TRAFALGAR GROUP

# FIRE ASSESSMENT REPORT

*Fire pillows and boards in floors and walls in accordance with AS 1530.4:2014*



Prepared for

Trafalgar Group

Report number: FAS200048
Revision: R3.3
Issued date: 25 November 2025 Expiry date: 31 May 2030

JENSEN HUGHES

## *Quality management*

| Revision | Date | Revision Description | | |
|---|---|---|---|---|
| R1.0 | Issue:<br>13 May 2020 | Draft Report issued to Trafalgar Group for review and comment. | | |
| | | **Prepared** | **Reviewed** | **Authorised** |
| | | Hon Wong | Mahmoud Akl | N/A |
| R1.1 | Issue:<br>27 May 2020 | Revised to include comment from Trafalgar Group | | |
| | | **Prepared** | **Reviewed** | **Authorised** |
| | | Hon Wong | Mahmoud Akl | Omar Saad |
| R2.0 | Issue:<br>22 Nov 2020 | Revised to include various variations such as aperture size, pillows colour and installation in blank openings. | | |
| | | **Prepared** | **Reviewed** | **Authorised** |
| | | Mohamad Mutafi | Mahmoud Akl | Mahmoud Akl |
| R2.1 | Issue:<br>26 Nov 2021 | Re-issued to address client's comments | | |
| | | **Prepared** | **Reviewed** | **Authorised** |
| | | Mohamad Mutafi | Mahmoud Akl | Mahmoud Akl |
| R2.2 | Issue:<br>22 Jul 2022 | Revised to include assessment of MonoWrap insulation | | |
| | | **Prepared** | **Reviewed** | **Authorised** |
| | | Sashini Sue | Imran Ahamed | Imran Ahamed |
| R3.0 | Issue:<br>04 Jun 2025 | Revalidated and revised to include variation in Trafalgar Fire Pillows incorporating increase in TWrap length and aperture size | | |
| | | **Prepared** | **Reviewed** | **Authorised** |
| | | Derek Thongcharen | Alim Rasel | Alim Rasel |
| R3.1 | Issue:<br>14 Jul 2025 | Revalidated and revised to include clarification regarding minimum distance of 40 mm between the services within a service penetration that is sealed with FyrePLUG pillows. | | |
| | | **Prepared** | **Reviewed** | **Authorised** |
| | | Derek Thongcharen | Alim Rasel | Alim Rasel |
| R3.2 | Issue:<br>03 Aug 2025 | Updated minor details for clarification of 40 mm clearance between services within a service penetration that is sealed with FyrePLUG pillows. | | |
| | | **Prepared** | **Reviewed** | **Authorised** |
| | | Derek Thongcharen | Alim Rasel | Alim Rasel |

| Revision | Date | Revision Description | | |
|---|---|---|---|---|
| R3.3 | Issue:<br>25 Nov 2025 | FPH-12 and FPH-13 updated to state no insulation wrap required. FPH-21 added as a single-service penetration with no insulation wrap required and the FRL extended to other separating elements. | | |
| | Expiry:<br>31 May 2030 | **Prepared** | **Reviewed** | **Authorised** |
| | | Kimal Wasalathilake | Alim Rasel | Alim Rasel |

**Jensen Hughes Fire Testing Pty Ltd**
**ABN 81 050 241 524**
**Formerly Warringtonfire Australia Pty Ltd**[1]



[1] *Warringtonfire Australia Pty Ltd was acquired by Jensen Hughes in December 2023. Jensen Hughes Fire Testing Pty Ltd is not affiliated, associated, authorised, or endorsed by Warringtonfire Australia Pty Ltd, Warringtonfire Testing and Certification Limited or its "Warringtonfire" or "Certifire" brands.*

## *Executive summary*

This report documents the findings of the assessment undertaken to determine the expected fire resistance level (FRL) of the Trafalgar FyrePlug pillows and Trafalgar TWrap / MonoWrap / FyreWrap and various other sealing systems –in accordance with AS 1530.4:2014 and AS 4072.1:2005 (R2016). This assessment was carried out at the request of Trafalgar Group.

The analysis conducted in section 5.0 of this report found that the proposed variations are expected to achieve the required FRL as shown in Table 1 and Table 2, in accordance with AS 1530.4:2014 and AS 4072.1:2005 (R2016).

*Table 1 Assessment outcome of services in wall systems*

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| Steel cable tray and Appendix D1 power cables | + A 116 mm thick wall that consists of 64 mm steel stud lined with two layers of 13 mm fire rated plasterboard on each side<br>+ 120 mm concrete or masonry wall | 60 mm Maxilite board in 800 mm × 800 mm aperture | FyreFLEX® Sealant in joint between plasterboard wall and Maxilite board on both sides and finished with 50 mm × 50 mm sealant fillet applied before wrapping around a maximum annular gap of 5 – 20 mm nominally | 300 mm single layer on both sides | **-/120/120** | FPH-1 |
| 100 mm O.D × 1.65 mm copper pipe | | | FyreFLEX® Sealant in joint between plasterboard wall and Maxilite board on both sides and finished with 50 mm × 50 mm sealant fillet applied before wrapping around a maximum annular gap of 10 mm nominally | The wrapping sequence shall be applied as follows: three layers over the initial 100 mm, reduced to two layers for the subsequent 200 mm, and continued with a single layer for the final 300 mm. | | FPH-2 |
| 150 mm O.D × 1.80 mm copper pipe | | | | The wrapping sequence shall be applied as follows: three layers over the initial 100 mm, reduced to two layers for the subsequent 200 mm, and continued with a single layer for the final 800 mm. | | FPH-3 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| Ø100 mm uPVC SC pipe | 78 mm Speedpanel wall system | 60 mm thick Maxilite board in a 300 mm × 300 mm aperture | 100 mm Trafalgar Fyrechoke collar fitted on pipe at penetration on both sides of the wall. Trafalgar FyreFLEX® sealant applied to a nominal depth of 10 mm in the annular gap on each sides | None | **-/120/120** | FPH-4 |
| 50 mm O.D × 1.2 mm copper pipe | | | 50 mm Trafalgar Fyrechoke collar fitted on pipe at penetration on both sides of wall. Trafalgar FyreFLEX® sealant applied to a nominal depth of 10 mm in the annular gap on each sides | | | FPH-5 |
| Ø100 mm uPVC SC pipe | 75 mm AAC Hebel wall | | 100 mm Trafalgar Fyrechoke collar fitted on pipe at penetration on both sides of wall. Trafalgar FyreFLEX® sealant applied to the full depth of the annular gap | None | **-/90/90** | FPH-6 |
| 50 mm O.D × 1.2 mm copper pipe | | | 8.5 mm annular gap was filled with FyreFLEX® sealant to full depth and finished with a 15 mm fillet on each side. | Insulation wrap length of 300 mm on fire side and 400 mm on the non-fire side | | FPH-7 |
| Ø60 mm CPVC sprinkler pipe | 78 mm Speedpanel wall system | SuperSTOPPER Maxi 650 fitted into a 670 mm × 140 mm aperture in the wall | Four layers of 1.8 mm thick intumescent strip fitted in the SuperSTOPPER.<br>FyreFLEX® sealant applied in a maximum nominal 10 mm annular gap to the full depth of the separating element | 100 mm wide strip wrap to be tied over the upstand metal angles protruding from wall surface forming a shroud with 25 mm of blanket lapping over wall surface on each side | **-/120/120** | FPH-8 |
| | 75 mm AAC Hebel wall | | | | **-/90/90** | FPH-9 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| Appendix D1 power cables on steel cable tray | + A 116 mm thick wall that consists of 64 mm steel stud lined with two layers of 13 mm fire rated plasterboard on each side<br>+ 120 mm thick concrete wall<br>+ 95 mm thick plasterboard lined steel stud shaft wall | FyrePlug pillows fitted into a 550 mm × 550 mm aperture in the wall. The aperture size must be limited to 400 mm × 300 mm when installed in shaftliner wall system. Pillows to be installed in a consistent horizontal configuration only | 50 mm × 50 mm fillet of FyreFLEX® sealant applied in the annular gap between service and FyrePlug Pillows and between cables, cable tray and onto the FyrePlug pillows | 300 mm on each side | **-/120/120** | FPH-10 |
| Copper pipe, including, brass or steel pipes up to 100 mm OD. as per clause 10.12.3, AS1530.4:2014 | | | | | | FPH-11 |
| TPS cable bundle | | | | None | | FPH-12 |
| CAT6 data cables | | | | None | | FPH-13 |
| Appendix D2 bundle of telecom cables on a steel cable tray consisting of:<br>+ 22 × Electra Tele 5OP × 2 × 0.5 TO ACA Tech STD008<br>+ 22 × Garland VTPL 350HF 24 AUG 50 PR LSZH CAT3 | | | | 300 mm on each side | **-/120/90** | FPH-14 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| 100 mm OD copper pipe, including copper, brass or steel pipes up to 100 mm dia. as per clause 10.12.3, AS 1530.4:2014. | + A minimum of 116 mm thick wall that consists of 64 mm steel stud lined with two layers of 13 mm fire rated plasterboard on each side<br>+ A minimum of 120 mm concrete or masonry wall | | | 600 mm on both sides of the wall | **-/180/180** | FPH-15 |
| TPS cable bundle | | | | None | **-/180/120** | FPH-16 |
| CAT6 data cables | | | | None | **-/180/120** | FPH-17 |
| DN100 Type B copper pipe, including, brass or steel pipes up to 100 mm OD. as per clause 10.12.3, AS1530.4:2014. | 78 mm Speedpanel wall | FyrePlug pillows fitted into 1000 mm wide × 300 mm high aperture in the wall | FyreFLEX® sealant applied between pipe and pillow interface with a 30 mm × 30 mm fillet on both the exposed and unexposed side. | First layer for 600 mm followed by a second layer for the first 300 mm only applied on both sides | **-/120/120** | FPH-18 |
| Bundle of TPS and CAT6 cables consisting of:<br>+ 5 × 2C+E 2.5 $mm^2$ Electra TPS Cables<br>+ 5 × CAT6 Delta Cables | | | FyreFLEX® sealant applied between cable services and pillow interface with a 30 mm × 30 mm fillet. Gaps between the cables sealed with FyreFLEX® on both the exposed and unexposed side | None | | FPH-19 |
| Appendix D1 power cables on a steel cable tray consisting of: | | | + FyreFLEX® sealant applied between cable services and pillow interface with a 30 mm × 30 mm fillet. Gaps between the cables sealed with FyreFLEX® | 600 mm on each side | | FPH-20 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| + 1 × 3C+E 185 mm² XLPE/PVC power cable<br>+ 4 × 3C+E 16 mm² PVC power<br>+ Ø 25 mm uPVC conduit with 1 × fibre optic cable | | | on both the exposed and unexposed side.<br>+ FyrePEX HP sealant applied inside the Ø65 mm PVC pipe – used as a pipe former – to a depth of 100 mm, with a backing rod around the Ø 25 mm PVC conduit. Gaps between the Ø 25 mm PVC conduit and the fire pillows sealed with FyrePEX HP sealant. | | | |
| Ø 25 mm uPVC conduit with 1 × fibre optic cable | 78 mm thick Speedpanel wall or other wall constructions with an established FRL of -/120/120 | | FyrePEX HP sealant applied inside the Ø65 mm PVC pipe – used as a pipe former – to a depth of 100 mm, with a backing rod around the Ø 25 mm PVC conduit. Gaps between the Ø 25 mm PVC conduit and the fire pillows sealed with FyrePEX HP sealant. | None | **-/120/120** | FPH-21 |
| DN100 Type B copper pipe, including, brass or steel pipes up to 100 mm OD. as per clause 10.12.3, AS1530.4:2014 | 75 mm Hebel AAC wall | FyrePlug pillows fitted into 1000 mm wide × 300 mm high aperture in the wall | FyreFLEX® sealant applied between pipe and pillow interface with a 30 mm × 30 mm fillet on both the exposed and unexposed side. | First layer for 600 mm followed by a second layer for the first 300 mm only applied on both sides | **-/90/90** | FPH-22 |
| Bundle of TPS and CAT6 cables consisting of:<br>+ 5 × 2C+E 2.5 mm² Electra TPS Cables | | | FyreFLEX® sealant applied between cable services and pillow interface with a 30 mm × 30 mm fillet. Gaps between the cables sealed with FyreFLEX® on both the exposed and unexposed side | None | | FPH-23 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| + 5 × CAT6 Delta Cables | | | | | | |
| Appendix D1 power cables on a steel cable tray consisting of:<br>+ 1 × 3C+E 185 $mm^2$ XLPE/PVC power cable<br>+ 4 × 3C+E 16 $mm^2$ PVC power<br>+ Ø 25 mm uPVC conduit with 1 × fibre optic cable | | | + FyreFLEX® sealant applied between cable services and pillow interface with a 30 mm × 30 mm fillet. Gaps between the cables sealed with FyreFLEX® on both the exposed and unexposed side.<br>+ FyrePEX HP sealant applied inside the Ø65 mm PVC pipe – used as a pipe former – to a depth of 100 mm, with a backing rod around the Ø 25 mm PVC conduit. Gaps between the Ø 25 mm PVC conduit and the fire pillows sealed with FyrePEX HP sealant. | 600 mm on each side | | FPH-24 |
| Ø 25 mm uPVC conduit with 1 × fibre optic cable | | | FyrePEX HP sealant applied inside the Ø65 mm PVC pipe – used as a pipe former – to a depth of 100 mm, with a backing rod around the Ø 25 mm PVC conduit. Gaps between the Ø 25 mm PVC conduit and the fire pillows sealed with FyrePEX HP sealant. | None | | FPH-25 |

**Note:**

The shown FRLs are applicable to Trafalgar FyrePlug pillows in either blue or orange colour.

+ The aperture sizes shown across all elements is maximum sizes. The height and/or width of the opening may be varied to a maximum
+ The insulation performance will be limited to 120 minutes if Trafalgar MonoWrap is used.

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| + The wall must have an established FRL either through testing or assessment by an Accredited Testing Laboratory. The minimum thickness of concrete wall must be 120 mm, 150 mm and 175 mm for FRL of -/120/120, -/180/180 and -/240/240 respectively.<br>+ Cables applicability can be extended to other brands with same physical construction.<br>+ A minimum spacing of 40 mm – from service to service within the same aperture – is acceptable for penetrations protected with FyrePLUG pillows, provided that:<br>- any overlap of fire-rated sealant preserves the aggregate sealant volume required for the two penetrations, and<br>- the FRL of the entire penetration system will be limited to the lowest performing service FRL | | | | | | |

*Table 2 Assessment outcomes in floor systems*

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap/MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| Small steel cable tray and D1 cables consisting of:<br>+ 1 × CMI Electrical OX37252C3CE 0.6/1kV 3C × 185 mm2 Cu + E (37 × 2.52 mm conductors) XLPE/PVC V-90<br>+ 1 × CMI Electrical Product 0.6/1kV × 90 1C × 630 mm2 CU 2013<br>+ 3 × Electra cables 2018 V-90 electric cable 450/750V SRVC 3060/e 6 mm2 × 3C + E CU RoHS GMA-501542 EA<br>+ 8 × APEC2017 V-90 Electric cable 0.6/1kV 16 mm2 CU | 175 mm concrete floor slab | 60 mm Maxilite Board over 1000 mm × 300 mm aperture in floor slab | FyreFLEX® sealant applied in a nominal 50 mm fillet arrangement around penetration and cable tray and cables on both sides | Single layer of 600 mm and a second layer of 400 mm overlapping the first layer. | **-/240/240** | FPV-1 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap/MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| 2 pair coils, 2 orange power cables and 2 CAT 6 cables consisting of:<br>+ Two 1/4" + 1/2" Ardent pair coil with 13 mm FR insulation<br>+ Two Prysmian L electric cable 0.6/1kV V-90 2C × 10 $mm^2$ + E × 4 $mm^2$ Cu<br>+ Two Prysmian MG× 6 4PE Category 6 | 175 mm concrete floor slab | SuperSTOPPER Mini 100 in the slot opening in the concrete slab protected all around by FyrePlug pillows friction fitted between the frame of the SuperSTOPPER and the slab edge of the floor opening. | Intumescent strips placed in SuperSTOPPER. A nominal 30 mm fillet FyreFLEX® sealant applied between pillows and flanges of the boxes at the interface. | None | **-/240/90** | FPV-2 |
| | | | | Wrap length of 300 mm. Tie wrap onto the unprotected upstand metal angles all around and extending 25 mm over the top of the pillows. | **-/240/180** | FPV-3 |
| Drink Python hose | | SuperSTOPPER Mini 150 fitted into opening in the concrete floor slab | Intumescent strip in SuperSTOPPERes., FyreFLEX® sealant applied along the maximum annular gap of 5 mm between the frame of the SuperSTOPPER and the slab edge. | None | **-/240/240** | FPV-4 |
| D1 power cable bundle and D2 communication cable bundle on a steel cable tray consisting of:<br>**D1 Bundle:**<br>+ 1 × CMI Electrical OX37252C3CE 0.6/1kV 3C × 185 $mm^2$ Cu + E (37 × 2.52 mm conductors) XLPE/PVC V-90<br>+ 1 × CMI Electrical Product 0.6/1kV × 90 1C × 630 $mm^2$ CU 2013 | 175 mm concrete floor slab | FyrePlug Pillows fitted into 300 mm wide × 1000 mm long aperture in the floor slab. | A nominal 30 mm fillet FyreFLEX® sealant applied in annular gap between services and pillows. | 500 mm above slab and secured with stainless steel cable 50 mm from the edges and centrally. | **-/120/120** | FPV-5 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap/MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| + 3 × Electra cables 2018 V-90 electric cable 450/750V SRVC 3060/e 6 $mm^2$ × 3C + E CU RoHS GMA-501542 EA<br>+ 8 × APEC2017 V-90 Electric cable 0.6/1kV 16 $mm^2$ CU<br>**D2 Bundle:**<br>+ 60 × Electra Tele 5OP × 2 × 0.5 TO ACA Tech STD008 01/05/2019 | | | | | | |
| Bundle of 15 fire alarm cables consisting of:<br>+ Firesense – TPS-1 50-2CT-ELV-FIRE light duty AS/ACIF | | | | None | **-/180/180** | FPV-6 |
| 1 bundle of 20 CAT6 and 1 NBN cable consisting of:<br>+ 6 mm Category 6 UTP PVC P36503024 IEC 60232-1 CM 4/23 AWG<br>+ 12 mm NBN Co. fibre optic corning cable – 24F | | | | None | **-/180/180** | FPV-7 |
| 1 × DN 50 type B copper pipe | Minimum 120 mm concrete floor slab | FyrePlug pillows fitted into 300 mm wide × 300 mm long aperture in the floor slab | FyreFLEX® sealant applied between the service and pillows to a nominal depth of 50 mm from the unexposed side. It finished on the | Single layer of 450 mm from the pillows on the top side only. Wraps secured with steel cable ties in the centre and 50 mm from the edges. | **-/120/120** for 120 mm slab and **-/180/120** | FPV-9 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap/MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| 1 × DN 100 type B copper pipe | | | unexposed side of the pillow with a 50 mm × 50 mm fillet.<br>Small beads of FyreFLEX® sealant were applied in the gaps between the pillow and the separating element. | Single layer of 600 mm wrap from the pillows on the top side only. Wraps secured with steel cable ties in the centre and 50 mm from the edges. | for 150 mm slab | FPV-10 |
| Up to four bundles of up to 5× single-core aluminium cables consisting of:<br>+ Four Electra cables, FALX12400 with XLPE sheath and measured 28-mm OD (insulation thickness 1.7 mm and maximum conductor area of 475.5 $mm^2$)<br>+ One MEC cable, a single core earth cable with PVC sheath and measured 20-mm OD, insulation thickness 1.7 mm and a maximum conductor area of 216.4 $mm^2$).<br>One bundle of two orange cables consisting of:<br>+ Electrical PVC cables 4C+E copper, a maximum conductor area of 16 $mm^2$ with measured 20 mm OD). | Minimum 150 mm concrete floor slab | FyrePlug pillows fitted into an aperture of up to 1000 mm × 300 mm aperture in the floor slab. | FyreFLEX® sealant applied between the service and pillows and at any visible gaps. | Single layer of TWrap 600 mm from the pillows with 100 mm overlap. Steel cable ties applied 50 mm from each end and at the centre of the TWrap | **-/120/120** | FPV-11 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap/MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| Up to four HELIAX co-axial 28 mm OD | | FyrePlug pillows fitted into 1000 mm × 300 mm aperture in the floor slab. | FyreFLEX® sealant applied between the service and pillows and at any visible gaps. It finished on the unexposed side of the pillow with a 30 mm × 30 mm FyreFLEX® fillet surrounding the cables | Single layer of TWrap 300 mm from the pillows with 50 mm overlap. Steel cable ties applied at 50 mm from each end of the TWrap | **-/120/120** | FPV-12 |
| Up to 20 fibre cables | | | | No insulation wrap applied | **-/120/120** | FPV-13 |

**Note:**

- The insulation performance will be limited to 120 minutes if Trafalgar MonoWrap is used.
- The concrete wall needs to be designed in accordance with AS 3600:2018 or AS 3700:2018 as appropriate.
- All floors must have an established FRL either through testing or assessment by an accredited testing laboratory.
- Cables applicability can be extended to other brands with same physical construction.
- A minimum spacing of 40 mm – from service to service within the same aperture – is acceptable for penetrations protected with FyrePLUG pillows, provided that:
  - any overlap of fire-rated sealant preserves the aggregate sealant volume required for the two penetrations, and
  - the FRL of the entire penetration system will be limited to the lowest performing service FRL

# Table of contents

# 1.0 Introduction

This report documents the findings of the assessment undertaken to determine the expected fire resistance level (FRL) of the Trafalgar FyrePlug Pillows and Trafalgar TWrap / MonoWrap or FyreWrap insulation system while protecting service penetrations in accordance with AS 1530.4:2014[2] and AS 4072.1:2005 (R2016)[3]. This assessment was carried out at the request of Trafalgar Group. The sponsor details are included in Table 3.

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.

*Table 3 Sponsor details*

| Sponsor | Address |
|---|---|
| Trafalgar Group | 26A Ferndell Street<br>South Granville<br>NSW 2142<br>Australia |

# 2.0 Framework for the assessment

## 2.1 Assessment approach

An assessment is a professional 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[4].

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.



[2] AS 1530.4:2014: 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

[3] AS 4072.1:2005 (R2016): Standards Australia 2005, *Components for the protection of openings in fire-resistant separating elements Service penetrations and control joints*, AS 4072.1:2005, Standards Australia, NSW

[4] 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.

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 and performance 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 and AS 4072.1:2005 (R2016).

This assessment has been written in accordance with the general principles outlined in EN 15725:2023[5] for extended application on the fire performance of construction products and building elements: Principle of EXAP standards and EXAP reports.

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[6] Amendment 1 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.

The proposed details and systems (building elements) in this report are confirmed to be assessed, without the aid of an active fire suppression system, based on prototype tests that are equivalent to or more severe than a standard fire test as specified in section 4.4, in accordance with NCC 2022 Amendment 1 S1C2(b). It is also confirmed that the differences between the proposed systems and details compared to the tested prototypes are considered minor in accordance with NCC 2022 Amendment 1 S1C2(c).

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 6 October 2021, 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.



[5] European Committee for Standardization, 2023, Extended application on the fire performance of construction products and building elements: Principle of EXAP standards and EXAP reports, EN 15725:2023, European Committee for Standardization, Brussels, Belgium

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

## 3.0 Requirements and 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 in accordance with AS 1530.4:2014 and AS 4072.1:2005 (R2016).
- 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.
- This assessment applies to wall systems exposed to fire from both sides in accordance with the requirements of AS 1530.4:2014, where vertical elements must be exposed to heat from the direction required to resist fire exposure.
- This assessment report has been prepared based on the fire resistance performance and condition of the systems at the time they were tested. Any deterioration of fire resistance performance due to external factors including but not limited to passage of time and exposure to elements – is not considered in this report.
- Jensen Hughes has provided this report on the fire performance of building elements in a controlled laboratory setting, strictly within the parameters allowed by the test standards and building regulations. The outcome of this report is intended to assist in verifying the suitability of the product or system for practical use in specific applications.
- 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) that is accredited to the same nominated standards of this report.
- This report has been prepared using information provided by others. Jensen Hughes has not verified the accuracy and/or completeness of that information and will not be responsible for any errors or omissions that may have been 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 expert handling, placing and finishing of the products on site. These variables are beyond the control and consideration of this report.

# 4.0 Description of the specimen and variations

## 4.1 Description of assessed systems

The tested specimen comprises of the Trafalgar FyrePlug pillow and Trafalgar TWrap insulation wrap. These systems have been tested over a number of years in accordance with AS 1530.4.

The FyrePlug pillows come in three sizes as illustrated in Table 4 – consisting of fabric bags filled with granular mineral wool material and the pillow lengths have been reduced over the years from 300 mm to 250 mm nominally. Trafalgar Group, previously trading as Fire Containment, purchased the FyrePlug pillow IP from Wormald. Trafalgar Group has advised that the formulation of the granular mineral wool infill material in the FyrePlug pillow remained the same over the years and the previous test data on the pillows would therefore have not varied and are valid.

TWrap is a 25 mm thick foil encapsulated ceramic fibre blanket for applying over services and penetrations in building elements (walls and floors) to provide additional insulation performance. The TWrap is supplied in rolls of 300 mm and 600 mm wide. MonoWrap is a 40 mm thick mineral fibre wool blanket with a silver foil. FyreWrap is a 38 mm thick foil encapsulated ceramic fibre blanket used to enhance the insulation performance of service penetrations.

The FyrePlug pillows is used as a substitute fire barrier over a predetermined opening in a wall or floor to facilitate existing or new services passing through the separating building element while maintaining the required fire resistance level or FRL of the separating building element and the service penetration systems in accordance with AS 1530.4:2014 and AS 4072.1:2005 (R2016). The general arrangement of Trafalgar FyrePlug pillows in walls and floors is detailed in Figure 1 and Figure 2. Table 4 and Table 5 show the dimension of the pillows and the recommended packing density of each size, respectively.

*Table 4 Dimensions of each pillow size*

| Pillow size | Width (mm) | Length (mm) | Height (mm) |
|---|---|---|---|
| Small | 100 | 250 | 40 |
| Medium | 200 | 250 | 40 |
| Large | 300 | 250 | 40 |

*Table 5 Packing density*

| Size of pillows | Required packing density |
|---|---|
| Small | 600 per square metre |
| Medium | 190 per square metre |
| Large | 125 per square metre |

The TWrap, MonoWrap or FyreWrap insulation blankets are applied over pipe and cable services penetrations in order to achieve the required insulation performance of the separating wall or floor element or maintain the FRL of the wall or floor systems.

## 4.2 Referenced test data

The assessment of the variation to the tested system and the determination of the performance are based on the results of the fire tests documented in the reports summarised in Table 6. Further details of the tested system are included in Appendix A.

*Table 6 Referenced test data*

| Report number | Test sponsor | Test date | Testing authority |
|---|---|---|---|
| SI 1562 | Fire Research Pty Ltd | 23 April 1982 | Department of Housing and Construction- Experimental Building Station (facility now known as CSIRO) |
| SI 1614 | | 4 August, 1982 | |
| NI 0387-2 | Masterbilt Industries | 4 March 1987 | Fire Research Laboratories |
| NI 4189 | Wormald International | 16 November 1989 | |
| NI 0790 | Wormald International, Boral Australian Gypsum and CSR | 18 April1990 | |
| EP 6372 | Fire Containment Pty Ltd | 3 July 2018 | BRANZ |
| FP 11935-001 | | 14 August 2019 | |
| FRT180323 R3.0 | Trafalgar Group | 29 November 2019 | Jensen Hughes (formerly known as Warringtonfire Australia) |
| FRT190292 R1.0 | | 16 January 2020 | |
| FRT190298 R1.0 | | 23 January 2020 | |
| FRT200257 R1.1 | | 2 October 2020 | |
| FRT210467 R1.1 | | 9 February 2022 | |
| FSP 2478 | | 9 October 2024 | CSIRO |

## 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 baseline standard fire tests are described in Table 7 and Table 8.

*Table 7 Variations to tested systems incorporating Trafalgar FyrePlug pillows and TWrap / MonoWrap or FyreWrap insulation*

| Reference test | Description | Variations |
|---|---|---|
| FP 11935-001 | In 11935- 001, the tested separating element was 116 mm steel stud plasterboard lined wall with 550 mm × 550 mm aperture filled with FyrePlug pillows as fire resistant barrier. Specimen 4 consisted of 300 mm wide ×47 mm deep cable tray with Appendix D1 power cables through FyrePlug pillows with FyreFLEX® sealant, and 300 mm lengths TWrap insulation (with 75 mm overlap) over cable tray and cables on either side of wall surface. Tray supported at 350 mm either side. The specimen achieved and FRL of -/90/120. | + Re-arrangement of pillow stacking without pillows orientated vertically over those orientated horizontally forming a tee to provide additional 1 minute of integrity performance for FRL - /120/120.<br>+ Variation of separating wall to concrete or masonry wall of minimum thickness of 120 mm. |
| | In 11935-001, the tested separating element was 116 mm steel stud plasterboard lined wall with 550 mm × 550 mm aperture filled with FyrePlug pillows as fire resistant barrier. Specimen 5 consisted of 100 mm OD copper pipe with 1.67 mm wall thickness through FyrePlug pillows with FyreFLEX® sealant around pipe circumference, and 300 mm lengths TWrap insulation (with 75 mm overlap) on either side of wall surface. Pipe supported at 600 mm on unexposed side. The system performed up to 180 minutes integrity and insulation. | + The results would apply to the same sealing system protecting copper, brass or ferrous metal pipes up to a maximum 101.6 mm OD having wall thicknesses equal or greater than those listed in Table 10.12.3.1 of AS 1530.4:2014.<br>+ Variation of separating wall to concrete or masonry 120 mm or thicker with minimum 2 hr fire rating. |
| | In 11935-001, the tested separating element was 116 mm steel stud plasterboard lined wall with 550 mm × 550 mm aperture filled with FyrePlug pillows as fire resistant barrier. Specimen 6 consisted of a bundle of 10 TPS PVC insulated cables laid (at lower edge of aperture) on pre-packed FyrePlug pillows and the aperture filled with FyrePlug pillows packed above cable bundles. FyreFLEX® sealant applied with fillet around interface on each side to the cable bundle and FyrePlug pillows. The system maintained the integrity and insulation performance for 180 minutes and 120 minutes, respectively. | + Variation of separating wall to concrete or masonry 120 mm or thicker with minimum 2 hr fire rating.<br>+ Variation of separating wall to concrete or masonry for 150 mm or thicker with minimum 3-hour rating. |

| Reference test | Description | Variations |
|---|---|---|
| | In 11935-001, the tested separating element was 116 mm steel stud plasterboard lined wall with 550 mm × 550 mm aperture filled with FyrePlug pillows as fire resistant barrier. Specimen 7 consisted of a bundle of 20 CAT6 PVC insulated data cables laid on pre-packed FyrePlug pillows, and the aperture filled with FyrePlug pillows packed above cable bundle. FyreFLEX® sealant applied with fillet around interface on each side to the cable bundle and FyrePlug pillows. The system maintained the integrity and insulation performance for 180 minutes and 120 minutes, respectively. | Variation of separating wall to concrete or masonry 120 mm or thicker with minimum 2 hr fire rating. |
| FRT180323 R3.0 | The Speedpanel separating wall element failed insulation along the C-track due direct conduction in the C track along the joint. Accordingly, an FRL of -/120/30 was attributed. | Install one layer of 13 mm fire rated plasterboard, 100 mm wide straps covering flange of the C-track.to maintain the insulation at the C track. |
| | A1 is a DN 100 type B copper pipe passing through system A penetration comprising a 350 mm wide × 450 mm deep aperture filled with Trafalgar FyrePlug pillows with FyreFLEX® sealant around pipe circumference, and 300 mm lengths TWrap insulation (with 75 mm overlap) on either side of wall surface. The system achieved an FRL of -/120/30. | + Extend TWrap insulation to 900 mm total lengths, add an additional layer of TWrap over the first 300 mm on each side to reduce the interface temperatures and to achieve 120 minutes in insulation.<br>+ Variation of separating wall to 75 mm Hebel wall |
| | In FRT180323 R3.0, the tested separating element was a 78 mm thick Speedpanel wall system A2 consists of a bundle of 5 × 2.5 mm² TPC power cables and 5 × CAT 6 data cables through Trafalgar FyrePlug pillows and with FyreFLEX® sealant. The system achieved an FRL of -/120/120 | Variation of separating wall to 75 mm Hebel AAC with reduced FRL -/90/90 |
| | In FRT180323 R3.0, system A3 consists of 3C+E 185 $mm^2$ power cable, 4 Nos of 3C+E 16 $mm^2$ power cable, Ø25 mm PVC conduit with fibre optic cable and cable tray through Trafalgar FyrePlug pillows and with FyrePEX sealant applied between pillows and PVC conduit with optic fibre. The interface between pillows and services were sealed with FyreFLEX® sealant on both sides.<br>FyrePEX sealant was applied inside the Ø65 mm PVC pipe that was used as a pipe former to a depth of 100 mm set with a backing rod around the Ø25 mm PVC conduit. Gaps between the Ø25 mm PVC conduit and fire pillows were sealed with FyrePEX sealant.<br>The system achieved an FRL of -/120/60 | + Extend TWrap insulation up to 600 mm to achieve 120 minutes in insulation.<br>+ Variation of separating wall to 75 mm Hebel AAC with reduced FRL of -/90/60 |

| Reference test | Description | Variations |
|---|---|---|
| FRT190292.R2.0 | In FRT190292 R2.0, the tested separating element was 175 mm concrete floor slab. System I2 consists of one D1 power cable bundle and 1 D2 communication cable bundle attached on a steel cable tray and insulated for 300 mm length on the unexposed side above the slab. The system maintained the integrity and insulation performance for 120 minutes. The FRL was derated as the specimen was part of a multiple penetration system that achieved an FRL of -/120/90. | Assessed FRL by isolating test that failed early in the multiple penetrations system. |
| | In FRT190292 R2.0 system I3 consists of one bundle of 15 fire alarm cables with FyreFLEX® sealant in annular gap. | Assessed to revise FRL by isolating specimen I2 |
| | In FRT190292 R2.0 system I4 consists of one bundle of 20 CAT 6 and 1 NBN cable protected by FyreFLEX® sealant. | Assessed to revised FRL by isolating specimen I2 |
| NI 0790 | In NI 0790, the tested separating element was 95 mm 2 hr rated plasterboard lined steel stud shaft wall system. Specimen E consists of appendix D2 bundle of telecom cables in a 190 mm steel cable tray. -/120/90 based on performance of 127 minutes with no integrity failure and 92 minutes insulation. | Provide TWrap insulation to improve on insulation performance. Other services previously tested in plasterboard and concrete wall systems can be installed in the 2-hour shaft wall system that is 95 mm thick an consists of 25 mm shaftliner from one side and two layers of 16 mm fire rated plasterboard on the other. |
| SI 1562 | In SI 1562, the tested separating element was a 230 mm thick brick wall a 1810 mm long × 440 mm high opening. The aperture was packed and filled with fire rated Fire Research pillows. FRL achieved was an FRL of -/240/240 | Data used for guidance to ascertain the performance of the Pillows in larger apertures. Aperture may be up to 1300 mm wide × 550 mm high in concrete or masonry walls equal or thicker than 120 mm.<br>Applicability of FyrePlug Pillows in apertures within concrete or masonry wall systems rated up to FRL -/180/180. |
| SI 1614 | In SI 1614, the tested separating element was 150 mm thick reinforced 3 hr fire rated concrete floor with 1000 mm long × 700 mm wide opening system 1. The opening in the floor slab was 1,000 mm long × 700 mm wide. The perimeter along the long slab edges were reinforced with 45 mm × 25 mm × 1.6 mm steel angles and the narrow sides were fitted with 45 mm square × 1.2 mm plate steel RHS forming mullion supports which act as joints between side-by-side slots forming a continuous length of multiple slots 700 mm wide along the floor slab as required. | No variation except those services protected by pillows in a 3-hr rated concreted floor system would have the FRL limited to maximum of -/180/120 when installed in this modular system |

| Reference test | Description | Variations |
|---|---|---|
| | The opening was packed with fire rated pillows. As the pillows were limited to installations in 200 mm maximum slot widths to ensure the pillows do not fall off, the 700 mm wide slot was divided into small modular frames of 200 mm maximum width using 25 mm square × 1.2 mm steel tube dividers secured to the concrete on the unexposed side.<br>The services passing through the opening and the pillows consisted of two packs of cables each with a group bundle consisting of 4 × Ø 25 mm Pyrotenax metal sheathed power supply cables. One bundle was fitted with steel mesh sleeve.<br>-/180/120 for pillows only.<br>-/180/30 for cables without sleeve<br>Performance of the cable with sleeve was 182 minutes without failure in integrity or insulation but the FRL would be limited to -/180/120. | |
| FSP 2478 | The test comprises of an 1800 mm × 1800 mm × 150 mm thick concrete slab penetrated by 5 (designated specimen 1 to 5) services and 2 multi-service penetrations (designated specimen 6 and 7). For the purposes of the variations, the specimen considered in this report refers to specimen 7a.<br>Specimen 7a is a multi-service penetration comprising of various types of cables passing through a 600 mm × 300 mm aperture tested in a 150 mm thick concrete slab as a horizontal separating element. The proposed fire pillows were used as a primary fire stopping element followed by a sealant as a local fire stopping element. | + It is proposed to increase the length of the TWrap design from 450 mm to 600 mm while assessing the assigned FRL up to -/120/120.<br>+ It is proposed to allow cables on the tray to be up to a maximum size of the cable core and/or bundle size.<br>+ It is proposed to allow services to be installed into openings up to 1000 mm × 300 mm. |

*Table 8 Variations to other tested systems and incorporating Maxilite Board, SuperSTOPPER Mini and SuperSTOPPER Maxi, and TWrap / MonoWrap insulation*

| Reference test | Description | Variations |
|---|---|---|
| FP6372 | In FP6372, the tested separating element was 75 mm thick Hebel PowerPanel wall. System 2b consists of a 50 mm OD × 1.2 mm copper pipe penetrated the Hebel wall and extended 500 mm into the furnace side with end capped and 500 mm from the wall on the unexposed side and open ended.<br>Annular gap was filled with FyreFLEX® sealant to full depth finished with 15 mm on each side. The pipe was wrapped for 300 mm on both sides with TWrap blanket insulation.<br>FRL achieved was -/120/90. | Extend insulation with an extra 100 mm TWrap. |

| Reference test | Description | Variations |
|---|---|---|
| FP11935-001 | In FP11935-001, the tested assembly was 116 mm thick steel stud frame wall lined with 2 layers of 13 mm USG Boral Firestop plasterboard on both sides. An aperture of 550 mm × 550 mm was formed in the wall and lined with a layer of 800 mm × 800 mm Maxilite Board overlapping the aperture on the unexposed side of the plasterboard wall for facilitating services passing through the wall.<br>Penetration 1 comprised a 100 mm OD × 1.65 mm thick copper pipe inserted through the 60 mm thick Maxilite Board and clamped to an external frame on the unexposed side. FyreFLEX® sealant applied to the annular gap. Pipe was wrapped with TWrap insulation (nominal 75 mm overlap on each wrap) for 420 mm from the board on exposed side and 600 mm on unexposed side. FRL achieved was -/120/60. | Provide first 100 mm with 3 layers of TWrap, next 200 mm with 2 layers and next 300 mm single layer. |
| | In FP11935-001, the tested assembly was 116 mm thick steel stud frame wall lined with 2 layers of 13 mm USG Boral Firestop plasterboard on both sides. Penetration 2 consists of 156 mm OD × 1.80 thick copper pipe inserted through the 60 mm thick Maxilite Board and clamped to an external frame on the unexposed side. FyreFLEX® sealant applied to the annular gap. Pipe was wrapped with TWrap insulation (nominal 75 mm overlap on each wrap) for 420 mm from the board on exposed side and 1,100 mm on unexposed side with the first 300 mm with two layers of TWrap. FRL achieved was -/120/90 | Provide first 100 mm with 3 layers of TWrap, next 200 mm with 2 layers and next 800 mm single layer |
| | In FP11935-001, the tested assembly was 116 mm thick steel stud frame wall lined with 2 layers of 13 mm USG Boral Firestop plasterboard on both sides Penetration 3 consists of 300 mm wide × 47 mm deep cable tray with Appendix D1 power cables through the lower section of the Maxilite Board. FyreFLEX® sealant applied into gap between Maxilite Board and cable tray and cables on both faces. The cables and the cable tray were wrapped with a single 300 mm long TWrap insulation wrap on both faces (with a nominal overlap of 75 mm).<br>FRL achieved was -/120/120. | Allowable variation in wall system to a 120 mm thick concrete wall |
| FRT190292 R4.0 | In FRT190292 R4.0, the separating element was 175 mm concrete slab. System E1 consists of D1 cables on a small steel cable tray with 450 mm TWrap on the unexposed side. FRL achieved was -/15/15. | Revised and assessed performance with isolation of surrounding failed test. |

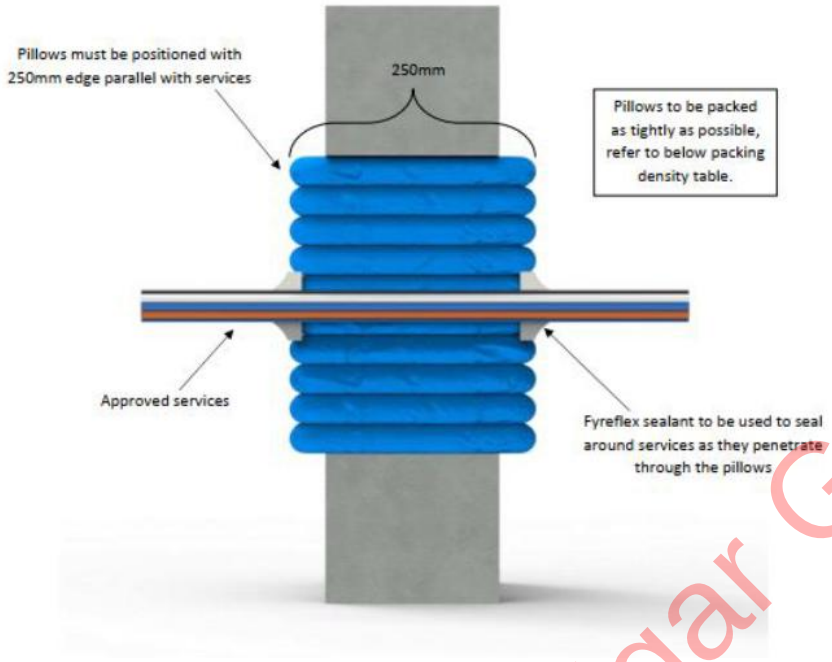


Figure 1 Proposed configuration of Trafalgar FyrePlug pillows in vertical walls

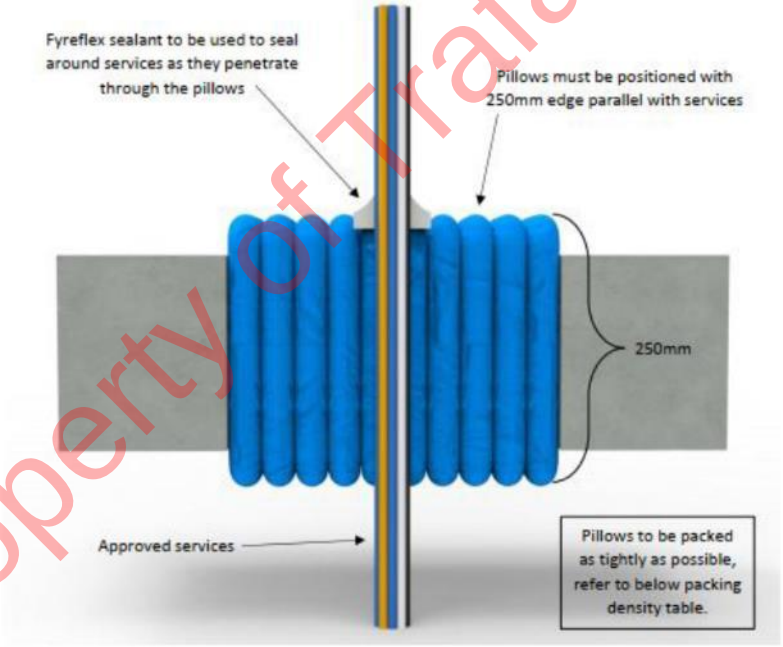


Figure 2 Proposed configuration of Trafalgar FyrePlug pillows in floors

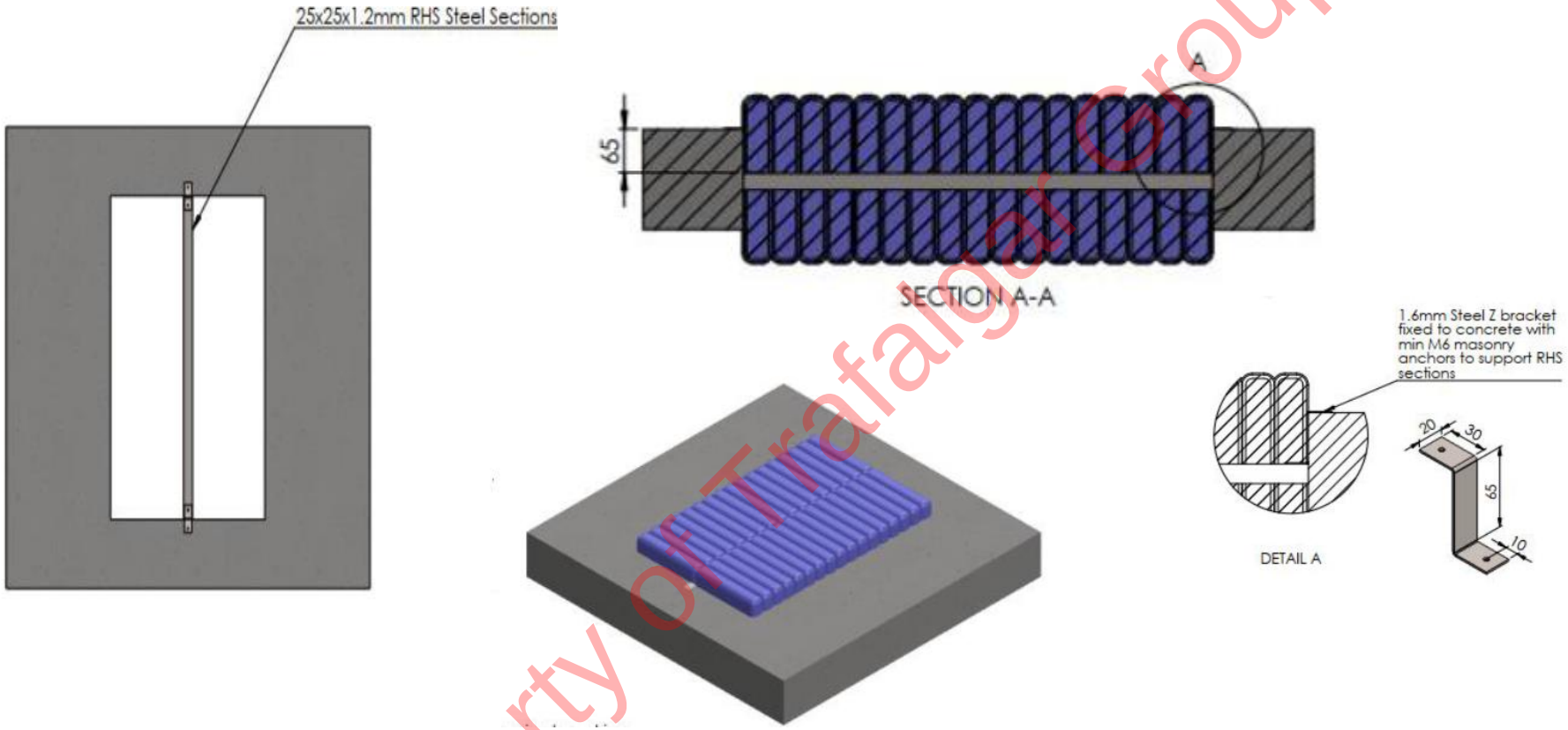


Figure 3 Proposed modular pillow detail

## 4.4 Test standard

The purpose of the test in accordance with AS 1530.4:2014 is to determine the fire resistance performance of the Trafalgar FyrePlug Pillows and TWrap, MonoWrap or FyreWrap insulation in sealing and protecting service penetrations in walls and floors, and to meet with AS 4072.1:2005 (R2016).

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.

## 4.5 Reference standard

AS 4072.1:2005 (R2016) 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. The Standard is to be applied in conjunction with AS 1530.4:2014 which provides the applicable test methods.

# 5.0 Assessment of services in Trafalgar FyrePlug pillows in walls and floors

## 5.1 Background

Trafalgar Group has over the years conducted tests on sealing systems for service penetrations in building elements to determine their ability to maintain the required fire resistance levels of the penetrated element. The tests were conducted in accordance with AS1530.4 and to various versions of the test standard.

The National Construction Code (NCC) has announced that NCC 2022 mandates all fire resistance tests to comply with the current version of AS 1530.4 – specifically AS 1530.4:2014 – which in turn references AS 4072.1:2005 (R2016) for requirements relating to service penetrations in building elements that must achieve a specified Fire Resistance Level (FRL).This assessment provides an overview of the test data from various fire resistance tests conducted over the years and determines if they are still relevant and accurate. The data is collated and compared with those from newly conducted tests in accordance with the current version of AS 1530.4 and AS 4072.1. Where the baseline data has not varied significantly, the relevant tests information will be referenced to validate the variations against the newly tested systems.

## 5.2 Tested systems and proposed variations

The referenced tests provided by Trafalgar Group include sealing systems for service penetrations directly in building elements and service penetrations via a secondary fire resistant barrier fitted into an aperture of appropriate dimensions to accommodate and to facilitate the sealing of the services passing through the aperture and building element. The barrier consists of one of the following:

- Maxilite Board,
- SuperSTOPPER Mini, SuperSTOPPER Maxi, and
- FyrePlug pillows.

The assessment on services penetrations through the building element directly will be only for metal pipes and electrical and communication cables, including cable trays. The assessment includes variations to the tested specimen with the use of TWrap, MonoWrap or FyreWrap insulation blankets to provide the required insulation performance for maintaining the required FRL of the building element.

Other variations to be assessed are the replacement of the separating element with other building elements of equivalent fire resistance levels.

## 5.3 Methodology

The method of assessment used is summarised in Table 9.

*Table 9 Method of assessment*

| Assessment method | |
|---|---|
| Level of complexity | Intermediate assessment |
| NCC procedure for determining FRL | Differs in only a minor degree from a tested prototype S1C2(b) and (c) |
| Type of assessment | Qualitative and quantitative - interpolation |

## 5.4 Assessment 1 – Service penetrations in Trafalgar FyrePlug pillows in vertical wall

### 5.4.1 Services penetrating Trafalgar FyrePlug pillows in plasterboard wall systems

In the referenced test report FP11935-001, a 2200 mm × 1000 mm × 116 mm thick steel stud lined with two layers of 13 mm thick fire rated plasterboard was tested. The wall consisted of two 550 mm × 550 mm apertures and fitted with seven pipe and cable penetrations. One of the apertures was protected with 800 mm × 800 mm Maxilite board which included one cable tray and two copper pipe penetrations. The other aperture was filled with a FyrePlug pillows and included one cable tray, one copper pipe, one TPS cable bundle and one CAT6 cable bundle penetrations.

#### *5.4.1.1 Services in Maxilite board*

**Test FP11935-001 Penetration No.1-**

The service is a 100 mm diameter copper pipe insulated with TWrap up to 420 mm on the exposed side and 600 mm on the unexposed side. The annular gap at the penetration was protected with FyreFLEX® sealant. The specimen performed to 180 minutes in integrity and 88 minutes in insulation.

From the test temperature vs time graphs, it is evident that the early failure in insulation was only at the interface on the Maxilite Board at 25 mm from the TWrap. All temperatures recorded elsewhere did not fail insulation for at least 120 minutes. It is likely that the excessive rise in temperature at the interface would be due to inability of the sealant in the annular gap around the pipe penetration to limit the heat transfer rate.

The temperature on the TWrap was below the limit for insulation failure for more than 120 minutes. Penetration No. 3 which incorporated electrical cables performed to an FRL of -/120/120 which indicates that the Maxilite board on its own without penetrations would have performed to at least the same or higher FRL.

**Test FP11935-001 Penetration No. 2-**

The service is a 156 mm dia. copper pipe insulated with TWrap for 420 mm on the exposed side and 1100 mm on the unexposed side and with a double layer of TWrap for the first 300 mm. The specimen failed in insulation in less than 120 minutes only on the Maxilite Board at the interface. The temperature on the Maxilite Board at the interface failed insulation at 104 minutes compared to 88 minutes for penetration No.1, an improvement of 16 minutes. The temperatures recorded elsewhere did not exceed the limit for failure for more than 120 minutes. The temperatures were generally lower than those for penetration No.1.

It appears from reviewing the test temperature graphs, that the insulation failure was due to insufficient insulation performance at the annular gap causing a higher rate of heat transfer from the penetration outwards along the unexposed surface of the board. Since the temperature on the TWrap at the interface was within the limit for failure for more than 120 minutes, it is considered that the interface temperature would likely be delayed in rising to the limit by at least 16 minutes if an additional layer of TWrap were added at the interface.

As there was no insulation failure on the TWrap for more than 120 minutes, the required width of the third layer would be minimal or a conservative 100 mm.

Based on the above discussion for penetration no.2, it is considered that if the copper pipe in penetration no.1 were to be insulated with 2 layers of TWrap for the first 300 mm and with a third 100 mm layer added at the interface, the specimen would likely have maintained insulation performance for at least 16 minutes.

The temperature on the bare pipe at the end of insulation, 600 mm from penetration no. 1 was only about 150°C above ambient after 120 minutes whilst corresponding temperature for penetration no. 2 at 1100 mm

away from the penetration was about 130°C. It is reasonable to assume that the lower temperature in the pipe for the latter would have been mainly due to the extra 500 mm length of single wrapped pipe.

The TWrap insulation requirements to be applied to both sides for fire exposure from either side are summarised as follows:

Penetration no.1- first 100 mm with 3 layers, next 200 mm with 2 layers and next 300 mm single layer.

Penetration no.2- first 100 mm with 3 layers, next 200 mm with 2 layers and next 800 mm single layer.

The results from the test for penetrations no.1 & 2 for the 100 mm and 150 mm diameter copper pipes will apply to brass, copper and ferrous metal pipes having wall thicknesses equal or greater than those listed in Table 10.12.3.1 of AS 1530.4:2014 for all pipe sizes up to and including 150 mm OD.

**Test FP11935-001 Penetration No.3 – Cable tray and power cables as per Appendix D1**

The service in penetration no.3 was a cable tray with power cables arranged in accordance with Appendix D1 in AS 1530.4:2014 and was wrapped with TWrap for 300 mm on both sides of the board.

The specimen performed to an FRL of -/120/120.

It is also noted that the test continued with “over burn” or beyond the rated FRL of the separating wall element which is -/120/120. From the temperature graphs, it indicated that even though the cables and cable tray, maintained integrity for at least 180 minutes, and failed insulation before 180 minutes, the Maxilite Board continued to maintain integrity as well as insulation for at least 180 minutes.

The Maxilite Board is therefore suitable as a fire resistance barrier installed in an aperture required to maintain an FRL of up to -/180/180.

Performance of penetrations in the board installed in a wall system with an FRL higher than -/120/120 will require further test data in accordance with AS 1530.4:2014 and AS 4072.1:2005.

#### *5.4.1.2 Services in Trafalgar FyrePlug pillows*

**Test FP11935-001 Penetration nos. 4, 5, 6 and 7**

In test report FP11935-001, an aperture 500 mm × 500 mm was formed in a 116 mm thick plasterboard lined steel stud wall system. The aperture was packed with FyrePlug Pillows. There were four service penetrations, nos. 4, 5, 6 and 7, through the aperture and FyrePlug Pillows.

Service penetration no. 4 consisted of an Appendix D1 power cables on a steel cable tray and was insulated with TWrap for a length of 300 mm from the wall surface on each side. The system performed to an FRL of -/90/120.

Looking at the temperature graphs and the performance of the FyrePlug Pillows at other penetrations, it appears that there was no integrity failure for 180 minutes of exposure. Additional information was provided in the form of time sequential photographs from the archive of the test laboratory of the specimen from the start of test and up to integrity failure with the cotton pad test. It appears that there was a relatively large gap created by the placement of vertically orientated pillows onto horizontal pillows at the bottom corner of the aperture adjacent to the specimen. Hot gases were escaping via the gap opening and resulting in integrity failure just under 120 minutes.

The FyrePlug pillows in all other areas were neatly packed with minimal gaps. It is obvious that if the pillows were better packed without having vertically orientated Pillows placed over horizontally orientated Pillows,

the specimen would have performed adequately in integrity for at least 180 minutes. It is therefore considered that if the FyrePlug pillows were packed tightly in one orientation only, the specimen penetration would have achieved an FRL of -/120/120 if testing in accordance with AS 1530.4:2014.

Service penetration no. 5 consisted of a Ø100 mm copper pipe insulated with TWrap for 600 mm from the wall surface on the unexposed side and 300 mm on the exposed side. The specimen maintained the integrity and insulation performance for 180 minutes. However, FRL was derated to FRL of -/120/120 to match the established FRL of the separating element. The achieved results of the sealing system are expected to be maintained when protecting copper, brass or ferrous metal pipes up to a maximum 101.6 mm OD having wall thicknesses equal or greater than those listed in Table 10.12.3.1 of AS 1530.4:2014.

Service penetration nos.6 and 7 consisted of bundle of TPS cables and a bundle of CAT6 data cables respectively. Both services maintained the integrity performance for the whole 180 minutes duration of the test. On the other hand, the insulation performance was compromised at 159 minutes for the TPS cable bundle and 173 minutes for the CAT6 data cable bundle. Ultimately, the FRL was derated to an FRL of -/120/120 for both services to match with the established FRL of the separating element.

### 5.4.2 Services penetrating Trafalgar FyrePlug pillow installed in Speedpanel wall

In test report FRT180323 R3.0, the test assembly consisted of a 78 mm thick Speedpanel wall system penetrated by 18 services across 15 systems.

An aperture of 350 mm wide × 450 mm high was made in the Speedpanel wall system. The opening was packed with FyrePlug Pillows all around the penetrating services over the full depth of the wall. There were three penetration services installed in system A.

In the fire test, system A failed insulation due to the location of a thermocouple placed on the C-track of the main separating Speedpanel wall system which had been assumed to have an established FRL of -/120/120. As noted from the test photographs, the aperture for system A was located close to the C-track of the main Speedpanel separating wall. The temperature graphs indicated a localised hot spot due to the rise in temperature in the C-track. The temperatures recorded further away from the C-track on the FyrePlug pillow and on the Speedpanel wall surface (from data collected for other penetration systems on the Speedpanel wall) were below the limits for insulation failure for the full duration of the fire test. It is therefore reasonable to consider that if the main wall system were to perform to its true FRL, ie., the temperature on the unexposed side of the entire Speedpanel wall system not exceeding the limit for maximum temperature rise, the fire performance of the penetration system services will be those recorded for the individual service penetration only.

It is proposed that the wall system be optionally replaced with an equivalent thickness (75 mm) Hebel AAC wall with a lower established FRL of -/90/90. It is considered that the systems would perform to the lower required FRL without any adverse effects if the fire stopping systems were to be applied.

**Test FRT190298 Penetration B**

In test report FRT190298 R1.0, penetration system B, a 300 mm square and 60 mm thick Maxilite Board was installed over a circular hole in a Speedpanel wall system. A similar sized hole was centrally cut into the Board to align with the hole in the Speedpanel. The purpose of the Maxilite Board is to facilitate the passage of a Ø100 mm uPVC pipe and to provide a uniform flat surface for mounting a fire collar for protecting the circular opening.

The system performed to the required FRL of -/120/120.

**Test FRT180323 R3.0 Penetration I**

In test report FRT180323 R3.0, penetration system I, a SuperSTOPPER Maxi 650 with dimensions of 650 mm wide × 115 mm high × 250 mm deep was fitted on both the exposed and unexposed side into an aperture of 670 mm × 140 mm in a Speedpanel wall system. The intumescent strips which were friction fitted into the Boxes were slit and notched to accommodate two services penetrations.

The services were I1, a Ø40 mm CPVC sprinkler pipe and I2, a Ø60 mm CPVC sprinkler pipe.

I1 performed to 121 minutes without failure in integrity and 24 minutes in insultation and I2 to 121 performed to 121 minutes without failure in both integrity and insulation. However, both SuperSTOPPER Maxis, being part of the penetration system performed only to 36 minutes in insulation with no integrity failure for 121 minutes.

Looking at the test data, it is evident that the intumescent did not adequately close off the penetration on the exposed side when the pipe material melted in I1. The intumescent in I2, a larger pipe, did close off evenly and did not allow the temperature on the intumescent in the unexposed SuperSTOPPER Maxi to rise above the limit for failure.

The early failure in insulation in the SuperSTOPPER Maxi on the unexposed side was due clearly due to heat conduction long the steel frame surrounding the SuperSTOPPER Maxi and at the interface 25 mm from the protruding metal angles of the frame (direct radiant heat from the heater metal angles). The fact that the temperatures recorded at the interface slightly further away did not fail insulation for 121 minutes indicates that the main issue is heat radiating from the metal fame.

As the steel frame is of relatively thin metal sheet (small sectional area) around the perimeter of the aperture, the heat flow rate is limited by the total section area. If the surface of the upstand metal frame were to be clad with TWrap insulation blanket, the temperature on the outer surface of the blanket would likely be below the lit for insulation failure for 120 minutes of exposure. This is due to the insulation properties of the blanket, the relatively low heat flow rate along material thickness at the perimeter and the larger surface area of the blanket surface limiting the temperature rise (heat sink effect). It is proposed that the outer surface of the box frame be wrapped with TWrap insulation blanket and extending or overlapping at least 25 mm over the wall panel surface along the perimeter of the aperture. The insulation shall be adequately tied onto the SuperSTOPPER frame.

If the SuperSTOPPER maxi unit were to be insulated with TWrap blanket as described above, the SuperSTOPPER will likely maintain insulation performance for at least 120 minutes if tested in accordance with AS 1530.4:2014. The results I2 can be revised to perform to an FRL of -/120/120.

It is proposed that the wall system be optionally replaced with an equivalent thickness (75 mm) Hebel AAC wall with a lower established FRL of -/90/90. It is considered that the systems would perform to the lower required FRL without any adverse effects if the fire stopping systems were to be applied.

**Test FRT180323 R3.0 Penetration service A1**

Penetration A1 consisted of a DN100 or 100 mm OD type B copper pipe insulated with 300 mm length TWrap from the wall on both sides. The sealing system at the service penetration performed with no failure for 121 minutes in integrity and to 75 minutes in insulation. The failure in insulation occurred firstly at the service after the TWrap at 75 minutes and later at the interface with the wall on the TWrap after 109 minutes. Using the same interpolation method for estimating the amount of insulation required from the previous discussion for test FP11935-001, it can be calculated that the additional insulation length required to attain a temperature at the service for 120 minutes exposure is 599 mm or 600 mm to the nearest wrap width. There is also a requirement to provide sufficient insulation at the interface by adding conservatively an

additional 300 mm wide TWrap at the interface in order to maintain a temperature below the maximum temperature limit for the full 120 minutes duration. In summary, the pipe shall be insulated with two layers of TWrap, first layer for 600 mm and second layer for the first 300 mm only.

**Test FRT180323 R3.0 Penetration service A2**

Penetration A2 consisted of a bundle of TPS and CAT6 cable protected by FyreFLEX® sealants and the FyrePlug Pillows. The service performed to 121 minutes without failure in both integrity and insulation. The penetration service A2 is therefore assessed positively to an FRL of -/120/120 in accordance with AS 1530.4:2014.

**Test FRT180323 R3.0 Penetration service A3**

Penetration A3 consisted of a series of power cables on a steel cable tray, using cable types derived from AS 1530.4:2014 Appendix D1. The services consisted of 1 × 3C+E 185 $mm^2$ XLPE/PVC power cable, 4 × 3C+E 16 $mm^2$ PVC power cables and a Ø25 mm uPVC conduit containing 1 × fibre-optic cable. The Ø25 mm uPVC conduit was installed with a 65 mm OD × 130 mm long PVC former.

As tested, the service assembly maintained integrity for 121 minutes and insulation for 87 minutes. Insulation failure at 87 and 98 minutes occurred on the 3C+E 185 $mm^2$ power cable and on the adjacent cable bunch located 25 mm from the sealant, respectively. No insulation failure was recorded on the uPVC conduit (at either the near or remote thermocouples). The service therefore failed in insulation at the power-cable service only.

By interpolation, using the same approach adopted for Service A1, it is assessed that an insulation length of at least 600 mm of TWrap applied over the cable tray and power cables would be sufficient to achieve 120 minutes insulation performance. On this basis, Penetration A3 can be assessed with an FRL of -/120/120, provided a minimum 600 mm length of TWrap is installed over the tray and power cables.

Where the Ø25 mm uPVC conduit (containing 1 × fibre-optic cable) is installed as a single-service penetration (i.e. in a dedicated opening) with the same wall construction, sealant type and depth, annular gap and similar support distances as in the test, TWrap is not required to be applied to the conduit. However, if the conduit shares an opening with power cables, the penetration remains governed by the power-cable assembly, and either a 600 mm length of TWrap must be provided over the cable tray and cables, or the conduit must be installed in a separate opening.

It is also proposed to extend the FRL derived for Ø25 mm uPVC conduit to other wall constructions with an established FRL of -/120/120. The proposed wall constructions include:

+ a minimum 116 mm thick wall consisting of 64 mm steel studs with two layers of fire-rated plasterboard on each side; and
+ a 120 mm thick concrete or masonry wall.

Of these, the tested 78 mm thick Speedpanel wall can generally be considered the least rigid wall system, noting its reduced thickness relative to the proposed alternatives. Installing the same service arrangement in more rigid wall systems with the same or greater FRL is therefore not expected to be detrimental to the fire performance of the penetration. On this basis, Ø25 mm uPVC conduit containing 1 × fibre-optic cable can be assessed for use in other wall constructions with an established FRL of -/120/120, for an FRL of -/120/120 – in accordance with AS 1530.4:2014.

### 5.4.3 Services penetrating a shaftwall system

**Test NI 0790 Penetration**

Penetration E in test NI 0790 consisted of a D2 bunch of telecom cables in a 190 mm steel cable tray protected by FyrePlug Pillows and FyreFLEX® sealants through a 400 mm wide × 300 mm high opening in a 95 mm plasterboard lined steel stud shaft wall system. The test was conducted in accordance with AS 1530.4:1990 which differs from the current 2014 version. The criteria for failure in integrity and insulation failure are almost the same except for the application of cotton pads in detecting integrity failure.

The data from test NI 0790 indicates that cotton pads were applied for checking possible failure during the test. The ongoing tests on service penetrations involving the use of FyrePlug Pillows over the years and to various versions of AS 1530.4, including the current version, has consistently produced positive results confirming the same performance in integrity and insulation. The results from the test conducted in NI 0790 would be considered as being accurate until confirmed otherwise by a repeat test in accordance with the current AS 1530.4:2014.

The service in NI 0790 performed to 127 minutes without integrity failure and 92 minutes in insulation. Comparing the performance of similar cable penetration I2 in test FRT190292, where TWrap is applied to insulate for a calculated length from the separating floor element, it can be similarly interpolated to provide TWrap insulation to achieve an improved insulation performance of at least 120 minutes.

In order to improve on the insulation performance from 92 minute to 120, the estimated TWrap length required for the service is approximately 300 mm. It is therefore conservatively considered that if the service were to be wrapped with 300 mm length of TWrap, the performance of the service penetration with the D2 cables and cable tray will likely achieve an FRL of -/120/120 if tested in accordance with AS 1530.4:2014.

**Various metal and cable services**

It is proposed to extend the performance achieved of services tested in plasterboard walls to 95 mm thick shaft wall system. After review of test data in NI 0790, it was observed that the thermocouples placed on the pillow did not exceed the maximum temperature rise threshold throughout the test duration except for thermocouple C5. Thermocouple C5 was placed 25 mm above the telecom cable penetrations. Further review of the time vs temperature curve showed that insulation failure occurred at 112 minutes. This insulation failure is a local weakness caused by the type of penetration in the Trafalgar FyrePlug pillow. The additional insulation wrapping proposed to be installed around the cable tray and cable services involves applying FyreFLEX® sealant in a fillet arrangement to seal the wrap back to the pillow. This arrangement is expected to push the thermocouple further up closer to thermocouple C4 where the maximum temperature recorded at 120 minutes did not exceed 90˚C.

Based on the above discussion, it is evident that the interface between the shaftwall system and Trafalgar FyrePlug pillow was maintained throughout the 120 minutes duration of the test. Accordingly, it is reasonable to consider that if the same service was to be installed in a 2-hour plasterboard or concrete wall, the integrity and insulation performances will be maintained for 120 minutes. Alternatively, the services tested in concrete and plasterboard wall system can be installed in the 95 mm thick Shaft wall system without any impact on the established FRL of the services in the Trafalgar FyrePlug pillow.

### 5.4.4 Services penetrating Trafalgar FyrePlug pillow in concrete or masonry walls

In accordance with the provisions in AS 1530.4:2014, the results for the test with a plasterboard lined frame wall system would be applicable for similar penetration and sealing systems installed in a concrete or masonry wall of the same or greater thickness. The results from the penetration in the Maxilite board

therefore would be applicable if installed in an equivalent 120 mm thick concrete or masonry separating wall element. With reference to test FP11935-001, the test continued for 3 hours in a wall rated to 2 hours and thermocouple data from the system maintained an integrity and insulation performance for up to 180 minutes. DN100 copper pipe did not fail integrity and insulation for 180 minutes. Other cable penetrations maintained integrity for 180 minutes and insulation for 120 minutes. Accordingly, it is reasonable to consider that if the proposed systems were to be installed into a concrete/masonry wall with an established FRL of -/180/180, both cable penetrations would be expected to achieve an FRL of -/180/120 and DN100 copper pipe would be expected to achieve an FRL of -/180/180.

### 5.4.5 Services penetrating Trafalgar FyrePlug pillow in 75 mm thick Hebel wall

**Test FP6372 Penetration 2b**

Penetration 2b in test FP6372 consisted of a 50 mm OD × 1.2 mm thick copper pipe penetrating a 75 mm Hebel PowerPanel wall system protected by FyreFLEX® sealant in the annular gap to full depth and finished with a 15 mm fillet on each side. The pipe was wrapped with TWrap for 300 mm on either side of the wall. The service performed to at least 125 minutes in integrity and 117 minutes in insulation. The assigned FRL was -/120/90. As the penetration fell short by just 3 minutes in insulation, the pipe could be insulated with an additional 100 mm to ensure that the insulation performance can be revised to provide an FRL of -/120/120.

The Hebel AAC wall has a similar temperature profile when heated as it is of a lightweight cement base core mixture, like that of Speedpanel, except that it has a lower established FRL of -/90/90. The system as tested in FRT190298 maintained the required FRL of the separating element, Speedpanel. It is considered that the same service penetration and construction setup and fire stopping will adequately perform to the required lower FRL of the Hebel wall of FRL -/90/90 if tested in accordance with AS 1530.4:2014.

## 5.5 Assessment 2 – Services penetrating Maxilite board, SuperSTOPPER mini, SuperSTOPPER maxi and Trafalgar FyrePlug pillows installed in floor systems

### 5.5.1 Maxilite Board

**Test FRT190292 Penetration E1**

E1 comprising D1 cables on a small steel cable tray with 450 mm TWrap on the unexposed side performed to 241 minutes without integrity failure and 154 minutes in insulation.

The specimen failed insulation mainly at the interface on the Maxilite Board and the service cable and on the service at the end of insulation. Attention is drawn to the failed E3 specimen which had improved insulation performance on the Board at the interface with an added patch board of 30 mm thick Maxilite board over the large 60 mm Maxilite board which covers the whole aperture for the E system. If specimen E1 were to have an added 30 mm thick Maxilite Board around the penetration it would have improved insultation for exposure to at least 240 minutes.

The other failure was at the cable at around 210 minutes. The cable was at 220°C above ambient at 240 minutes. Using the same interpolation and assumption as for penetration no.2 in test FP11935-001, it can be calculated that the E1 will require an additional 87 mm of extra length of insulation to maintain insulation performance on the cables for 240 minutes.

The current data set does not provide adequate correlation to substantiate a 240-minute fire-resistance rating solely through increased insulation length. Nonetheless, the addition of a 30 mm Maxilite patch board with the installation of one layer of 600 mm wrap and a second layer of 400 mm wrap overlapping the first

layer, is expected to enhance the insulation performance. With this modification, Specimen E1 is expected to achieve an FRL of –/240/240 when tested in accordance with AS 1530.4:2014.

**Test FRT190292 Penetration F**

Specimen F, consisting of a large pair coil, an orange power cable and a CAT 6 cable, performed up to 130 minutes of integrity with insulation failure in 115 minutes when the temperature at power cable service F11, 25 mm from the TWrap exceeded 180 K above ambient. The temperatures at the interface on the TWrap and on the separating element performed adequately within the maximum temperature limits for more than 120 minutes. Using double interpolation, it can be estimated that if the TWrap were to be extended by at 63 mm minimum. If the insulation TWrap were extended by 100 mm the service penetration will likely achieve an FRL of -/120/120 if tested in accordance with AS 1530.4:2014.

### 5.5.2 SuperSTOPPER Mini and SuperSTOPPER Maxi

**Test FRT190292 Penetration I1**

The penetration system I1 in test report FRT190292.4 consisted of six electrical cables penetrating through a SuperSTOPPER Mini 100 installed on the unexposed side of a concrete floor slab. The penetration I1 performed to 241 minutes with no integrity failure and 103 minutes in insulation.

From the temperature versus time graphs, the low insulation performance was due mainly to the rise in temperature of the uninsulated framing angles around the perimeter of the aperture in the floor on the unexposed side. Looking at the temperatures of recorded elsewhere which maintained insulation for at least 180 minutes, including at the interface on the surface of the FyrePlug Pillow adjacent to the uninsulated metal framing, the system insulation performance would have been improved to at least 180 minutes if the metal angles were insulated as discussed above for specimen I1 in test FRT180323 R3.0. The metal frame around the aperture rising above the floor slab if insulated with a strip of TWrap all around cover the exposed metal angles and extending to the floor onto the slab surface, lapping by at least 25 mm.

It is also noted that the performance of I1 was affected by the failure of other services in the penetrating system I. It is considered that the failed system should be isolated from the other individual penetration service performance as the primary fire stopping element, the FyrePlug pillows, itself performed to at least 220 minutes in insulation and without integrity failure for 241 minutes. Penetration service I1 is therefore considered to likely perform to an FRL of -/240/180 if tested in accordance with AS 1530.4:2014.

**Test FRT190292 Penetration H**

Service penetration H in test report FRT190292.4 incorporated a drink python hose protected by a SuperSTOPPER Mini 150 installed in a Ø160 mm hole in the concrete floor slab on the unexposed side. The system performed to an FRL of -/240/240.

### 5.5.3 FyrePlug Pillows

**Test FRT190292 Penetration system I**

In test report FRT190292.4, an aperture of 300 mm wide × 1000 mm long was made in 175 mm concrete floor slab. The opening was packed all around the penetrating services with FyrePlug pillows. There were four electrical services penetrations installed in system I.

**Test FRT190292 Penetration system I2**

Penetration I2 consisted of one D1 power cable bundle and 1 D2 communication cable bundle attached on a steel cable tray and insulated for 300 mm length on the unexposed side above the slab. The service

penetration performed to 147 minutes in integrity and 98 minutes in insulation. The services were wrapped with TWrap for 300 mm length. From the data, the insulation held the service from insulation failure for 98 minutes. If insulation performance were to be extended to 120 minutes, an additional length of TWrap to give the extra 22 minutes will be necessary. From the temperatures rise versus time, it is noted that the rate of rise of temperature rise increases toward the 98 minutes exposure compared with at the start of the test. The extra insulation length can be estimated as a ratio of 22/98 × 300 mm = 67 mm. As the rate of temperature rise was much higher towards the end of the exposure, a correction factor of 3.02/2.17 is applied, giving adjusted minimum extra length of 93 mm. If an extra 200 mm of insulation wrap were applied, the penetration service would have conservatively achieved an insulation performance for at least 120 minutes.

The penetration service would likely perform to an FRL of -/120/120 if the service were wrapped for a total length of 600mm.

**Test SI 1614 System 1**

Test 1614 was conducted using modular framed slots which could be duplicated to infinite lengths to facilitate the protection building service risers penetration fire rated floor slabs. System 1 consisted of a 1000 mm long × 700 mm wide opening in a 150 mm thick reinforced concrete floor. The perimeter along the long slab edges were reinforced with 45 mm × 25 mm × 1.6 mm steel angles and the narrow sides were fitted with 45 mm square × 1.2 mm plate steel RHS forming mullion supports which act as joints between side-by-side slots forming a continuous length of multiple slots 700 mm wide along the floor slab as required.

The services were protected by FyrePlug Pillows placed in the retaining steel angles and mullions. It provides a means of adding a flexible solution for additional new services in existing installation by extending the modules to accommodate the additional services. The system performed to the 3-hr fire rating of the floor slab. It also provides indication of the limits of the Fyreplug in protecting 3 hr rated floor slab openings to a maximum of 120 minutes in insulation or a maximum FRL of -/180/120.

**Test FSP 2478**

Specimen 7a comprises five cable bundles attached to a 620 mm wide × mm high cable tray with metal ties. Four of these bundles each include five single-core aluminium cables (four Electra FALX12400 cables with XLPE sheathing and one MEC single-core cable with PVC sheathing). The fifth bundle comprises two orange 4C+E copper cables, also sheathed in PVC.

Both the cable tray and cables are wrapped with TWrap insulation, which extends 450 mm from the unexposed face of a 150 mm-thick concrete slab. This wrap overlaps by 100 mm, secured with metal ties placed 50 mm from the wrap's exposed edge and from the slab surface. Another metal tie was applied at the centre of the TWrap. The entire assembly passes through a 600 mm × 300 mm slab opening, friction-filled with FyrePLUG® Fire Pillows to close any spaces around the services. Remaining small gaps are sealed with FyreFLEX® Intumescent Sealant.

Each bundle carries thermocouples (TCs) dedicated to each cable type within the group (i.e., the black Electra cables, the green MEC cable, and the orange 4C+E cables). Test results for Specimen 7a show that insulation failure occurred at 109 minutes specifically on the black aluminium cored cable in Bundle No. 1, where the temperature rose more than 180K (starting from a 14°C ambient). No integrity failure was recorded for the entire duration; however, because of the early insulation failure, an FRL of -/120/90 was assigned.

An in-depth review of FSP 2478 test data confirms that most thermocouples positioned 25 mm from the end of the TWrap remained below the 180K temperature-rise threshold until at least 120 minutes, apart from

thermocouple S54 (the one that failed at 109 minutes). Given that adjacent bundles—particularly Nos. 2, 3, and 5, which use identical cable arrangements—maintained insulation longer, it appears that local deficiencies in installing FyreFLEX® Sealant and FyrePLUG® Pillows may have influenced the outcome for Bundle No. 1. Bundle No. 2, for instance, reached its insulation limit around 120 minutes, while Bundles No. 3, 4, and 5 displayed even lower recorded temperatures (≤ 150°C at 120 minutes), implying a broader margin of safety.

Bundle No. 4 (comprising two 5 core copper cables) outperformed the aluminium cable bundles despite copper's generally higher thermal conductivity. Its highest recorded temperature at 120 minutes was only 100°C. Based on the temperature trend from Bundle 1 through Bundle 5, there are indications of a local failure.

However, in the absence of test evidence to provide a definitive cause of failure and to provide a safety margin, the TWrap length is proposed to be increased from 450 mm to 600 mm. Based on the foregoing data, the possibility of upgrading the FRL of Specimen 7a to -/120/120 does exist, contingent on addressing the installation shortfalls suggested by the possibility of a local nature of the 109 minute failure. Increasing the TWrap length from 450 mm to 600 mm is expected to improve the performance of Bundle No.1 and is therefore positively assessed.

Specimen F of RTF FT1882.01, incorporating an Appendix D1, Group A cable bundle on a 470 mm-wide tray with a 300 mm 'Sample B' intumescent wrap, recorded TC 86 (located 600 mm from the FyreBATT) at ≤ 200 °C for 120 min on a 630 mm² copper conductor. As aluminium exhibits lower thermal conductivity than copper, aluminium cables protected by an extended 600 mm TWrap are expected to perform at least equivalently, if not more favourably.

On the basis of:

- the localised nature of the 109 min insulation breach,
- the satisfactory performance of adjacent bundles, and
- corroborative temperature data at a 600 mm offset from a comparable test assembly,

the proposed extension of TWrap to 600 mm is considered technically sound and capable of achieving an upgraded FRL of -/120/120 for the configuration represented by Specimen 7a.

### 5.5.4 Aperture size in floors

It is proposed to install penetration system B with an FRL -/180/120 tested in FRT200257, in a bigger aperture size with dimension (300 mm wide × 1000 mm long). With reference to test FRT190292.4, penetration system I2 showed no signed of failure in integrity and insulation for 147 minutes and 98 minutes respectively. However, it was positively assessed to -/120/120 if the service was wrapped for a total length of 500 mm. Hence, the proposed penetration system would likely perform to an FRL of -/120/120.

**Test FRT200257 penetration system B**

In test report FRT200257, an aperture of 300 mm wide × 300 mm long was made in a 120 mm thick concrete floor slab. The opening was packed with FyrePlug pillows all around the penetrating services over the full depth of the floor.

Penetration system B consisted of two services, a DN 50 type B copper pipe insulated with 450 mm long TWrap from the pillows on the unexposed side above the slab and a DN 100 type B copper pipe insulated with 600 mm long TWrap from the pillows on the unexposed side above the slab. FyreFLEX® sealant was applied between the service and the pillows to a nominal depth of 50 mm from the unexposed side. It

finished on the unexposed side of the pillows with a 50 mm × 50 mm fillet. Small beads of sealant were applied in the gaps between the pillow and the separating element. The service penetration performed to 180 minutes in integrity and 152 in insulation.

**Test FSP 2478**

Report FAS200048 R2.2 cites fire test FRT190292 (System I2) in Section 5.5.4, which confirms that a 300 mm × 1000 mm penetration through a 175 mm-thick concrete floor slab can attain an FRL of –/120/120 when the penetrating services are encapsulated with wrap extending 500 mm from the slab's unexposed face.

In a separate assessment (FSP 2478), two thermocouples (S48 and S49) were mounted 25 mm from the perimeter of a 600 mm × 300 mm opening in a 150 mm-thick concrete slab, on both the north and south sides. After 120 minutes of furnace exposure, the recorded temperatures remained ≤ 85 °C, demonstrating minimal heat transfer to the slab body. It is also well established that a 120 mm-thick concrete slab can independently achieve an FRL of –/120/120 without supplementary protection.

On this basis—and with the proposed increase in wrap length from 450 mm to 600 mm—it is reasonable to conclude that a 300 mm × 1000 mm aperture in a 150 mm thick concrete slab will likewise satisfy an FRL of –/120/120. Accordingly, the aperture dimensions are considered acceptable under the specified conditions.

## 5.6 Assessment of variation in Trafalgar FyrePlug pillow colour

It is proposed to extend the achieved fire resistance performance of the Trafalgar FyrePlug pillows to cover different colours. It is understood that the variation in colour is only due to the difference in pigment in the pillow's fire-retardant fabric. Moreover, Trafalgar group has confirmed that pillows of different colours are made of the same material and filled with the same quantity and material of the granulated mineral fibre – which provides the fire-resistant characteristic of the Trafalgar FyrePlug pillows.

As the colour pigment is not expected to introduce any detrimental effect to the fire resistance performance of the pillow as a protection system, the FRL established in Table 11 and Table 12 can be maintained if the Trafalgar FyrePlug pillow with different colour were tested in accordance with AS 1530.4:2014 and assessed in accordance with AS 4072.1:2005.

## 5.7 Assessment of Trafalgar FyrePlug pillow as a blank seal

The referenced tests included Trafalgar FyrePlug pillow installed in vertical and horizontal separating elements. In all the referenced tests, the pillows were penetrated by various types of services. It is proposed to assess the expected fire resistance performance of the Trafalgar FyrePlug pillows when installed in a vertical and horizontal separating element as a blank seal.

Test SI 1562 was set up with FyrePlug Pillows filling up a 1810 mm long × 440 mm wide aperture in a 230 thick brick wall tested positively for 240 minutes in accordance with AS 1530.4:1975. When tested, the Trafalgar FyrePlug pillow was found to maintain the integrity and insulation performance for the whole duration of the 240 minutes test. This test result provides confidence in using the Trafalgar FyrePlug pillows for large apertures to provide a flexible fire resistance barrier for building services penetrations of up to 240 minutes.

As no gaps were observed during the test on the tested pillow, the differences in the integrity criteria would not have affected the outcome of the test if tested in accordance with AS 1530.4:2014. However, due to the age of the test data and the highlighted variations between both standards summarised in Appendix C, the test results of this test will be taken at face value and will be considered as secondary test data

In all the recent test reports, the proposed Fyreplug pillows were tested while penetrated by other services. After review of the test reports, it was confirmed that all the pillows maintained the integrity and insulation throughout the test duration. At no point, any signs of gaps forming or flaming were observed. While the tested aperture in test report SI 1562 was 1810 mm × 440 mm, a conservative approach was followed where the maximum aperture is limited to 1000 mm × 300 mm.

## 5.8 Assessment of alternative insulation

### 5.8.1 TWrap vs MonoWrap insulation

Some of the services assessed in the previous sections were insulated with 25 mm thick Trafalgar TWrap. It is proposed that; these services will be insulated with an alternative 40 mm thick MonoWrap insulation material. The fire performance of the TWrap and Mono Wrap is therefore compared to determine if Trafalgar MonoWrap can be used as an alternative insulation material to the tested TWrap. Based on test report FRT210467 R1.1, two Ø40 mm copper pipes – marked as specimen F and specimen G were tested in a 150 mm thick concrete floor. The annular gap between the pipe and separating element was sealed with Trafalgar FyreFLEX® sealant. Specimen F was insulated with Trafalgar MonoWrap while specimen G was insulated with Trafalgar TWrap on the unexposed side to a height of 300 mm. The recorded temperatures on the Wraps are listed in Table 10.

*Table 10 Recorded temperature on Trafalgar TWrap and MonoWrap in test report FRT210467 R1.1*

| Penetration system/ Control joint | T/C # | Description | Temp (°C) at t (minutes) | | | | | | | Limit* (minutes) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | t=0 | t=30 | t=60 | t=90 | t=120 | t=180 | t=240 | |
| F | 030 | On the wrap, south side, 25 mm away from the slab | 24 | 43 | 66 | 82 | 95 | 206 | 172 | 169 |
| | 031 | On the wrap, east side, 25 mm away from the slab | 24 | 39 | 58 | 74 | 86 | 197 | 212 | 220 |
| | 032 | On the wrap, south side, 25 mm away from the end of the wrap | 24 | 35 | 46 | 52 | 57 | 162 | 146 | - |
| | 033 | On the wrap, east side, 25 mm away from the end of the wrap | 24 | 34 | 46 | 54 | 61 | 183 | 139 | 183 |
| G | 038 | On the wrap, south side, 25 mm away from the slab | 24 | 47 | 67 | 85 | 100 | 145 | 233 | 204 |
| | 039 | On the wrap, east side, 25 mm away from the slab | 24 | 51 | 74 | 91 | 109 | 167 | 275 | 195 |

| Penetration system/ Control joint | T/C # | Description | Temp (°C) at t (minutes) | | | | | | | Limit* (minutes) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | t=0 | t=30 | t=60 | t=90 | t=120 | t=180 | t=240 | |
| | 040 | On the wrap, south side, 25 mm away from the end of the wrap | 24 | 41 | 55 | 61 | 68 | 110 | 201 | 216 |
| | 041 | On the wrap, east side, 25 mm away from the end of the wrap | 24 | 44 | 62 | 66 | 73 | 119 | 215 | 209 |
| *** Limit time is the time to the nearest whole minute, rounded down to the nearest minute, at which the temperature recorded by the thermocouple does not rise by more than 180 K above the initial temperature.** | | | | | | | | | | |

From the recorded data, it is noted that, the temperature on the MonoWrap remains similar or lower than TWrap up to 120 minutes. However, the temperature on MonoWrap exceeds the temperature of TWrap from 180 minutes onwards. Based on the above, it can be conservatively estimated that, the services protected with Trafalgar TWrap will perform similarly or better if they are protected with Trafalgar MonoWrap instead, at least up to 120 minutes. Based on the above, services protected with Trafalgar MonoWrap are positively assessed for 120 minutes of insulation performance.

### 5.8.2 TWrap vs FyreWrap insulation wrap

FyreWrap is a 38 mm foil encapsulated wrapping system supplied by Unifrax with a density of 96 kg/m³. TWrap is also supplied by Unifrax with a 25 mm foil encapsulated wrap with the same infill material and a density of 128 kg/m³. The fire resistance performance of the FyreWrap was established in test FCO 3226c where the wrap was used in protecting duct subjected to internal fire conditions. Ultimately, it is considered that the reduction in density when compared to TWrap is compensated by the increased thickness. As both wraps are made from the same material, it is reasonable to consider that the insulation performance achieved in TWrap can be extended to cover the same services when protected with FyreWrap

## 5.9 Conclusion

This assessment demonstrates that the service penetrations protected by the Trafalgar Group resistant barrier and sealing systems as summarised in Table 11 and Table 12 are expected to achieve the shown FRLs in accordance with AS 1530.4:2014.

*Table 11 Assessment outcome in vertical walls*

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| Steel cable tray and Appendix D1 power cables | + A 116 mm thick wall that consists of 64 mm steel stud lined with two layers of 13 mm fire rated plasterboard on each side<br>+ 120 mm concrete or masonry wall | 60 mm Maxilite board in 800 mm × 800 mm aperture | FyreFLEX® Sealant in joint between plasterboard wall and Maxilite board on both sides and finished with 50 mm × 50 mm sealant fillet applied before wrapping around a maximum annular gap of 5 – 20 mm nominally | 300 mm single layer on both sides | **-/120/120** | FPH-1 |
| 100 mm O.D × 1.65 mm copper pipe | | | FyreFLEX® Sealant in joint between plasterboard wall and Maxilite board on both sides and finished with 50 mm × 50 mm sealant fillet applied before wrapping around a maximum annular gap of 10 mm nominally | The wrapping sequence shall be applied as follows: three layers over the initial 100 mm, reduced to two layers for the subsequent 200 mm, and continued with a single layer for the final 300 mm. | | FPH-2 |
| 150 mm O.D × 1.80 mm copper pipe | | | | The wrapping sequence shall be applied as follows: three layers over the initial 100 mm, reduced to two layers for the subsequent 200 mm, and continued with a single layer for the final 800 mm. | | FPH-3 |
| Ø100 mm uPVC SC pipe | 78 mm Speedpanel wall system | 60 mm thick Maxilite board in a 300 mm × 300 mm aperture | 100 mm Trafalgar Fyrechoke collar fitted on pipe at penetration on both sides of the wall. Trafalgar FyreFLEX® sealant applied to a nominal depth of 10 mm in the annular gap on each sides | None | **-/120/120** | FPH-4 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| 50 mm O.D × 1.2 mm copper pipe | | | 50 mm Trafalgar Fyrechoke collar fitted on pipe at penetration on both sides of wall. Trafalgar FyreFLEX® sealant applied to a nominal depth of 10 mm in the annular gap on each sides | | | FPH-5 |
| Ø100 mm uPVC SC pipe | 75 mm AAC Hebel wall | | 100 mm Trafalgar Fyrechoke collar fitted on pipe at penetration on both sides of wall. Trafalgar FyreFLEX® sealant applied to the full depth of the annular gap | None | **-/90/90** | FPH-6 |
| 50 mm O.D × 1.2 mm copper pipe | | | 8.5 mm annular gap was filled with FyreFLEX® sealant to full depth and finished with a 15 mm fillet on each side. | Insulation wrap length of 300 mm on fire side and 400 mm on the non-fire side | | FPH-7 |
| Ø60 mm CPVC sprinkler pipe | 78 mm Speedpanel wall system | SuperSTOPPER Maxi 650 fitted into a 670 mm × 140 mm aperture in the wall | Four layers of 1.8 mm thick intumescent strip fitted in the SuperSTOPPER.<br>FyreFLEX® sealant applied in a maximum nominal 10 mm annular gap to the full depth of the separating element | 100 mm wide strip wrap to be tied over the upstand metal angles protruding from wall surface forming a shroud with 25 mm of blanket lapping over wall surface on each side | **-/120/120** | FPH-8 |
| | 75 mm AAC Hebel wall | | | | **-/90/90** | FPH-9 |
| Appendix D1 power cables on steel cable tray | + A 116 mm thick wall that consists of 64 mm steel stud lined with two layers of 13 mm fire rated plasterboard on each side | FyrePlug pillows fitted into a 550 mm × 550 mm aperture in the wall. The aperture size must be limited to 400 mm × 300 mm when installed in shaftliner wall system. Pillows to be installed in a | 50 mm × 50 mm fillet of FyreFLEX® sealant applied in the annular gap between service and FyrePlug Pillows and between cables, cable tray and onto the FyrePlug pillows | 300 mm on each side | **-/120/120** | FPH-10 |
| Copper pipe, including, brass or steel pipes up to 100 mm OD. as per clause | | | | | | FPH-11 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| 10.12.3, AS1530.4:2014 | + 120 mm thick concrete wall<br>+ 95 mm thick plasterboard lined steel stud shaft wall | consistent horizontal configuration only | | | | |
| TPS cable bundle | | | | None | | FPH-12 |
| CAT6 data cables | | | | None | | FPH-13 |
| Appendix D2 bundle of telecom cables on a steel cable tray consisting of:<br>+ 22 × Electra Tele 5OP × 2 × 0.5 TO ACA Tech STD008<br>+ 22 × Garland VTPL 350HF 24 AUG 50 PR LSZH CAT3 | | | | 300 mm on each side | **-/120/90** | FPH-14 |
| 100 mm OD copper pipe, including copper, brass or steel pipes up to 100 mm dia. as per clause 10.12.3, AS 1530.4:2014. | + A minimum of 116 mm thick wall that consists of 64 mm steel stud lined with two layers of 13 mm fire rated plasterboard on each side<br>+ A minimum of 120 mm concrete or masonry wall | | | 600 mm on both sides of the wall | **-/180/180** | FPH-15 |
| TPS cable bundle | | | | None | **-/180/120** | FPH-16 |
| CAT6 data cables | | | | None | **-/180/120** | FPH-17 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| DN100 Type B copper pipe, including, brass or steel pipes up to 100 mm OD. as per clause 10.12.3, AS1530.4:2014. | 78 mm Speedpanel wall | FyrePlug pillows fitted into 1000 mm wide × 300 mm high aperture in the wall | FyreFLEX® sealant applied between pipe and pillow interface with a 30 mm × 30 mm fillet on both the exposed and unexposed side. | First layer for 600 mm followed by a second layer for the first 300 mm only applied on both sides | **-/120/120** | FPH-18 |
| Bundle of TPS and CAT6 cables consisting of:<br>+ 5 × 2C+E 2.5 $mm^2$ Electra TPS Cables<br>+ 5 × CAT6 Delta Cables | | | FyreFLEX® sealant applied between cable services and pillow interface with a 30 mm × 30 mm fillet. Gaps between the cables sealed with FyreFLEX® on both the exposed and unexposed side | None | | FPH-19 |
| Appendix D1 power cables on a steel cable tray consisting of:<br>+ 1 × 3C+E 185 $mm^2$ XLPE/PVC power cable<br>+ 4 × 3C+E 16 $mm^2$ PVC power<br>+ Ø 25 mm uPVC conduit with 1 × fibre optic cable | | | + FyreFLEX® sealant applied between cable services and pillow interface with a 30 mm × 30 mm fillet. Gaps between the cables sealed with FyreFLEX® on both the exposed and unexposed side.<br>+ FyrePEX HP sealant applied inside the Ø65 mm PVC pipe – used as a pipe former – to a depth of 100 mm, with a backing rod around the Ø 25 mm PVC conduit. Gaps between the Ø 25 mm PVC conduit and the fire pillows sealed with FyrePEX HP sealant. | 600 mm on each side | | FPH-20 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| Ø 25 mm uPVC conduit with 1 × fibre optic cable | 78 mm thick Speedpanel wall or other wall constructions with an established FRL of -/120/120 | | FyrePEX HP sealant applied inside the Ø65 mm PVC pipe – used as a pipe former – to a depth of 100 mm, with a backing rod around the Ø 25 mm PVC conduit. Gaps between the Ø 25 mm PVC conduit and the fire pillows sealed with FyrePEX HP sealant. | None | **-/120/120** | FPH-21 |
| DN100 Type B copper pipe, including, brass or steel pipes up to 100 mm OD. as per clause 10.12.3, AS1530.4:2014 | 75 mm Hebel AAC wall | FyrePlug pillows fitted into 1000 mm wide × 300 mm high aperture in the wall | FyreFLEX® sealant applied between pipe and pillow interface with a 30 mm × 30 mm fillet on both the exposed and unexposed side. | First layer for 600 mm followed by a second layer for the first 300 mm only applied on both sides | **-/90/90** | FPH-22 |
| Bundle of TPS and CAT6 cables consisting of:<br>+ 5 × 2C+E 2.5 $mm^2$ Electra TPS Cables<br>+ 5 × CAT6 Delta Cables | | | FyreFLEX® sealant applied between cable services and pillow interface with a 30 mm × 30 mm fillet. Gaps between the cables sealed with FyreFLEX® on both the exposed and unexposed side | None | | FPH-23 |
| Appendix D1 power cables on a steel cable tray consisting of:<br>+ 1 × 3C+E 185 $mm^2$ XLPE/PVC power cable | | | + FyreFLEX® sealant applied between cable services and pillow interface with a 30 mm × 30 mm fillet. Gaps between the cables sealed with FyreFLEX® on both the exposed and unexposed side.<br>+ FyrePEX HP sealant applied inside the Ø65 mm PVC pipe – | 600 mm on each side | | FPH-24 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap / MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| + 4 × 3C+E 16 mm$^2$ PVC power<br>+ Ø 25 mm uPVC conduit with 1 × fibre optic cable | | | used as a pipe former – to a depth of 100 mm, with a backing rod around the Ø 25 mm PVC conduit. Gaps between the Ø 25 mm PVC conduit and the fire pillows sealed with FyrePEX HP sealant. | | | |
| Ø 25 mm uPVC conduit with 1 × fibre optic cable | | | FyrePEX HP sealant applied inside the Ø65 mm PVC pipe – used as a pipe former – to a depth of 100 mm, with a backing rod around the Ø 25 mm PVC conduit. Gaps between the Ø 25 mm PVC conduit and the fire pillows sealed with FyrePEX HP sealant. | None | | FPH-25 |

**Note:**

The shown FRLs are applicable to Trafalgar FyrePlug pillows in either blue or orange colour.

+ The aperture sizes shown across all elements is maximum sizes. The height and/or width of the opening may be varied to a maximum
+ The insulation performance will be limited to 120 minutes if Trafalgar MonoWrap is used.
+ The wall must have an established FRL either through testing or assessment by an Accredited Testing Laboratory. The minimum thickness of concrete wall must be 120 mm, 150 mm and 175 mm for FRL of -/120/120, -/180/180 and -/240/240 respectively.
+ Cables applicability can be extended to other brands with same physical construction.
+ A minimum spacing of 40 mm – from service to service within the same aperture – is acceptable for penetrations protected with FyrePLUG pillows, provided that:
  - any overlap of fire-rated sealant preserves the aggregate sealant volume required for the two penetrations, and
  - the FRL of the entire penetration system will be limited to the lowest performing service FRL

*Table 12 Assessment outcome in floors systems*

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap/MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| Small steel cable tray and D1 cables consisting of:<br>+ 1 × CMI Electrical OX37252C3CE 0.6/1kV 3C × 185 mm2 Cu + E (37 × 2.52 mm conductors) XLPE/PVC V-90<br>+ 1 × CMI Electrical Product 0.6/1kV × 90 1C × 630 mm2 CU 2013<br>+ 3 × Electra cables 2018 V-90 electric cable 450/750V SRVC 3060/e 6 mm2 × 3C + E CU RoHS GMA-501542 EA<br>+ 8 × APEC2017 V-90 Electric cable 0.6/1kV 16 mm2 CU | 175 mm concrete floor slab | 60 mm Maxilite Board over 1000 mm × 300 mm aperture in floor slab | FyreFLEX® sealant applied in a nominal 50 mm fillet arrangement around penetration and cable tray and cables on both sides | Single layer of 600 mm and a second layer of 400 mm overlapping the first layer. | **-/240/240** | FPV-1 |
| 2 pair coils, 2 orange power cables and 2 CAT 6 cables consisting of:<br>+ Two 1/4" + 1/2" Ardent pair coil with 13 mm FR insulation<br>+ Two Prysmian L electric cable 0.6/1kV V-90 2C × 10 $mm^2$ + E × 4 $mm^2$ Cu | 175 mm concrete floor slab | SuperSTOPPER Mini 100 in the slot opening in the concrete slab protected all around by FyrePlug pillows friction fitted between the frame of the SuperSTOPPER and the slab edge of the floor opening. | Intumescent strips placed in SuperSTOPPER. A nominal 30 mm fillet FyreFLEX® sealant applied between pillows and flanges of the boxes at the interface. | None | **-/240/90** | FPV-2 |
| | | | | Wrap length of 300 mm. Tie wrap onto the unprotected upstand metal angles all around and extending 25 mm over the top of the pillows. | **-/240/180** | FPV-3 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap/MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| + Two Prysmian MG× 6 4PE Category 6 | | | | | | |
| Drink Python hose | | SuperSTOPPER Mini 150 fitted into opening in the concrete floor slab | Intumescent strip in SuperSTOPPERes., FyreFLEX® sealant applied along the maximum annular gap of 5 mm between the frame of the SuperSTOPPER and the slab edge. | None | **-/240/240** | FPV-4 |
| D1 power cable bundle and D2 communication cable bundle on a steel cable tray consisting of:<br>**D1 Bundle:**<br>+ 1 × CMI Electrical OX37252C3CE 0.6/1kV 3C × 185 mm$^2$ Cu + E (37 × 2.52 mm conductors) XLPE/PVC V-90<br>+ 1 × CMI Electrical Product 0.6/1kV × 90 1C × 630 mm$^2$ CU 2013<br>+ 3 × Electra cables 2018 V-90 electric cable 450/750V SRVC 3060/e 6 mm$^2$ × 3C + E CU RoHS GMA-501542 EA | 175 mm concrete floor slab | FyrePlug Pillows fitted into 300 mm wide × 1000 mm long aperture in the floor slab. | A nominal 30 mm fillet FyreFLEX® sealant applied in annular gap between services and pillows. | 500 mm above slab and secured with stainless steel cable 50 mm from the edges and centrally. | **-/120/120** | FPV-5 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap/MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| + 8 × APEC2017 V-90 Electric cable 0.6/1kV 16 $mm^2$ CU<br>**D2 Bundle:**<br>+ 60 × Electra Tele 5OP × 2 × 0.5 TO ACA Tech STD008 01/05/2019 | | | | | | |
| Bundle of 15 fire alarm cables consisting of:<br>+ Firesense – TPS-1 50-2CT-ELV-FIRE light duty AS/ACIF | | | | None | **-/180/180** | FPV-6 |
| 1 bundle of 20 CAT6 and 1 NBN cable consisting of:<br>+ 6 mm Category 6 UTP PVC P36503024 IEC 60232-1 CM 4/23 AWG<br>+ 12 mm NBN Co. fibre optic corning cable – 24F | | | | None | **-/180/180** | FPV-7 |
| 1 × DN 50 type B copper pipe | Minimum 120 mm concrete floor slab | FyrePlug pillows fitted into 300 mm wide × 300 mm long aperture in the floor slab | FyreFLEX® sealant applied between the service and pillows to a nominal depth of 50 mm from the unexposed side. It finished on the | Single layer of 450 mm from the pillows on the top side only. Wraps secured with steel cable ties in the centre and 50 mm from the edges. | **-/120/120** for 120 mm slab and **-/180/120** | FPV-9 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap/MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| 1 × DN 100 type B copper pipe | | | unexposed side of the pillow with a 50 mm × 50 mm fillet.<br>Small beads of FyreFLEX® sealant were applied in the gaps between the pillow and the separating element. | Single layer of 600 mm wrap from the pillows on the top side only. Wraps secured with steel cable ties in the centre and 50 mm from the edges. | for 150 mm slab | FPV-10 |
| Up to four bundles of up to 5× single-core aluminium cables consisting of:<br>+ Four Electra cables, FALX12400 with XLPE sheath and measured 28-mm OD (insulation thickness 1.7 mm and maximum conductor area of 475.5 $mm^2$)<br>+ One MEC cable, a single core earth cable with PVC sheath and measured 20-mm OD, insulation thickness 1.7 mm and a maximum conductor area of 216.4 $mm^2$).<br>One bundle of two orange cables consisting of:<br>+ Electrical PVC cables 4C+E copper, a maximum conductor area of 16 $mm^2$ with measured 20 mm OD). | Minimum 150 mm concrete floor slab | FyrePlug pillows fitted into an aperture of up to 1000 mm × 300 mm aperture in the floor slab. | FyreFLEX® sealant applied between the service and pillows and at any visible gaps. | Single layer of TWrap 600 mm from the pillows with 100 mm overlap. Steel cable ties applied 50 mm from each end and at the centre of the TWrap | **-/120/120** | FPV-11 |

| Service | Separating element system | Penetration fire barrier | Fire stopping details | TWrap/MonoWrap or FyreWrap insulation | FRL | System No. |
|---|---|---|---|---|---|---|
| Up to four HELIAX co-axial 28 mm OD | | FyrePlug pillows fitted into 1000 mm × 300 mm aperture in the floor slab. | FyreFLEX® sealant applied between the service and pillows and at any visible gaps. It finished on the unexposed side of the pillow with a 30 mm × 30 mm FyreFLEX® fillet surrounding the cables | Single layer of TWrap 300 mm from the pillows with 50 mm overlap. Steel cable ties applied at 50 mm from each end of the TWrap | **-/120/120** | FPV-12 |
| Up to 20 fibre cables | | | | No insulation wrap applied | **-/120/120** | FPV-13 |

**Note:**

- The insulation performance will be limited to 120 minutes if Trafalgar MonoWrap is used.
- The concrete wall needs to be designed in accordance with AS 3600:2018 or AS 3700:2018 as appropriate.
- All floors must have an established FRL either through testing or assessment by an accredited testing laboratory.
- Cables applicability can be extended to other brands with same physical construction.
- A minimum spacing of 40 mm – from service to service within the same aperture – is acceptable for penetrations protected with FyrePLUG pillows, provided that:
  - any overlap of fire-rated sealant preserves the aggregate sealant volume required for the two penetrations, and
  - the FRL of the entire penetration system will be limited to the lowest performing service FRL

## 6.0 Validity

Jensen Hughes does not endorse the tested or assessed products and systems 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 sponsor is responsible for formally notifying Jensen Hughes of any additional testing performed on their product/system. This obligation applies regardless of where the test was conducted, the results of the test, or whether it was initially considered part of Jensen Hughes' ongoing assessment. The primary goal of this notification is to allow Jensen Hughes to review the changes and determine whether they require re-evaluation or re-testing to determine whether the changes have affected the product's performance. It is important that the client promptly notify Jensen Hughes if any such changes are implemented.

The procedures for the conduct of tests and the assessment of test results are subject to constant review and improvement. The sponsor 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 that is expected to be demonstrated when subjected to test conditions 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 Summary of supporting test data

## A.1 Test report – FP6372

*Table 13 Information about test report FP6372*

| Item | Information about test report |
|---|---|
| Report sponsor | Fire Containment Pty Ltd |
| Test laboratory | BRANZ, 1222 Moonshine Road, Porirua 5381, New Zealand. |
| Test date | The fire resistance test was completed on 03/07/2018. |
| Test standards | The test was done in accordance with AS1530.4-2014. |
| Variation to test standards | None |
| General description of *tested specimens* | The tested specimens comprised four pipe penetrations and an access panel in a 75 mm thick Hebel PowerPanel wall.<br>Specimen 1 consisted of a 100mm OD uPVC pipe with 100 mm Fyrechoke collars on each side and FyreFLEX® sealant to full depth in annular gap. The conduit extended 500 mm from the wall on the exposed side with its end capped and 2000 mm from the wall on the unexposed side with its end open.<br>Specimen 2a consisted of a 25 mm OD uPVC conduit containing a fibre optic cable with 25 mm Fyrechoke collar on each side and FyreFLEX® sealant to full depth in annular gap. The conduit extended 500 mm from the wall on the exposed side with its end capped and 2000 mm from the wall on the unexposed side with its end open.<br>Specimen 2b consisted of a 50 mm OD × 1.2 mm copper pipe with a 300 mm wide TWrap blanket on each side and FyreFLEX® sealant to full depth in the annular gap between the pipe and Hebel wall finished with 15 mm on each side. The pipe extended 500 mm from the wall surface and was capped at the end on the exposed side only.<br>Specimen 3 consisted of a 450 mm × 450 mm Trafalgar FRC fire rated access panel installed on the unexposed side of the Hebel wall with 8 g × 100 mm plasterboard screws. The opening in the Hebel wall was trimmed all around with 75 mm × 50 mm × 1.2 mm slotted angles which were fixed with 8 g × 65 mm CSK plasterboard screws.<br>Specimen 4 consisted of a 25 mm OD × 2.52 mm Pex-Al Pex gas pipe with Trafalgar FyrePex intumescent sealant in the annual gap to 25 mm depth and finished with a 35 mm fillet on each side. The specimen pipe protrudes 500 mm into the furnace side from the wall with the end capped. |
| Instrumentation | The test report states that the instrumentation was in accordance with AS 1530.4:2014. |

The test specimen achieved the following result:

*Table 14 Results summary for this test report*

| Specimen | Penetration details | Integrity performance (minutes) | Insulation performance (minutes) | FRL |
|---|---|---|---|---|
| 1 | 100 mm OD uPVC pipe with 100 mm Fyrechoke Collars on each side and FyreFLEX® sealant to full depth in annular gap. | 125 | 125 | **-/120/120** |
| 2a | 25 mm OD uPVC conduit containing a fibre optic cable with 25 mm Fyrechoke collar on each side and FyreFLEX® sealant to full depth in annular gap. | 125 | 125 | **-/120/120** |

| Specimen | Penetration details | Integrity performance (minutes) | Insulation performance (minutes) | FRL |
|---|---|---|---|---|
| 2b | 50 mm OD copper pipe with a 300 mm wide TWrap blanket on each side and FyreFLEX® sealant to full depth in the annular gap between the pipe and Hebel wall finished with a 15 mm fillet on each side. | 125 | 117 | **-/120/90** |
| 3 | 450 mm × 450 mm Trafalgar FRC fire rated access panel installed on the unexposed side.<br>Opening in the Hebel wall trimmed all around with 75 mm × 50 mm × 1.2 mm slotted angles | 92 | 17 | **-/90/-** |
| 4 | 25 mm OD × 2.52 mm Pex-Al Pex gas pipe with Trafalgar FyrePex intumescent sealant in the annual gap to 25 mm depth and finished with a 35 mm fillet on each side. | 125 | 125 | **-/120/120** |

## A.2 Test report – FP11935-001

*Table 15 Information about test report FP11935-001*

| Item | Information about test report |
|---|---|
| Report sponsor | Fire Containment Pty Ltd |
| Test laboratory | BRANZ, 1222 Moonshine Road Porirua 5381, New Zealand. |
| Test date | The fire resistance test was completed on 14/08/2019. |
| Test standards | The test was done in accordance with AS1530.4-2014. |
| Variation to test standards | None |
| General description of tested specimen | The specimen wall consisted of a nominally 2200 mm high × 1000 mm wide × 116 mm thick steel stud lined with two layers of 13 mm thick USG Boral Firestop plasterboard on each face. There were two 550 mm × 550 mm apertures, located one above the other, in the wall and were fitted with seven pipe and cable penetrations.<br>The upper aperture was lined on the unexposed side with a layer of 60 mm thick Maxilite Board and included one cable tray and two copper pipe penetrations.<br>The lower aperture was filled with FyrePlug pillows and included one cable tray, one copper pipe, one TPS cable bundle and one CAT6 cable bundle penetrations. |
| Instrumentation | The test report states that the instrumentation was in accordance with AS 1530.4:2014. |

The test specimen achieved the following result:

*Table 16 Results summary for this test report*

| Specimen | Penetration details | Integrity performance (mins) | Insulation performance (mins) | FRL |
|---|---|---|---|---|
| 1 | 100 mm OD copper pipe inserted through 60 mm thick Maxilite Board (800 mm × 800 mm) and clamped to an external frame on the unexposed side. FyreFLEX® sealant applied to the annular gap. Pipe was wrapped with TWrap insulation (nominal 75 mm overlap on each wrap) for 420 mm from the wall on exposed side and 600 mm on unexposed side. | 180 – No failure | 88 | **-/120/60** |
| 2 | 156 mm OD copper pipe inserted through 60 mm thick Maxilite Board (800 mm × 800 mm) and clamped to an external frame on the unexposed side. FyreFLEX® sealant applied to the annular gap. Pipe was wrapped with TWrap insulation (nominal 75 mm overlap on each wrap) for 420 mm from the wall on exposed side and 1,100 mm on unexposed side. The pipe had a double layer of TWrap for the first 300 mm on the unexposed side. | 180 – No failure | 104 | **-/120/90** |

| Specimen | Penetration details | Integrity performance (mins) | Insulation performance (mins) | FRL |
|---|---|---|---|---|
| 3 | Cable tray with Appendix D power cables fitted through the upper aperture in the lower section of the Maxilite Board. FyreFLEX® sealant applied into gap between Maxilite Board and cable tray and cables on both faces. 300 mm × 300 mm TWrap insulation wrap (with no foil) placed over the cables the cable tray wrapped with a single 300 mm long TWrap insulation wrap on both faces (with a nominal overlap of 75 mm). | 180 – No failure | 144 | **-/120/120** |
| 4 | Cable tray with Appendix power cables fitted through the lower aperture on top of prepacked FyrePlug pillows and the area of the aperture above the cable tray filled with FyrePlug Pillows. FyreFLEX® sealant applied around cables, cable tray and on FyrePlug pillows. 300 mm × 300mm TWrap insulation wrap (with no foil) placed over the cables on both faces and cable tray packed into the edges of the cable tray. The cable tray wrapped with a single 300 mm long TWrap insulation wrap on both faces (with a nominal overlap of 75 mm). | 119 – cotton wool pad | 150 | **-/90/120** |
| 5 | 100 mm OD copper pipe mounted on external frame on unexposed face and FyrePlug pillows packed into the aperture until filled. FyreFLEX® sealant applied around pipe circumference and on FyrePlug pillows on both exposed and unexposed faces. Pipe wrapped with 300 mm long layers of TWrap insulation (nominal 75 mm overlap on each wrap). | 180 – No failure | 180 – No failure | **-/120/120** |
| 6 | Bundle of 10 TPS PVC insulated cables laid on pre-packed FyrePlug pillows, and the aperture filled with FyrePlug pillows packed above cable bundles. FyreFLEX® sealant applied to the cable bundles and FyrePlug pillows. | 180 – No failure | 159 | **-/120/120** |
| 7 | Bundles of 20 CAT6 PVC insulated data cables laid on pre-packed FyrePlug pillows, and the aperture filled with FyrePlug pillows packed above cable bundles. FyreFLEX® sealant applied to the cable bundles and FyrePlug pillows. | 180 – No failure | 173 | **-/120/120** |

## A.3 Test report – FRT180323 R3.0

*Table 17 Information about test report*

| Item | Information about test report |
|---|---|
| Report sponsor | Trafalgar Group |
| Test laboratory | Jensen Hughes Fire Testing, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia. |
| Test date | The fire resistance test was completed on 29/11/2018. |
| Test standards | The test was done in accordance with AS1530.4-2014. |
| Variation to test standards | The length of unprotected service on the unexposed face in penetration system B projected 690 mm from the unexposed side of the separating element, which is greater than the 500 mm prescribed in AS 1530.4:2014 Clause 10.4.2. Due to this variation an FRL rating could not be assigned to the tested penetration system B. |
| General description of tested specimen | The separating element consisted of a nominal 3000 mm × 3000 mm × 78 mm Speedpanel wall system with 15 varying penetration systems. These were protected by Trafalgar FyreFLEX®™ sealant, Trafalgar FYREPLEX™ HP sealant, Trafalgar Fyrechoke collars, Trafalgar FyrePlug pillows, Trafalgar SuperSTOPPER™ Maxi 650, and Maxilite Board.<br>The service penetrations included copper pipes, cable bundles, PE-Xa pipes, Pe-Xb pipes, sprinkler pipes, CAT6 cables, uPVC pipes and conduits. |
| Instrumentation | The test report states that the instrumentation was in accordance with AS 1530.4:2014. |

The test specimen achieved the following result:

*Table 18 Results summary for this test report*

| System | | Penetration details | Criteria | Results | FRL |
|---|---|---|---|---|---|
| A | 0 | Speedpanel without penetrations | Structural adequacy | Not applicable | **-/120/30** |
| | | | Integrity | No failure at 121 minutes | |
| | | | Insulation | Failure at 38 minutes | |
| | 1 | DN100 type B copper pipe (1.63 mm wall thickness). FyrePlug pillows are packed around the services and sealed together with FyreFLEX® sealant. A 300mm section of the TWrap wrapped around the pipe on the unexposed side and exposed side. FyrePEX sealant applied inside the Ø65 mm PVC pipe used as a pipe former | Structural adequacy | Not applicable | |
| | | | Integrity | No failure at 121 minutes | |
| | | | Insulation | Failure at 75 minutes | |
| | 2 | | Structural adequacy | Not applicable | |
| | | | Integrity | No failure at 121 minutes | |

| System | | Penetration details | Criteria | Results | FRL |
|---|---|---|---|---|---|
| | | 5 Nos of 2.5 mm$^2$ 2C+E TPS cables and 5 Nos of CAT 6 cables. FyreFLEX® applied at the interface between the cable services and the pillows. | Insulation | No failure at 121 minutes | |
| | 3 | 3C+E 185 mm$^2$ power cable, 4 Nos of 3C+E 16 mm$^2$ power cable, Ø25 mm PVC conduit with fibre optic cable and cable tray. The gaps between the 3C+E 185 mm$^2$ power cable, 3C+E 16 mm$^2$ power cable and 3C+E 16 mm$^2$ power cable and the fire pillow sealed with FyreFLEX® sealant. While the gaps between the Ø 25 mm uPVC conduit with fibre optic cable and the fire pillows were sealed with FyrePEX sealant. The interface between the pillows and the services were sealed with FyreFLEX® sealant with a nominal 30 × 30 mm fillet on both sides of the separating element. | Structural adequacy | Not applicable | |
| | | | Integrity | No failure at 121 minutes | |
| | | | Insulation | Failure at 87 minutes | |
| B | | DN150 type b copper pipe. FyreFLEX® sealant applied in the annular gap to full depth finished with a nominal 30 × 30 mm fillet on both exposed and unexposed sides. | Structural adequacy | Not applicable | N/A (No FRL assigned as specimen set up was non-conforming). |
| | | | Integrity | No failure at 121 minutes | |
| | | | Insulation | Failure at 10 minutes | |
| C | | 3/8” + 3/4” Pair Coil with 19 mm Ardent FR insulation, 2.5 mm$^2$ 2C+E circular Cable and Delta CAT6 Cable. FyreFLEX® sealant was applied at the annular gap to a depth of nominal 15 mm on both the exposed and unexposed side. Ø80 mm collar was retrofitted around the service on both the exposed and unexposed side. Annular gaps in the fire-collar between the service and the fire-collar were sealed with FyreFLEX® sealant. | Structural adequacy | Not applicable | **-/120/90** |
| | | | Integrity | No failure at 121 minutes | |
| | | | Insulation | Failure at 117 minutes | |
| D | | | Structural adequacy | Not applicable | **-/120/120** |
| | | | Integrity | No failure at 121 minutes | |

| System | | Penetration details | Criteria | Results | FRL |
|---|---|---|---|---|---|
| | | Ø20 mm PE-Xa pipe. A backing rod was inserted to a depth of 60 mm from the unexposed side. FyrePEX HP sealant was then applied in the annular gap from the unexposed side to the backing rod. | Insulation | No failure at 121 minutes | |
| E | | Ø20 mm PE-Xb pipe. A backing rod was inserted to a depth of 60 mm from the unexposed side. FyrePEX HP sealant was applied in the annular gap from the unexposed side to the backing rod. | Structural adequacy | Not applicable | **-/120/120** |
| | | | Integrity | No failure at 121 minutes | |
| | | | Insulation | No failure at 121 minutes | |
| F | | Ø20 mm PE-X-AL-PEX pipe. A backing rod was inserted to a depth of 60 mm from the unexposed side. FyrePEX HP sealant was applied in the annular gap from the unexposed side to the backing rod. | Structural adequacy | Not applicable | **-/120/60** |
| | | | Integrity | No failure at 121 minutes | |
| | | | Insulation | Failure at 60 minutes | |
| G | | 2 Nos of Delta CAT6 cables, 2 Nos of 2.5mm$^2$ 2C+E Prysmian cable and 2 Nos of Firesense cable. FyreFLEX® sealant was applied at the annular gap to full depth of the separating element and finished with a nominal 30 × 30 mm fillet on both the exposed and unexposed sides. | Structural adequacy | Not applicable | **-/120/120** |
| | | | Integrity | No failure at 121 minutes | |
| | | | Insulation | No failure at 121 minutes | |
| H | | 3 Nos of 3C+E 16 mm$^2$ Electra Cables. FyreFLEX® sealant was applied at the annular gap to full depth of the separating element and finished with a nominal 30 × 30 mm fillet on both the exposed and unexposed side. | Structural adequacy | Not applicable | **-/120/30** |
| | | | Integrity | No failure at 121 minutes | |
| | | | Insulation | Failure at 46 minutes | |
| I | 0 | SuperSTOPPER Maxi consisting of a 650 mm wide × 125 mm high × steel frame | Structural adequacy | Not applicable | **-/120/0** |
| | | | Integrity | No failure at 121 minutes | |
| | | | Insulation | Failure at 36 minutes | |
| | 1 | | Structural adequacy | Not applicable | |
| | | | Integrity | No failure at 121 minutes | |

| System | | Penetration details | Criteria | Results | FRL |
|---|---|---|---|---|---|
| | | Ø40 mm CPVC Sprinkler Pipe. A SuperSTOPPER Maxi was installed in the aperture on both the exposed and unexposed side. A nominal 10 mm annular gap was left around the outside of the SuperSTOPPER maxi and was filled with FyreFLEX® sealant to full depth of the separating element. The intumescent foam in the SuperSTOPPER Maxi was cut down the centre line, with two opening notched 5 mm undersize to allow a friction fit around the two services on both the exposed and unexposed side. | Insulation | Failure at 24 minutes | |
| | 2 | Ø60 mm CPVC Sprinkler Pipe. A SuperSTOPPER maxi was installed in the aperture on both the exposed and unexposed side. A nominal 10 mm annular gap was left around the outside of the SuperSTOPPER Maxi and was filled with FyreFLEX® sealant to full depth of the separating element. The SuperSTOPPER Maxi was cut down the centre line, with two opening notched 5 mm undersize to allow a friction fit around the two services on both the exposed and unexposed side. | Structural adequacy | Not applicable | |
| | | | Integrity | No failure at 121 minutes | |
| | | | Insulation | No failure at 121 minutes | |
| J | | 3/8” + 3/4” Pair Coil with 19 mm Ardent FR insulation, 2.5 $mm^2$ 2C+E Electra Cable and Delta CAT6 Cable. A backing rod was inserted to a depth of 60 mm from the unexposed side. FyrePEX HP sealant was then applied in the annular gap from the unexposed side to the backing rod. | Structural adequacy | Not applicable | **-/120/60** |
| | | | Integrity | No failure at 121 minutes | |
| | | | Insulation | Failure at 79 minutes | |
| K | | | Structural adequacy | Not applicable | **-/120/90** |
| | | | Integrity | No failure at 121 minutes | |

| System | Penetration details | Criteria | Results | FRL |
|---|---|---|---|---|
| | 3/8" + 3/4" Pair Coil with PE insulation, 2.5mm$^2$ 2C+E Electra Cable and Delta CAT6 Cable. A backing rod was inserted to a depth of 60 mm from the unexposed side. FyrePEX HP sealant was then applied in the annular gap from the unexposed side to the backing rod. | Insulation | Failure at 115 minutes | |
| L | Blank seal. FyreFLEX® sealant was used to seal the Maxilite Board to the separating element, filling the grooves of the panel and finished with a nominal 15 × 15 mm fillet along the perimeter. Maxilite Board over the aperture on the unexposed side. | Structural adequacy | Not applicable | **-/90/60** |
| | | Integrity | Failure at 105 minutes | |
| | | Insulation | Failure at 64 minutes | |
| M | Ø100 mm uPVC pipe. FyreFLEX® sealant was applied at the annular gap on both the exposed and unexposed side. Ø100 mm collar was retrofitted around the service on both the exposed and unexposed side of the wall. | Structural adequacy | Not applicable | **-/120/60** |
| | | Integrity | No failure at 121 minutes | |
| | | Insulation | Failure at 72 minutes | |
| N | Ø50 mm uPVC pipe. FyreFLEX® sealant was applied at the annular gap on both the exposed and unexposed side. Ø50 mm collar was retrofitted around the service on both the exposed and unexposed side. | Structural adequacy | Not applicable | **-/120/60** |
| | | Integrity | No failure at 121 minutes | |
| | | Insulation | Failure at 85 minutes | |
| O | Ø25 mm PVC conduit with 1 × fibre optic cable. FyreFLEX® sealant was applied at the annular gap on both the exposed and unexposed side. Micro collar was retrofitted around the service on both the exposed and unexposed side of the wall. | Structural adequacy | Not applicable | **-/120/90** |
| | | Integrity | No failure at 121 minutes | |
| | | Insulation | Failure at 113 minutes | |

## A.4 Test report – FRT190292 R4.0

*Table 19 Information about test report*

| Item | Information about test report |
|---|---|
| Report sponsor | Trafalgar Group |
| Test laboratory | Jensen Hughes Fire Testing, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia. |
| Test date | The fire resistance test was completed on 16/01/2020. |
| 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 consisted of a nominal 4500 mm × 3500 mm × 175 mm 40MPa normal weight concrete floor slab with 10 penetration systems and control joint.<br>System A1 consisted of 15 × CAT 6 cables, 15 × fire alarm TPS cables, 15 × 2C+E 2.5 $mm^2$ TPS cables and 1 × small cable tray<br>System A2 consisted of 1 × D2 communication cable and 1 × small cable tray<br>System A3 consisted of 1 × D1 power cable and 1 × small cable tray. System A1 to A3 were protected by Trafalgar FyreFLEX®™ sealant.<br>System B consisted of 1 × DN100 type B copper pipe with Trafalgar TWrap and Trafalgar FyreFLEX®™ sealant<br>System C consisted of 1 × DN50 type B copper pipe with Trafalgar TWrap and Trafalgar FyreFLEX®™ sealant<br>System D consisted of 40 mm wide control joint with Trafalgar FyreFLEX®™ sealant<br>System E1 consisted of 1 × D1 power cables and 1 × small cable tray with Trafalgar TWrap and Trafalgar FyreFLEX®™ sealant<br>System E2 consisted of 1 × DN100 type B copper pipe with Trafalgar TWrap and Trafalgar FyreFLEX®™ sealant<br>System E3 consisted of 1 × DN150 type B copper pipe with Trafalgar TWrap, Trafalgar FyreFLEX®™ sealant, and Trafalgar Maxilite Board 30 mm<br>System E4 consisted of 1 × M10 threaded rod with Trafalgar TWrap and Trafalgar FyreFLEX®™ sealant<br>System F consisted of 8 × 3/8” + 3/4” pair coils, 3 × 1/4” + 1/2” pair coils, 11 × 2C 10 mm2 + E × 4 mm2 power cables, 11 × CAT 6 cables and 1 × NBN cable with Trafalgar TWrap and Trafalgar FyreFLEX®™ sealant<br>System G consisted of 1 × NB150 MD steel pipe with Trafalgar TWrap and Trafalgar FyreFLEX®™ sealant<br>System H consisted of 1 × drink python with Trafalgar SuperSTOPPER™ Mini 150-R and Trafalgar FyreFLEX®™ sealant<br>System I1 consisted of 2 × 1/4” + 1/2” pair coils, 2 × 2C 10 mm2 + E × 4 mm2 power cables and 2 × CAT6 cables with Trafalgar SuperSTOPPER™ Mini 100-R and Trafalgar FyreFLEX®™ sealant<br>System I2 consisted of 1 × D1 power cable, 1 × D2 communication cable and 1 × large cable tray with Trafalgar TWrap and Trafalgar FyreFLEX®™ sealant<br>System I3 consisted of 15 × fire alarm TPS cables with Trafalgar FyreFLEX®™ sealant<br>System I4 consisted of 20 × CAT 6 cables and 1 × NBN cable with Trafalgar FyreFLEX®™ sealant<br>System J1 consisted of 1 × D2 communication cable and 1 × small cable tray with Trafalgar TWrap and Trafalgar FyreFLEX®™ sealant.<br>System J2 consisted of 1 × D1 power cable and 1 × small cable tray with Trafalgar TWrap and Trafalgar FyreFLEX®™ sealant |
| Instrumentation | The test report states that the instrumentation was in accordance with AS 1530.4:2014. |

The test specimen achieved the following result:

*Table 20 Results summary for this test report*

| Penetration system and control joint | | Service | Criteria | Results | FRL |
|---|---|---|---|---|---|
| A | 1 | 15 × CAT 6 cables<br>15 × fire alarm TPS cables<br>15 × 2C+E 2.5 mm$^2$ TPS cables<br>1 × small cable tray | Structural adequacy | Not applicable | **-/120/60** |
| | | | Integrity | No failure at 241 minutes | |
| | | | Insulation | Failure at 144 minutes | |
| | 2 | 1 × D2 communication cable<br>1 × small cable tray | Structural adequacy | Not applicable | |
| | | | Integrity | Failure at 152 minutes | |
| | | | Insulation | Failure at 79 minutes | |
| | 3 | 1 × D1 power cable<br>1 × small cable tray | Structural adequacy | Not applicable | |
| | | | Integrity | Failure at 223 minutes | |
| | | | Insulation | Failure at 77 minutes | |
| B | | 1 × DN100 type B copper pipe | Structural adequacy | Not applicable | **-/240/60** |
| | | | Integrity | No failure at 241 minutes | |
| | | | Insulation | Failure at 60 minutes | |
| C | | 1 × DN50 type B copper pipe | Structural adequacy | Not applicable | **-/240/60** |
| | | | Integrity | No failure at 241 minutes | |
| | | | Insulation | Failure at 74 minutes | |
| D | | 40 mm wide control joint | Structural adequacy | Not applicable | **-/240/120** |
| | | | Integrity | No failure at 241 minutes | |
| | | | Insulation | Failure at 158 minutes | |
| E | 1 | 1 × D1 power cables<br>1 × small cable tray | Structural adequacy | Not applicable | **-/15/15** |
| | | | Integrity | No failure at 241 minutes | |
| | | | Insulation | Failure at 154 minutes | |
| | 2 | 1 × DN100 type B copper pipe | Structural adequacy | Not applicable | |
| | | | Integrity | Failure at 214 minutes | |

| Penetration system and control joint | | Service | Criteria | Results | FRL |
|---|---|---|---|---|---|
| | | | Insulation | Failure at 150 minutes | |
| | 3 | 1 × DN150 type B copper pipe | Structural adequacy | Not applicable | |
| | | | Integrity | Failure at 28 minutes | |
| | | | Insulation | Failure at 28 minutes* | |
| | 4 | 1 × M10 threaded rod | Structural adequacy | Not applicable | |
| | | | Integrity | No failure at 241 minutes | |
| | | | Insulation | No failure at 241 minutes | |
| F | | 8 × 3/8” + 3/4” pair coils<br>3 × 1/4” + 1/2” pair coils<br>11 × 2C 10 $mm^2$ + E × 4 $mm^2$ power cables<br>11 × CAT 6 cables<br>1 × NBN cable | Structural adequacy | Not applicable | **-/120/90** |
| | | | Integrity | Failure at 130 minutes | |
| | | | Insulation | Failure at 115 minutes | |
| G | | 1 × NB150 MD steel pipe | Structural adequacy | Not applicable | **-/240/120** |
| | | | Integrity | No failure at 241 minutes | |
| | | | Insulation | Failure at 170 minutes | |
| H | | 1 × drink python | Structural adequacy | Not applicable | **-/240/240** |
| | | | Integrity | No failure at 241 minutes | |
| | | | Insulation | No failure at 241 minutes | |
| I | 1 | 2 × 1/4” + 1/2” pair coils<br>2 × 2C 10 $mm^2$ + E × 4 $mm^2$ power cables<br>2 × CAT6 cables | Structural adequacy | Not applicable | **-/120/90** |
| | | | Integrity | No failure at 241 minutes | |
| | | | Insulation | Failure at 103 minutes | |
| | 2 | 1 × D1 power cable | Structural adequacy | Not applicable | |

| Penetration system and control joint | | Service | Criteria | Results | FRL |
|---|---|---|---|---|---|
| | | 1 × D2 communication cable<br>1 × large cable tray | Integrity | Failure at 147 minutes | |
| | | | Insulation | Failure at 96 minutes | |
| | 3 | 15 × fire alarm TPS cables | Structural adequacy | Not applicable | |
| | | | Integrity | No failure at 241 minutes | |
| | | | Insulation | Failure at 181 minutes | |
| | 4 | 20 × CAT 6 cables<br>1 × NBN cable | Structural adequacy | Not applicable | |
| | | | Integrity | Failure at 193 minutes | |
| | | | Insulation | Failure at 193 minutes* | |
| J | 1 | 1 × D2 communication cable<br>1 × small cable tray | Structural adequacy | Not applicable | **-/120/90** |
| | | | Integrity | Failure at 131 minutes | |
| | | | Insulation | Failure at 108 minutes | |
| | 2 | 1 × D1 power cable<br>1 × small cable tray | Structural adequacy | Not applicable | |
| | | | Integrity | No failure at 241 minutes | |
| | | | Insulation | Failure at 113 minutes | |

## A.5 Test report – FRT190298 R1.0

*Table 21 Information about test report*

| Item | Information about test report |
|---|---|
| Report sponsor | Trafalgar Group |
| Test laboratory | Jensen Hughes Fire Testing, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia. |
| Test date | The fire resistance test was completed on 23/01/2020. |
| Test standards | The test was done in accordance with AS1530.4-2014. |
| Variation to test standards | None |
| General description of tested specimen | The test specimen consisted of a Speedpanel wall system (1600 mm × 1600 mm × 78 mm) penetrated by two penetration systems and an access panel protected with Trafalgar TWrap, Trafalgar Fyrchoke collar and Trafalgar and FyreFLEX® sealant. |
| Instrumentation | The test report states that the instrumentation was in accordance with AS 1530.4:2014. |

The test specimen achieved the following result:

*Table 22 Results summary for this test report*

| Penetration system / access panel | Penetration services | Criteria | Results | Fire resistance level (FRL) |
|---|---|---|---|---|
| A | 100NB steel pipe protruding 500 mm on the exposed side and 750 mm on the unexposed side. The pipe was sealed with FyreFLEX® sealant from both sides of the wall to the full depth of the Speedpanel. Two 300 mm wide strips of TWrap were applied longitudinally along the unexposed face of the pipe to a length of 450 mm. | Structural adequacy | Not applicable | **-/120/90** |
| | | Integrity | No failure at 121 minutes | |
| | | Insulation | Failure at 113 minutes | |
| B | DN100 uPVC pipe protruding 500 mm on the exposed side and nominally 2000 mm on the unexposed side. Services protected with Maxilite Board fixed into place over the aperture on the unexposed face. FyreFLEX® sealant was applied to all joins in the Maxilite Board and through the ribbed profile of the Speedpanel behind the Maxilite. Sealant was also applied to the annular gaps around the pipe on the exposed face to a nominal depth of 10 mm. | Structural adequacy | Not applicable | **-/120/120** |
| | | Integrity | No failure at 121 minutes | |
| | | Insulation | No failure at 121 minutes | |
| C | 600 mm × 600 mm Access Panel. The unexposed face of the opening was lined with 100 mm wide strips of 13 mm fire rated plasterboard. FyreFLEX® sealant was applied to the inside edge of the opening and the access panel was mounted through the unexposed side. FyreFLEX® sealant was used to fill any gaps behind the flanges on the unexposed face. | Structural adequacy | Not applicable | **-/120/45** |
| | | Integrity | No failure at 121 minutes | |
| | | Insulation | Failure at 49 minutes | |

## A.6 Test report – NI 0387-2

*Table 23 Information about test report*

| Item | Information about test report |
|---|---|
| Report sponsor | Masterbilt Industries |
| Test laboratory | Fire Research Laboratories, 59 Normanby Road, Notting Hill, Victoria 3168, Australia. |
| Test date | The fire resistance test was completed on 04/03/1987. |
| Test standards | The test was done in accordance with AS1530.4-1985. |
| Variation to test standards | None |
| General description of tested specimen | The test construction consisted of a 3-hr fire rated 140 mm thick × 2720 mm wide × 1620 mm high concrete block wall with an opening of 800 mm wide × 600 mm high located centrally and at 400 mm above the base of the wall. Three groups of services were erected through the opening:<br>+ a length of 90 mm O.D. steel water pipe<br>+ a group of 8 PVC covered 220/415 V power cables, comprising 2 × Ø 12 mm, 2 × Ø 18 mm and 4 × Ø 20 mm on a 150 mm wide perforated galvanised steel cable tray, and<br>+ a rectangular bundle of 60 PVC covered 100-wire telecommunication cables, bundles with flat steel strap retainers at 600 mm intervals.<br>Fyre Pillows were packed into the opening around the services using a total of 60 size F.R.P. 1 (300 mm × 300 mm × 40 mm) and 14 F.R.P. 2 (300 mm × 220 mm × 40 mm.<br><br>The interfaces between the pillows and the three service penetrations were sealed to a depth of approximately 50 mm from the surface of the wall with Firecaulk foaming sealant. A bead of the foaming sealant was applied to the annular gap between the pillows and the surface of the wall opening.<br><br>The telecommunication cable bundle and the power cables with tray, including the steel pipe, were given two coats of Fyretex intumescent compound over 600 mm lengths extending through the pillows and protruding 300 mm beyond the unexposed face.<br><br>An Insulgard heat shielding system was erected around each of the penetrations on the unexposed face of the specimen, covering a length of 250 mm extending outward from the unexposed face. The Insulgard consisted of a flexible outer shielding element of small aperture expanded steel mesh designed to wrap around the service element or group of elements and distanced from the hot surfaces by a specially designed low conduction flexible metal profile spacing system.<br><br>The services extended 2000 from the wall on the unexposed side and 100 mm from the wall into the surface. |
| Instrumentation | The test report states that the instrumentation was in accordance with AS 1530.4:1985. |

The test specimen achieved the following result:

*Table 24 Results summary for this test report*

| Separating wall element and service penetrations | Fire Resistance Performance | | |
|---|---|---|---|
| | Integrity (minutes) | Insulation (minutes) | FRL |
| 800 mm × 600 mm opening in a 140 mm thick concrete block wall system of 3 hr fire resistance rating incorporating these 3 groups of services passing through the opening: | 184 | 184 | **-/180/180** |

| Separating wall element and service penetrations | Fire Resistance Performance | | |
|---|---|---|---|
| | Integrity (minutes) | Insulation (minutes) | FRL |
| + A 90 mm OD steel water pipe.<br>+ A group of 8 PVC covered 220/415 V power cables, comprising 2 × Ø 12 mm, 2 × Ø 18 mm and 4 × Ø 20 mm on a 150 mm wide perforated galvanised steel cable tray.<br>+ a rectangular bundle of 60 PVC covered 100-wire telecommunication cables, bundles with flat steel strap retainers at 600 mm intervals.<br>The services were protected by Fyre Pillows packed between the services within the opening. The gaps at the interface between the pillows and the services were filled with Firecaulk foaming sealant to a depth of 50 mm and a bean of the sealant was also applied along the perimeter interface. The cables, cable tray and the steel pipe were given 2 coats of Fyretex intumescent sealant over 600 mm lengths, extending through the pillows to 300 mm beyond the unexposed face. The unexposed side of each service was wrapped with Insulguard over a length of 250 mm from the wall. | | | |

## A.7 Test report – NI 0790

*Table 25 Information about test report*

| Item | Information about test report |
|---|---|
| Report sponsors | Wormald International, Boral Australian Gypsum and CSR. |
| Test laboratory | Fire Research Laboratories, 59 Normanby Road, Notting Hill, Victoria 3168, Australia. |
| Test date | The fire resistance test was completed on 18/04/1990. |
| Test standards | The test was done in accordance with AS1530.4-1990. |
| Variation to test standards | None |
| General description of tested specimen | The test construction consisted of a 95 mm thick 2 hr fire rated shaft wall 2540 mm high × 1930 mm wide. A deflection head detail was provided at the top of the wall with the plasterboard sheets terminated 20 mm below the head. A central vertical control joint of 22 mm through gap was provided. Both the control joint and the deflection head were fire stopped with FyreFLEX® sealant.<br>The following services penetrated the shaft wall:<br>+ Service A – 100 mm uPVC pipe fire stopped with a Fyrechoke wall collar. The pipe had 110 mm OD with 3.2 mm wall thickness.<br>+ Service B – 200 mm copper pipe fire stopped with FyreFLEX®. The pipe was 203 mm OD with 2.03 mm wall thickness.<br>+ Service C – 150 mm copper pipe fire stopped with FyreFLEX®. The pipe had 203 mm OD with 2.03 mm wall thickness.<br>+ Service D – Assorted power cables supported by 390 mm cable tray and fire stopped by FyreFLEX®. The cables were –<br>- One 41 mm OD single core power cable with 127 conductors, each approximately 2.52 mm diameter. The sheathing was double, comprising an outer 2 mm thick black PVC layer and a 2.4 mm thick red PVC inner layer.<br>- One38 mm OD single core power cable wth127 aluminium conductors, each approximately 2.52 mm diameter. The sheathing was double, comprising an outer 2 mm thick black PVC layer and a 2.4 mm thick red PVC inner layer.<br>- Three 16 mm OD single core power cables. Each cable comprised 37 copper conductors, each of approximately 1.78 mm diameter. The conductors were sheathed with 1.6 mm thick red PVC.<br>- Three 14 mm OD single core power cables. Each cable comprised 19 aluminium conductors, each of approximately 1.78 mm diameter. The conductors were sheathed with 1.4 mm thick red PVC.<br>- One 54 mm OD 3 core plus earth PVC insulated, PVC sheathed power cable. Each earth core comprised 19 copper wires, each of 2.14 mm diameter.<br>- Four 20 mm OD diameter 3 core plus earth PVC insulated, PVC sheathed cables. Each power core comprised 7 copper wires each approximately 1.7 mm diameter. The earth core comprised 7 copper wires each approximately 1.04 mm diameter.<br>+ Service E – Bundle of 10 × 6 telecommunication cables supported by a 190 mm cable tray, penetrating a 400 mm × 300 mm opening in the shaft wall and fire stopped with a combination of FyrePlug Pillows and FyreFLEX®.<br>Services A and B were erected in position before the shaft wall was built, simulating pre-existing services. |
| Instrumentation | The test report states that the instrumentation was in accordance with AS 1530.4:1990. |

The test specimen achieved the following result:

*Table 26 Results summary for this test report*

| Item | Description | Fire Resistance Performance | |
|---|---|---|---|
| | | Integrity (mins) | Insulation (mins) |
| - | Deflection head | No failure at 127 | 110 |
| - | Control joint – 22 mm wide | No failure at 127 | 105 |
| Service A | 100 mm uPVC pipe fire stopped with a Fyrechoke wall collar. The pipe had 110 mm OD with 3.2 mm wall thickness | No failure at 127 | No failure at 127 |
| Service B | 200 mm copper pipe fire stopped with FyreFLEX®. The pipe was 203 mm OD with 2.03 mm wall thickness | No failure at 127 | 0* |
| Service C | 150 mm copper pipe fire stopped with FyreFLEX®. The pipe had 203 mm OD with 2.03 mm wall thickness. | No failure at 127 | 0* |
| Service D | Assorted power cables supported by 390 mm cable tray and fire stopped by FyreFLEX®. | No failure at 127 | 59 |
| Service E | Bundle of 10 × 6 telecommunication cables supported by a 190 mm cable tray | No failure at 127 | 92 |
| Note - * insulation level not measured | | | |

## A.8 Test report – NI 4189

*Table 27 Information about test report*

| Item | Information about test report |
|---|---|
| Report sponsor | Wormald International |
| Test laboratory | Fire Research Laboratories, 59 Normanby Road, Notting Hill, Victoria 3168, Australia. |
| Test date | The fire resistance test was completed on 16/11/1989. |
| Test standards | The test was done in accordance with AS 1530.4:1985. |
| Variation to test standards | None |
| General description of tested specimen | The test construction comprised a 75 mm thick E-core floor panel with a central opening 400 mm long × 400 mm wide. The following services were fitted through the opening:<br>+ Service A - 100 mm copper pipe, 101 mm OD and 1.2 mm wall thickness.<br>+ Service B – 7 × 4 bundle of 28 telecommunication cables, each of 15 mm diameter with 100 strands. Each strand comprised a 0.5 mm diameter central copper conductor insulated with PVC. The strands were bundled and sheathed in 1.2 mm thickness PVC.<br>+ Service C – 200 mm cable tray with assorted power cables comprising:<br>- a 43 mm OD single core power cable consisting of 127 copper conductors, 2.5 mm diameter with a 2.5 mm thick inner black PVC sheath and a 3 mm thick outer black PVC sheath.<br>- Three 16 mm diameter 3-core plus earth PVC insulated, PVC sheathed power cables. Each power core comprised 7 copper wires of 1 mm diameter each. The power and earth cores were sheathed with orange PVC of approximately 1.7 mm thickness.<br>- Three 20 mm OD single core power cables. Each cable comprising 37 copper conductors each approximately 2.25 mm diameter with approximately 2.0 mm thick red PVC sheath.<br>- One 21 mm OD multicore PVC insulated, PVC sheathed control cable with 25 cores. Each core comprised 7 copper wires, each approximately 0.5 mm diameter insulated with PVC approximately 1.5 mm thick. All cores were sheathed with orange PVC approximately 2 mm diameter.<br>- One 24 mm OD 3-core plus earth, PVC insulated, PVC sheathed power cable. Each power core comprised 19 copper wires, each approximately 1.35 mm diameter. The earth core comprised 7 copper wires each approximately 1.04 mm diameter. The power cores were insulated with PVC approximately 1.5 mm thick and the earth core was insulated with PVC approximately 1 mm thick. The power and earth cores were sheathed with orange PVC approximately 2 mm diameter.<br>The cable tray and cables were 2275 mm long, projected 300 mm from the underside of the E-core panel into the furnace and a minimum 2000 mm above the upper surface of the E-core panel.<br>The opening was filled by packing with FyrePlug pillows consisting of 21 size FR P1 – 300 mm × 300 mm × 40 mm thick and 1 size FR P2- 300 mm × 250 mm × 40 mm thick.<br>The pillows were packed around all services.<br>FyreFLEX® was applied to the interface between the FyrePlug pillows, the services and E-core. The services protruded 200 mm from the underside of the E-core into |

| Item | Information about test report |
|---|---|
| | furnace and 2000 mm above the upper surface of the E-core panel. The pipe was capped at the exposed end and open at the opposite end. |
| Instrumentation | The test report states that the instrumentation was in accordance with AS 1530.4:1985. |

The test specimen achieved the following result:

*Table 28 Results summary for this test report*

| Item | Description | Fire resistance performance | |
|---|---|---|---|
| | | Integrity (minutes) | Insulation (minutes) |
| FirePLUG pillows | FirePLUG pillows covering sections of the opening in the E-core panel unpenetrated. | No failure at 124 | 123 |
| Service A | 100 mm copper pipe, 101 mm OD and 1.2 mm wall thickness. | No failure at 124 | 14 |
| Service B | 7 × 4 bundle of 28 telecommunication cables, each of 15 mm diameter with 100 strands. Each strand comprised a 0.5 mm diameter central copper conductor insulated with PVC. The strands were bundled and sheathed in 1.2 mm thickness PVC | No failure at 124 | 64 |
| Service C | 200 mm cable tray with assorted power cables comprising:<br>+ A 43 mm OD single core power cable.<br>+ Three 16 mm diameter 3-core plus earth PVC insulated, PVC sheathed power cables.<br>+ Three 20 mm OD single core power cables.<br>+ One 21 mm OD multicore PVC insulated, PVC sheathed control cable with 25 cores.<br>+ One 24 mm OD 3-core plus earth, PVC insulated, PVC sheathed power cable.<br>The cable tray and cables were 2275 mm long, projected 300 mm from the underside of the E-core panel into the furnace and a minimum 2000 mm above the upper surface of the E-core panel. | No failure at 124 | 55 |
| The opening was filled by packing with FyrePlug pillows.<br>FyreFLEX® was applied to the interface between the FyrePlug pillows, the services and E-core.<br>In accordance with AS 1530.4:1985 the FyrePlug pillows, and the service penetration systems protected by the FyrePlug pillows and FyreFLEX® sealant all achieved a fire resistance rating of 2 hr. | | | |

## A.9 Test report – SI 1562

*Table 29 Information about test report*

| Item | Information about test report |
|---|---|
| Report sponsor | Fire Research Pty Ltd |
| Test laboratory | Department of Housing and Construction- Experimental Building Station (facility now under CSIRO). |
| Test date | The fire resistance test was completed on 23/04/1982. |
| Test standards | The test was done in accordance with AS 1530.4:1975. |
| Variation to test standards | None |
| General description of tested specimen | The test construction comprised a 1810 mm long × 440 mm high × 230 mm thick wide opening in a brick wall.<br>Fire Research fire resistant pillows which consisted of two sizes, of which the larger was 310 mm long × 310 mm wide and the half size pillow was 310 mm long × 200 mm wide. Both pillows were nominally 40 mm thick and fabric cases each filled with mineral fibres. The pillows were placed with the 310 mm length over the 230 mm opening width.<br>The ends of the pillows were lightly tamped so that the installed thickness of the pillows was approximately 250 mm. The pillows were stacked until the opening was filled by the pillows using both the large and half size pillows. |
| Instrumentation | The test report states that the instrumentation was in accordance with AS 1530.4:1975. |

The test specimen achieved a fire resistance performance of 240 minutes in integrity (from observation of no flaming or collapse of the pillow stack over the wall opening) and 240 minutes in insulation. The specimen was assigned a 4-hour fire rating.

## A.10 Test report – SI 1614

*Table 30 Information about test report*

| Item | Information about test report |
|---|---|
| Report sponsor | Fire Research Pty Ltd |
| Test laboratory | Department of Housing and Construction- Experimental Building Station (facility now under CSIRO). |
| Test date | The fire resistance test was completed on 04/08/1982. |
| Test standards | The test was done in accordance with AS 1530.4-1975. |
| Variation to test standards | None |
| General description of tested specimen | The specimen incorporated two systems for protecting openings of 1,000 mm long × 700 mm wide formed in a 150 mm thick reinforced concrete floor to facilitate the installation of services such as telecommunication cables. The perimeter along the long slab edges were reinforced with 45 mm × 25 mm × 1.6 mm steel angles and the narrow sides were fitted with 45 mm square × 1.2 mm plate steel RHS forming mullion supports which act as joints between side-by-side slots forming continuous lengths of multiple slots 700 mm wide along the floor slab as required.<br>System 1 was described a rigid fire stop and consisted of vermiculite-based panels with a supporting steel frame.<br>System 2 was described as a flexible fire stop and consisted of flexible pillows. As the pillows were limited to installations in 200 mm maximum slot widths to ensure the pillows do not fall off, the 700 mm wide slot was divided into small modular frames of 200 mm maximum width using 25 mm square × 1.2 mm steel tube dividers secured to the concrete on the unexposed side.<br>Each system was designed for installation in slots up to 700 mm wide and of indefinite length in concrete floors.<br>The test specimen incorporated two modular sections of each system. One modular section of each system incorporated penetrating services consisting of two bundles of power cables.<br>One bundles of power cables in each system was fitted with a steel mesh sleeve to prevent combustible material from coming in contact with the cables, whilst the other bundle in each system was not so fitted. |
| Instrumentation | The test report states that the instrumentation was in accordance with AS 1530.4:1975. |

The test specimen achieved the following result:

*Table 31 Results summary for this test report*

| Item | Description of service penetration | Fire stopping system | Fire resistance performance | |
|---|---|---|---|---|
| | | | Integrity (minutes) | Insulation (minutes) |
| System A | Two packs each with a group bundle consisting of 4 × Ø25 mm Pyrotenax metal sheathed power supply cables. One bundle was fitted with steel mesh sleeve. | | No failure at 182 | Cables with sleeve:<br>+ 49 on panel<br>+ 17 on cables at 25 mm<br>+ 60 on cables at 400 mm |

| Item | Description of service penetration | Fire stopping system | Fire resistance performance | |
|---|---|---|---|---|
| | | | Integrity (minutes) | Insulation (minutes) |
| | | 100 mm thick rigid vermiculite-based fire barrier panels installed in the floor within modular steel support frames connected by steel bracing cross members to create a slot opening 700 mm wide and 150 mm deep. Annular gaps around service penetrations and local joints in panel were filled to a depth of 20mm with a foaming intumescent sealant | | Cables with sleeve:<br>No failure on panel or cables |
| | Panel only without service penetrations | | No failure at 182 | 158 on joint<br>No failure on panel at 182 |
| Service B | Two packs each with a group bundle consisting of 4 × Ø 25 mm Pyrotenax metal sheathed power supply cables. One bundle was fitted with steel mesh sleeve. | 310 mm high × 310 mm wide × 40 mm thick fabric pillows filled with mineral fibres placed over the floor slot opening and around the penetrating service power cable bundles.<br>2 winds of intumescent bandage 200 mm overall height wrapped around each pack of power cables. | No failure at 182 | Cables without sleeve:<br>+ 95 on pillows<br>+ 34 on cables at 25 mm<br>+ 83 on cables at 400 mm |
| | | | | Cables with sleeve:<br>No failure on pillows or cables |
| | Pillows only without service penetrations | | No failure at 182 | 167 |

## A.11 Test report – FRT200257 R1.1

*Table 32 Information about test report*

| Item | Information about test report |
|---|---|
| Report sponsor | Trafalgar Group |
| Test laboratory | Jensen Hughes Fire Testing, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia. |
| Test date | The fire resistance test was completed on 10/02/2021. |
| Test standards | The test was done in accordance with AS1530.4-2014. |
| Variation to test standards | None |
| General description of tested specimen | The separating element consisted of a 1760 mm × 1200 mm × 120 mm normal weight concrete floor slab with three penetration systems A, B and C<br>System A consisted of 1 × Ø25 mm PE-Xa/Al/PE, 8 × 16 mm2 3C+E power cables, 1 × 3/8 + 3/4 FR pair coil w/ 13 mm insulation and 1 × 1/4 + 3/8 FR pair coil w/ 13 mm insulation. The system was protected by Trafalgar FyreSet FR mortar, SuperSTOPPER cast-in 350 × 125, TWrap and FyreFLEX® sealant.<br>System B consisted of 1 × DN 50 type B copper pipe and 1 × DN 100 type B copper pipe. The system was protected by Trafalgar TWrap, FyreFLEX® sealant and FyrePlug pillows.<br>System C consisted of 1 × DN 150 type B copper pipe. The system was protected by Trafalgar Insulguard and FyreFLEX® sealant. |
| Instrumentation | The test report states that the instrumentation was in accordance with AS 1530.4:2014. |

The test specimen achieved the following result:

*Table 33 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 | |
| | 1 | Structural adequacy | Not applicable | |
| | | Integrity | No failure at 181 minutes | |
| | | Insulation | Failure at 152 minutes | |
| | 2 | Structural adequacy | Not applicable | |
| | | Integrity | No failure at 181 minutes | |
| | | Insulation | Failure at 156 minutes | |
| C | | Structural adequacy | Not applicable | -/180/120 |

| Penetration system | Criteria | Results | Fire resistance level (FRL) |
|---|---|---|---|
| | Integrity | No failure at 181 minutes | |
| | Insulation | Failure at 126 minutes | |

## A.12 Test report – FRT210467 R1.1

*Table 34 Information about test report*

| Item | Information about test report |
|---|---|
| Report sponsor | Trafalgar Group |
| Test laboratory | Warringtonfire, 2/409-411 Hammond Rd, Dandenong South VIC 3175 |
| Test date | The fire resistance test was completed on 09 February 2022. |
| Test standards | The test was done in accordance with AS 1530.4:2014 |
| Variation to test standards | None. |
| General description of tested specimen | Two Ø40 mm copper pipes (Specimen F and G) were tested in 150 mm thick concrete floor. The annular gap between the pipe and the separating element was sealed with Trafalgar FyreFLEX®. The pipes were insulated with Trafalgar MonoWrap and TWrap respectively. |
| 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 35.

*Table 35 Results summary for this test report*

| Specimen | Integrity | Insulation |
|---|---|---|
| Copper pipe insulated with MonoWrap | 241 minutes | 155 minutes |
| Copper pipe insulated with TWrap | 241 minutes | 169 minutes |

## A.13 Test report – FSP 2478

*Table 36 Information about test report*

| Item | Information about test report |
|---|---|
| **Report sponsor** | Trafalgar Group Pty Ltd |
| **Test laboratory** | Infrastructure Technologies (also known as CSIRO) |
| **Test date** | The fire resistance test was completed on 9 October 2024. |
| **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 comprises of 1800 mm × 1800 mm × 150 mm thick concrete slab penetrated by five services (designated specimen 1 – 5) and two multi-services penetrations (designated specimen 6 and 7). |
| **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 37.

*Table 37 Results summary for this test report*

| Specimen No. | Penetration Details | Integrity | Insulation |
|---|---|---|---|
| **1** | A cast-in 150 PVC DWV Stack pipe protected by FyreCOLLAR Castin Stack 150 V2 – fitted with Type R intumescent | 15 minutes | 9 minutes |
| **2** | 120 mm Drinks python consisting of 14 tubes with 30 mm thick insulation and protected by FyrePEX and Unicorn collar | 124 minutes | 124 minutes |
| **3** | Three copper pipes with nominal diameters of 40 mm and 65 mm protected by FyreFLEX and 450 mm TWrap | 124 minutes | 114 minutes |
| **4** | A cast-in 225 mm PVC-U Storwater heavy duty SN2 pipe protected by a 225 mm cast-in Jumbo collar | 10 minutes | 13 minutes |
| **5** | A cast-in 150 mm PVC DWv pipe protected by 150 mm cast-in Jumbo collar | 120 minutes | 118 minutes |
| **6** | Two layer is FyreBatt friction fitted in a 150 mm × 400 mm protecting multiservices | 124 minutes | 124 minutes |
| **7** | FyrePLUG pillows fitted in a 600 mm × 300 mm opening, protecting multiservices | 124 minutes | 109 minutes |

# Appendix B Relevance of AS 1530.4:1975 test data with respect to AS 1530.4:2014

The referenced fire resistance tests SI 1562 and SI 1614 was conducted in accordance with AS 1530.4:1975, which differs slightly from AS 1530.4:2014. These minor variations and their potential effect on the fire resistance performance of the referenced test specimens are discussed below.

## B.1 Discussion

**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 of diameter 1.0 mm and an overall diameter of 3mm. The measuring junction protrudes 25 mm from the supporting heat-resistant tube.

The furnace thermocouples specified in AS 1530.4:1975 are not nominated.

There would likely be more influence on results due to the difference in heat transfer conditions between furnaces, which are not fully controlled by the current fire resistance test standards, rather than the minor differences in the thermocouple construction.

The positioning of furnace thermocouples from the exposed face of the specimen at the start of the fire resistance test were required to be between 75 mm and 300 mm in AS 1530.4:1975. In AS 1530.4:2014, the distance is required to be 100 mm + 10 mm.

As the furnace should be adequately insulated, any possible temperature disparities inside the furnace are expected to be minimal. Therefore, the minor variation in the location of the furnace thermocouples, relative to the exposed face of the specimen, would not significantly affect the test results.

**Furnace pressure**

The furnace pressure required by AS 1530.4:1975 is not nominated.

AS 1530.4:2014 requires a minimum pressure differential of 15Pa ± 3Pa above the laboratory atmosphere at the centre of the lowest penetration for vertical specimens and 20 Pa ± 3 Pa at 100 mm below the soffit for horizontal specimens.

AS 1530.4:1975 does not nominate a pressure and the pressure was not recorded for the reference test.

In absence of any gaps, cracks or fissures forming in the reference test, it is unlikely that a variation in pressure between the two methods would have an impact on the performance of the test at the junction of the damper and the wall.

The variations in furnace pressure conditions are not expected to have significant effect on the outcome of the referenced fire resistance tests at the junction of the damper and the wall.

It is a requirement of AS 1530.4:2014 that for vertical elements a furnace gauge pressure of zero (0) Pa is established at a height of 500 mm above the notional floor level. Therefore, at the top of a vertical specimen 3000 mm high and based on a pressure gradient of 8.5 Pa/m for typical furnace conditions, the pressure could potentially be 21.2 Pa.

The potential difference in specified furnace pressures between the standards is not expected to be significant, provided the integrity of the specimen is maintained. Furthermore, given that the specified

tolerances are +3 Pa, the minor variation in furnace pressure is not expected to have significantly affected the outcome of the referenced fire resistance test.

**Integrity criteria**

The integrity criteria differ slightly between AS 1530.4:2014 and AS 1530.4:1975.

At the junction of the damper or aperture and wall the specimen is deemed to have failed the integrity criterion in accordance with AS 1530.4:2014 when any of the following occur:

- Sustained flaming on the unexposed face (10 seconds).
- Ignition of cotton pad when it is applied for up to 30 seconds (for elements not exceeding insulation).
- Development of a gap through which a 6mm gap gauge can pass through to the furnace and moved 150 mm along, or development of a gap through which a 25 mm gap gauge can pass through to the furnace.
- The cotton pad test is by observation, not included in an AS 1530.4:1975 compliant test; however, it is not applied after the specimen has exceeded insulation.

The integrity criteria for AS 1530.4:1975 are similar. A specimen is deemed to have failed integrity if a crack or fissure opens during the test that allows the passage of hot gases or flames.

The differences in these criteria are therefore not likely to result in significant integrity performance or the AS 1530.4:1975 result will be more stringent.

**Insulation criteria**

The insulation criteria of AS 1530.4:1975 and AS 1530.4:2014 remain the same, although the location of thermocouples has been revised. These differences are not considered relevant to the performance of the proposed construction.

As no gaps were observed during the test on the tested construction or at the junction of the damper and the wall, the differences in the integrity criteria would not have affected the outcome of the test if tested in accordance with AS 1530.4:2014.

## B.2 Applicability of test data to AS 1530.4:2014

In the absence of any integrity failure observed on the unexposed faces of the specimen tested and the basis of the discussion above, it is concluded that: the test results obtained from the referenced fire resistance tests – in accordance with AS 1530.4:1975 – can be applied to assess the likely fire resistance performance at the junction of the damper and the wall, if tested in accordance with AS 1530.4:2014.

# Appendix C Relevance of AS 1530.4:1985 test data with respect to AS 1530.4:2014

The referenced fire resistance tests NI 03872 and NI 4189 was conducted in accordance with AS 1530.4:1985, which differs slightly from AS 1530.4:2014. These minor variations and their potential effect on the fire resistance performance of the referenced test specimens are discussed below.

## C.1 Discussion

Furnace temperature regime

The furnace heating regime in fire resistance tests conducted in accordance with AS 1530.4:2014 follows a similar trend to that in AS 1530.4:1985. The specified specimen heating rate in AS 1530.4:1985 is given by:

$$T_t - T_0 = 345log_{10}(8t + 1)$$

AS 1530.4:2014 specifies furnace temperature follows the trend below:

$$T_{AS1530.4-2014} = 345log_{10}(8t + 1) + 20$$

Where:

$T_t$ = furnace temperature at time t, in °C.

$T_0$ = initial furnace temperature at time t, in °C, ≥10°C and ≤ 40°C.

$t$ = time into the test, measured from the ignition of the furnace, in minutes.

The heating regimes in AS 1530.4:1985 and AS 1530.4:2014 vary, in that the former is an expression of the temperature rise in the furnace above an initial ambient temperature, but the latter (although similar) assumes that the initial furnace temperature (T0) is 20°C irrespective of the actual ambient temperature. A test conducted in accordance with AS 1530.4:1990 on a warm day – ambient temperature above 20°C – could therefore be slightly more onerous than that in accordance with AS 1530.4:2014.

The parameters outlining the accuracy of control of the furnace temperature in AS 1530.4:2014 and AS 1530.4:1985 are not appreciably different.

**Furnace overpressure**

AS 1530.4:1985 requires a minimum pressure differential of 8 Pa above the laboratory atmosphere for both vertical and horizontal specimens.

AS 1530.4:2014 requires a minimum pressure differential of 15 Pa ± 3 Pa above the laboratory atmosphere, at the centre of the lowest penetration for vertical specimens and 20 Pa ± 3 Pa at 100 mm below the soffit for horizontal specimens.

The increase in furnace overpressure is only expected to be significant if cracks or fissures have developed in the test specimen.

**Performance criteria**

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

- structural adequacy
- integrity

- insulation

**Structural adequacy**

The structural adequacy criteria are not relevant to this test.

**Integrity**

The specimen shall be deemed to have failed regarding the service penetrations, in accordance with AS 1530.4:2014, if the specimen:

- collapses.
- sustains flaming on the non-fire side in excess of 10 seconds.
- ignites a cotton pad within 30 seconds when applied.

The integrity criterion varies slightly between AS 1530.4:1985 and AS 1530.4:2014. The specimen is deemed to have failed to AS 1530.4:1985 if the specimen:

- collapses.
- develops cracks, fissures or, other openings through which flames or hot gases can pass.
- sustained flaming on the non-fire side in excess of 10 seconds.

The integrity criterion in accordance with AS 1530.4:1985 is generally more stringent. Integrity failure would normally occur prior to failure in accordance with AS 1530.4:2014.

**Insulation**

The insulation criteria of AS 1530.4:1985 and AS 1530.4:2014 remain the same, although the location of thermocouples has been revised. These differences are not considered relevant to performance of the proposed construction.

## C.2 Application of the test data to AS 1530.4:2014

In general, the furnace exposure conditions of AS 1530.4:1985 are not appreciably different to AS 1530.4:2014.

The difference in specified furnace pressures between the revisions of AS 1530.4 (1985 to 2014) is only expected to be significant if cracks or fissures have developed in the test specimen, as higher furnace overpressure has a greater tendency to force hot gases from the furnace to the non-fire side, with potentially adverse effects on both integrity and insulation performance.

Test NI 03872 did not record any integrity failure for the whole duration of the 184 minutes of the test.

Test NI 4189 did not record any integrity failure for the whole duration of the 124 minutes of the test.

Based on the above discussion, it is considered that integrity performance of the tests NI 03872 and NI 4189 can be used to assess the integrity performance of the proposed construction if subjected to a fire resistance test in accordance with AS 1530.4:2014.

# Appendix D Relevance of AS 1530.4:1990 test data with respect to AS 1530.4:2014

The referenced fire resistance test NI 0790 was conducted in accordance with AS 1530.4:1990, which differs slightly from AS 1530.4:2014. These variations and their potential effect on the fire resistance performance of the referenced test specimens are discussed below.

## D.1 Discussion

**Furnace temperature regime**

The furnace heating regime in fire resistance tests, conducted in accordance with AS 1530.4:2014, follows a similar trend to that in AS 1530.4:1990. The specified specimen heating rate in AS 1530.4:1990 is given by:

$$T_t - T_0 = 345log_{10}(8t + 1)$$

AS 1530.4:2014 specifies furnace temperature to follow the following trend:

$$T_{AS1530.4-2014} = 345log_{10}(8t + 1) + 20$$

Where:

$T_t$ = furnace temperature at time t, in °C.

$T_0$ = initial furnace temperature at time t, in °C, ≥10°C and ≤ 40°C.

$t$ = time into the test, measured from the ignition of the furnace, in minutes.

The heating regimes in AS 1530.4:1990 and AS 1530.4:2014 vary, in that the former is an expression of the temperature rise in the furnace above an initial ambient temperature and the latter (although similar) assumes that the initial furnace temperature (T0) is 20°C irrespective of the actual ambient temperature. A test conducted in accordance with AS 1530.4:1990 on a warm day – ambient temperature above 20°C – could therefore be slightly more onerous than that in accordance with AS 1530.4:2014.

The parameters outlining the control accuracy of the furnace temperature in AS 1530.4:2014 and AS 1530.4:1990 are not appreciably different.

**Furnace overpressure**

AS 1530.4:2014 requires a minimum pressure differential of 8 Pa above the laboratory atmosphere for both vertical and horizontal specimens.

AS 1530.4:2014 requires a minimum pressure differential of 15 Pa ± 3 Pa above the laboratory atmosphere at the centre of the lowest penetration for vertical specimens, and 20 Pa ± 3 Pa at 100 mm below the soffit for horizontal specimens.

The increase in furnace overpressure is only expected to be significant if cracks or fissures have developed in the test specimen.

**Performance criteria**

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

- structural adequacy.
- integrity.

- insulation.

**Structural adequacy**

The structural adequacy criteria are not relevant to this test.

**Integrity**

The specimen shall be deemed to have failed regarding the service penetrations, in accordance with AS 1530.4:2014, if the specimen:

- collapses.
- sustains flaming on the non-fire side in excess of 10 seconds.
- ignites a cotton pad within 30 seconds when applied.

The integrity criterion varies slightly between AS 1530.4:1990 and AS 1530.4:2014. The specimen is deemed to have failed to AS 1530.4:1990 if the specimen:

- collapses.
- develops cracks, fissures or other openings through which flames or hot gases can pass.
- sustained flaming on the non-fire side in excess of 10 seconds.

The integrity criterion in accordance with AS 1530.4:1990 is generally more stringent. Integrity failure would normally occur prior to failure in accordance with AS 1530.4:2014.

**Insulation**

The insulation criteria of AS 1530.4:1990 and AS 1530.4:2014 remain the same, although the location of thermocouples have been revised. These differences are not considered relevant to the performance of the proposed construction.

## D.2 Application of test data to AS 1530.4:2014

In general, the furnace exposure conditions of AS 1530.4:1990 are not appreciably different to AS 1530.4:2014.
The difference in specified furnace pressures between the revisions of AS 1530.4 (1990 to 2014) are only expected to be significant if cracks or fissures have developed in the test specimen, as higher furnace overpressure has a greater tendency to force hot gases from the furnace to the non-fire side, with potentially adverse effects on both integrity and insulation performance.
Test NI 0790 records no integrity failure throughout the 127 minutes duration of the test.
Based on the above discussion, it is considered that integrity performance of test NI 0790 can be used to assess the insulation and integrity performance of the proposed construction if subjected to a fire resistance test in accordance with AS 1530.4:2014.