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Fire assessment report

Fire resistance performance of floor penetrations protected by FyreSet mortar and TWrap or FyreWrap.

Sponsor: Trafalgar Group

Report number: FAS200424 Revision: R1.1

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Quality management

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			Prepared by	**Reviewed by**	**Authorised by**
		Name	Hon Wong	Mahmoud Akl	Omar Saad
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			Prepared by	**Reviewed by**	**Authorised by**
	Expiry: 28/02/2026	**Name**	Hon Wong	Mahmoud Akl	Omar Saad
		Signature			

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Executive summary

This report documents the findings of the assessment undertaken to determine the likely fire resistance level (FRL) of large apertures protected with Trafalgar FyreSet mortar penetrated by service penetrations protected with FyreFLEX sealant, FyreBOX, Fyrechoke and TWrap or FyreWrap insulation if tested in accordance with AS 1530.4:2014 and complying with the general requirements of AS 4072.1:2005 for service penetrations.

FyreSet mortar is a special cement based mixture fo rmulated specifically for fire rating applications, in particular openings in fire barriers that include complicated or mixed service penetration types.

TWrap is a 25 mm thick foil-faced, ceramic fibre fire protection wrap that been engineered to provide insulation performance on service penetrations.

FyreWrap is a 38 mm thick foil-faced, mineral fibre fire protection wrap that been engineered to provide insulation performance on service penetrations.

FyreFLEX fire rated sealant is a water based, low VOC and environmentally friendly fire rated, intumescent based sealant. FyreFLEX has two distinct applications, the first being fire protection of construction and expansion joints in fire rated barriers. The second application being fire stopping of services passing through openings in fire barriers.

FyreBOX Cast-In allows for multiple and mixed services to pass through it, and in close vicinity to each other, the main feature of this sealing system is that it eliminates the need for 200 mm separation between adjacent services. It also allows for cable trays to pass directly through it.

Fyrechoke Conduit Micro Fire Collars are compact sized retrofit product, designed to provide maximum protection against the spread of fire & smoke through separating elements where they are penetrated by plastic conduits.

The analysis in section 5 of this report found that the proposed systems together with the described variations are likely to achieve the FRL as shown in Table 1, Table 2 and Table 3, if tested in accordance with AS 1530.4:2014 and assessed in general accordance with AS 4072.1:2005.

Table 1 Assessment outcome for electrical services penetrations

Product	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
15 × CAT6, 15 × TPS and 15 × Fire alarm cables	Recommended 150 mm min. concrete slab for optimum performance	100 mm deep FyreSet mortar within the aperture and 40 mm fillet (30 mm for the comm. cable bundle) of FyreFlex sealant around the penetrations on top of the slab.	N/A	-/240/120
D2 comm. cables			N/A	-/120/60
D1 power cables- 1 × electrical 3C × 185 mm^2 Cu + E 1 × electrical 1C × 630 mm^2 Cu + E 3 × electrical 3C × 6 mm^2 Cu + E 3 × electrical 16 mm^2 Cu			N/A	-/120/60 for the large 630 mm^2 cable, the rest reassigned- -/120/90 for the 185 mm^2 Cu + E and -/120/120 for the remainder with or without cable tray. Where cable tray is removed, adequate cable support and permanent fixings must be provided for each of the cables or cable bundles.

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Product	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
D1 power cables- 8 × 16 mm^2 3C + E		350 mm × 125 mm FyreBox cast in 120 mm thick 600 mm × 300 mm FyreSet mortar pad within the concrete. 25 mm fillet of FyreFlex sealant applied at the interface between FyreBox and the mortar.	1 layer of 450 mm high TWrap covering all around and on top of the FyreBox	-/120/120
D1 power cables- 1 × electrical 1C × 630 mm^2 Cu + E 1 × electrical 3C × 185 mm^2 Cu + E 8 × 16 mm^2 3C + E 3 × 6 mm^2 3C + E		FyreSet mortar cast 100 mm high over the aperture on top of concrete slab and aperture.	450 mm high from unexposed side of concrete slab of single layer TWrap	-/240/180
10 × CAT6, 10 × TPS and 10 × Fire alarm cables			N/A	-/240/180
D1 power cables- 1 × electrical 1C × 630 mm^2 Cu + E 1 × electrical 3C × 185 mm^2 Cu + E 8 × 16 mm^2 3C + E 3 × 6 mm^2 3C + E and D2 comm cables group comprising 60 CAT 3 cables		FyreSet mortar cast into an 800 mm square opening in the concrete slab providing a 100 mm high (from the lower face of slab) infill pad in the opening for device penetrations. 50 mm fillet of FyreFlex sealant applied on top of mortar at the annular gap of the services penetrations.	450 mm high from unexposed side of concrete slab of single layer TWrap	-/240/120 with cable tray. -/240/180 without cable tray (retaining insulation TWrap) and cables are to be individually and adequately supported.
D1 power cables- 1 × electrical 1C × 630 mm^2 Cu + E 1 × electrical 3C × 185 mm^2 Cu + E 8 × 16 mm^2 3C + E 3 × 6 mm^2 3C + E				-/240/120 with cable tray -/240/180 without cable tray (retaining insulation TWrap) and cables are to be individually and adequately supported.

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Table 2 Assessment outcome for other pipe service penetrations

Product	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
Pair coils with insulation 25 mm PEXA pipe 25 mm PEX-AL-PEX or any other pipes assigned an FRL of up to -/120/120 (adequate spacing and intumescent strips must be provided accordingly).	Recommended 150 mm min. concrete slab for optimum performance	350 mm × 125 mm FyreBox cast in 120 mm thick 600 mm × 300 mm FyreSet mortar pad within the concrete. 25 mm fillet of FyreFlex sealant applied at the interface between FyreBox and the mortar. 50 mm fillet FyreFlex sealant applied along the annular gap and to 50 mm depth at the service penetrations on top of the slab.	1 layer of TWrap covering all around and on top of the FyreBox	-/120/120 The FyreBOX provides an alternative membrane for penetrations with any pipe services capable of attaining an FRL of up to -/120/120
DN 50 type B copper pipe (including all CU pipes up to DN50)		The FyreSet mortar was cast 110 mm high over the aperture on top and overlapping 3 edges by 50 mm with the remaining side stacked with hollow cement blockwork	450 mm single layer on top of slab.	-/240/120 or with FyreSet mortar within the slab - -/120/120
NB 100 steel pipe				-/240/240
DN 32 type B copper pipe (assessed service)			300 mm or 450 mm single layer	-/90/90 or with 450 mm length TWrap - -/240/120
DN 50 copper pipe (including all CU pipes up to DN50)		FyreSet mortar cast within aperture in concrete slab to 100 mm high from bottom of slab.	450 mm single layer	-/120/120
DN 80 copper pipe (including all CU pipes up to DN80)			600 mm single layer	-/120/120
DN 100 copper pipe (including all Cu pipes up to DN100)			800 mm single layer FyreWrap	-/120/120
DN 150 copper pipe (including all CU pipes up to DN150)			1200 mm TWrap with a second layer 300 mm length from base.	-/120/120

Notes:

- The formwork is generally removed after the FyreSet mortar has set but may be optionally retained.
- The maximum size FyreBox from the test data was 350 mm × 125 mm and shall remain as such unless further positive test data for larger FyreBox dimensions are made available. The setting for the FyreBox within an aperture in the concrete slab will be increased accordingly up to a maximum FyreBox of 350 mm × 350 mm.
- The FyreBOX was cast into the slab during the test but may be alternatively retrofitted with fire sealants installed along the perimeter annular gaps of the outer casing.

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Table 3 Assessment outcome for PVC conduits

Product	Reference test	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
25 mm rigid PVC conduit	FRT200118 R1.0	120 mm minimum thickness concrete	FyreSet mortar cast within aperture in concrete slab to 100 mm high from bottom of slab. Each pipe service penetration fitted with FyreChoke Micro fire collar on the exposed side.	N/A	-/120/120
25 mm flex PVC conduit				N/A	-/120/120

The variations and outcome of this assessment are subject to the limitations and requirements described in sections 2, 3 and 6 of this report. The results of this report are valid until 28 February 2026.

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Contents

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1. Introduction

This report documents the findings of the assessment undertaken to determine the likely fire resistance level (FRL) of large apertures protected with Trafalgar FyreSet mortar with service penetrations protected with Trafalgar FyreFLEX sealant, FyreBOX, Fyrechoke and TWrap insulation if tested in accordance with AS 1530.4:2014[1] and complying with the general requirements of AS 4072.1:2005[2] for service penetrations.

This assessment was carried out at the request of Trafalgar Group.

The sponsor details are included in Table 4.

Table 4 Sponsor details

Sponsor	Address
Trafalgar Group	26A Ferndell Street South Granville NSW 2142 Australia

2. Framework for the assessment

2.1 Assessment approach

An assessment is an opinion about the likely performance of a component or element of structure if it was subject to a standard fire test.

No specific framework, methodology, standard or guidance documents exists in Australia for doing 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 2019[3].

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 will 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 if the elements were to be tested in accordance with AS 1530.4:2014.

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.

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[1] Standards Australia 2014, Components for the protection of openings in fire-resistant separating elements– Part 1: Services penetrations and control joints, AS 4072.1-2005, Standards Australia, NSW
[2] Standards Australia 2005, 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
[3] Passive Fire Protection Forum (PFPF), 2019, Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence, Passive Fire Protection Forum (PFPF), UK.

2.2 Compliance with the National Construction Code

This assessment report has been prepared to meet the evidence of suitability requirements of the National Construction Code Volumes One and Two – Building Code of Australia (NCC) 2019 Amendment 1[4] under A5.2 (1) (d) and 2016 under specification A2.3, including amendments.

This assessment has been written in accordance with the general principles outlined in EN 15725:2010[5] for extended application reports on the fire performance of construction products and building elements. It also references test evidence for meeting a performance requirement or deemed to satisfy (DTS) provisions of the NCC under A5.4 for fire resistance levels, as applicable to the assessed systems.

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 14 January 2021, Trafalgar Group confirmed that:

- To their knowledge the component or element of structure, which is the subject of this assessment, has 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 that are expected if the system/s were tested in accordance with AS 1530.4:2014.
- The results of this assessment are applicable to fire exposure from below for the assessed floor system.
- This report is only valid for the assessed systems 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).
- 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.
- 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 the expert handling, placing and finishing of the products on site. These variables are beyond the control and consideration of this report.

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[4] National Construction Code Volume One – Building Code of Australia 2019 Amendment 1, Australian Building Codes Board, Australia.
[5] 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.

4. Description of the specimen and variations

4.1 System description

Trafalgar had previously tested the performance of their FyreSet mortar with or without the use of TWrap insulation in protecting service penetrations, in combination with FyreFLEX sealants in concrete floor slabs exposed to fire from below. The tests were conducted in accordance with AS 1530.4:2014 and in compliance with AS 4072.1:2005 in various setups and services such as copper pipes, PVC pipes and conduits, electrical power cables and communication cables.

Trafalgar Group had requested Warringtonfire to assess the various proposed variations to the test setups and the possibility of interchangeability of setups, based on the test data, for the tested common service penetrations, ie. such as same sized copper pipes and cable bundles.

4.2 Referenced test data

The assessment of the variation to the tested system and the determination of the likely performance is based on the results of the fire tests documented in the reports summarised in Table 5. Further details of the tested system are included in Appendix A.

Table 5 Referenced test data

Report number	Test sponsor	Test date	Testing authority
FRT190292 R4.0	Trafalgar Fire	16 January 2020	Warringtonfire Australia Pty Ltd
FRT200118 R1.0	Trafalgar Group	21 May 2020	Warringtonfire Australia Pty Ltd
FRT200255 R1.0	Trafalgar Group	30 September 2020	Warringtonfire Australia Pty Ltd
FRT200256 R1.0	Trafalgar Group	1 October 2020	Warringtonfire Australia Pty Ltd
FRT200257 R1.0	Trafalgar Group	2 October 2020	Warringtonfire Australia Pty Ltd

4.3 Variations to the tested systems

An identical system has not been subject to a standard fire test. We have therefore assessed the systems using baseline test information for similar systems. The variations to the tested systems– together with the referenced standard fire tests – are described in Table 6.

Table 6 Variations to tested systems

Item number	Reference test	Description	Variations
A1	FRT190292.4	The tested specimen consisted of a 175 mm thick concrete slab with an aperture of 800 mm × 500 mm protected with 140 mm deep FyreSETcast-into mortar. Annular gap between the local aperture and FyreSET mortar was protected with FyreFLEX sealant was applied to top side of the penetrations.	It is proposed to assign FRL of -/240/120 applied to cables of the same construction in bundles of up 15× quantity (max 45× cables per cable tray). Cable/bundles 40 mm apart with or with cable tray
A2			N/A
A3			Assign FRL based on cable construction: "Up to 8 × 16mm² 3c+E copper cables -/120/120, 1×180 mm² 3c+E copper cable -/120/90. Cable/bundles 40mm apart with/without cable tray" (reference AS 4072 clause 4.5.1)
A1	FRT200255	The tested specimen consisted of a 120 mm thick concrete slab with an aperture of 800 mm × 800 mm protected with 100 mm deep	-/180/120 FRL assigned for individual specimen, Additional (separate) variation for -/180/180 FRL with additional TWrap length (600mm from the

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Item number	Reference test	Description	Variations
		FyreSETcast-into mortar. Annular gap between the local aperture and FyreSET mortar was protected with FyreFLEX sealant applied to 15 mm depth and on top side of the penetrations. All services were protected with FyreFLEX sealant applied to top side of the penetration and TWRAP insulation wrap. Note that specimen A7 was insulated with FyreWrap.	slab) and/or additional depth of mortar infill. Additional variation to allow penetration in surface mounted mortar for -/120/120 as per FRT200256.
A2			-/240/120 FRL assigned for individual specimen. Additional variation to allow penetration in surface mounted mortar for -/120/120 as per FRT200256. Additional separate variation to remove cable trays (cable only) and allow for FRL -/240/180
A3			-/120/120 FRL assigned for individual specimen
A6			Review mode of failure, copper should not melt before 2 hours in a fire resistance test. Propose variation to assign FRL -/120/120 if the pipe didn't melt early (refer to specimen A7 for data). Additional variation to allow penetration in surface mounted mortar for -/120/120 as per FRT200256.
A7			-/120/120 FRL assigned for individual specimen. Additional variation to allow penetration in surface mounted mortar for -/120/120 as per FRT200256.
A1	FRT200256	The tested specimen consisted of a 120 mm thick concrete slab with an aperture of 450 mm × 450 mm protected with 100 mm high surface mounted FyreSET mortar, surface mounted on 9 mm timber formwork. Along one edge a block wall was constructed to simulate a riser shaft wall. Annular gap between the local aperture and FyreSET mortar was protected with FyreFLEX sealant applied to top side of the penetrations. Services were further wrapped with TWrap to aid in the insulation performance	-/240/180 FRL assigned for individual specimen. Additional variation to allow penetration in use in a back filled mortar system for -/240/180 as per FRT200255.
A2			-/240/180 FRL assigned for individual specimen. Additional variation to allow penetration in use in a back filled mortar system for -/240/180 as per FRT200255.
A3			Variation to include this penetration into mortar systems as installed in FRT200255 (infilled into slab).
A4			-/240/240 FRL assigned for individual specimen, in a slab 175mm thick. Additional Variation to include this penetration into mortar systems as installed in FRT200255 (infilled into slab)
A	FRT200257	The tested specimen consisted of a 120 mm thick concrete slab with an aperture of 600 mm × 300 mm protected with 120 mm deep FyreSET mortar. A 350 mm × 125 mm internal size FyreBOX was cast-in the mortar to	It is proposed to confirm that the FyreBOX, FyreSET and TWrap interface will acheive -/120/120. Service types and their configurations inside the

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Item number	Reference test	Description	Variations
		protect various cable, PEX and copper pipes.	FyreBOX may be approved by others.
A2	FRT200118	The tested specimen consisted of a 120 mm thick concrete slab with an aperture of 800 mm × 600 mm protected with 100 mm deep FyreSET mortar. Services A2 and A3 were protected with FyreCHOKE collar installed on top side of formwork fixed on place. Service A4 was protected with FyreFLEX sealant applied to top side of the penetrations and 50 mm depth. Further the service was wrapped with 1200 mm length of TWrap and a second layer of 300 mm.	-/120/120 FRL assigned for individual specimen. Additional variation to allow penetration in surface mounted mortar for -/120/120 as per FRT200256.
A3			-/120/120 FRL assigned for individual specimen. Additional variation to allow penetration in surface mounted mortar for -/120/120 as per FRT200256.
A4			-/120/120 FRL assigned for individual specimen. Additional variation to allow penetration in surface mounted mortar for -/120/120 as per FRT200256.

4.4 Purpose of the test

The purpose of the test in accordance with AS 1530.4:2014 is to determine the fire resistance performance of the Trafalgar FyreSet mortar and TWrap insulation in sealing and protecting service penetrations in floors, and to meet with AS 4072.1:2005.

AS 1530.4:2014 sets out the methods of testing to determine the fire resistance of elements of construction when subjected to standard fire exposure conditions.

AS 4072.1:2005 sets out the minimum requirements for the construction, installation and application of fire resistance tests to sealing systems around penetrations through building elements that are required to have a fire resistance level (FRL) or, if applicable, a resistance in the incipient spread of fire.

4.5 Schedule of components

Table 7 outlines the schedule of components for the assessed systems subject to a fire test, as referenced in Appendix A.

Table 7 Schedule of components of assessed systems

Item	Description	
Separating element		
1.	Item name	Concrete floor slab
	Product description	120 mm thick concrete slab
Sealant		
2.	Item name	Sealant
	Product name	Trafalgar FyreFlex sealant
	Density	1600 kg/m³ (provided by test sponsor)
Wrap		
3.	Item name	TWrap
	Product name	Trafalgar TWrap
	Fibre wool density	132 kg/m³
	Description	25 mm thick ceramic mineral fibre blanket faced with aluminium foil supplied in a 300 mm wide roll.
4.	Item name	CWrap

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Item	Description		
	Product name	Trafalgar CWrap	
	Fibre wool density	119 kg/m³	
	Description	25 mm thick ceramic mineral fibre blanket faced with aluminium foil supplied in a 300 mm wide roll.	
5.	Item name	FyreWrap	
	Product name	Trafalgar FyreWrap Elite 1.5	
	Fibre wool density	114 kg/m³	
	Description	38 mm thick mineral fibre blanket faced with aluminium foil supplied in a 300 mm wide roll.	
Mortar			
6.	Item name	Mortar	
	Product name	Trafalgar FyreSet™ FR mortar	
	Material	Lightweight cement mortar	
	Density	850 kg/m³	
Fire box			
7.	Item name	Fire box	
	Product name	Trafalgar FyreBOX ™ cast-in 350 × 125 – generally retrofitted in existing concrete slabs with fire sealants applied in the annular gaps along the perimeter of the outer casing.	
	Fire box details	Internal box width	350 mm
		Internal box length	125 mm
		External box width	368 mm
		External box length	144 mm
		Overall box width (including flange)	450 mm
		Overall box length (including flange)	225 mm
		Overall box height	380 mm
		Outer shell thickness	1.1 mm thick mild steel
	Intumescent details	Number of layers	One layer made from four nominal 1.8 mm thick layers on all four internal sides
		Width	340 mm
		Height	100 mm
		Overall thickness	7.3 mm
		Density	1201 kg/m³
	Intumescent foam details	Number of layers	1
		Overall width	355 mm
		Overall height	130 mm
		Thickness	43 mm
		Density	69 kg/m³
	Product name	External casing key flange	
	Flange profile	20 mm × 30 mm × 10 mm ‘z’ profile	
	Overall size	Overall width	320 mm

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Item	Description		
		Overall height	30 mm
		Length	33 mm
		Outer shell thickness	1 mm thick galvanised mild steel
Fire collar			
8.	Item name	Fire collar	
	Product name	Trafalgar FyreChoke™ Conduit Micro Fire Collar- 25	
	Collar details	Outer diameter	37 mm
		Inner diameter	26 mm
		Height	52 mm
		Outer shell thickness	0.5 mm thick mild steel
	Intumescent details	Number of layers	Two layers
		Average width	50 mm
		Average thickness	2 mm
		Average density	1249 kg/m³
	Installation	The fire collar must be installed around the plastic pipe services onto the formwork for the mortar before the mortar was poured. The fire collar must be secured to the formwork with fixing through the flanges.	
Backing Rod			
9.	Item name	Backing rod	
	Size	Ø10 mm × 100 mm (cut to size)	
	Description	Open cell backing rod or closed cell backing rod	
Services			
10.	Item name	D1 power cable group	
	Cable sizes	Cable description	O.D
		1 × Electra cables 2014 X-90 electric cable 0.6/1kV XLPE16300 630 mm² Cu	41 mm
		1 × Prysmian L Electrical cable 0.6/1kV X-90 3C × 185 mm² + E 70 mm²	52 mm
		3 × Advance cables 2017 V90 Electrical cable 450/750V 6 mm² 3C+E	13 mm
		8 × WW VIPERCON Electric cable 3C + E 16 XLPE / PVC 5V90 AS/NZS 5000.1 0.6/1kV 2019 1016 UA	18 mm
11.	Item name	D2 communication cable group	
	Product name	60 × Prysmian DW Maxtel CAT 3 50 PR internal telephone 0.5 mm T50P I J/N 65048/C 08/17	
	Size	Width (mm)	Height (mm)
		18	11
12.	Item name	Copper pipe manufactured in accordance with AS 1432	
	Sizes	DN 32 type B	Outer diameter: 31.75 mm
			Inner diameter: 29.31mm
			Thickness: 1.22 mm
		DN 50 type B	Outer diameter: 50.8 mm
			Inner diameter: 48.36 mm

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Item	Description		
			Thickness: 1.22 mm
		DN 80 type B	Outer diameter: 76.2 mm
			Inner diameter: 72.94 mm
			Thickness: 1.63 mm
		DN 100 type B	Outer diameter: 101.6 mm
			Inner diameter: 98.34 mm
			Thickness: 1.63 mm
13.	Item Name	PVC rigid conduit	
	Sizes	O.D 25 mm × 2 mm (t)	
14.	Item name	PVC flexi conduit	
	Sizes	O.D 25 mm × 1.3 mm (t)	
15.	Item name	Up to 600 cable tray	
	Product name	Ezystrut ET3 steel cable tray– ET3 600G	
	Overall size	Width	625 mm
		Height	53 mm
		Thickness	0.7 mm thick galvanised steel
Fixings			
16.	Item name	Masonry anchors	
	Product description	Ø6 mm × 40 mm long masonry anchors	
17.	Item name	Z angles	
	Size	50 × 50 × 90 mm × 1mm thick	
	Material	Galvanised steel	
18.	Item name	Cable ties	
	Product description	4.6 mm stainless steel cable ties	
19.	Item name	Foil tape	
	Product description	Aluminium reinforced foil tape	
20.	Main aperture size	800 mm wide × 800 mm long	
Local fire stopping protection			
21.	Cables	FyreFLEX sealant was applied to top side of the penetration	
22.	Metal pipes	FyreFLEX sealant was applied to top side of the penetration	
23.	PVC conduits	FyreFLEX sealant was applied to top side of the penetration	

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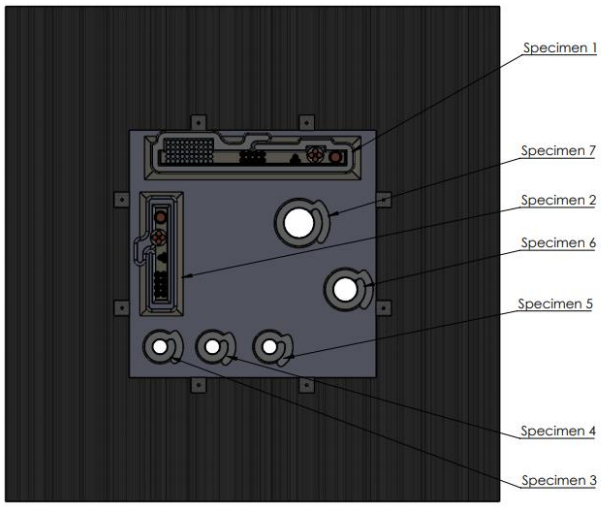
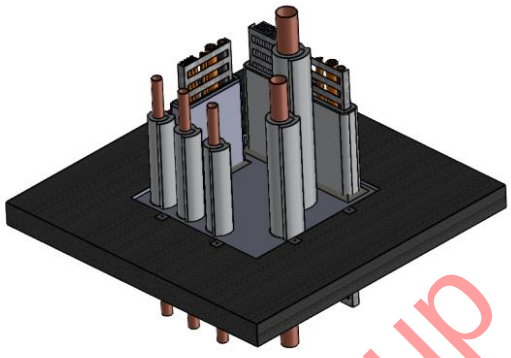
Figure 1 to Figure 4 show the assessed systems.





Specimen	Opening Size	Firestopping	Services
1	Cast-in	Fyreset Mortar	600mm Cable tray with Appendix D1 and Comms D2 cables with Twrap
2	Cast-in	Fyreset Mortar	300mm Cable tray with Appendix D1 cables with Twrap
3	70	Fyreset Mortar & Fyreflex sealant	DN50 Copper pipe with TWrap
4	70	Fyreset Mortar & Fyreflex sealant	DN50 Copper pipe with CWrap
5	70	Fyreset Mortar & Fyreflex sealant	DN50 Copper pipe with FyreWrap
6	100	Fyreset Mortar & Fyreflex sealant	DN80 Copper pipe with TWrap
7	120	Fyreset Mortar & Fyreflex sealant	DN100 Copper pipe with FyreWrap

Figure 1 Plan view of penetration system components on the unexposed side (drawings provided by Trafalgar group- specimens 1 to 7 correspond with specimens identified as A1 to A7 respectively in the test report.)

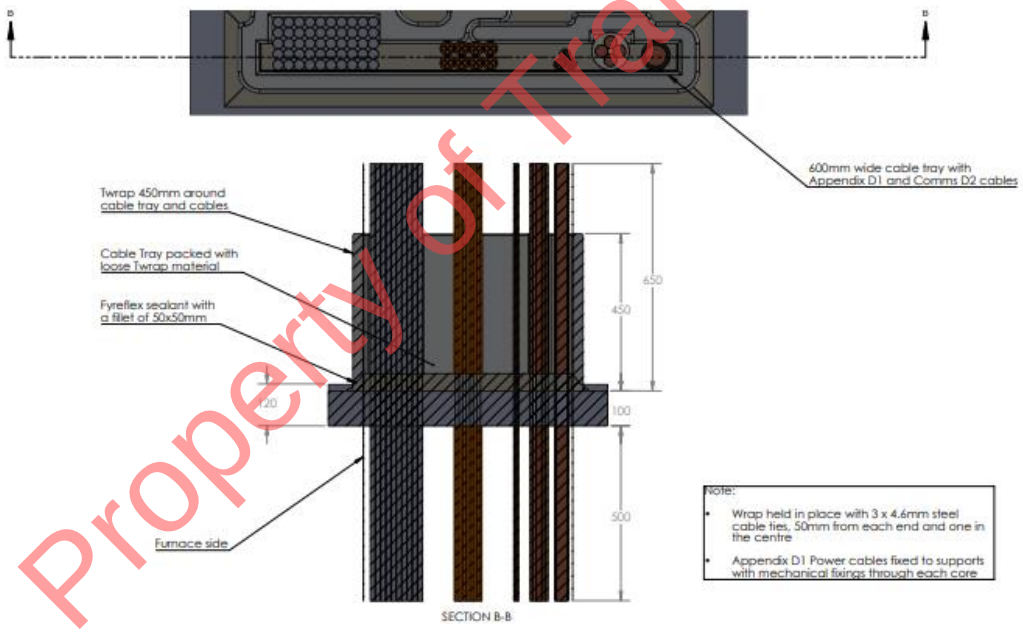


Figure 2 Details and sectional view across specimen 1

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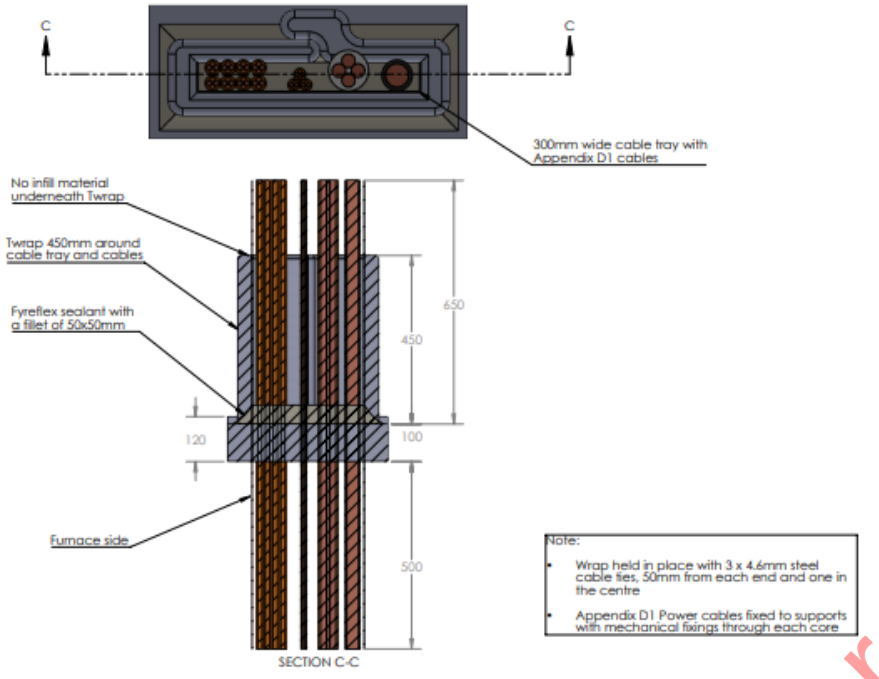

Figure 3 Details and sectional view across specimen 2

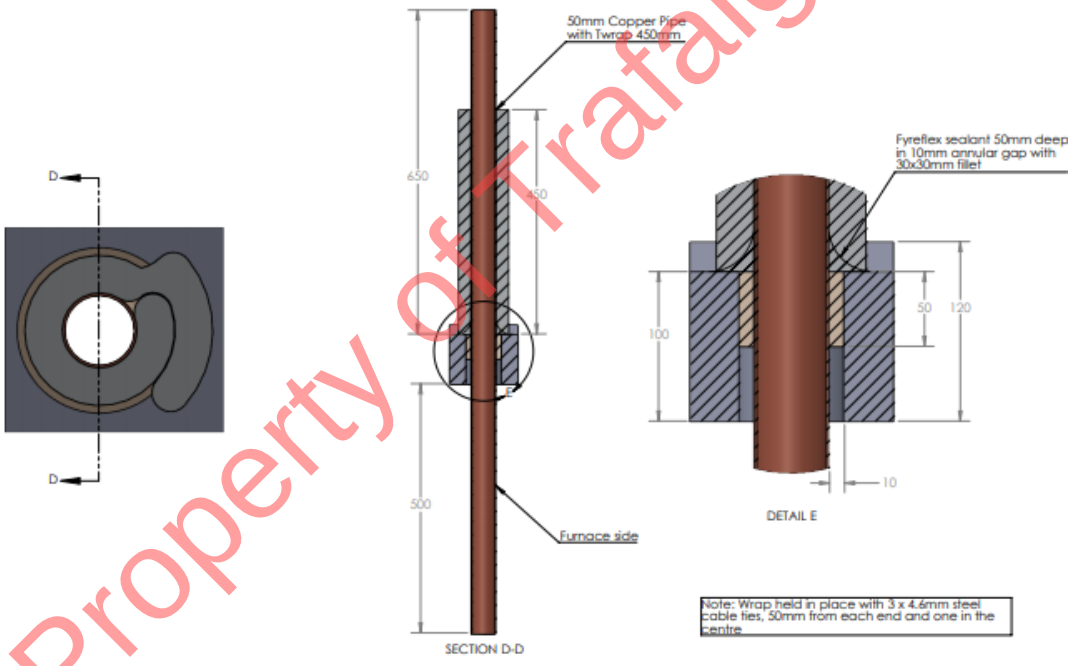

Figure 4 Details and sectional view across specimen 3

Property of Trafalgar Group

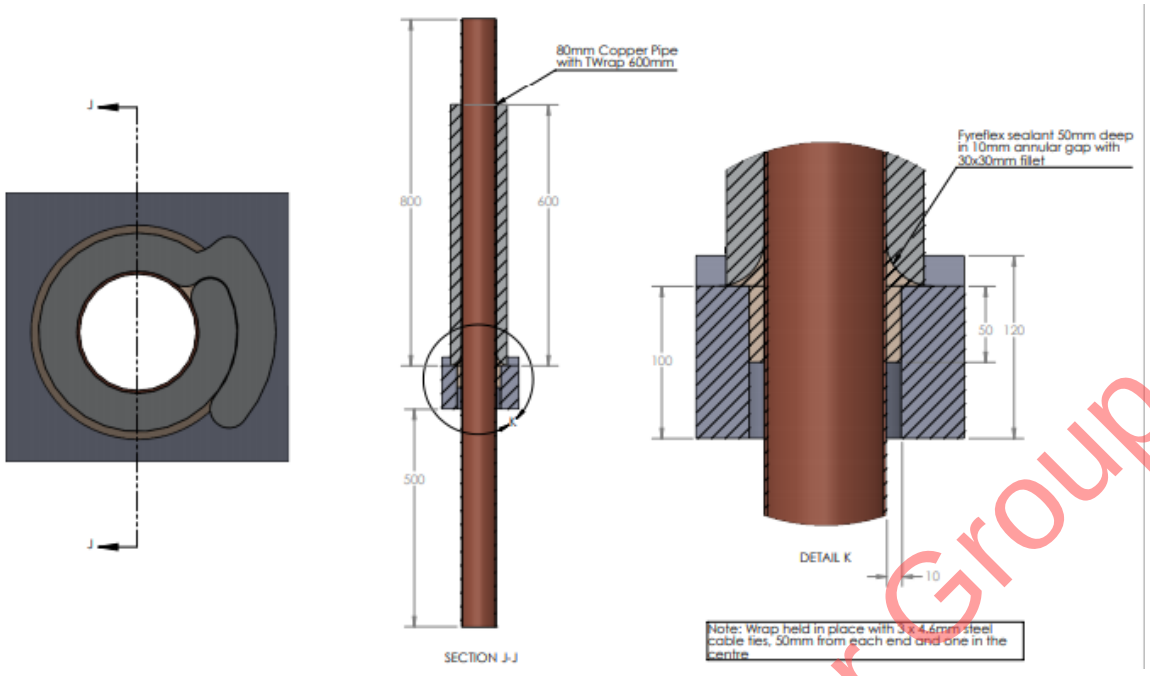

Figure 5 Details and sectional view across specimen 6

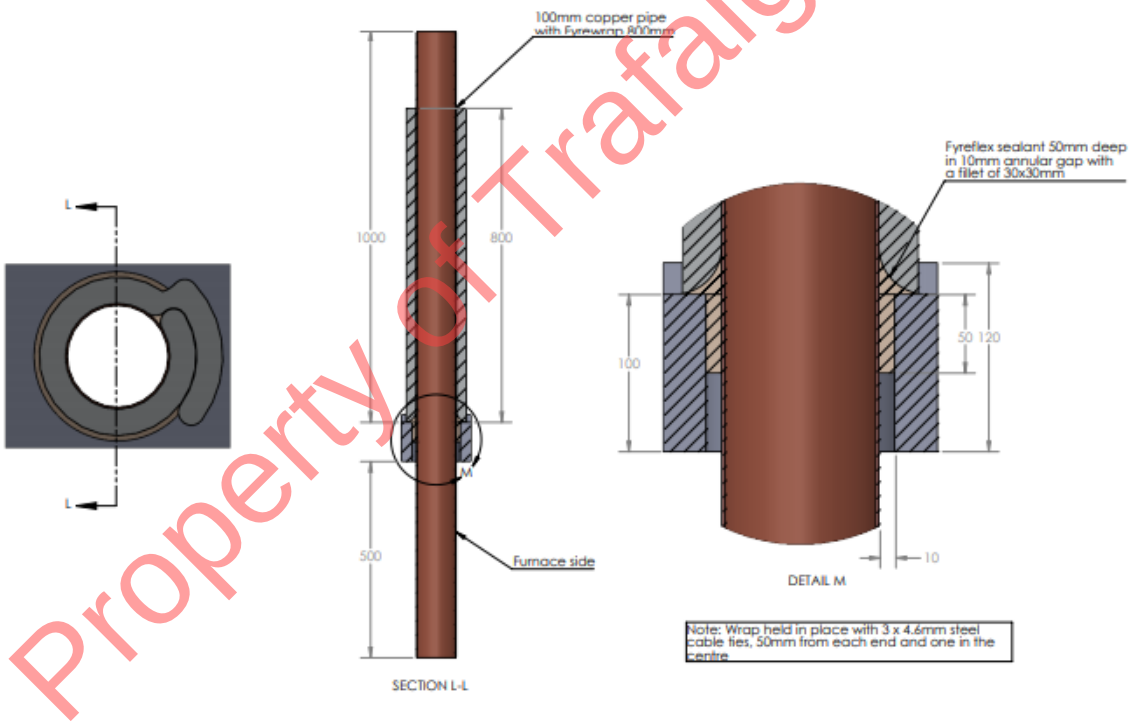

Figure 6 Details and sectional view across specimen 7

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5. Assessment of variations to tested specimens and systems.

5.1 Description of variation

There are a number of variations in each of the test reports as requested by the Trafalgar Group, some of which are related to specimens grouped together within a tested system. They were assigned a lower common FRL that may not reflect on the individual performance of each of the specimens within the same system.

The variations requested by the Trafalgar Group are as indicated in the previous section in Table 6.

5.2 Methodology

The method of assessment used is summarised in Table 8.

Table 8 Method of assessment

Assessment method	
Level of complexity	Intermediate assessment – most of the assessment was simple with interpolation and correlation of data, however, there were some technical discussions based on the likely behaviour of the individual components when exposed.
Type of assessment	Qualitative– interpolation Comparative

5.3 Assessment

In FRT190292 R4.0 the separating element was a 4500 mm long, 3500 mm wide and 175 mm thick concrete floor slab. There were 10 penetration systems installed in the concrete slab (from A to J) and the service penetration of interest for this assessment is system A.

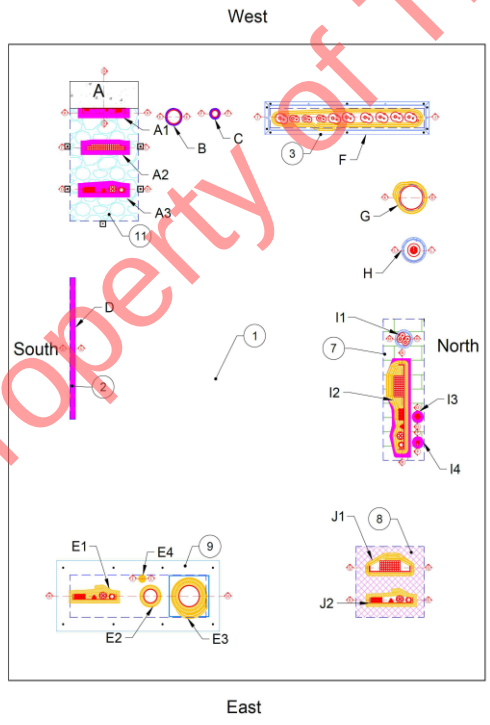

Figure 7 Plan view of tested specimens on the unexposed side from FRT190292 R4.0

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System A comprised a 500 mm wide × 800 mm long aperture in the 150 mm thickness concrete slab with 100 mm thick FyreSet mortar filling the opening as the main fire-resistant barrier. System A incorporated 3 services penetrations through the FyreSet mortar. They are specimens A1, A2 and A3.

A1 comprised a 350 mm wide cable tray with 15 × CAT 6 cables, 15 × fire alarm TPS cables and 15 × 2C+E 2.5 mm² TPS cables. The three services were each bundled together and secured to the cable tray with steel cable ties. The services along with the cable tray protruded nominally 500 mm from the unexposed side of the main fire-stopping protection and nominally 500 mm from the exposed side of the separating element.

A2 comprised a 350 mm wide cable tray with 1 × D2 communication cable A3 comprised a 350 mm wide cable tray with 1 × D1 power cable.

5.3.1 Specimen A1

The thermocouples for specimen A1 did not register integrity or insulation failure for more than 120 minutes or integrity for 240 minutes. However, due to the other specimens installed within the common penetration failing in insulation early, the specimen was assigned an FRL of -/120/ 60. The variation to reassign the tested specimen for FRL of -/240/120 is therefore justifiable.

5.3.2 Specimen A2

No change to assigned FRL-/120/60.

5.3.3 Specimen A3

The early failure in insulation occurred in the 630 mm² D1 power cable bundle in 77 minutes was followed by the 185 mm² for more than 90 minutes with the 8 × 16 mm² lasting beyond 120 minutes. In accordance with AS 4072.1 Clause 4.5.1 the Testing Laboratory can reassign the remaining cable bundles accordingly, in isolation, from the early failure in the larger D1 cable.

5.4 Assessment of specimens tested in FRT200257 R1.0

The test was conducted on a 1760 mm wide × 1200 mm long × 120 mm thick concrete floor slab. Three apertures were cut into the slab with dimensions, 600 mm wide × 300 mm long, 300 mm wide × 300 mm long and Ø170 mm for the services installations.

The penetration systems were A, B and C.

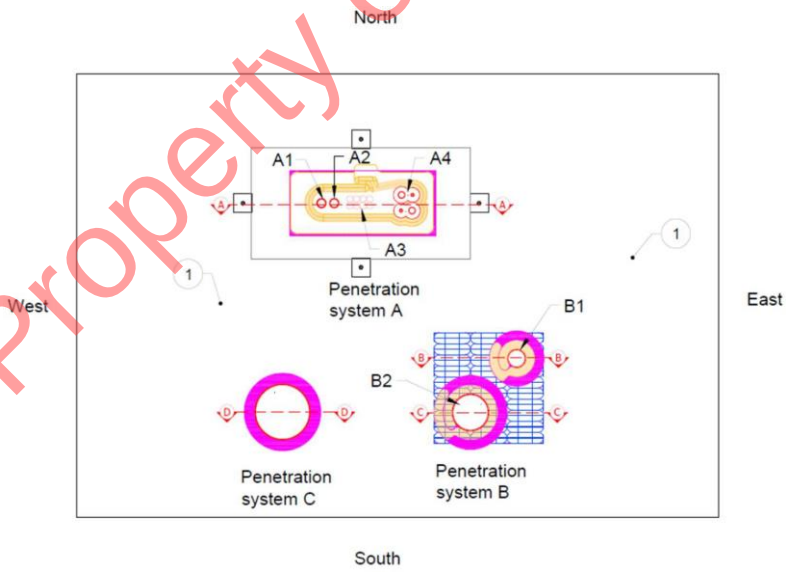

Figure 8 Plan view of the tested specimen from FRT200257 R1.0

Property of Trafalgar Group

5.4.1 System A

System A incorporated a Fire Box fitted into the penetration and the services penetrating the box, consisted of:

- A1 was a Ø25 Xa/Al/PE pipe.
- A2 was a Ø25 mm PE-Xa pipe.
- A3 comprising 8 × 16 mm² 3C+E power cables.
- A4 comprising 1 × 3/8 + 3/4 FR pair coil with 13 mm insulation and 1 × 1/4 + 3/8 FR pair coil with 13 mm insulation.

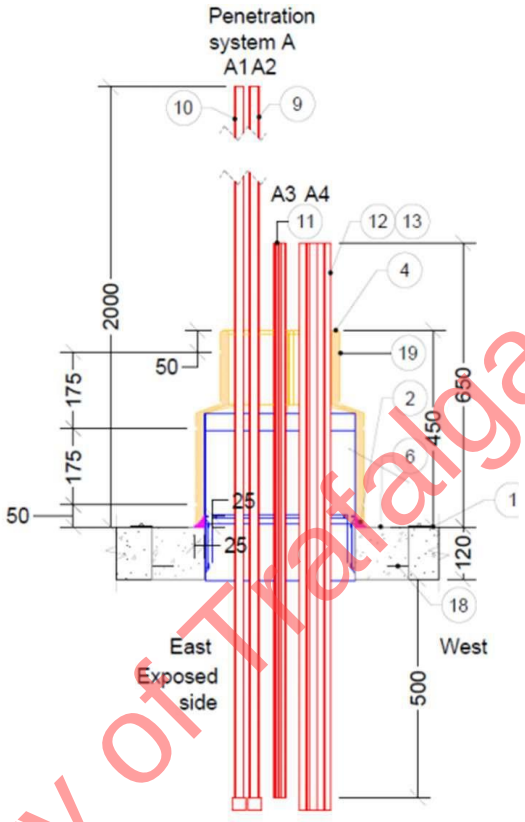

Figure 9 Cross section of FyreBox in penetration system A in FRT200257 R1.0

From the test data it appears that the FyreBox containing the intumescent strips, with FyreFlex sealant applied between the base of the FyreBox and the annular strip of FyreSet mortar all around the FyreBox together with TWrap at the interface of the service penetrations. The mortar provides an equivalent substitute to the concrete slab and matching the baseline FRL of -/120/120. The temperature graphs indicate that the system has the ability to hold down the temperature rise to within the limits of the test standard on the unexposed side for up to the period of failure in insulation or integrity of at least 120 minutes. It would also mean that the system will perform for at least 120 minutes in a concrete slab penetration of equal or greater than 120 mm thickness.

The results would provide a baseline membrane for penetrations in the system for any other service penetrations that were proven to maintain an FRL of up to -/120/120, with the system installed within a concrete slab of equal or greater than 120 mm thickness. This is on the condition that there should be allowance for placement of adequate intumescent foam strips to provide cover for the service penetrations within the box, ie. the ratio of intumescent to penetration area should be maintained to ensure an adequate fire seal (with reference to data from previous positively tested services installed within the FyreBox).

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5.5 Assessment of specimens tested in FRT200256 R1.0

The test was conducted on a 1760 mm wide × 1200 mm long × 120 mm thick concrete floor slab. An 800 mm square aperture was cut out and backfilled over the opening with FyreSet mortar from the unexposed side of the slab to a 100 mm height.

There were 2 penetration systems, namely A and B. System A consisted of:

- A1 comprising a 300 mm cable tray with a D1 group of power cables. The services were insulated on the unexposed side with single layer of TWrap to height of 450 mm above the concrete slab surface and on top of the FyreFlex sealant applied over the annular gap of the slab penetration (around the cable tray and in between the cables).
- A2 comprising a bundle of cables consisting of 10 × TPS cables, 10 × CAT6 cables and 10 × Fire alarm cables. A 50 mm fillet of FyreFlex sealant was applied at the penetration on the unexposed side around the cables.
- A3 comprising a DN 50 type B copper pipe. FyreFlex sealant was applied in the aperture at the annular gap to a depth of 50 mm from the unexposed side and finished with a 30 mm × 30 mm fillet on top. The pipe was insulated with a single layer of TWrap to 450 mm above the slab and on top of the sealant.

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- A4 comprising a NB 100 MD steel pipe. FyreFlex sealant was applied in the aperture at the annular gap to a depth of 50 mm from the unexposed side and finished with a 30 mm × 30 mm fillet on top. The pipe was insulated with a single layer of TWrap to 450 mm above the slab and on top of the sealant.

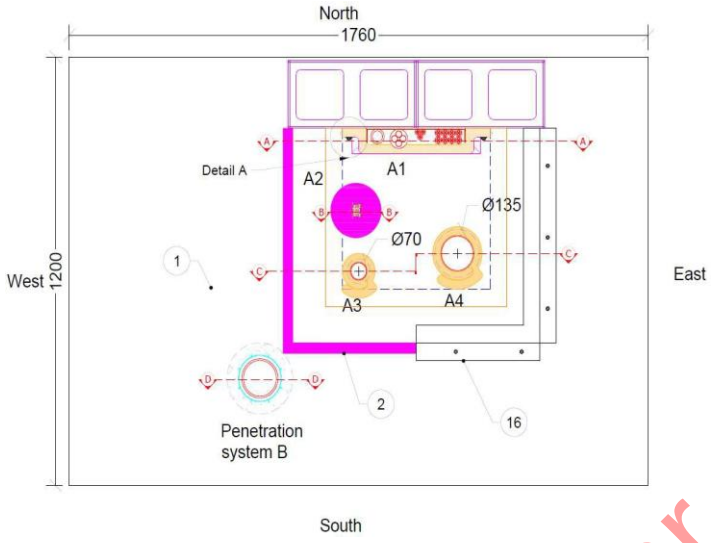

Figure 10 Plan view of tested specimens from FRT200256 R1.0

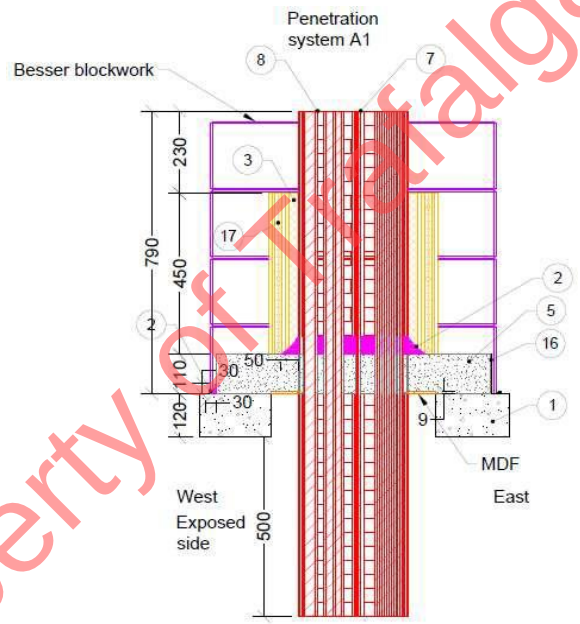

Figure 11 Sectional view across specimen A1 from FRT200256 R1.0

5.5.1 Specimen A1

Specimen A1 was assigned an FRL of -/240/120 even though the actual performance for the particular service penetration performed up to 241 minutes in integrity and 210 minutes in insulation as the system A was assigned the lowest of the FRL's within the group of penetrations tested in System A. Specimen A1 could therefore be assessed with an FRL of -/240/180.

5.5.2 Specimen A2

Specimen A2 which performed up to 241 minutes in integrity and 210 minutes in insulation could be similarly assessed with FRL -/240/180.

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5.5.3 Specimen A3

Specimen A3 remains as tested and assigned with FRL -/240/120.

5.5.4 Specimen A4

Specimen A4 which performed to at least 241 minutes in integrity and insulation without failure could therefore be assessed with FRL -/240/240.

5.5.5 Added specimen copper pipe

The added pipe for assessment is a DN 32 type B copper pipe to be installed in the same manner as specimen A3.

Based on the test data specimen A3, a DN 50 type B copper pipe with 450 mm length of TWrap insulation installed on the unexposed side performed to an FRL of -/240/120, the DN 50 copper pipe, a much small sized pipe, would have at least performed to at least 120 minutes in insulation with 450 mm length of TWrap insulation. With regards to the integrity performance, it is considered that as the larger pipe performed to 240 minutes in integrity, the DN 32 copper would likely perform to at least 120 minutes, ie. the rated FRL of the 120 mm concrete slab if tested in accordance with AS 1530.4:2014.

In addition, if the TWrap were to be reduced to 300 mm in length, the insulation performance will likely be reduced proportionally. As assessed in report FAS200424 CA1.0 to the Trafalgar Group on 29 October 2020, the insulation performance would likely be downgraded to 90 minutes. It would likely perform to an FRL of -/120/90 installed in a 120 mm minimum thickness concrete floor slab in the same manner as specimen A3.

5.6 Assessment of specimens tested in FRT200255 R1.0

The test was conducted on a 1760 mm wide × 1200 mm long × 120 mm thick concrete floor slab. An 800 mm square aperture was cut out and backfilled with FyreSet mortar from the exposed side of the slab to a 100 mm depth. There were 7 services penetrations (A1 to A7) made after the FyreSet mortar had set. The main fire stopping system performed for 241 minutes with no integrity failure and failed insulation at 210 minutes. The system, however, had been downgraded due to the melting of the exposed end cap of specimen A6 resulting in venting on the exposed end and having to be capped off in 125 minutes. The service failed insulation at 117 minutes when the cap melted. This resulted in all tested services to be assigned the same FRL of -/120/90. The schedule of components and installation details are in section 4.5.

The services were as outlined below:

- A1 comprising a 600 mm cable tray with a D1 group of power cables and a D2 group of communication cables. The services were insulated on the unexposed side with single layer of TWrap to height of 450 mm above the concrete slab surface and on top of the FyreFlex sealant applied over the annular gap of the slab penetration (around the cable tray and in between the cables).
- A2 comprising a 300 mm cable tray with a D1 group of power cables. The services were insulated on the unexposed side with single layer of TWrap to height of 450 mm above the concrete slab surface and on top of the FyreFlex sealant applied over the annular gap of the slab penetration.
- A3, A4 and A5 each comprising a DN 50 type B copper pipe. A3 was insulated on the unexposed side with 450 mm length of single layer TWrap, A4 was insulated with 450 mm length of single layer CWrap and A5 was insulated with 450 mm length of single layer FyreWrap. The annular gaps of all services penetrations were protected with FyreFlex sealant.
- A6 comprising a DN 80 type B copper pipe. The service was insulated with a 600 mm length single layer of TWrap from the surface of the slab up on the unexposed side and on top of the FyreFlex sealant around the pipe penetration.

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- A7 comprising a DN 100 type B copper pipe. The service was insulated with a 800 mm length single layer of FyreWrap to 800 mm from the surface of the slab up on the unexposed side and on top of the FyreFlex sealant around the pipe penetration.

5.6.1 Specimen A6

It was unusual for the end cap of specimen A6, a DN 80 copper pipe to have melted in 117 minutes of exposure when a similar copper pipe in specimen A7, a DN 100 copper pipe, maintained integrity for up to about 150 minutes. Specimen A6 is therefore expected to maintain integrity for at least more than 120 minutes. It appears that there could likely have been a bad batch or sub-standard end cap fitted. Insulation performance would be similarly affected and would have performed to at least 120 minutes based on the performance of specimen A7, giving a revised FRL of -/120/120.

5.6.2 Specimen A7

Specimen A7 performed up to 146 minutes in insulation and for 151 minutes without integrity failure. With the assessment of A6 to be reassigned with an FRL of -/120/120, specimen A could be similarly reassigned with an FRL of -/120/120.

5.6.3 DN 32 type B copper pipe

A DN 32 type B copper pipe was assessed in FAS200424 CA 1.0, dated 29 October 2020 and issued by Warringtonfire, based on the test data from FRT200118 and FRT200255. The assessment is as follows-

There were two specimens in FRT200118 namely:

- Service penetration A5 comprising a 100 mm NB copper pipe with 600 mm length TWrap insulation
- Service penetration A6 comprising a 50 mm NB copper pipe with 300 mm length TWrap insulation

Both specimens penetrated a 100 mm deep FyreSet mortar pad installed in an opening in a 120 mm thick concrete slab. A 50 mm depth of FyreFlex sealant with 13 mm fillet was applied between the pipe and opening in the FyreSet mortar.

A5 (100 mm NB pipe) performed to 66 minutes in insulation and A6 (50 mm NB pipe) to 72 minutes. Both pipes had no integrity failure for more than 120 minutes.

Using the data from the test at the interface for the 100 mm and the 50 mm pipe, it is noted that there is an average temperature difference of 33°C between the two services after 60 minutes exposure. Using the reasoning that the 100 mm NB copper pipe has 4 times the cross sectional area of the 50 mm NB pipe, the amount of heat flowing through the 100 mm NB pipe at the penetration would be roughly 4 times that of the 50 mm NB pipe. With the same reasoning, the 32 mm NB pipe is 2.44 times smaller in bore area and therefore would likely have a heat flow rate 2.44 times less. The interpolated figures for the 32 mm NB pipe would result in a reduction of 20°C from the temperatures recorded for the 50 mm NB pipe.

We can conservatively, say by using half the difference, the likely temperature at the 32 NB service pipe or TWrap would be 10°C lower throughout then the test 50 mm NB pipe.

After 90 minutes of exposure, the expected temperatures on the TWrap at the interface would likely be 194°C and 195°C at the service pipe which makes it right on the line in terms of pass/fail for 90 minutes exposure.

The results are too close to call at the service end as the margin of error is higher towards the end of the TWrap insulation. It is therefore recommended that the TWrap insulation be extended by at least 100 mm to provide more confidence in assessing the insulation performance.
The data from a repeated test of the same specimen in test FRT200255 was analysed but with the unexposed end of the pipe capped mid-way through instead of being open as required by AS 1530.4:2014, it resulted in an FRL being applied less than the required 120 minutes. This was due to the fact that the surrounding penetration service caused flaming and the pipe services had to be capped at the unexposed side. However, the results were still applicable for up to 90 minutes.

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Penetration A3 in test FRT200255 consisted of a 50 mm NB copper pipe penetrating a 100 mm depth of FyreSet mortar pad installed in an opening in a 120 mm thick concrete slab. A 50 mm depth of FyreFlex sealant with 30 mm fillet was applied between the pipe and opening in the FyreSet mortar. The pipe was insulated with 450 mm length of TWrap.

After 60 minutes exposure the temperature of specimen A3 on the TWrap at the interface was 106°C. As there was an issue with localised adjacent flaming the temperature at 90 minutes could only be extrapolated and is calculated at [(106-19)/60 × 90] + 19 = 149.5°C. The expected temperature at the service pipe after 90 minutes exposure is interpolated between 145°C at 120 minutes and 128°C at 60 minutes or 137.5°C at 90 minutes. This compares with 205°C at the service after 90 minutes with 300 mm TWrap or a temperature rise of 68°C over a 150 mm reduction of length of TWrap.

It is expected that the 50 mm NB copper service pipe would have a temperature of not more than 205°C after 90 minutes of exposure with 300 mm TWrap. Allowing for a 10°C reduction in temperature as calculated earlier in section 1.2, the predicted temperature of an equivalent 32 mm NB copper pipe with 300 mm TWrap after 90 minutes of exposure would be 195°C or 176°C above ambient.

The interface temperature at the TWrap with 32 NB copper pipe would also perform better than the tested 50 mm NB copper which incidentally has already complied with the required performance for 90 minutes of exposure. The FRL of the nominal bore (NB) or DN 32 type B copper pipe would likely be -/90/90 if tested in accordance with AS1530.4:2014.

However, if the DN 32 copper pipe were to be insulated with same TWrap length ie. 450 mm and sealed with FyreFlex at the interface it would have performed to the same performance level as the tested specimen DN 50 copper pipe, i.e FRL of -/240/120.

5.6.4 Specimen A1

With the correction made to the system performance ie. with the reassigning of A6 with a revised FRL, specimen A1 would be assigned with the FRL based on the performance as tested ie. FRL -

/240/120. It is not possible to extrapolate the likely performance of specimen A1 with added length of insulation TWrap without additional data to provide correlation. This is mainly due to fact that the cables are insulated and the insulation may melt during the test making it difficult to extract any meaningful data for correlation and in particular some extrapolation with confidence. The variation in performance of the specimen with surface mounted mortar as in FRT200256 would likely be acceptable.

At closer look the insulation performance of all the cables except the 8 × 16 mm^2 3C + E, they performed for at least 180 minutes. The cables could therefore be re-assigned individually FRL to -/240/180 except for the 8 × 16 mm^2 3C + E with FRL of -/240/120. It is also noted that the 8 × 16 mm^2 3C + E cable was installed alongside the large bundle of communication D2 cables on the common tray. Comparing the results from specimen A2, where the same 8 × 16 mm^2 3C + E cable performed to 180 minutes in insulation without the D2 bundle beside it, it is considered that the 8 × 16 mm^2 3C + E cable would have achieved FRL of -/240/180 if it wasn't affected by the D2 cable bundle.

5.6.5 Specimen A2

Specimen A2 performed to 241 minutes without integrity failure and up to 165 minutes in insulation and can be similarly reassigned as per A1 to FRL -/240/120.

If the cable tray were to be removed, it would appear that the performance would have been to those temperatures recorded at the specimens as long as the cables were provided with equivalent and adequate supports. Without further testing, it is conservatively considered that the cables in the same group attached to the cable tray would have performed to the highest temperature recorded in the cables, i.e the least performing, if the cable tray were to be removed. The insulation performance would likely be for 184 minutes recorded in the larger power cable bundle.

It is considered that the FRL for specimen A2 could be reassigned to -/240/180 without cable tray but that the cables must be adequately supported independently in the absence of the cable tray.

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5.6.6 Specimen A3

Specimen A3 performed to 129 minutes without integrity failure and up to 126 minutes in insulation and can be similarly reassigned to FRL -/120/120.

5.7 Assessment of specimens tested in FRT200118 R1.0

The separating element was a 1760 mm wide, 1200 mm long and 120 mm thick concrete floor slab. There was only one penetration system in the concrete slab with an aperture of 800 mm wide × 600 mm long. The system consisted of 6 services penetrations designated from A1 to A6. The services were:

- A1 comprising a 625 mm wide cable tray with a D1 power cable bundle and a D2 power cable bundle.
- A2 comprising a Ø25 mm flexible PVC conduit.
- A3 comprising a Ø25 mm rigid PVC conduit.
- A4 comprising a DN 150 type B copper pipe.
- A5 comprising a DN 100 type B copper pipe.
- A6 comprising a DN 50 type B.

The aperture in the separating element was sealed with 100 mm depth of FyreSet mortar measure from the exposed side, forming a secondary separating element within the penetration in the concrete slab.

After the mortar was set the 6 services penetrations were made with each service penetration protected by FyreFlex sealant along the annular gap on the unexposed side and insulated accordingly with TWrap for the copper pipes and the cable tray and cable bundles. Both PVC pipe specimens A2 and A3 were fitted with FyreChoke fire collars on the exposed side.

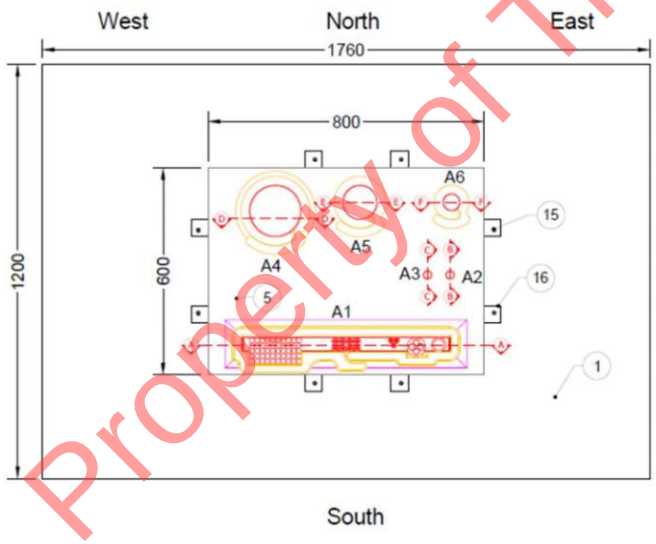

Figure 12 Plan view of tested specimens in FRT200118 R1.0

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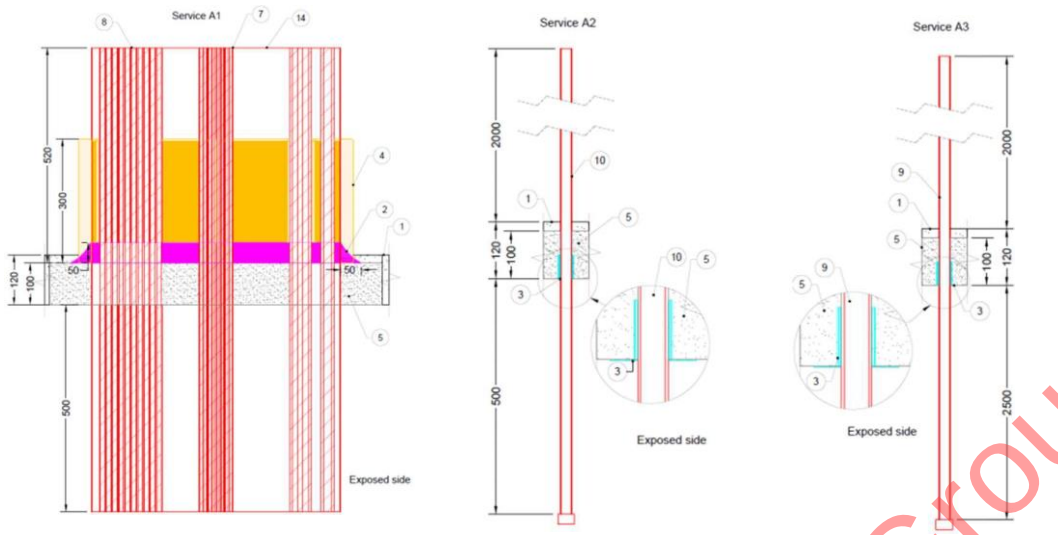

Figure 13 Cross sections A-A, B-B and C-C from FRT200118 R1.0

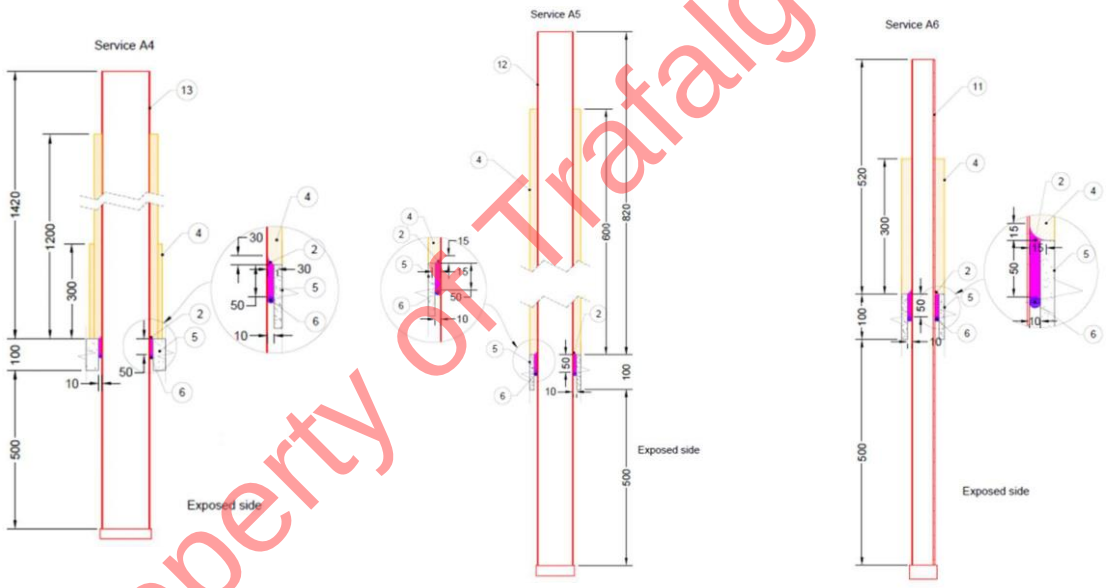

Figure 14 Cross sections D-D, E-E and F-E from FRT200118 R1.0

The overall specimen system performance was affected by the failure in specimen A1 which failed insulation in 61 minutes and integrity at 118 minutes with a cotton pad test, resulting in the tested specimens being assigned the base FRL of -/90/60.

5.7.1 Specimen A1

Specimen A1 failed early in insulation and integrity resulting in an FRL of -/90/60.

5.7.2 Specimens A2 to A6

Specimens A2, A3 and A4 performed much better with no insulation failure for more than 120 minutes. The temperature graphs of specimens A2, A3 and A4 did not show signs of integrity failure with no spikes until past 130 minutes and would have attained integrity and insulation performance for 120 minutes.

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Specimen A3, being in close proximity to the flaming around the services in A1, was deemed to have failed integrity at the same time as A1. If specimen A1 were to be remote from A3, the integrity performance of A3 would have been at least 120 minutes.

Specimens A2, A3 and A4 would therefore have likely performed to an FRL of -/120/120 if tested in accordance with AS 1530.4:2014.

Specimens A5 and A6 were similar to A1 and will remain with the assigned FRL of -/90/60.

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5.8 Overview of the assessed systems

The outcome of the assessment of the various services penetrations could be collated collectively and grouped into three categories, namely:

- Electrical and communication cables and cable bundles
- Pipe services
- PVC pipes

Table 9 Summary of assessment of electrical cable services penetrations

Product	Reference test	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
15 × CAT6, 15 × TPS and 15 × Fire alarm cables	FRT190292 R4.0	Tested with 120 mm concrete slab Recommended 150 mm min. concrete slab for optimum performance	100 mm deep FyreSet mortar within the aperture and 40 mm fillet (30 mm for the comm. cable bundle) of FyreFlex sealant around the penetrations on top of the slab.	N/A	-/240/120
D2 comm. cables				N/A	-/120/60
D1 power cables- 1 × electrical 3C × 185 mm^2 Cu + E 1 × electrical 1C × 630 mm^2 Cu + E 3 × electrical 3C × 6 mm^2 Cu + E 3 × electrical 16 mm^2 Cu				N/A	-/120/60 for the large 630 mm^2 cable, the rest reassigned- -/120/90 for the 185 mm^2 Cu + E and -/120/120 for the remainder
D1 power cables- 8 × 16 mm^2 3C + E	FRT200257 R1.0		350 mm × 125 mm FyreBox cast in 120 mm thick 600 mm × 300 mm FyreSet mortar pad within the concrete. 25 mm fillet of FyreFlex sealant applied at the interface between FyreBox and the mortar.	1 layer of 450 mm high TWrap covering all around and on top of the FyreBox	-/120/120
D1 power cables- 1 × electrical 1C × 630 mm^2 Cu + E 1 × electrical 3C × 185 mm^2 Cu + E 8 × 16 mm^2 3C + E 3 × 6 mm^2 3C + E	FRT200256 R1.0		The FyreSet mortar was cast 110 mm high over the aperture on top and overlapping 3 edges by 50 mm with the remaining side stacked with hollow cement blockwork.	450 mm high from unexposed side of concrete slab of single layer TWrap	-/240/180
10 × CAT6, 10 × TPS and 10 × Fire alarm cables				N/A	-/240/180
D1 power cables- 1 × electrical 1C × 630 mm^2 Cu + E 1 × electrical 3C ×	FRT200255 R1.0		FyreSet mortar cast into an 800 mm square opening in the concrete slab	450 mm high from unexposed side of	-/240/120 as tested.

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Product	Reference test	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
185 mm² Cu + E 8 × 16 mm² 3C + E 3 × 6 mm² 3C + E and D2 comm cables group comprising 60 CAT 3 cables			providing a 100 mm high (from the lower face of slab) infill pad in the opening for device penetrations. 50 mm fillet of FyreFlex sealant applied on top of mortar at the annular gap of the services penetrations.	concrete slab of single layer TWrap	-/240/180 without cable tray.
D1 power cables- 1 × electrical 1C × 630 mm² Cu + E 1 × electrical 3C × 185 mm² Cu + E 8 × 16 mm² 3C + E 3 × 6 mm² 3C + E					-/240/120 with cable tray and -/240/180 without cable tray.

Table 10 Summary of assessment of pipe services penetrations

Product	Reference test	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
Pair coils with insulation 25 mm PEXA pipe 25 mm PEX-AL-PEX or any other pipes assigned an FRL of up to -/120/120 (adequate spacing and intumescent strips must be provided accordingly).	FRT200257 R1.0	Tested with 120 mm concrete slab Recommended 150 mm min. concrete slab for optimum performance	350 mm × 125 mm FyreBox cast in 120 mm thick 600 mm × 300 mm FyreSet mortar pad within the concrete. 25 mm fillet of FyreFlex sealant applied at the interface between FyreBox and the mortar. 50 mm fillet FyreFlex sealant applied along the annular gap and to 50 mm depth at the service penetrations on top of the slab.	1 layer of TWrap covering all around and on top of the FyreBox	-/120/120 The FyreBOX provides an alternative membrane for penetrations with any pipe services capable of attaining an FRL of up to -/120/120
DN 50 type B copper pipe (including all CU pipes up to DN50)	FRT200256 R1.0		The FyreSet mortar was cast 110 mm high over the aperture on top and overlapping 3 edges by 50 mm with the remaining side stacked with hollow cement blockwork	450 mm single layer on top of slab.	-/240/120 or with FyreSet mortar within the slab - -/120/120
NB 100 steel pipe (including all steel pipes up to NB 100)					-/240/240
DN 32 type B copper pipe (assessed service)				300 mm or 450 mm single layer	-/90/90 or with 450 mm length TWrap - -/240/120
DN 50 copper pipe (including all CU pipes up to DN50)	FRT200255 R1.0		FyreSet mortar cast within aperture in concrete slab to 100	450 mm single layer	-/120/120

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Product	Reference test	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
DN 80 copper pipe (including all CU pipes up to DN80)			mm high from bottom of slab.	600 mm single layer	-/120/120
DN 100 copper pipe (including all Cu pipes up to DN100)				800 mm single layer FyreWrap	-/120/120
DN 150 copper pipe (including all CU pipes up to DN150)	FRT200118 R1.0			1200 mm TWrap with a second layer 300 mm length from base.	-/120/120

Table 11 Summary of assessment of PVC conduits

Product	Reference test	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
25 mm rigid PVC conduit	FRT200118 R1.0	120 mm minimum thickness concrete	FyreSet mortar cast within aperture in concrete slab to 100 mm high from bottom of slab. Each pipe service penetration fitted with FyreChoke Micro fire collar on the exposed side.	N/A	-/120/120
25 mm flex PVC conduit				N/A	-/120/120

5.9 Conclusion

This assessment demonstrates that the services penetrations protected by 100 mm thick FyreSet mortar over an aperture in a concrete floor slab is likely to achieve the results as summarised in Table 12, Table 13 and Table 14, if they were tested in accordance with AS 1530.4:2014.

From the above assessment of the performance of the various services penetrations with the Trafalgar FyreSet mortar installed in various setups and for various services penetrations and the test data available, the following have been identified:

- The installation of the FyreBox into a FyreSet mortar lined aperture in the concrete floor slab provides for readymade penetration box for miscellaneous multiple services for penetrating the floor slab requiring only intumescent strips to protect the opening within the box. It is on condition that the services had already been previous tested and are capable of achieving the required FRL of the particular floor slab. The maximum number of services that can be fitted through the FyreBox will be limited by the minimum space required for filling with intumescent strips to ensure adequate coverage to maintain fire resistance performance. The maximum size of FyreBox has not been ascertained as there is insufficient test data for confirmation or assessing. It appears that the insulation performance of the system is provided by the TWrap at the service interface at the entrance of the FyreBox and the surrounding FyreSet mortar to some extent.
- The tests FRT200255 and FRT200256 are much the same except that in FRT200255 the FyreSet mortar was backfilled into aperture of the slab on the exposed side to 100 mm thick whereas in FRT200256 the FyreSet mortar formed an additional layer over the aperture on top of the slab on the unexposed side. There is minimal insulation performance between the services tested in either test, however, it appears that the services tested in FRT200256

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appeared to perform better in integrity. The data from either test may be interchangeable but will likely be limited to the maximum performance in test FRT200255, ie. with the FyreSet mortar cast into the aperture on the exposed side.

Table 12 Assessment of electrical cable services penetrations

Product	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
15 × CAT6, 15 × TPS and 15 × Fire alarm cables	Recommended 150 mm min. concrete slab for optimum performance	100 mm deep FyreSet mortar within the aperture and 40 mm fillet (30 mm for the comm. cable bundle) of FyreFlex sealant around the penetrations on top of the slab.	N/A	-/240/120
D2 comm. cables			N/A	-/120/60
D1 power cables- 1 × electrical 3C × 185 mm^2 Cu + E 1 × electrical 1C × 630 mm^2 Cu + E 3 × electrical 3C × 6 mm^2 Cu + E 3 × electrical 16 mm^2 Cu			N/A	-/120/60 for the large 630 mm^2 cable, the rest reassigned- -/120/90 for the 185 mm^2 Cu + E and -/120/120 for the remainder
D1 power cables- 8 × 16 mm^2 3C + E		350 mm × 125 mm FyreBox cast in 120 mm thick 600 mm × 300 mm FyreSet mortar pad within the concrete. 25 mm fillet of FyreFlex sealant applied at the interface between FyreBox and the mortar.	1 layer of 450 mm high TWrap covering all around and on top of the FyreBox	-/120/120
D1 power cables- 1 × electrical 1C × 630 mm^2 Cu + E 1 × electrical 3C × 185 mm^2 Cu + E 8 × 16 mm^2 3C + E 3 × 6 mm^2 3C + E		The FyreSet mortar cast 100 mm high over the aperture on top of concrete slab and aperture.	450 mm high from unexposed side of concrete slab of single layer TWrap	-/240/180
10 × CAT6, 10 × TPS and 10 × Fire alarm cables			N/A	-/240/180
D1 power cables- 1 × electrical 1C × 630 mm^2 Cu + E 1 × electrical 3C × 185 mm^2 Cu + E 8 × 16 mm^2 3C + E 3 × 6 mm^2 3C + E and D2 comm cables group comprising 60 CAT 3 cables		FyreSet mortar cast into an 800 mm square opening in the concrete slab providing a 100 mm high (from the lower face of slab) infill pad in the opening for service penetrations. 50 mm fillet of FyreFlex sealant applied on top of mortar at the annular	450 mm high from unexposed side of concrete slab of single layer TWrap	-/240/120 with cable tray. -/240/180 without cable tray (retaining insulation TWrap) and cables are to be individually and adequately supported.

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Product	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
D1 power cables- 1 × electrical 1C × 630 mm^2 Cu + E 1 × electrical 3C × 185 mm^2 Cu + E 8 × 16 mm^2 3C + E 3 × 6 mm^2 3C + E		gap of the services penetrations.		-/240/120 with cable tray -/240/180 without cable tray (retaining insulation TWrap) and cables are to be individually and adequately supported.

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Table 13 Assessment of pipe services penetrations

Product	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
Pair coils with insulation 25 mm PEXA pipe 25 mm PEX-AL-PEX	Recommended 150 mm min. concrete slab for optimum performance	350 mm × 125 mm FyreBox cast in 120 mm thick 600 mm × 300 mm FyreSet mortar pad within the concrete. 25 mm fillet of FyreFlex sealant applied at the interface between FyreBox and the mortar. 50 mm fillet FyreFlex sealant applied along the annular gap at the service penetrations and on top of the slab.	1 layer of TWrap covering all around and on top of the FyreBox	-/120/120
DN 50 type B copper pipe (including all CU pipes up to DN50)		The FyreSet mortar was cast 110 mm high over the aperture on top and overlapping 3 edges by 50 mm with the remaining side stacked with hollow cement blockwork	450 mm single layer on top of slab.	-/240/120 or with FyreSet mortar within the slab - -/120/120
NB 100 steel pipe (including all steel pipes up to NB 100)				-/240/240
DN 32 type B copper pipe (assessed service)			300 mm or 450 mm single layer	-/90/90 or with 450 mm length TWrap - -/240/120
DN 50 copper pipe (including all CU pipes up to DN50)		FyreSet mortar cast within aperture in concrete slab to 100 mm high from bottom of slab.	450 mm single layer	-/120/120
DN 80 copper pipe (including all CU pipes up to DN80)			600 mm single layer	-/120/120
DN 100 copper pipe (including all Cu pipes up to DN100)			600 mm single layer FyreWrap	-/120/120
DN 150 copper pipe (including all CU pipes up to DN150)			1200 mm TWrap with a second layer 300 mm length from base.	-/120/120

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Table 14 Assessment of PVC conduits

Product	Separating element	Main fire stopping protection	TWrap and other insulation	Assessed FRL
25 mm rigid PVC conduit	120 mm minimum thickness concrete	FyreSet mortar cast within aperture in concrete slab to 100 mm high from bottom of slab. Each pipe service penetration fitted with FyreChoke Micro fire collar on the exposed side.	N/A	-/120/120
25 mm flex PVC conduit			N/A	-/120/120

6. Validity

Warringtonfire Australia does not endorse the tested or assessed product in any way. The conclusions of this assessment may be used to directly assess fire hazard, but it should be recognised that a single test method will not provide a full assessment of fire hazard 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 information and experience available at the time of preparation. 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 likely 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. Building certifiers and other third parties are responsible for deciding if they accept this assessment in a particular context that is outside the scope of this report.

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Appendix A Summary of supporting test data

A.1 Test report – FRT190292 R4.0

Table 15 Information about test report

Item	Information about test report
Report sponsor	Trafalgar Fire
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 16 January 2020.
Test standards	The test was done in accordance with AS 1530.4:2014.
Variation to test standards	None
General description of tested specimen	The separating element was a 4500 mm long, 3500 mm wide and 175 mm thick concrete floor slab. There were 10 penetration systems installed in the concrete slab (from A to J) and the service penetration system of interest for this assessment is system A. System A comprised a 500 mm wide × 800 mm long aperture in the concrete slab with 150 mm thick FyreSet mortar filling the opening as the main fire-resistant barrier. System A incorporated 3 services penetration through the FyreSet mortar. They are: • A1 comprising a 350 mm wide cable tray with 15 × CAT 6 cables, 15 × fire alarm TPS cables and 15 × 2C+E 2.5 mm2TPS cables. The three services were each bundled together and secured to the cable tray with steel cable ties. The services along with the cable tray protruded nominally 500 mm from the unexposed side of the main fire-stopping protection and nominally 500 mm from the exposed side of the separating element. • A2 comprising a 350 mm wide cable tray with 1 × D2 communication cable • A3 comprising a 350 mm wide cable tray with 1 × D1 power cable FyreFlex acrylic sealant was applied around the services penetrations and finished with a fillet all around.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2014.

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

Table 16 Results summary for this test report

Penetration system	Service ID	Criteria	Results	Fire resistance level (FRL)
A	A1	Structural adequacy	Not applicable	-/120/60
		Integrity	No failure at 241 minutes	
		Insulation	Failure at 144 minutes	
	A2	Structural adequacy	Not applicable	
		Integrity	Failure at 152 minutes	
		Insulation	Failure at 79 minutes	
	A3	Structural adequacy	Not applicable	
		Integrity	Failure at 223 minutes	
		Insulation	Failure at 77 minutes	

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A.2 Test report – FRT200118 R1.0

Table 17 Information about test report

Item	Information about test report
Report sponsor	Trafalgar Group
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 21 May 2020
Test standards	The test was done in accordance with AS 1530.4:2014.
Variation to test standards	None
General description of tested specimen	The separating element was a 1760 mm wide, 1200 mm long and 120 mm thick concrete floor slab. There was only one penetration system in the concrete slab with an aperture of 800 mm wide × 600 mm long. The system consisted of 6 services penetrations designated from A1 to A6. The services were: • A1 comprising a 625 mm wide cable tray with a D1 power cable bundle and a D2 power cable bundle. • A2 comprising a Ø25 mm flexible PVC conduit. • A3 comprising a Ø25 mm rigid PVC conduit. • A4 comprising a DN 150 type B copper pipe. • A5 comprising a DN 100 type B copper pipe • A6 comprising a DN 50 type B The penetration opening was sealed with 100 mm depth of FyreSet mortar measure from the exposed side, virtually forming a secondary separating element within the penetration in the concrete slab. After the mortar was set the 6 services penetrations were made with each service penetration protected by FyreFlex sealant along the annular gap on the unexposed side and insulated accordingly with TWrap for the copper pipes and the cable tray and cable bundles. Both PVC pipe specimens A2 and A3 were fitted with FyreChoke fire collars on the exposed side.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2014.

The test specimen achieved the following results – see Table 18.

Table 18 Results summary for this test report

Penetration system	Criteria	Results	Fire resistance level (FRL)
A	Structural adequacy	Not applicable	-/90/90
	Integrity	Failure in 118 minutes	
	Insulation	Failure in 61 minutes	

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A.3 Test report – FRT200255 R1.0

Table 19 Information about test report

Item	Information about test report
Report sponsor	Trafalgar Group
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 30 September 2020
Test standards	The test was done in accordance with AS 1530.4:2014.
Variation to test standards	Services for services penetration A3 to A7 were capped on the unexposed side after a certain period during the test and the test after that period was considered non-compliant in accordance with the standard and an FRL could not be assigned then after. There were periods of the pressure being 1 Pas below that prescribed by the standard. However, as there were no significant events that would have likely affected the test, the under pressure would unlikely have invalidated the test results.
General description of tested specimen	The test was conducted on a 1760 mm wide × 1200 mm long × 120 mm thick concrete floor slab. An 800 mm square aperture was cut out and backfilled with FyreSet mortar from the exposed side of the slab to a 100 mm depth. 7 services penetrations (A1 to A7) were made after the mortar had set. The services were: • A1 comprising a 600 mm cable tray with a D1 group of power cables and a D2 group of communication cables. The services were insulated on the unexposed side with single layer of TWrap to height of 450 mm above the concrete slab surface and on top of the FyreFlex sealant applied over the annular gap of the slab penetration (around the cable tray and in between the cables). • A2 comprising a 300 mm cable tray with a D1 group of power cables. The services were insulated on the unexposed side with single layer of TWrap to height of 450 mm above the concrete slab surface and on top of the FyreFlex sealant applied over the annular gap of the slab penetration. • A3, A4 and A5 each comprising a DN 50 type B copper pipe. • A3 was insulated on the unexposed side with 450 mm length of single layer TWrap, A4 was insulated with 450 mm length of single layer CWrap and A5 was insulated with 450 mm length of single layer FyreWrap. The annular gaps of all services penetrations were protected with FyreFlex sealant. • A6 comprising a DN 80 type B copper pipe. The service was insulated with 1 layer of TWrap to 600 mm height from the surface of the slab on the unexposed side and on top of the FyreFlex sealant around the pipe penetration. • A7 comprising a DN 100 type B copper pipe. The service was insulated with 1 layer of TWrap to 800 mm height from the surface of the slab on the unexposed side and on top of the FyreFlex sealant around the pipe penetration.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2014.

The test specimen achieved the following results – see Table 20.

Table 20 Results summary for this test report

Penetration system		Criteria	Results	Fire resistance level (FRL)
A	Main fire stopping protection	Structural adequacy	Not applicable	-/120/90*
		Integrity	No failure at 241 minutes	
		Insulation	Failure at 210 minutes	

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Penetration system		Criteria	Results	Fire resistance level (FRL)
	A1	Structural adequacy	Not applicable	
		Integrity	Failure at 234 minutes	
		Insulation	Failure at 147 minutes	
	A2	Structural adequacy	Not applicable	
		Integrity	No failure at 241 minutes	
		Insulation	Failure at 165 minutes	
	A3	Structural adequacy	Not applicable	
		Integrity	No failure at 129 minutes*	
		Insulation	Failure at 126 minutes	
	A4	Structural adequacy	Not applicable	
		Integrity	No failure at 149 minutes*	
		Insulation	Failure at 131 minutes	
	A5	Structural adequacy	Not applicable	
		Integrity	No failure at 149 minutes*	
		Insulation	Failure at 133 minutes	
	A6	Structural adequacy	Not applicable	
		Integrity	No failure at 125 minutes*	
		Insulation	Failure at 117 minutes	
	A7	Structural adequacy	Not applicable	
		Integrity	No failure at 151 minutes	
		Insulation	Failure at 146 minutes	

Notes:

- The FRLs for the specimens are only applicable to the tested orientation, ie. with fire from below the slab only.
- '*' indicates that the services for the penetration systems were capped on the unexposed side at that time.
- '#' indicates that the services for penetration systems A3 to A7 were capped on the unexposed side at a certain time of the test duration and no longer complied with section 10.4.5 of AS 1530.4:2014. An FRL therefore cannot be assigned after that time period

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A.4 Test report – FRT200256 R1.0

Table 21 Information about test report

Item	Information about test report
Report sponsor	Trafalgar Group
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 1 October 2020
Test standards	The test was done in accordance with AS 1530.4:2014.
Variation to test standards	None
General description of tested specimen	The test was conducted on a 1760 mm wide × 1200 mm long × 120 mm thick concrete floor slab. An 800 mm square aperture was cut out and backfilled with FyreSet mortar from the exposed side of the slab to a 100 mm depth. • There were 2 penetration system A and B. System A consisted of: • A1 comprising a 300 mm cable tray with a D1 group of power cables. The services were insulated on the unexposed side with single layer of TWrap to height of 450 mm above the concrete slab surface and on top of the FyreFlex sealant applied over the annular gap of the slab penetration (around the cable tray and in between the cables). • A2 comprising a bundle of cables consisting of 10 × TPS cables, 10 × CAT6 cables and 10 × Fire alarm cables. A 50 mm fillet of FyreFlex sealant was applied at the penetration on the unexposed side around the cables. • A3 comprising a DN 50 type B copper pipe. FyreFlex sealant was applied in the aperture at the annular gap to a depth of 50 mm from the unexposed side and finished with a 30 mm × 30 mm fillet on top. The pipe was insulated with a single layer of TWrap to 450 mm above the slab and on top of the sealant. • A4 comprising a NB 100 MD steel pipe. FyreFlex sealant was applied in the aperture at the annular gap to a depth of 50 mm from the unexposed side and finished with a 30 mm × 30 mm fillet on top. The pipe was insulated with a single layer of TWrap to 450 mm above the slab and on top of the sealant. System B consisted of Ø100 mm uPVC SC pipe. A FyreChoke fire collar was cast in the slab on the exposed side.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2014.

The test specimen achieved the following results – see Table 22.

Table 22 Results summary for this test report

Penetration system		Criteria	Results	Fire resistance level (FRL)
A	Main fire stopping protection	Structural adequacy	Not applicable	-/240/120
		Integrity	No failure at 241 minutes	
		Insulation	Failure at 150 minutes	
	A1	Structural adequacy	Not applicable	
		Integrity	No failure at 241 minutes	
		Insulation	Failure at 210 minutes	
	A2	Structural adequacy	Not applicable	
		Integrity	No failure at 241 minutes	
		Insulation	Failure at 210 minutes	
	A3	Structural adequacy	Not applicable	
		Integrity	No failure at 241 minutes	

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Penetration system		Criteria	Results	Fire resistance level (FRL)
		Insulation	Failure at 139 minutes	
	A4	Structural adequacy	Not applicable	
		Integrity	No failure at 241 minutes	
		Insulation	No failure at 241 minutes	
B		Structural adequacy	Not applicable	-/0/0
		Integrity	Failure at 11 minutes	
		Insulation	Failure at 10 minutes	
Note: The FRLs for the specimens are only applicable to the tested orientation, ie. with fire from below the slab only.				

A.5 Test report – FRT200257 R1.0

Table 23 Information about test report

Item	Information about test report
Report sponsor	Trafalgar Group
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 2 October 2020
Test standards	The test was done in accordance with AS 1530.4:2014.
Variation to test standards	None
General description of tested specimen	The test was conducted on a 1760 mm wide × 1200 mm long × 120 mm thick concrete floor slab. Three apertures were cut into the slab with dimensions, 600 mm wide × 300 mm long, 300 mm wide × 300 mm long and Ø170 mm for the services installations. The penetration systems were A, B and C. System A incorporated a Fire Box fitted into the penetration and the services penetrating the box consisted of: • A1 was a Ø25 Xa/Al/PE pipe. • A2 was a Ø25 mm PE-Xa pipe. • A3 comprising 8 × 16 mm2 3C+E power cables. • A4 comprising 1 × 3/8 + 3/4 FR pair coil with 13 mm insulation and 1 × 1/4 + 3/8 FR pair coil with 13 mm insulation. System B consisted of: • B1 comprising a DN 50 type B copper pipe. • B2 comprising a DN 100 type B copper pipe System C consisted of a DN 150 type B copper pipe.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2014.

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The test specimen achieved the following results – see Table 24

Table 24 Results summary for this test report

Penetration system		Criteria	Results	Fire resistance level (FRL)
A		Structural adequacy	Not applicable	-/120/120
		Integrity	Failure at 137 minutes	
		Insulation	Failure at 137 minutes	
B	Main fire stopping protection	Structural adequacy	Not applicable	-/180/120
		Integrity	No failure at 181 minutes	
		Insulation	Failure at 162 minutes	
	B1	Structural adequacy	Not applicable	
		Integrity	No failure at 181 minutes	
		Insulation	Failure at 152 minutes	
	B2	Structural adequacy	Not applicable	
		Integrity	No failure at 181 minutes	
		Insulation	Failure at 156 minutes	
C		Structural adequacy	Not applicable	-/180/120
		Integrity	No failure at 181 minutes	
		Insulation	Failure at 126 minutes	
Note: The FRLs for the specimens are only applicable to the tested orientation, ie. with fire from below the slab only.				

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Perth

Unit 22, 22 Railway Road
Subiaco WA 6008
Australia
T: +61 8 9382 3844

Canberra

Unit 10, 71 Leichhardt Street
Kingston ACT 2604
Australia
T: +61 2 6260 8488

Sydney

Suite 802, Level 8, 383 Kent Street
Sydney NSW 2000
Australia
T: +61 2 9211 4333

Brisbane

Suite 6, Level 12, 133 Mary Street
Brisbane QLD 4000
Australia
T: +61 7 3238 1700

Melbourne – NATA registered laboratory

Unit 2, 409-411 Hammond Road
Dandenong South VIC 3175
Australia
T: +61 3 9767 1000

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