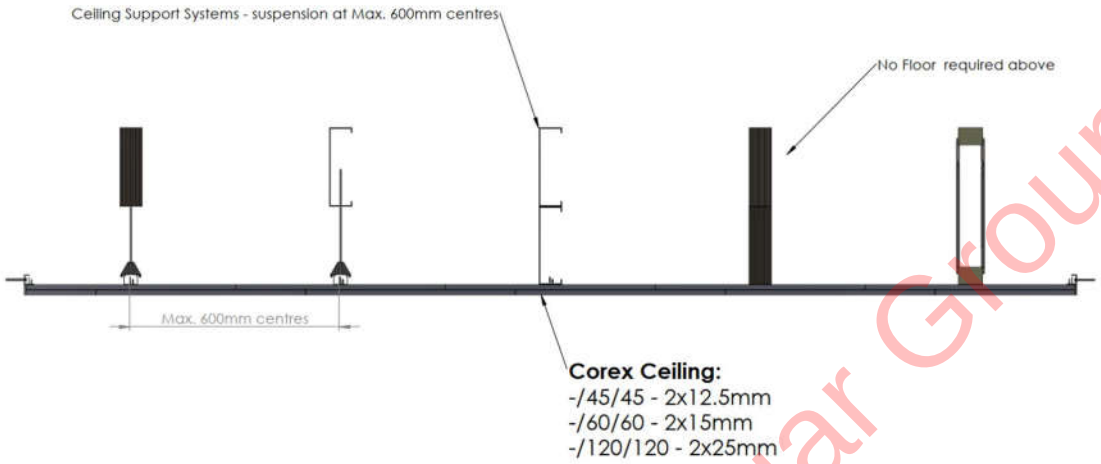


Figure 1 Ceiling systems arrangement

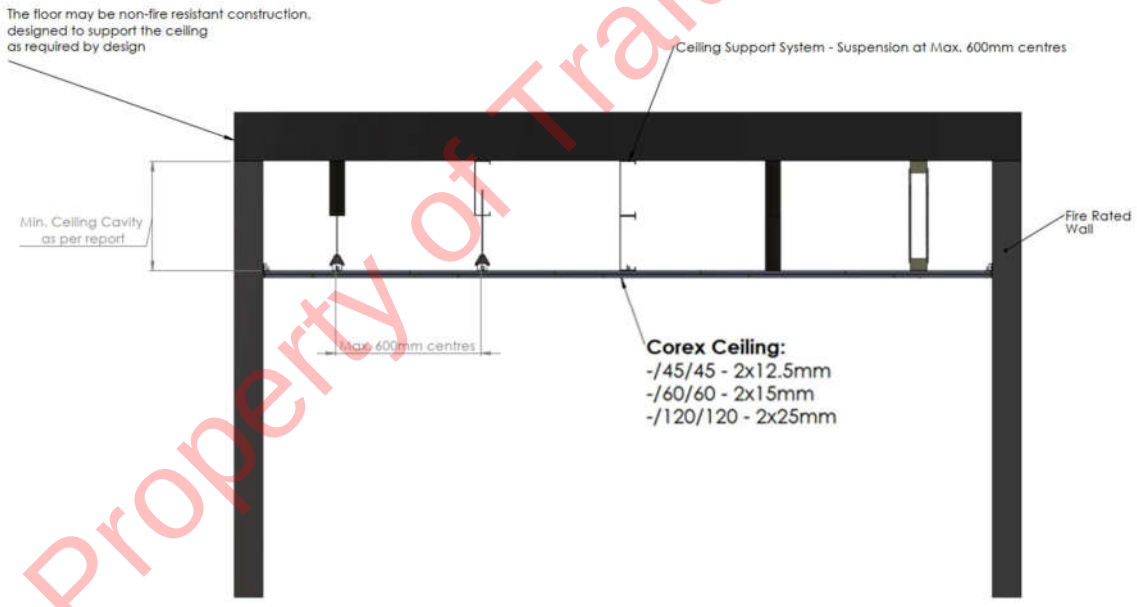


Figure 2 Floor-ceiling systems arrangement

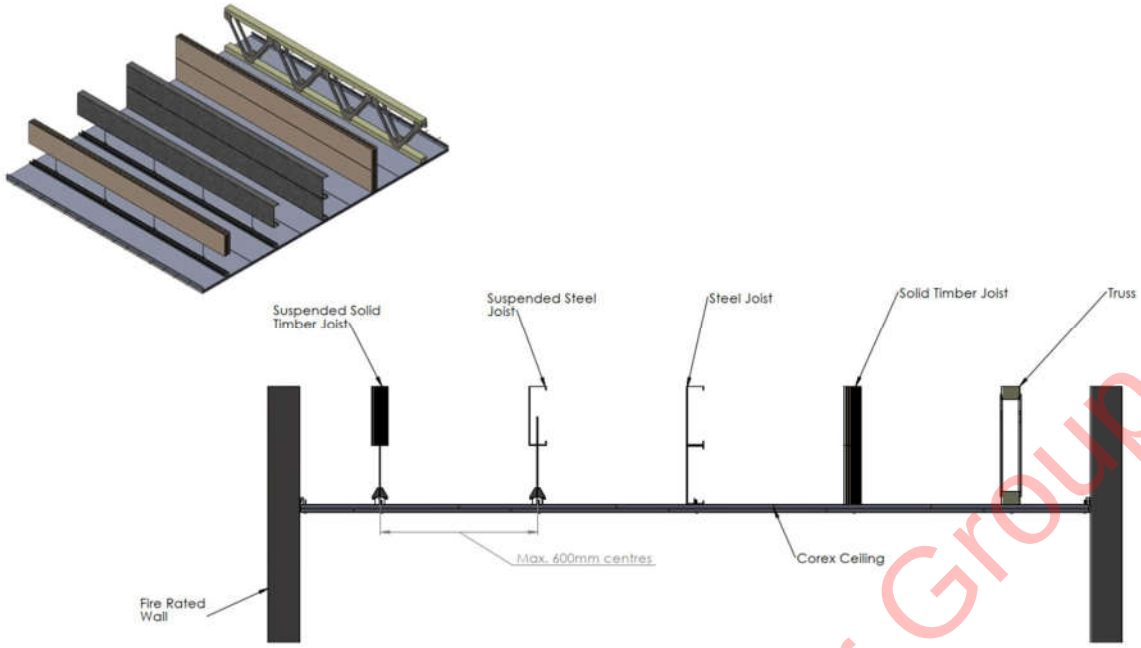


Figure 3 Framing options

Fixing Screws		
Corex Thickness	1st Layer (300mm Centres)	2nd Layer (150mm Centres)
2x12.5mm	6g x 25mm	6g x 38mm
2x15mm	6g x 38mm	6g x 45mm
2x25mm	6g x 45mm	8g x 70mm

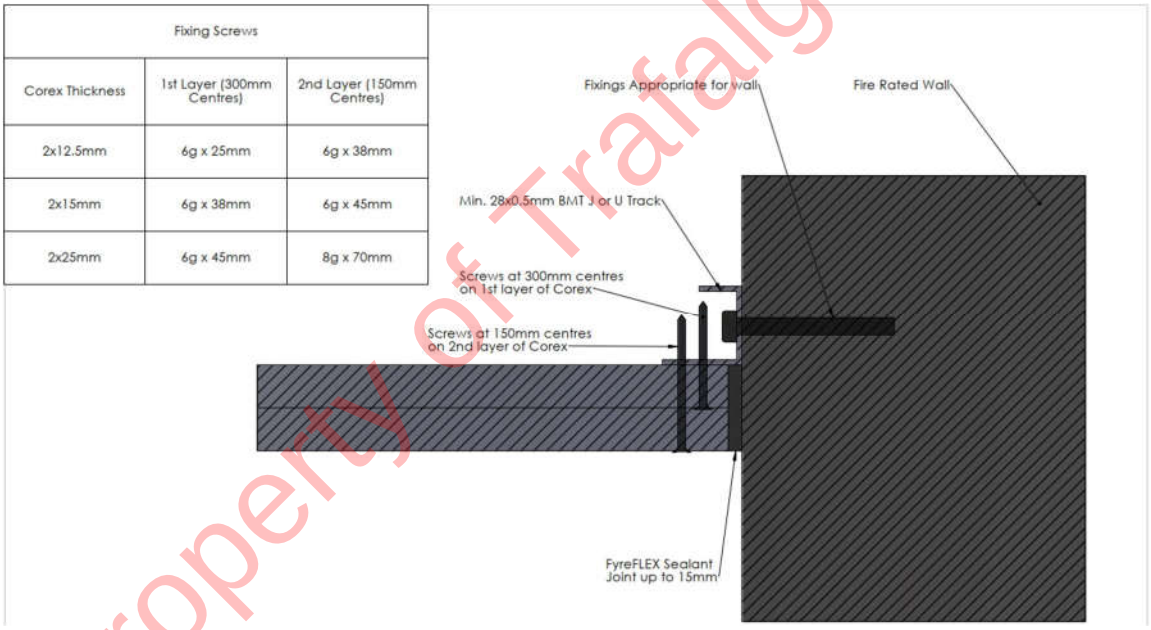


Figure 4 Edge details

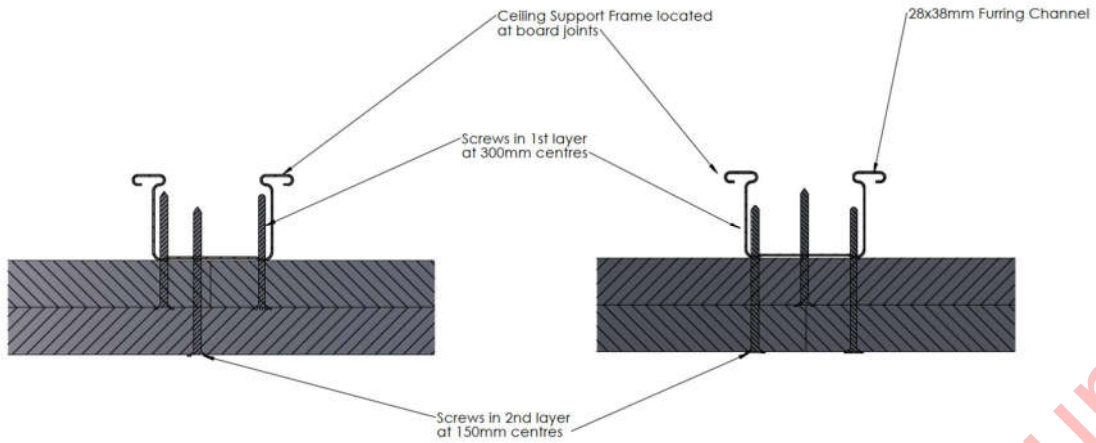


Figure 5 Board joints

Figure 6 Board arrangement

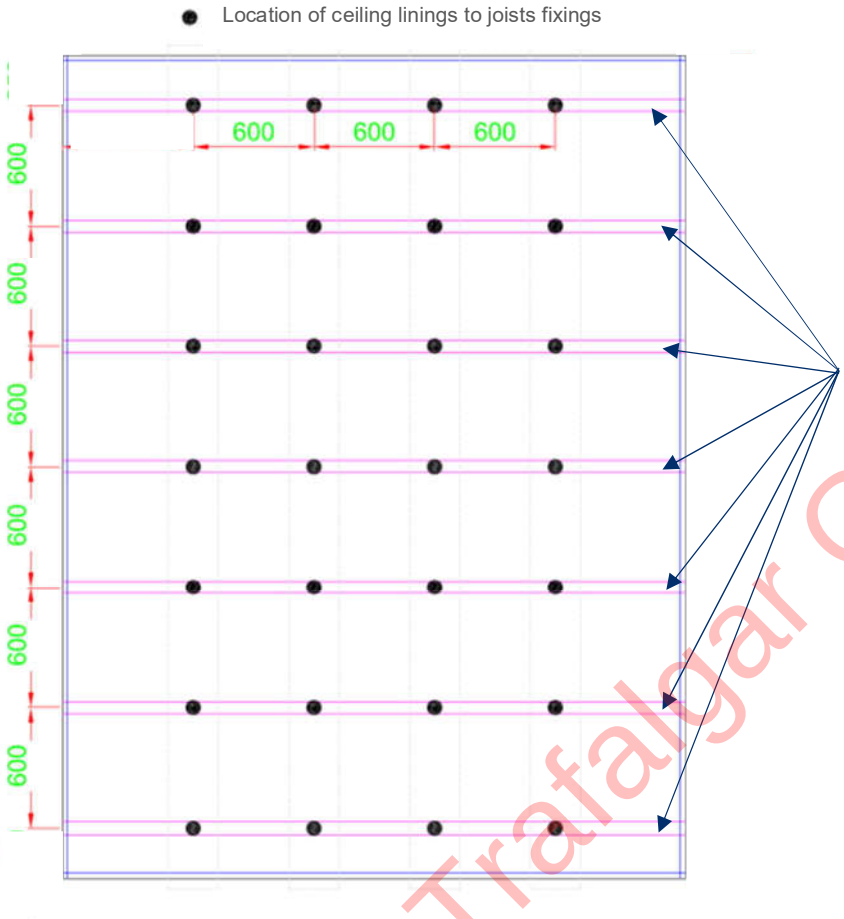


Figure 7 A1 COREX ceiling linings to floor joists fixing locations

5. Relevance of EN 1364-2:2018 and BS EN 1363-1:2020 test data with respect with AS 1530.4:2014

5.1 Description of variation

Fire resistance test RFTR22056, RFTR22118 and RFTR22164 were conducted in accordance with EN 1364-2:2018, which differs from AS 1530.4:2014.

EN 1364-2:2018 requires the furnace and test equipment to be setup as specified in EN 1363-1:2012[6]. However, it is known that the EN 1363-1:2012 is withdrawn and replaced by BS EN 1363-1:2020[7], hence the relevance of EN 1364-2:2018 and BS EN 1363-1:2020 test data with respect to AS 1530.4:2014 is discussed in this section. In addition, the effect that these differences had on the fire resistance performance of test specimens is discussed below.

5.2 Methodology

The method of assessment used is summarised in Table 6.

Table 6 Method of assessment

Assessment method	
Level of complexity	Intermediate assessment
Type of assessment	Qualitative

5.3 Assessment

5.3.1 Temperature regime

The furnace temperature regime for fire resistance tests conducted in accordance with AS 1530.4:2014 follows the same trend as EN 1363-1:2020.

The parameters outlining the accuracy of control of the furnace temperature in AS 1530.4:2014 and EN 1363-1:2020 are not appreciably different.

5.3.2 Furnace thermocouples

The furnace thermocouples specified in AS 1530.4:2014 are type K, mineral insulated metal sheathed (MIMS), with a stainless-steel sheath having a wire diameter of less than 1.0 mm and an overall diameter of 3 mm. The measuring junction protrudes at least 25 mm from the supporting heat resistant tube.

The furnace thermocouples specified in EN 1363-1:2020 are required to be plate thermometers comprised of an assembly of a folded nickel alloy plate with a thermocouple fixed to it and insulation material. The folded metal plate shall be constructed from a strip of austenitic nickel based superalloy for high temperature oxidation resistance, (150 ± 1) mm long by (100 ± 1) mm wide by (0.7 ± 0.1) mm, folded to the design. The measuring junction shall consist of nickel chromium/nickel aluminium wire as defined in EN 60584-1, contained within mineral insulation in a heat resisting steel alloy sheath of nominal diameter range of 1 mm to 3 mm, the hot junctions being electrically insulated from the sheath. The thermocouple hot junction shall be fixed to the geometric centre of the plate by a small strip made from the same material as the plate. The strip can be approximately 18 mm × 6 mm if it is spot welded to the plate and nominally 25 mm × 6 mm if it is screwed to the plate. The screw shall be 2 mm in diameter. The assembly of plate and thermocouple shall be fitted with a pad of inorganic insulation material nominally (97 ± 1) mm × (97 ± 1) mm by (10 ± 1) mm thick and with a density of (280 ± 30) kg/m^3.

The furnace control thermocouples required by EN 1363-1:2020 are less responsive than those specified by AS 1530.4:2014. This variation in sensitivity can produce a potentially more onerous

[6] European Committee for Standardization, 2012, Fire resistance tests Part 1 – General requirements, BS EN 1363-1:2012, European Committee for Standardization, Brussels, Belgium.
[7] European Committee for Standardization, 2020, Fire resistance tests Part 1 – General requirements, BS EN 1363-1:2020, European Committee for Standardization, Brussels, Belgium.

heating condition for specimens tested to EN 1363-1:2020, particularly when the furnace temperature is changing quickly in the early stages of the test.

5.3.3 Furnace pressure

The pressure of the furnace is the same for AS 1530.4:2014 and EN 1363-1:2020. For horizontal elements, both standards required the furnace to be operated such that a pressure of 20 Pa is established at a position 100 mm below the underside of the test specimen above that of the laboratory atmosphere.

The parameters outlining the accuracy of control of the furnace pressure in AS 1530.4:2014 and EN 1363-1:2020 are also not appreciably different.

5.3.4 Performance criteria

AS 1530.4:2014 specifies the following performance criteria for building materials and structures:

- structural adequacy (not relevant to this report)
- integrity
- insulation

Integrity

The integrity criteria differ slightly between AS 1530.4:2014 and EN 1363-1:2020.

Both test standards require the framed cotton pad to be applied or placed against the surface of the test specimen until ignition of the cotton pad or for a maximum of 30 seconds, with AS 1530.4:2014 allowing for a $\pm$ 2 second margin. The standards state that integrity failure shall be deemed to have occurred upon ignition of the cotton pad, which is defined as glowing or flaming.

Both standards allow for small adjustments in the position of the cotton pad to achieve the maximum effect from the hot gases.

For irregularities in the surface, both standards state clearance shall be maintained between the cotton pad and any part of the test specimen surface during the measurement, with EN 1363-1:2020 specifically stating a minimal clearance of 30 mm must be maintained.

The failure criteria in relation to the gap gauges between the two standards are identical.

The failure criteria in relation to flaming between the two standards are slightly different. AS 1530.4:2014 states that sustained flaming on the surface of the unexposed face for 10 seconds or longer shall be deemed an integrity failure, whereas EN 1363-1:2020 states that the occurrence and duration of any flaming on the unexposed surface shall be recorded – without mentioning any sustained flaming in terms of time.

Based on the above, it is considered that the general integrity criteria of EN 1363-1:2020 is slightly onerous than AS 1530.4:2014. Thus, it is considered the tested system will maintain the fire resistance performance as tested – in accordance with AS 1530.4:2014..

Insulation

The general insulation criteria of AS 1530.4:2014 and EN 1363-1:2020 are not appreciably different.

For average unexposed side temperature, AS 1530.4:2014 requires measuring the average temperature rise on the unexposed face of the specimen with five thermocouples evenly distributed over the test specimen to monitor the temperature of the unexposed surface of the specimen. One thermocouple shall be placed close to the centre and the rest shall be placed close to the centre of each quarter section. EN 1363-1:2020 required the thermocouples to be located at or near the centre of the test specimen and at or near the centre of each quarter section. Both standards required the average temperature thermocouple to avoid hotspots such as thermal bridges, joints, junctions, connections and fixings; EN 1363-1:2020 specifically stated that the average temperature thermocouple shall be at least 50 mm away from these hotspots.

For maximum temperature in accordance with AS 1530.4:2014, the standard required to have additional thermocouples attached to the specimen to measure the maximum temperature rise at

locations that are considered to have a higher heat transfer. The distance of the thermocouples from the joints shall be 15 ± 2 mm.

For maximum temperature in accordance with EN 1363-1:2020, the standard required the thermocouples to be attached, with a minimum of two thermocouples being applied for each type of joint/feature or location of concern. When positioning a thermocouple near a discontinuity, the centre of the thermocouple disc shall not be placed closer than 20 mm to the discontinuity. Rules for the application of thermocouples for evaluating the maximum unexposed face temperature rise are given in the specific test method. Minor hotspots due to fixings such as screws, nails or staples shall be ignored.

For the internal thermocouples, the requirements from both standards are similar. AS 1530.4:2014 states that, where possible, the first 25 mm of each thermocouple shall be in the isothermal plane so that the specimen is not damaged. EN 1363-1:2020 required the thermocouples to be fixed so that they don't affect the fire performance of the specimen.

Based on the above comparison, it is considered that the temperature measurements recorded in the referenced test reports could be used to assess the fire performance of the proposed construction – if tested in accordance with AS 1530.4:2014.

5.3.5 Application of test data to AS 1530.4:2014

The variation in furnace heating regimes, furnace pressure, furnace thermocouples, and the responses of the different thermocouple types to the furnace conditions are not expected to have an overall significant effect on the outcome of the referenced fire resistance test.

Based on the above discussion, the referenced test data from RFTR22056, RFTR22118 and RFTR22164 can be used to support this assessment conducted to AS 1530.4:2014.

6. Assessment of FyreFLOOR systems

6.1 Description of variation

The proposed FyreFLOOR ceiling systems consisted of two layers of 12.5 mm thick, 15 mm thick or 25 mm thick A1 COREX ceiling linings supported by various ceiling joists, with or without floor lining.

This assessment was done to determine the expected performance of the system in accordance with AS 1530.4:2014.

6.2 Methodology

The method of assessment used is summarised in Table 7.

Table 7 Method of assessment

Assessment method	
Level of complexity	Intermediate assessment
Type of assessment	Qualitative

6.3 Assessment

6.3.1 Evidence from referenced fire tests

The referenced test reports RFTR22164, RFTR22056 and RFTR22118 consist of ceiling systems with the same ceiling framework and edge details, but with different ceiling lining thickness and fixing arrangement. The ceiling frameworks for all three tests were constructed with galvanised steel profiles ceiling U-tracks and C-studs. The ceiling U-tracks were fixed to the supporting construction with M6 × 45 mm CD6-45 steel dowel, with fixings 50 mm from edge of the supporting construction and at 600 mm centres. The C-shaped galvanised steel studs were fitted inside the U-shaped profiles with a 10 mm gap between the U-track and C-stud. The distance between each ceiling C-stud is 600 mm.

For the ceiling systems with two layers of 12.5 mm thick (RFTR22164) or 15 mm thick (RFTR22056) A1 COREX board, 14 steel hangers were used to support the ceiling linings and supporting joists – spaced at 1200 mm centres; whereas for the two layers of 25 mm thick (RFTR22118) ceiling system, 28 steel hangers were used to connect between the ceiling linings and supporting joists – spaced at 600 mm centres. The hanger bars were 3.8 mm diameter × 400 mm long, and fixed to concrete beams above the testing frame with steel dowels and L steel bars.

The tested plasterboard linings were covered with fiberglass mattress on both faces of the board. The plasterboards were staggered at the bottom face of the suspended ceiling system. FERZTEK joint compound were applied and located at the joints of plasterboards at the second layer. Self-adhesive fibre glass joint tapes were used at the joints of plasterboard at the second layer before the application of the joint compound.

The plasterboard linings were fixed to the framework with self-tapping steel screws. For the two layers of 12.5 mm thick ceiling system (RFTR22164), the first (inner) layer was fixed with 3.5 mm diameter × 38 mm long COREX BV38 at 300 mm between screws, where the second (outer) layer was fixed with 3.5 mm diameter × 45 mm long COREX BV45 at 150 mm between screws. For the two layers of 15 mm thick ceiling system (RFTR22056), the first (inner) layer was fixed with 3.5 mm diameter × 38 mm long COREX BV38 at 300 mm between screws, where the second (outer) layer was fixed with 3.5 mm diameter × 45 mm long COREX BV45 at 150 mm between screws. For the two layers of 25 mm thick ceiling system (RFTR22118), the first (inner) layer was fixed with 3.5 mm diameter × 45 mm long COREX BV45 at 300 mm between screws, where the second (outer) layer was fixed with 4.2 mm diameter × 70 mm long COREX BV70 at 150 mm between screws.

Floor lining was not involved for all three tests. Unexposed thermocouples were placed on the unexposed side of the A1 COREX linings.

The two layers of 12.5 mm thick ceiling system (RFTR22164) recorded no integrity failure throughout the 52 minutes test but failed insulation at 52 minutes. The two layers of 15 mm thick ceiling system (RFTR22056) recorded no integrity or insulation failure throughout the 66 minutes test. The two layers

of 25 mm thick ceiling system (RFTR22118) recorded no integrity or insulation failure throughout the 132 minutes test.

6.3.2 Assessment of FyreFLOOR systems

General

It is proposed to assess the fire resistance performance of the FyreFLOOR system in accordance with AS 1530.4:2014. The proposed systems are shown in Figure 1 to Figure 7. Section 5 of this report concluded that the variation in furnace heating regimes, furnace pressure, furnace thermocouples, and the responses of the different thermocouple types to the furnace conditions between the testing standard and AS 1530.4:2014 are not expected to have an overall significant effect on the outcome of the referenced fire resistance test, and thus the referenced test data from RFTR22056, RFTR22118 and RFTR22164 can be used to support this assessment in accordance with AS 1530.4:2014.

The test outcomes are summarised in Table 8.

Table 8 Summary of referenced test report RFTR22056, RFTR22118 and RFTR22164

Referenced test	Ceiling lining	Outcome	Assigned FRL
RFTR22056	2 × 12.5 mm thick A1 COREX board	No integrity failure at 52 minutes, but with insulation failure at 52 minutes	-/45/45
RFTR22118	2 × 15 mm thick A1 COREX board	No integrity or insulation failure at 66 minutes	-/60/60
RFTR22164	2 × 25 mm thick A1 COREX board	No integrity or insulation failure at 132 minutes	-/120/120

Performance of the proposed ceiling systems without floor lining

As discussed in section 5, it is expected the tested ceiling system in RFTR22056, RFTR22118 and RFTR22164 would perform similarly when tested in accordance with AS 1530.4:2014. It is expected that the proposed FyreFLOOR ceiling system would perform similarly to the test systems, as long as the variations of the framework, floor joists and edge details do not have adverse impact to the overall ceiling system.

The proposed ceiling systems are supported by various type of joists as shown in Figure 1 to Figure 3, which involves steel and timber joists. Table 8 shows that the tested two layers of 12.5 mm thick, 15 mm thick and 25 mm thick ceiling system are capable of maintaining an insulation performance for 45 minutes, 60 minutes and 120 minutes, respectively. While the insulation criteria is to prevent an average temperature rise of 140 °C or a maximum temperature rise of 180 °C, it is expected that during the period of the assigned FRL, the temperature of the ceiling joists would be around 200 °C.

According to AS/NZS 4600:2018[8], the strength reduction factor of cold-formed steel is around 0.9 when the material reached 200 °C, which is a 10% loss in strength. While the FyreFLOOR systems are non-loadbearing, the 90% remaining material strength is considered sufficient to support the self-weight of the ceiling linings. Therefore, it is considered that the FyreFLOOR system would not structurally collapse during the period of the assigned FRL when supported with cold-formed steel joists – with the corresponding ceiling lining shown in Table 8.

The structural capacity of a timber element in a fire scenario depends on its residual cross-section area, which is associated with its charring. According to EN 1995-1-2:2004[9] clause 3.4.1, the charring temperature of timber is around 300 °C, meaning that timber elements are not expected to experience any strength loss below this temperature. As discussed previously, the temperature of the joists is expected to be around 200 °C – when protected by the corresponding ceiling lining shown in Table 8. Combining these test outcomes with the charring information provided in EN 1995-1-2:2004, it is expected that the timber joists would not experience any strength loss during a fire scenario. Therefore, it is concluded that the ceiling linings would not structurally collapse during the period of

[8] Standards Australia, 2018, Cold-formed steel structures, AS/NZS 4600:2018, Standards Australia, NSW.
[9] European Committee for Standardization, 2004, Eurocode 5: Design of timber structures – Part 1-2: General – Structural fire design, EN 1995-1-2:2004, European Committee for Standardization, Brussels, Belgium.

the assigned FRL when supported with timber joists – with the corresponding ceiling lining shown in Table 8.

In the referenced test, the perimeter of the supporting frame was formed by 28 mm wide × 27 mm deep × 0.5 mm thick U tracks, which were fixed to the supporting construction by M6 × 45 mm steel dowel. The ceiling linings were fixed to the frame and positioned hard-up against the supporting construction with no sealant applied. It is proposed to install the FyreFLOOR system as shown in Figure 4, which consisted of minimum 28 × 0.5 mm BMT J or U track as the perimeter frame, and with FyreFLEX sealant fully filled the 15 mm gap between the linings and the supporting element.

The variation in the perimeter frame is not expected to degrade the fire resistance performance of the FyreFLOOR system, as the depth and thickness of the framing tracks are similar to the tested system.

In a fire scenario, materials would more or less expand or deform due to the change in thermal condition, which is likely to result in gap forming between components. The inclusion of FyreFLEX sealant to the 15 mm gap between the ceiling lining and the supporting wall is expected enable some degree of movement between the ceiling linings and the supporting wall. Thus, it is expected that the proposed edge details shown in Figure 4 would achieve similar or better fire resistance performance than the tested system in the referenced test reports.

Fire resistance performance of the proposed floor-ceiling systems

A discussed in section 6.3.1 and 6.3.2, the ceiling system tested in RFTR22056, RFTR22118 and RFTR22164 were able to maintain an integrity and insulation performance for 45 minutes, 60 minutes and 120 minutes without any floor lining – with the appropriate lining thickness as shown in Table 8. When a non-combustible floor lining is included onto the system, overall thickness of the floor/ceiling system is increased as such the integrity and insulation performance of the system are expected to achieve similar or better performance than tested.

Nevertheless, given that a ceiling cavity is now created, heat is expected to be trapped within the cavity resulting in structural joists to experience higher temperatures than the tested systems. Based on the referenced test reports, the average unexposed side temperature of the ceiling lining for the 2 × 12.5 mm, 2 × 15 mm and 2 × 25 mm thick system was close to or below 100 °C at 45 minutes, 60 minutes and 120 minutes, respectively. While this provides a reasonable safety margin for the structural joists, it is considered that the increase in cavity temperature – caused by the inclusion of floor lining – would not be significant to compromise the structural adequacy of the floor joists.

Based on the above, it is concluded that the inclusion of the floor lining – as shown in Figure 2 – would not degrade the fire resistance performance of the FyreFLOOR systems.

6.4 Assessment outcome

This assessment demonstrates that the FyreFLOOR systems are expected to achieve the fire resistance performance as shown in Table 9 – in accordance with AS 1530.4:2014.

Table 9 Fire resistance performance of FyreFLOOR systems

Ceiling lining	Floor lining	Referenced figure	Fire resistance level (FRL)
2 × 12.5 mm A1 COREX boards	NA	Figure 1, Figure 3, Figure 4, Figure 5, Figure 6, Figure 7	-/45/45
2 × 15 mm A1 COREX boards			-/60/60
2 × 25 mm A1 COREX boards			-/120/120
2 × 12.5 mm A1 COREX boards	Any non-combustible floor lining.	Figure 2, Figure 4, Figure 5, Figure 6, Figure 7	-/45/45
2 × 15 mm A1 COREX boards			-/60/60
2 × 25 mm A1 COREX boards			-/120/120

7. Validity

Warringtonfire does not endorse the tested or assessed product in any way. The conclusions of this assessment may be used to directly assess fire resistance, but it should be recognised that a single test method will not provide a full assessment of fire resistance under all conditions.

Due to the nature of fire testing and the consequent difficulty in quantifying the uncertainty of measurement, it is not possible to provide a stated degree of accuracy. The inherent variability in test procedures, materials and methods of construction, and installation may lead to variations in performance between elements of similar construction.

This assessment is based on test data, information and experience available at the time of preparation. If contradictory evidence becomes available to the assessing authority, the assessment will be unconditionally withdrawn and the report sponsor will be notified in writing. Similarly, the assessment should be re-evaluated, if the assessed construction is subsequently tested since actual test data is deemed to take precedence.

The published procedures for the conduct of tests and the assessment of test results are subject to constant review and improvement. It is therefore recommended that this report be reviewed on, or before, the stated expiry date.

This assessment represents our opinion about the performance of the proposed systems expected to be demonstrated on a test in accordance with AS 1530.4:2014, based on the evidence referred to in this report.

This assessment is provided to Trafalgar Group for their own specific purposes. This report may be used as evidence of suitability in accordance with the requirements of the relevant National Construction Code. Building certifiers and other third parties must determine the suitability of the systems described in this report for a specific installation.

Appendix A Drawings and additional information

Table 10 Details of drawings

Figure	Drawing title	Dwg no	Date	Drawn by
Figure 1	Ceiling systems 1a-1c	1	13 December 2022	DP (Trafalgar Group)
Figure 2	Ceiling systems 2a-2c	2		DP (Trafalgar Group), edited by Warringtonfire
Figure 3	Ceiling systems framing options	3		DP (Trafalgar Group)
Figure 4	Ceiling systems edge details	4		
Figure 5	Ceiling systems board joints	5		
Figure 6	Ceiling systems board overlaps	6		
Figure 7	COREX ceiling linings to floor joists fixing locations	-	1 February 2023	Extracted from RFTR22118, edited by Warringtonfire

Appendix B Summary of supporting test data

B.1 Test report – RFTR22056

Table 11 Information about test report RFTR22056

Item	Information about test report
Report sponsor	DALSAN AICI SAN. VE TIC. A.S.
Test laboratory	Efectis Era Avrasya Test Ve Belgelendirme A.S, Dilovasi OSE. 5. Kisim First Cad. No:18, 41455 Dilovasi, Kocaeli, Turkey
Test date	The fire resistance test was done on 12 May 2022.
Test standards	The test was done in accordance with EN 1364-2:2018.
Variation to test standards	None
General description of tested specimen	The test specimen consisted of a ceiling system formed by two layers of 15 mm thick A1 COREX fixed to the bottom of the framework. The panels were 1200 mm wide × 2000 mm long × 15 mm thick. The framework was formed by U-shaped (TU) and C-shaped (TC) galvanised steel profiles. The U-shaped steel tracks were 3100 mm or 4100 mm long × 28 mm wide × 27 mm deep × 0.5 mm thick, fixed to the testing frame with M6 × 45 mm CD6-45 steel dowel. The fixings were 50 mm from edge of the supporting construction and 600 mm centres between steel dowels. The C-shaped galvanised steel tracks were 3080 mm long × 60 mm wide × 27 mm high × 0.6 mm thick, fitted inside the U-shaped profiles with a 10 mm gap between the ceiling U-track and ceiling C-track. The distance between each ceiling C-stud is 600 mm. The framework was suspended by 14 galvanised quick hanger (C type) and hanger bar. The hanger bars were 3.8 mm diameter × 400 mm long, and fixed to concrete beams above the testing frame with steel dowels and L steel bars. Resilient tape – which is polyethylene foam sound insulating tap – was used between supporting construction and U-shape profiles. The tap was 25 mm wide × 3 mm thick with a nominal density of 30 kg/m^3, located between the supporting construction and U-shaped profiles. The plasterboard linings were fixed to the framework with self-tapping steel screws. The first (inner) layer was fixed with 3.5 mm diameter × 38 mm long COREX BV38 at 300 mm between screws, where the second (outer) layer was fixed with 3.5 mm diameter × 45 mm long COREX BV45 at 150 mm between screws. Both faces of the plasterboards were covered with fiberglass mattress, with 205 g/m^2 unit area weight of fiberglass mattress on one face of the plasterboard. The plasterboard layers were staggered at the bottom of the suspended ceiling system. The test was conducted for 66 minutes.
Instrumentation	The test report states that the instrumentation was in accordance with EN 1363-1:2020.

The test specimen achieved the following results – see Table 12.

Table 12 Results summary for this test report RFTR22056

Item	Criteria	Outcome
Integrity	Cotton pad	No failure
	6 mm diameter gap gauges	No failure (not applied)
	25 mm diameter gap gauges	No failure (Not applied)
	Flames longer than 10 seconds	Not observed
Insulation	Average temperature	No failure
	Maximum temperature	No failure

B.2 Test report – RFTR22118

Table 13 Information about test report RFTR22118

Item	Information about test report
Report sponsor	DALSAN AICI SAN. VE TIC. A.S.
Test laboratory	Efectis Era Avrasya Test Ve Belgelendirme A.S, Dilovasi OSE. 5. Kisim First Cad. No:18, 41455 Dilovasi, Kocaeli, Turkey
Test date	The fire resistance test was done on 20 July 2022.
Test standards	The test was done in accordance with EN 1364-2:2018.
Variation to test standards	None
General description of tested specimen	The test specimen consisted of a ceiling system formed by two layers of 25 mm thick A1 COREX fixed to the bottom of the framework. The panels were 1200 mm wide × 2000 mm long × 25 mm thick. The framework was formed by U-shaped (TU) and C-shaped (TC) galvanised steel profiles, The U-shaped steel tracks were 3100 mm or 4100 mm long × 28 mm wide × 27 mm deep × 0.5 mm thick, fixed to the testing frame with M6 × 45 mm CD6-45 steel dowel. The fixings were 50 mm from edge of the supporting construction and 600 mm centres between steel dowels. The C-shaped galvanised steel tracks were 3080 mm long × 60 mm wide × 27 mm high × 0.6 mm thick, fitted inside the U-shaped profiles with a 10 mm gap between the ceiling U-track and ceiling C-track. The distance between each ceiling C-stud is 600 mm. The framework was suspended by 28 galvanised quick hanger (C type) and hanger bar. The hanger bars were 3.8 mm diameter × 400 mm long, and fixed to concrete beams above the testing frame with steel dowels and L steel bars. Resilient tape – which is polyethylene foam sound insulating tap – was used between supporting construction and U-shape profiles. The tap was 25 mm wide × 3 mm thick with a nominal density of 30 kg/m^3, located between the supporting construction and U-shaped profiles. The plasterboard linings were fixed to the framework with self-tapping steel screws. The first (inner) layer was fixed with 3.5 mm diameter × 45 mm long COREX BV45 at 300 mm between screws, where the second (outer) layer was fixed with 4.2 mm diameter × 70 mm long COREX BV70 at 150 mm between screws. Both faces of the plasterboards were covered with fiberglass mattress, with 205 g/m^2 unit area weight of fiberglass mattress on one face of the plasterboard. The plasterboard layers were staggered at the bottom of the suspended ceiling system. The test was conducted for 132 minutes.
Instrumentation	The test report states that the instrumentation was in accordance with EN 1363-1:2020.

The test specimen achieved the following results – see Table 14.

Table 14 Results summary for this test report RFTR22118-

Item	Criteria	Outcome
Integrity	Cotton pad	No failure (not applied)
	6 mm diameter gap gauges	No failure (not applied)
	25 mm diameter gap gauges	No failure (not applied)
	Flames longer than 10 seconds	Not observed
Insulation	Average temperature	No failure
	Maximum temperature	No failure

B.3 Test report – RFTR22164

Table 15 Information about test report RFTR22164

Item	Information about test report
Report sponsor	DALSAN AICI SAN. VE TIC. A.S.
Test laboratory	Efectis Era Avrasya Test Ve Belgelendirme A.S, Dilovasi OSE. 5. Kisim First Cad. No:18, 41455 Dilovasi, Kocaeli, Turkey
Test date	The fire resistance test was done on 5 October 2022.
Test standards	The test was done in accordance with EN 1364-2:2018.
Variation to test standards	None
General description of tested specimen	The test specimen consisted of a ceiling system formed by two layers of 12.5 mm thick A1 COREX fixed to the bottom of the framework. The panels were 1200 mm wide × 2000 mm long × 12.5 mm thick. The framework was formed by U-shaped (TU) and C-shaped (TC) galvanised steel profiles, The U-shaped steel tracks were 3100 mm or 4100 mm long × 28 mm wide × 27 mm deep × 0.5 mm thick, fixed to the testing frame with M6 × 45 mm CD6-45 steel dowel. The fixings were 50 mm from edge of the supporting construction and 600 mm centres between steel dowels. The C-shaped galvanised steel tracks were 3080 mm long × 60 mm wide × 27 mm high × 0.6 mm thick, fitted inside the U-shaped profiles with a 10 mm gap between the ceiling U-track and ceiling C-track. The distance between each ceiling C-stud is 600 mm. The framework was suspended by 14 galvanised quick hanger (C type) and hanger bar. The hanger bars were 3.8 mm diameter × 400 mm long, and fixed to concrete beams above the testing frame with steel dowels and L steel bars. Resilient tape – which is polyethylene foam sound insulating tap – was used between supporting construction and U-shape profiles. The tap was 25 mm wide × 3 mm thick with a nominal density of 30 kg/m^3, located between the supporting construction and U-shaped profiles. The plasterboard linings were fixed to the framework with self-tapping steel screws. The first (inner) layer was fixed with 3.5 mm diameter × 25 mm long COREX BV25 at 300 mm between screws, where the second (outer) layer was fixed with 3.5 mm diameter × 38 mm long COREX BV38 at 150 mm between screws. Both faces of the plasterboards were covered with fiberglass mattress, with 205 g/m^2 unit area weight of fiberglass mattress on one face of the plasterboard. The plasterboard layers were staggered at the bottom of the suspended ceiling system. The test was conducted for 52 minutes.
Instrumentation	The test report states that the instrumentation was in accordance with EN 1363-1:2020.

The test specimen achieved the following results – see Table 16.

Table 16 Results summary for this test report RFTR22164

Item	Criteria	Outcome
Integrity	Cotton pad	No failure (not applied)
	6 mm diameter gap gauges	No failure (not applied)
	25 mm diameter gap gauges	No failure (not applied)
	Flames longer than 10 seconds	Not observed
Insulation	Average temperature	No failure
	Maximum temperature	Failure at 51 minutes

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