

# The fire resistance of Maxilite in accordance with AS 1530.4 – 2014 and AS 4072.1 – 2005 Amdt 1

## Assessment Report

**Author:** Keith Nicholls  
**Assessment Number:** FCO 2586 Revision E  
**Date:** 2/11/2023  
**The Client:** Trafalgar Fire Containment

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## Inquiries should be addressed to:

Fire Testing and Assessments  
NATA Registered Laboratory  
14 Julius Avenue  
North Ryde, NSW 2113  
Telephone +61 2 94905444

Author  
Infrastructure Technologies  
14 Julius Avenue  
North Ryde, NSW 2113  
Telephone +61 2 94905500

The Client(s)  
Trafalgar Fire Containment  
26A Ferndell Street  
South Granville, NSW, 2142  
Telephone 1800 888 714




## Report Details:

Report CSIRO Reference number: FCO-2586/CO5651

## Report Status and Revision History:

VERSION	STATUS	DATE	DISTRIBUTION	ISSUE NUMBER
Previous Issue	Final	17/3/2020	Client/CSIRO	FCO-2586 Ver17Mar20
Revision A	Final	31/5/2022	Client/CSIRO	FCO-2586 Rev A
Revision B	Final	30/6/2022	Client/CSIRO	FCO-2586 Rev B
Revision C	Final	10/11/2022	Client/CSIRO	FCO-2586 Rev C
Revision D	Final	30/10/2023	Client/CSIRO	FCO-2586 Rev D
Revision E	Final	2/11/2023	Client/CSIRO	FCO-2586 Rev E

## Report Authorization:

AUTHOR	REVIEWED BY	AUTHORISED BY
Keith Nicholls	Jing Xu	Keith Nicholls
		
2/11/2023	2/11/2023	2/11/2023

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# 1 Introduction

This report is an assessment of the fire resistance of Maxilite in accordance with AS 1530.4 – 2014 and AS 4072.1 – 2005 Amdt 1.

This report supersedes all previous versions of report number FCO 2586.

This report is prepared for the purpose of meeting the requirements of NCC 2019 Volume 1 Schedule 5 Clauses 2 (b) and 2(c) and NCC 2022 Volume 1 Clauses S1C2 (b) and (c) as appropriate for FRL.

This report reviews and confirms the extent to which the reference tests listed in Section 2 meet the requirements of the test standards listed in Section 4 of the report. The proposed variations to the tested construction presented in Section 3 are subject to an analysis in Appendix B, and the conclusions are presented in Section 5 of this report.

The field of applicability of the results of this assessment report is presented in Section 6 and subject to the requirements, validity and limitations of Sections 7, 8 and 9.

## 2 Supporting Data

This assessment report refers to various test reports to support the analysis and conclusions of this report. They are listed below;

Report Reference	Test Standard	Outline of Test Specimen
NI 2689	AS 1530.4 -1985	A fire resistance test on a 75mm thick E core panel penetrated by various penetrations and protected with FyreFLEX.
FR 3891	AS 1530.4 -2005	A fire resistance test on a 120 mm thick concrete slab was built into a concrete lined specimen holder and positioned on top of a 3 m x 4 m horizontal furnace and penetrated with 21 specimens.
FP 6202	AS 1530.4 -2014	A fire resistance test on various pipe services penetrating a vertical Maxilite board fire stopping system in a plasterboard wall.
FP 6251	AS 1530.4 -2014	A fire resistance test on various pipe services penetrating a vertical Maxilite board fire stopping system in a plasterboard wall.
EWFA 51894700.1	AS 1530.4 -2014	A fire resistance test on a 175mm thick concrete slab penetrated by various pipes and cables protected by Trafalgar FyreBOX Maxi and FyreBOX Mini, FyreBOX Cast-in penetration protection systems.
FRT 180357.1	AS 1530.4 -2014	A fire resistance test of a section of 75mm thick Hebel wall system with 11 varying service penetrations.
FRT 180392.1	AS 1530.4 -2014	A fire resistance test on a 116mm thick plasterboard wall system penetrated by 10 services protected with various fire stop systems.
FRT 180323.3	AS 1530.4 -2014	A fire resistance test on a 78mm thick Speedpanel wall system penetrated by 18 services protected with various fire stop systems.
FRT 190292.1	AS 1530.4 -2014	A fire resistance test on a 175mm thick concrete slab penetrated by various services protected with various fire stop systems.
FSP 1753	AS 1530.4 -2014	A fire resistance test on five (5) service installations penetrating a 75-mm thick Hebel wall system protected by a combination of Trafalgar Fire passive fire stopping systems.
FSP 1795	AS 1530.4 -2014	A fire resistance test on a 75-mm thick Hebel AAC panel wall system protected by various Trafalgar Fire passive fire stopping systems.
FSP 1907	AS 1530.4 -2014	A fire resistance test on a 1000 mm x 1000 mm Maxilite bulkhead containing various joint and perimeter details mounted centrally within a 1000-mm square opening in a 260 mm thick concrete slab.



Report Reference	Test Standard	Outline of Test Specimen
FSP 1913	AS 1530.4 -2014	A fire resistance test on Firebox Maxi sealing systems protecting service penetrations through an autoclaved aerated concrete (AAC) panel wall system.
FSP 1989 Rev.A	AS 1530.4 -2014	A fire resistance test on various pipe services penetrating a horizontal Maxilite board fire stopping system.
FSP 1991 Rev.A	AS 1530.4 -2014	An ad-hoc fire resistance test on two sources of Maxilite boards.
FSP 2106	AS 1530.4 -2014	A fire resistance test on Maxilite ceiling board (Grey) fire stopping system penetrated by seven (4) service pipe penetrations.
FSP 2146	AS 1530.4 -2014	A fire resistance test on a 150mm thick concrete slab penetrated by various services protected with various fire stop systems.
FP 11935-001a.1	AS 1530.4 -2014	A fire resistance test on various pipe services penetrating a vertical Maxilite board fire stopping system in a plasterboard wall.
FSH 2076	AS 1530.4 -2014	A fire resistance test on a suspended bulkhead ceiling system comprising various Maxilite board types and joint details, protecting a steel framed floor system.
FRT 200397 R1.2	AS 1530.4 -2014	A fire resistance test on a 78mm Speedpanel wall penetrated by various services and protected with various fire stop systems.
FRT 220112	AS 1530.4 -2014	A fire resistance test on a section of solid Corex wall penetrated by various services and protected with various fire stop systems.
EWFA 51288000.2	AS 1530.4 -2014	A fire resistance test on a section of 75mm Hebel wall penetrated by various services and protected with various fire stop systems

The test report NI 2689 was tested by Fire Research Laboratories and sponsored by Wormald International. The sponsor of this assessment report claims to own this test report.

The test report FSH 2076, FSP 2106, FSP 2146, FSP 1753, FSP 1795, FSP 1907, FSP 1913, FSP 1989 Rev.A and FSP 1991 Rev.A were undertaken by CSIRO North Ryde and sponsored by Fire Containment Pty Ltd.

The test report FR 3891 was undertaken by Branz, NZ and sponsored by Abesco. Permission has been given for the use of these reports for this assessment.

The test report FP 6202, FP 6251 and FP 11935-001 were undertaken by Branz, NZ and sponsored by Trafalgar.

The test report EWFA 51288000.2, FRT 220112, FRT 180357.1, FRT 190292.1, FRT 180392.1, EWFA 51894700.1, FRT 200397 R1.2 and FRT 180323.3 was undertaken by Warringtonfire (previously known as Exova Warrington Fire and sponsored by Trafalgar.

## 3 Proposed Variations

### 3.1 The form of construction

This assessment relates to barriers made from Maxilite that are installed within a building as four forms of construction.

#### **1 - Floor-ceiling or roof-ceiling system as defined by constructions in AS 1530.4 – 2014 Section 4.1.2 (b) and (d) with or without resistance to the incipient spread of fire**

This system is a composite loadbearing element of a building comprising both a floor and ceiling providing horizontal fire separation.

As shown in Figure 1, the ceiling element (element 4) is intended to work in conjunction with the floor (element 1 or 2) to provide the required FRL from below. It is evaluated in accordance with AS 1530.4-2014 Section 4 clause 4.3.4 and clause 4.3.6

As shown in Figures 63-65, the ceiling element (fire rated plasterboard lining) is intended to work in conjunction with the floor (element 1 or 2) to provide the required FRL from below. The Maxilite board acts as a patch in the opening of the plasterboard lining only.

This system can also be used to prevent the spread of fire from one compartment to another through the ceiling cavity.**2- Ceiling system or ceiling system for resistance to the incipient spread of fire as defined by constructions in AS 1530.4 – 2014 Section 4.1.2 (f)**

This system is a non-loadbearing element of a building providing horizontal fire separation independent of a floor or roof structure. This system can also be used to prevent the spread of fire from one compartment to another through the ceiling cavity.

As shown in Figures 12 and 13, the ceiling element (element 4) is intended to provide the full FRL performance from below AND is required to resist the effects of fire from through the opening(s) in the wall (element 3). The floor (element 2) is required to resist fire from below and provide support to the ceiling (element 4) based on design. There are two primary cases where separation involves two or three compartments, refer to Figures 12 and 13. It is evaluated in accordance with AS 1530.4-2014 Section 4 clause 4.3.7.

#### **3- Flat penetration seal as defined by constructions in AS 1530.4 – 2014 Section 10**

This system is a method of providing a penetration seal to an opening in a vertical or horizontal separating element and the general arrangement is shown in Figures 18-20. When applied to a wall, the system is designed to resist fire exposure from either side. When applied to a floor or ceiling, the fire exposure is from below. It is evaluated in accordance with AS 1530.4-2014 Section 10. See section 3.4.

#### **4 - Boxout penetration seal as defined by constructions in AS 1530.4 – 2014 Section 10**

This system is a method of providing a penetration seal to an opening in a vertical or horizontal separating element. This method introduces a boxout on one side of the barrier and penetrations are treated at the Maxilite barrier. Where sufficient clearance can be provided around Services, all penetration solutions may be applied. Where there is not sufficient clearance around services penetration solutions are more limited. It is evaluated in accordance with AS 1530.4-2014 Section 10. See section 3.5.

The constructions described in 1 to 4 above may act as support construction for seals around service penetrations as listed in Section 3.7 and Section 3.8 of this report.

## 5 - Flat seal as defined by constructions in AS 1530.4 – 2014 Section 10

This system is a method of providing a seal to an opening in a horizontal separating element and the general arrangement is shown in Figures 18 and 59. When applied to a floor or ceiling, the fire exposure is from below. It is evaluated in accordance with AS 1530.4-2014 Section 10. See section 3.4.

## 3.2 Maxilite floor-ceiling or roof-ceiling system

The proposed construction shall be for Maxilite floor-ceiling or roof-ceiling system as tested in FSH 2076 subject to the following variations;

- The fire exposure is from below the Maxilite ceiling (element 4) to the top of the floor (element 1 or 2)
- The construction of the Maxilite ceiling (element 4) shall comprise
  - Either one or more sheets of up to 2040mm long x 1220mm wide x 30mm, 40mm or 60mm thick Grey Maxilite board or
  - One or more sheets of up to 1500mm long x 1000mm wide x 30mm, 40mm or 60mm thick White Maxilite board
  - Board fixings generally shall be a minimum of 50mm away from the Maxilite board edge. Where the board is fixed over 50mm angles a minimum edge distance of 25mm is permitted.
  - Maxilite board can be angle fixed to vertical support construction as shown in Figure 3
  - Maxilite board can be angle fixed to vertical and horizontal support construction as shown in Figure 4
  - The vertically orientated side of the board can only comprise a single board from top to bottom (i.e., only vertical joints are allowed between two vertically orientated boards)
  - In one, two or three-sided forms of construction as shown in Figures 2a, 2b, 2c, 2d
  - The inclusion of Plastic Skeleton Connectors made from LDPE between metal angles shown in Figures 26a-26d
- It is required that the walls (element 3a, 3b, 3c or 3d) shall have the required FRL without the assistance of the ceiling (element 4) and provide the required support to the floor (element 1 or 2) and Maxilite ceiling (element 3a, 3b, 3c or 3d)
- The floor (element 1) may be non-fire-rated construction and designed to support the ceiling (element 4) or services as required by design.
- The floor (element 2) shall be of fire-rated construction and have the required FRL without the assistance of the ceiling (element 4) and provide the required support for the ceiling (element 4).
- Variation to the protection of structural steel elements supporting the ceiling.
- Only the floor-ceiling or roof-ceiling system with a minimum of 60mm thickness across all the entire face of the Maxilite ceiling membrane can be penetrated by services. It may include services that penetrate
  - Wall (element 3a, 3b, 3c or 3d) and Maxilite ceiling (element 4) as shown in Figures 1 and 2a
    - Services shall be protected at the wall (element 3a, 3b, 3c or 3d) and Maxilite ceiling (element 4) with systems listed in Sections 3.7 and 3.8
    - Floor/roof may be non-fire rated (element 1) or fire rated (element 2)
  - Non-fire-rated roof/floor construction (element 1) and Maxilite ceiling (element 4) Figures 1 and 2a.
    - Services shall be protected at the Maxilite ceiling (element 4) with systems listed in Section 3.8
    - The gap between the roof/floor (element 1) and services shall be sealed on the unexposed side of the roof/floor (element 1) with at least a 15mm fillet of Trafalgar FyreFLEX sealant

- Floor construction with the required FRL (element 2) and Maxilite ceiling (element 4) as shown in Figures 1, 2b, 2c, 2d
  - Services shall be protected at the floor (element 2) and Maxilite ceiling (element 4) with systems listed in Section 3.8
- Maxilite ceiling (element 4) only as shown in Figures 1, 2a, 2b, 2c, 2d
  - Services shall be protected at the Maxilite ceiling (element 4) with systems listed in Section 3.8
  - The floor or roof construction above the ceiling may be non-fire-rated (element 1) or fire rated (element 2)
- Maxilite ceiling (element 4) shall not support the weight of any service penetrations. All services shall be supported from above independently of the ceiling.
- Services shall be spaced by a minimum of 40mm
- The general arrangement of this system is shown in Figures 1 and 2a, 2b, 2c, and 2d, examples of construction details are shown in Figures 3-11, 34
- Penetration details are shown in Sections 3.7 and 3.8 of this report.
- The inclusion of 15mm thick x 100mm wide Corex Board (900kg/m<sup>3</sup>) as a cover strip option in place of 9mm Orbit board for up to 120 minute applications.
- Inclusion of access panel in the Maxilite ceiling (element 4) as per Figures 60a, 60b, 61, and 62
  - Maximum aperture in Maxilite support construction size of 600mmx600mm
  - The Access panels must be mounted into 1x 60mm or 2x 30mm white or grey Maxilite boards regardless of application
  - Installed at least 300mm away from the edge of any Maxilite sheet and may be installed across a joint centrally, where the maximum cut-out in the Maxilite construction is maximum of 300mm as per Figure 62 and Table 11a. Joint to be cover with a cover strip as per Figure 21b
  - Where Access panel is larger than 500mm x 500mm, Maxilite part of the floor/roof ceiling or ceiling system shall be reinforced with Unistrut around the access panel opening as per Figure 60b

**Table 1 – Schedule of components**

Item	Description	
1	<b>Name</b>	<b>Floor or roof construction without independent FRL</b>
	<b>Material</b>	<p><b>Floor or roof construction shall be:</b></p> <ul style="list-style-type: none"> <li>- Concrete floor slab (non-fire rated), or</li> <li>- Timber or steel framed floor framing system with particleboard, plywood, Compressed FC sheet flooring or timber strip flooring, or</li> <li>- Timber or steel framed roof framing system with sheet metal with Anticon or tile roof.</li> </ul>
	<b>Specification</b>	Designed in installed in accordance with relevant Australian Standards as non-fire rated construction.
2	<b>Name</b>	<b>Floor or roof construction with independent FRL</b>
	<b>Material</b>	<p><b>Floor or roof construction shall be:</b></p> <ul style="list-style-type: none"> <li>- Concrete floor slab with the required FRL, or</li> <li>- Timber or steel framed floor framing system with particleboard, plywood, Compressed FC sheet flooring or timber strip flooring, Timber or steel framed roof framing system with sheet metal with Anticon or tile roof, each protected from below with a fire rated ceiling membrane capable of achieving the required FRL</li> </ul>
	<b>Specification</b>	Floor or roof construction is designed, tested or assessed to achieve the required FRL as a floor or roof.
2a	<b>Name</b>	<b>3<sup>rd</sup> party Floor/ceiling or roof/ceiling construction with an independent FRL and where RISF is required</b>
	<b>Construction</b>	<p><b>Floor/roof construction shall be:</b></p> <ul style="list-style-type: none"> <li>- Concrete floor slab (non-fire rated), or</li> <li>- Timber or steel framed floor framing system with particleboard, plywood, Compressed FC sheet flooring or timber strip flooring, or</li> <li>- Timber or steel framed roof framing system with sheet metal with Anticon or tile roof.</li> </ul> <p><b>Ceiling membrane construction shall be:</b></p> <ul style="list-style-type: none"> <li>- Steel or timber framing system lined on exposed side with                             <ul style="list-style-type: none"> <li>o 2x layers (minimum 1x13mm &amp; 1x 16mm fire grade plasterboard) with a minimum cavity height of 600mm with a tested or assessed FRL of at least 60/60/60 and an RISF of at least 60 minutes.</li> <li>o 3x layers (minimum 3x16mm fire grade plasterboard) with a minimum cavity height of 500mm with a tested or assessed FRL of at least 120/120/120 and an RISF of at least 60 minutes</li> </ul> </li> </ul>
	<b>Specification</b>	Floor/Ceiling systems with fire grade plasterboard must be tested or assessed for an FRL of up to 60/60/60 or 120/120/120 and RISF of at least 60 minutes.
3a	<b>Name</b>	<b>Concrete or Masonry Wall</b>
	<b>Material</b>	Concrete or solid masonry wall
	<b>Specification</b>	Minimum 90mm thick concrete wall in accordance with AS 3600 or masonry wall in accordance with AS 3700.
3b	<b>Name</b>	<b>Hebel AAC or Walsc AAC Wall</b>
	<b>Size</b>	Minimum 75mm thick Hebel or Walsc AAC wall (single mesh)
	<b>Installation</b>	As required to achieve FRL as a wall with the required aperture
	<b>Specification</b>	Tested or assessed for an FRL of -/90/90 as a wall when incorporating an aperture.

Item	Description	
3c	<b>Name</b>	<b>Plasterboard lined stud wall</b>
	<b>Construction</b>	Tested or assessed for an FRL of -/90/90 or -/120/120 as a wall when incorporating an aperture.
	<b>Aperture in the wall treatment</b>	Aperture to be framed out, clad with the same number of layers of fire grade plasterboard as cladding the wall, fixed at 150mm centre by two rows of screws. <ul style="list-style-type: none"> <li>- Maxilite board (item 5) to be fixed into the plasterboard lined wall studs via Steel angle (item 7)</li> <li>- Maxilite board (item 5) is to be fixed into the plasterboard shaft wall CH studs via Steel angle (item 7), on the plasterboard side only.</li> </ul>
3d	<b>Name</b>	<b>Plasterboard shaft wall</b>
	<b>Construction</b>	Tested or assessed for an FRL of -/120/120 as a wall when incorporating an aperture.
	<b>Aperture in the wall treatment</b>	Aperture to be framed out, clad with the same number of layers of fire grade plasterboard as cladding the wall, fixed at 150mm centre by two rows of screws. <ul style="list-style-type: none"> <li>- Maxilite board (item 5) to be fixed into the plasterboard lined wall studs via Steel angle (item 7)</li> <li>- Maxilite board (item 5) is to be fixed into the plasterboard shaft wall CH studs via Steel angle (item 7), on the plasterboard side only.</li> </ul>
4	<b>Name</b>	<b>Maxilite board</b>
	<b>Material</b>	Proprietary board with a density of 330kg/m <sup>3</sup>
	<b>Size</b>	<p><b>Nominal sheet size for Maxilite board</b>  Grey Maxilite: 2040mm long x 1220mm wide  White Maxilite: 1500mm long x 1000mm wide</p> <p><b>Required board thickness for roof-ceiling and floor-ceiling system as per section 3.2</b>  30mm, 40mm or 60mm  Minimum of 40mm required for vertically hanging faces  Minimum of 60mm required for the entire face with penetrations.</p> <p><b>Required board thickness for ceiling system as per section 3.3 and flat penetration seal as per section 3.4.</b>  Minimum 60mm across all faces</p> <p><b>Required board thickness for boxout system as per section 3.5.</b>  40mm or 60mm, a minimum of 60mm is required for the entire face with penetrations.</p> <p><b>Required board thickness for flat seal in a floor as per section 3.6.</b>  40mm or 60mm, a minimum of 60mm is required for the entire face with penetrations.</p> <p><b>Required board thickness for flat seal in a floor as per section 3.11.</b>  A minimum of 60mm is required for the patch.</p> <p><b>Required board size for cover strip.</b>  Minimum 30mm thick x 100mm wide</p> <p><b>Required board thickness for steel section protection in Figures 5a, 5b and 17a.</b>  30mm, 40mm or 60mm white Maxilite based on design  40mm or 60mm grey Maxilite based on design</p>

Item	Description	
	Installation	<p><b>Fixings for 60mm thick Maxilite overlapped opening, face fixed directly onto support construction.</b></p> <ul style="list-style-type: none"> <li>• <b>Masonry / Concrete walls or concrete slab</b> <ul style="list-style-type: none"> <li>○ M6x100mm masonry anchor at 400mm centres, 50mm in from the edge.</li> </ul> </li> <li>• <b>AAC wall</b> <ul style="list-style-type: none"> <li>○ 10gx100mm plaster screws at 200mm centres, 50mm in from the edge.</li> </ul> </li> <li>• <b>Plasterboard wall</b> <ul style="list-style-type: none"> <li>○ 8g x 100mm screw at 200mm centres. 50mm in from the edge into the steel framing of the opening.</li> </ul> </li> <li>• <b>Plasterboard ceiling lining with furring channel</b> <ul style="list-style-type: none"> <li>○ 10g x 100mm screws 50mm in from the corners of the board and at mid span of board</li> </ul> </li> </ul> <p><b>Fixings for Maxilite-to-steel angle, Maxilite cover strip at the wall junction or Unistrut to Maxilite</b></p> <p>30mm Maxilite board - 8g-45mm screws at 200mm centres  40mm Maxilite board - 8g-60mm screws at 200mm centres  60mm Maxilite board - 8g-80mm screws at 200mm centres</p> <p><b>Fixings for Maxilite cover strip at the centre of two Maxilite boards</b></p> <p>30mm Maxilite board - 8g-45mm screws in pairs at 200mm centres  40mm Maxilite board - 8g-60mm screws in pairs at 200mm centres  60mm Maxilite board - 8g-80mm screws in pairs at 200mm centres</p>
5	Name	<b>Orbit or Corex board – cover strips for Section 3.2 and Section 3.3 construction</b>
	Material	Calcium silicate board (1100-1200kg/m <sup>3</sup> ) Glass reinforced gypsum (900kg/m <sup>3</sup> )
	Size	Orbit board – 9mm thick x 100mm wide Corex board - 15mm thick x 100mm wide
	Installation	<b>Fixings for cover strip at the centre of two Maxilite boards</b> 8g-40mm screws in pairs at 200mm centres
6	Name	<b>Sealant</b>
	Material	Trafalgar FyreFLEX sealant
	Installation	<ul style="list-style-type: none"> <li>- Applied between Maxilite board and support construction – min. 15mm fillet unless indicated otherwise in the figures below</li> <li>- Applied in any gap between Maxilite boards</li> <li>- Applied at the perimeter of the cover strips and Maxilite board – fillet based on the design as per the figures below</li> <li>- Applied as sealant fillet around penetration services – various, see relevant figures</li> <li>- Fill the gaps between Maxilite board service penetrations</li> <li>- Fill gaps between services and floor/roof structure (element 1 or 2)</li> </ul>
7	Name	<b>Steel Angle</b>
	Material	Minimum of 50 x 50 x 0.9mm steel angle with a maximum length of 1200mm
	Installation	<p>To be installed with a 20mm clearance between angles</p> <p><b>Masonry / Concrete walls to steel angle fixings</b></p> <ul style="list-style-type: none"> <li>• M6-50mm long masonry anchors at 400mm centers for up to 240 minute applications or</li> <li>• 6mm x 50mm long steel knock in anchors at 400mm centres for up to 120 minute applications</li> </ul> <p><b>AAC wall fixings to steel angle fixings</b> 8g x 45mm screws at 400mm centres</p> <p><b>Plasterboard wall to steel angle fixings</b> 8g-45mm screws at 200mm centres into the wall stud</p>



Item	Description	
8	<b>Name</b>	<b>Steel rod</b>
	<b>Installation</b>	Unprotected steel rod
	<b>Specification</b>	Where used above a ceiling system that achieves the required FRL from below it shall be designed to support the weight of the ceiling at ambient temperature  Where used above a ceiling system and is exposed to the effects of fire, it shall be designed to support the weight of the ceiling at a temperature appropriate for full fire exposure at the required FRL period
9	<b>Name</b>	<b>Structural steel section</b>
	<b>Installation</b>	Designed to support Maxilite board for the required FRL period
	<b>Specification</b>	Where installed in accordance with Figures 5a, 5b or 17a, a structural steel section with Hp/A less than that for a 50x50x3 SHS and designed in accordance with AS4100-2021 for a structurally critical temperature of 340°C up to 120 minutes.
10	<b>Name</b>	<b>Maxilite board access panel</b>
	<b>Specification</b>	- As per Figures 60a and 60b and Table 11a
	<b>Installation</b>	- Minimum 60mm thick Maxilite board to support Access Panel - Access Panel shall be installed at least 300mm away from the edge of any Maxilite sheet and may be installed across a joint centrally, where the maximum cut-out in the Maxilite construction is 300mm. Joint to be cover with a cover strip as per Figures 21a or 21b
11	<b>Name</b>	<b>Air Transfer Grille – LVH 44</b>
	<b>Specification</b>	- Maximum 600mm x 600mm size. - It is required that the air-transfer grille shall be tested or assessed as an air transfer grille in accordance with AS1530.4-2014 section 10 to achieve the required FRL when exposed to fire from either side when installed in a wall.
	<b>Installation</b>	- Minimum 60mm thick Maxilite board to support Air Transfer Grille - Gaps between the air-transfer grille and Maxilite board to be 10mm and filled with FyreFLEX sealant to the full depth. - Air-transfer grille shall be fixed to one side of Maxilite via steel mounting angle flange of 50mm wide x 25mm high x 0.9mm size and 8g x 50mm screws at maximum 200mm centres. Fixings must also be installed 100mm from each corner of the damper cell. - Air-transfer grille shall be installed at least 300mm away from the edge of any Maxilite sheet and may be installed across a joint centrally, where the maximum cut-out in the Maxilite construction is 300mm. Joint to be cover with a cover strip as per Figures 21a or 21b. - Installed accordance with Figure 45a and Table 7a



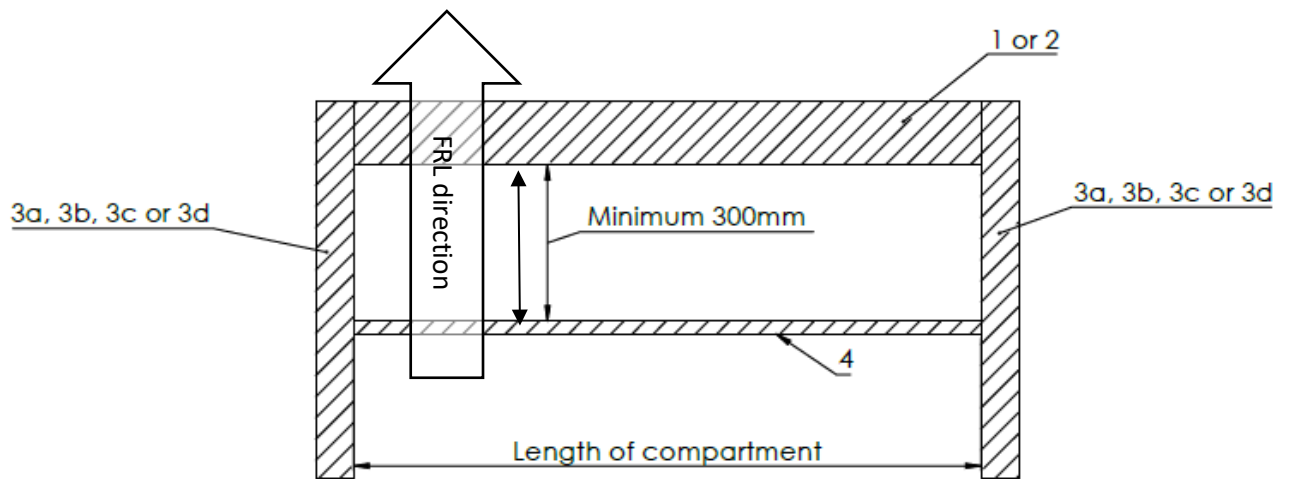


Figure 1: Maxilite (item 4) as a floor-ceiling or roof-ceiling system - elevation section view

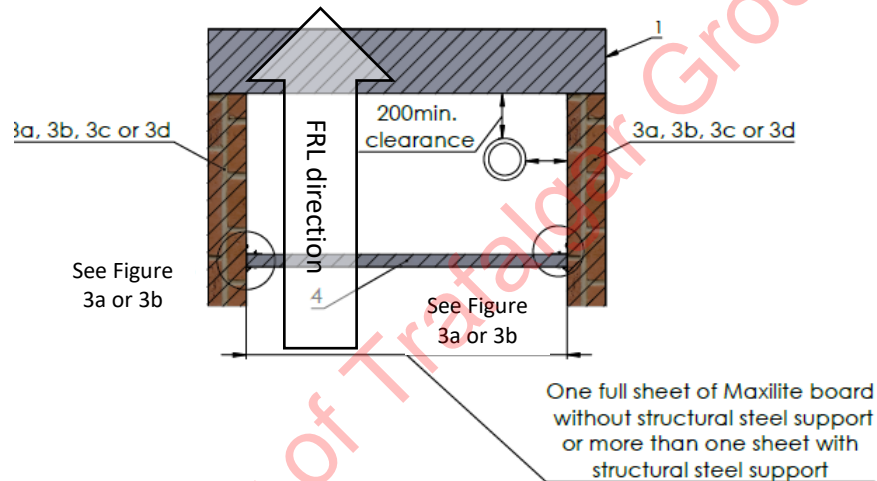


Figure 2a: One sided roof-ceiling or floor-ceiling system for roof or floor systems without independent FRL - section view

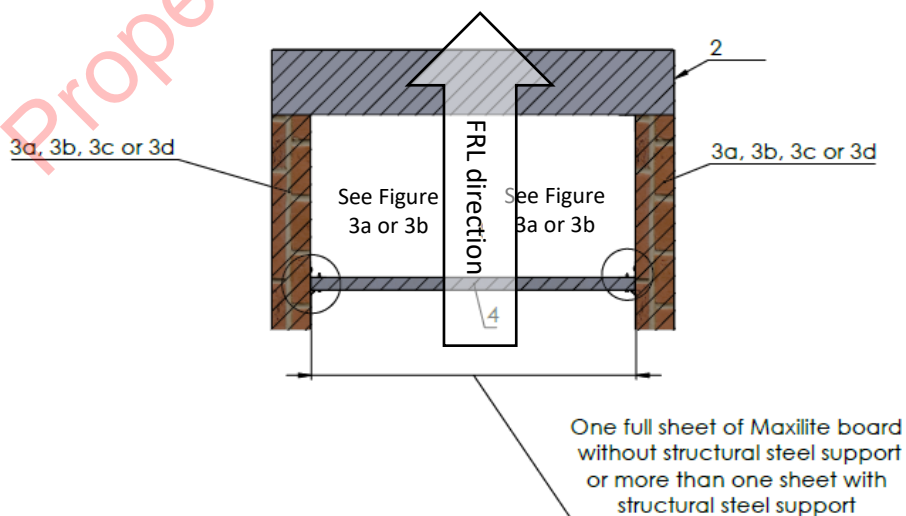
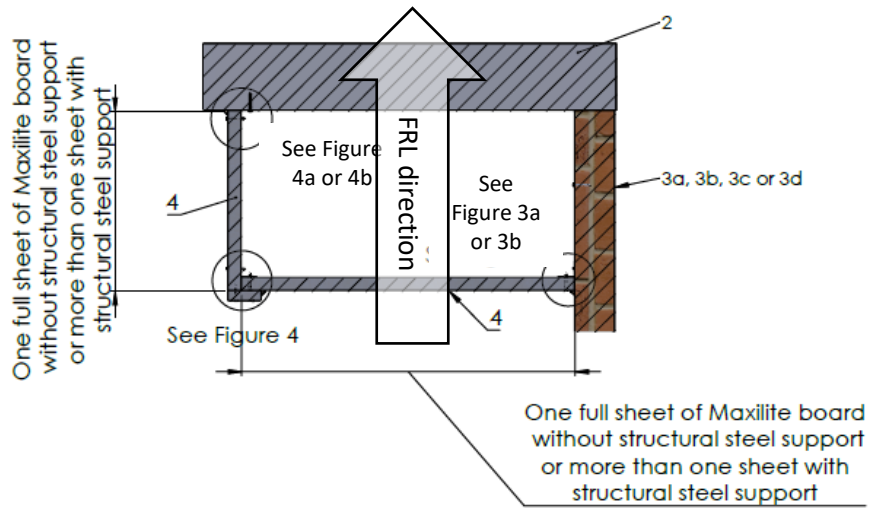
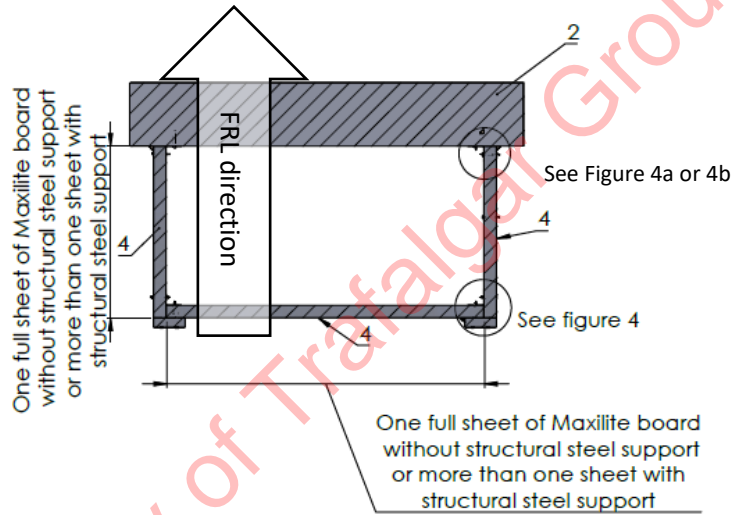


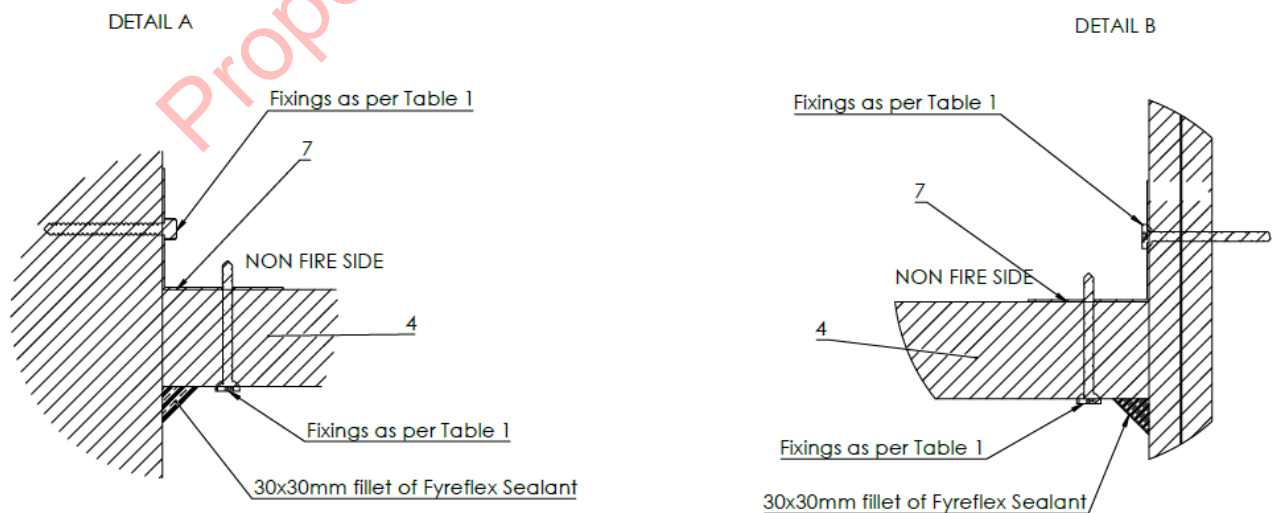
Figure 2b: One sided roof-ceiling or floor-ceiling system for roof or floor systems with independent FRL - section view



**Figure 2c: Two sided roof-ceiling or floor-ceiling system for roof or floor systems with independent FRL - section view**

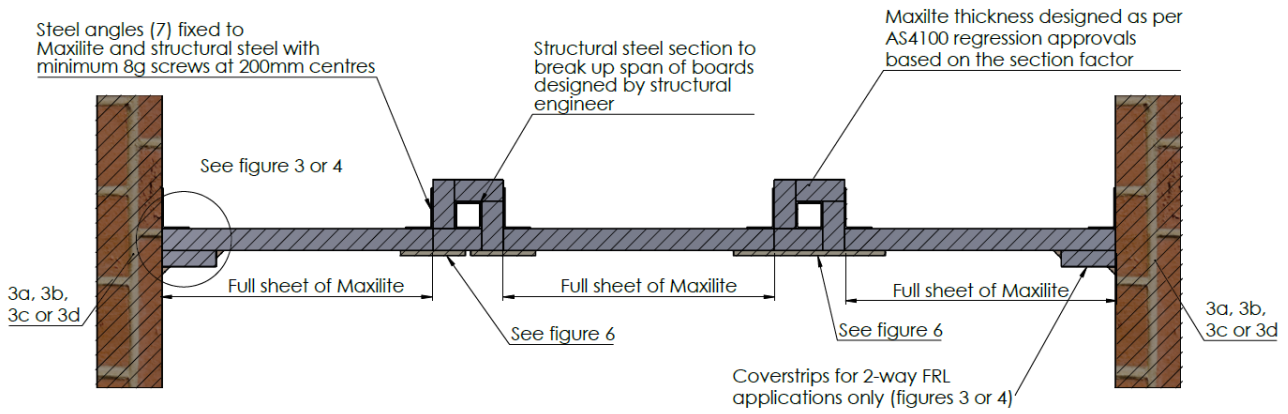


**Figure 2d: Three sided roof-ceiling or floor-ceiling system for roof or floor systems with independent FRL - section view**



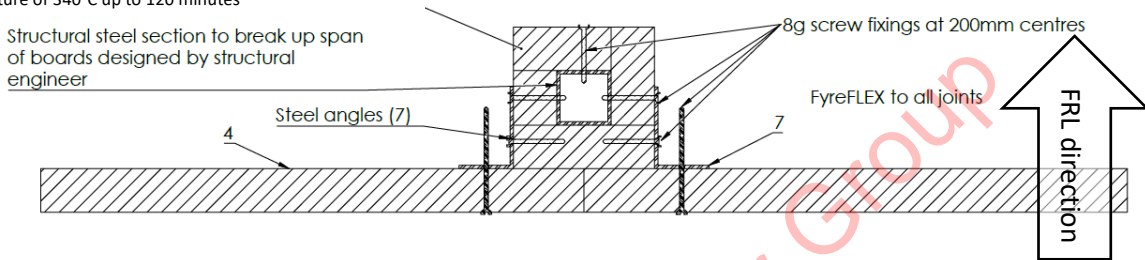
**Figure 3: Maxilite as a floor-ceiling or roof-ceiling system corner junction details 1- section view**



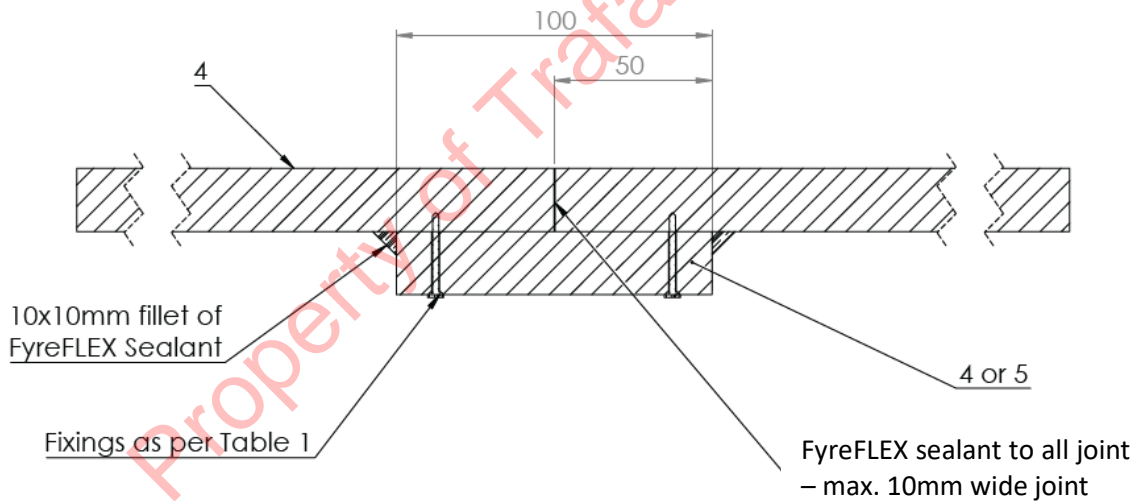


Structural steel section with or without support rods. Section shall have a  $H_p/A$  less than that for a 50x50x3 SHS and designed in accordance with AS 4100-2021 for a structurally critical temperature of 340°C up to 120 minutes

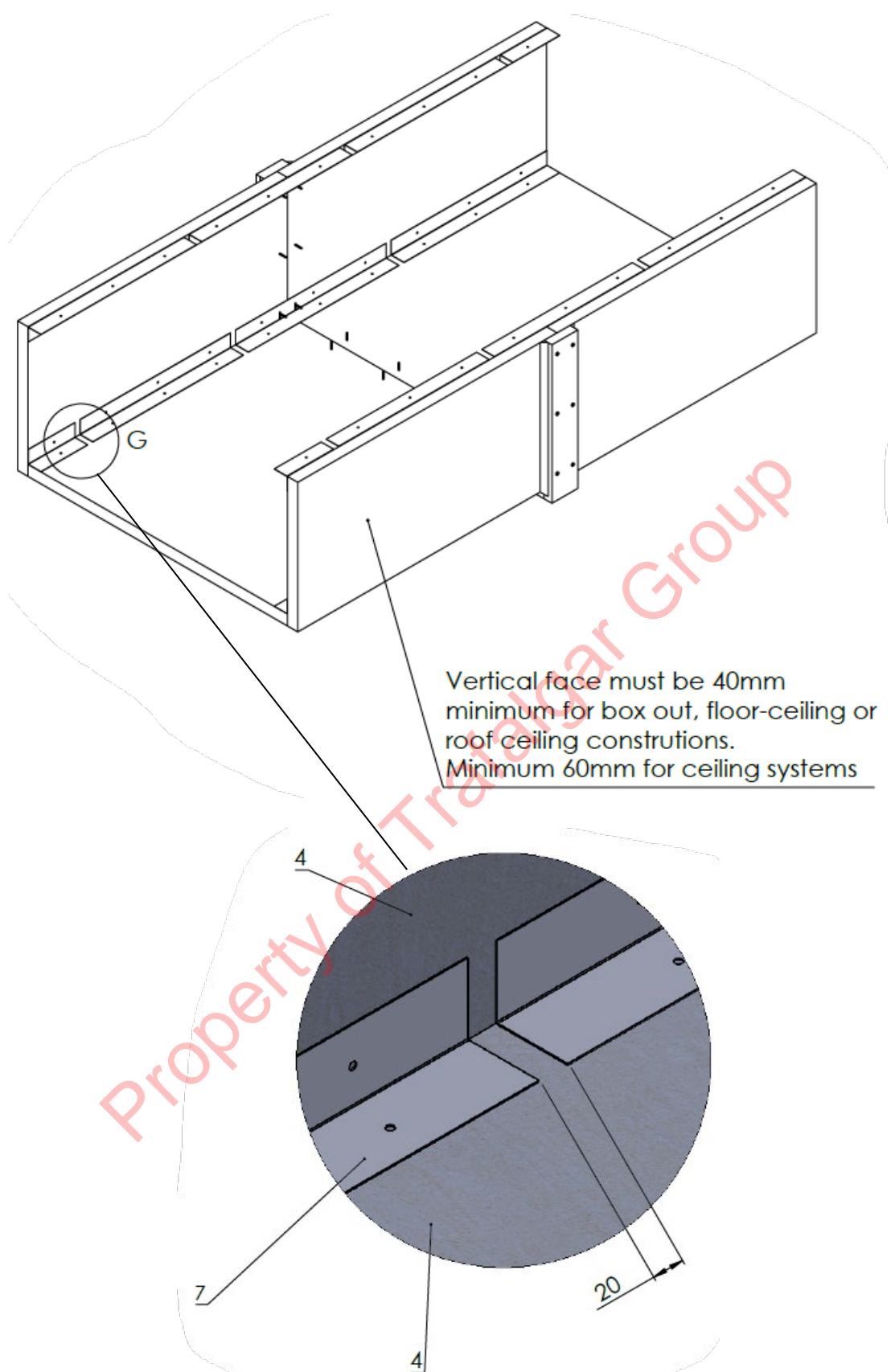
**Alternate modular joint detail:**



**Figure 5b: Support structure with or without support rods for floor-ceiling or roof-ceiling system (fire from below only)**

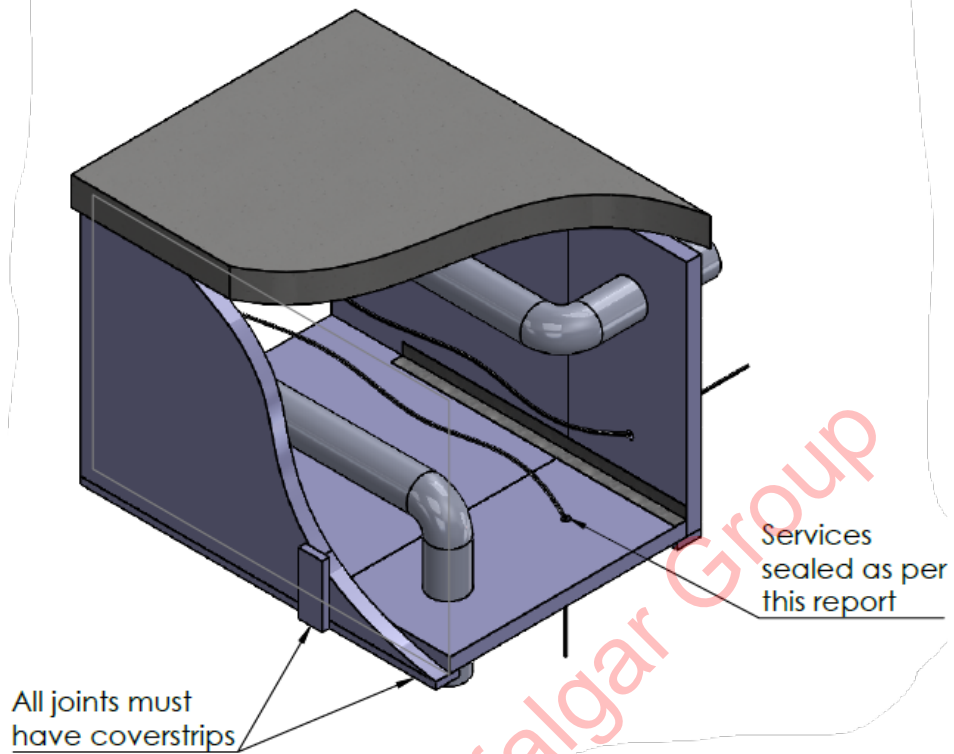


**Figure 6: Maxilite or 9mm Orbit board joint strip treatment for joints in horizontally orientated boards or vertical joints in vertically orientated boards**

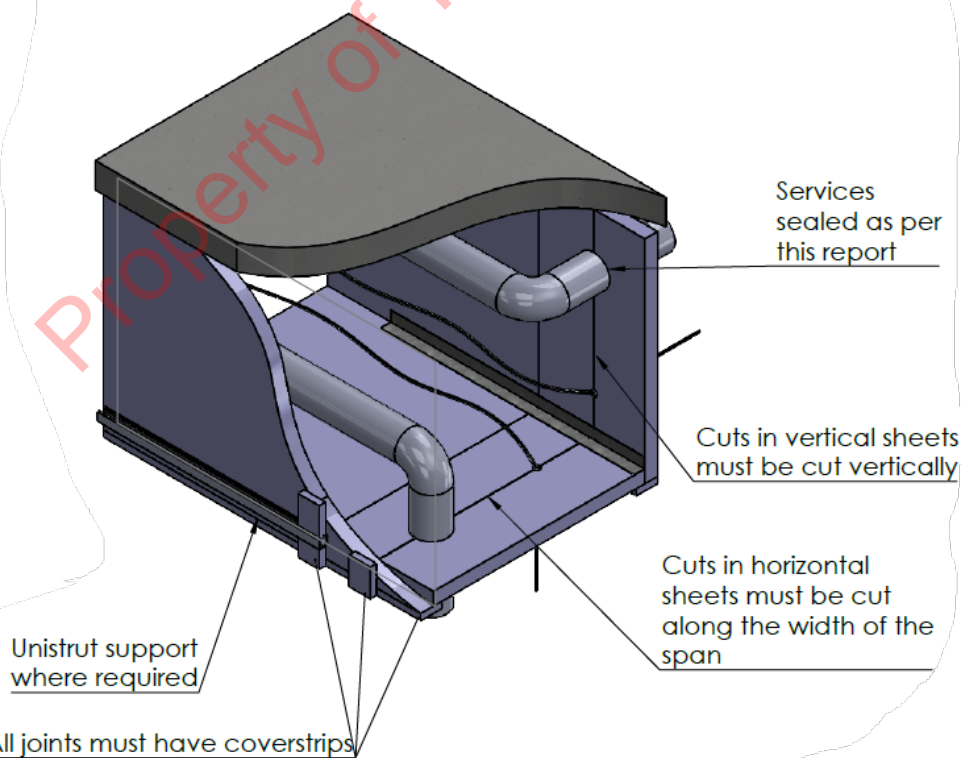


**Figure 7: Maxilite as a ceiling, floor-ceiling or roof-ceiling system angle detail**

**A - Penetrations installed without cutting sheets**



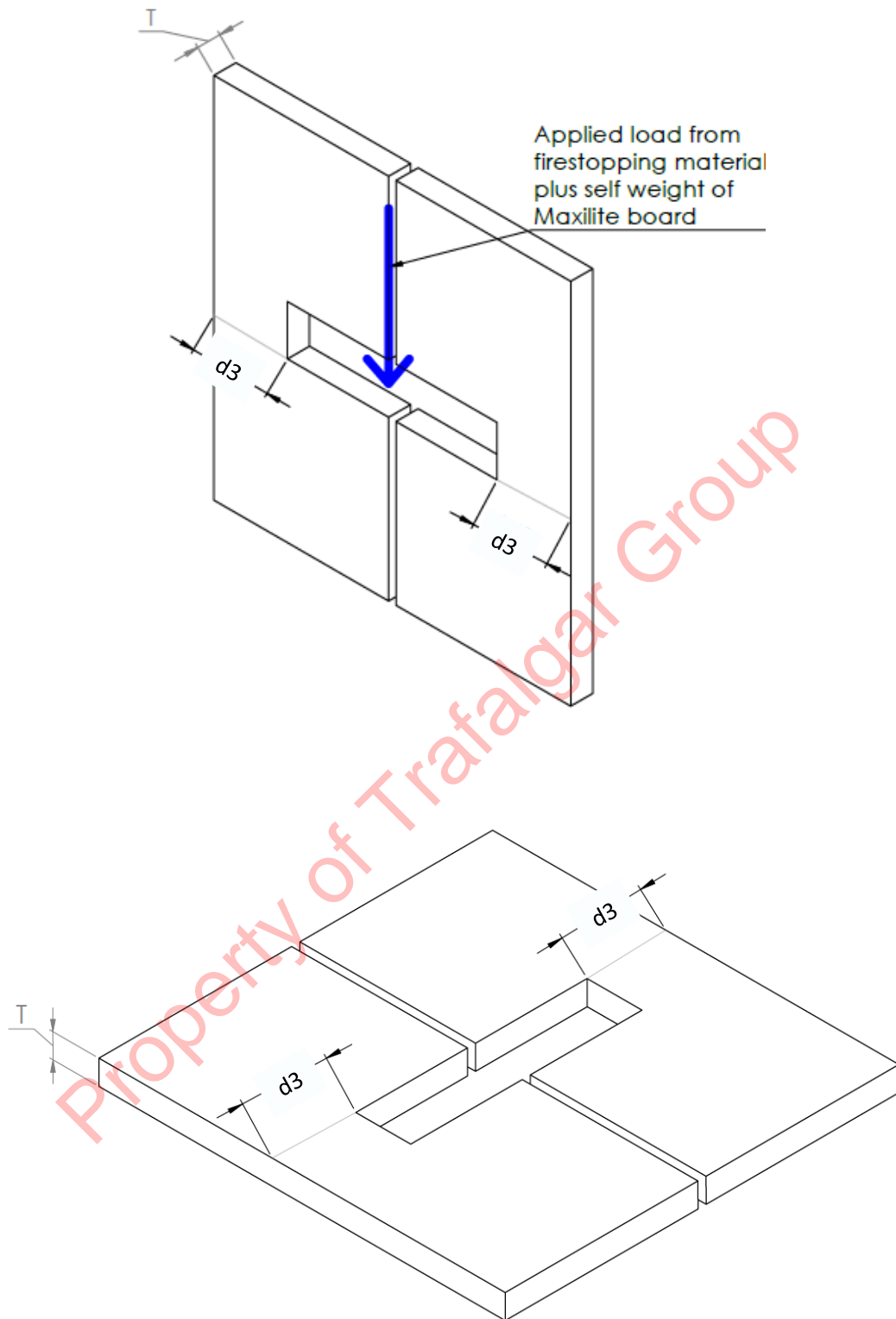
**B - Penetrations installed by cutting sheets**



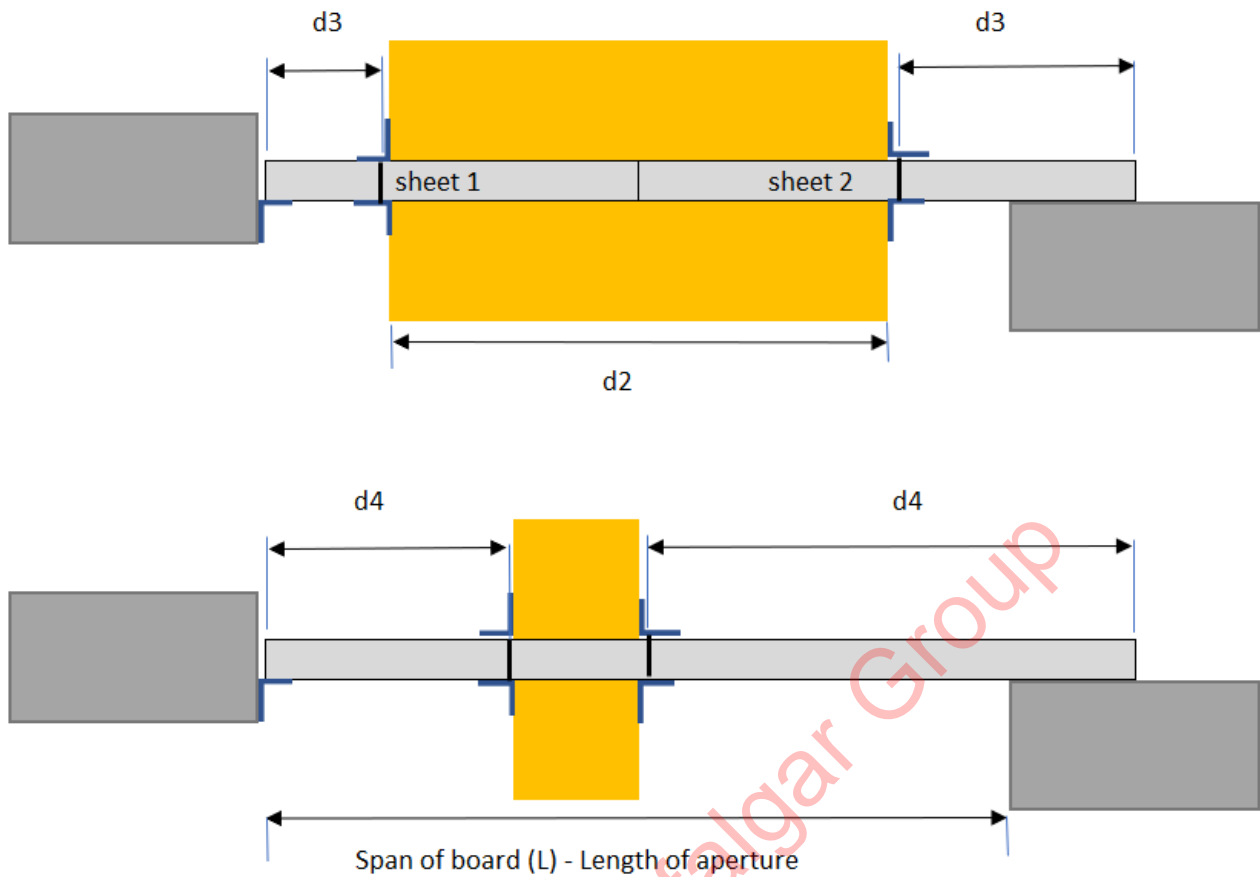
**Figure 8: Examples of Maxilite board joint treatment detail around penetrations– Isometric view**



### Openings in vertical board penetrations



**Figure 9: Openings in minimum 60mm thick Maxilite board with an opening for FyreBOX. Two sheets only.**



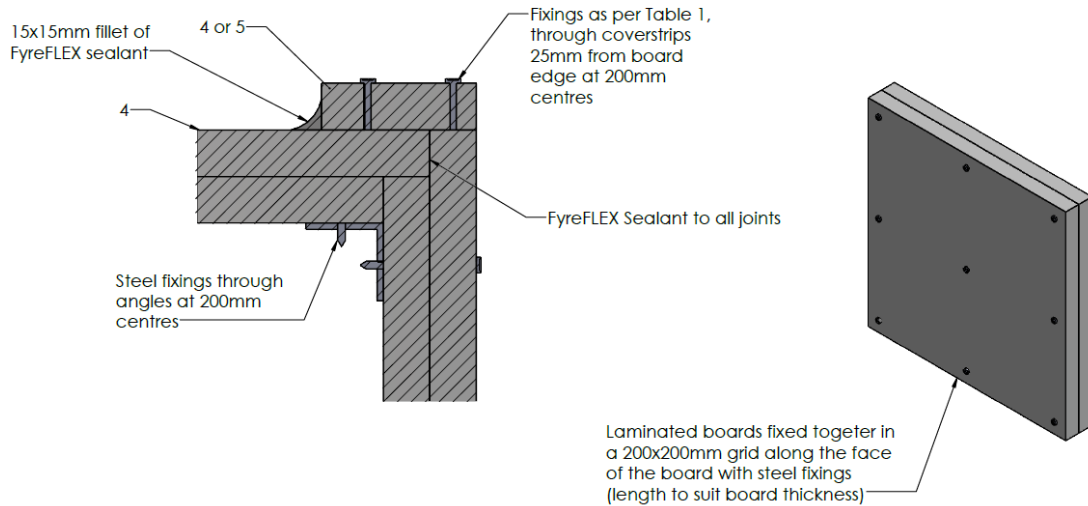
Notes to Figures 9a and 9b

Item	Description
Span	Separation of support for sheet
D2	Width of the box (eg 350, 450...750) etc
D3	Sheet width between the short edge of the box and the edge of the sheet. It shall be at least 150mm for spans up to 850mm. For larger spans refer to Table
D4	Sheet width between the long edge of the box and the edge of the sheet. It shall be at least 150mm for spans up to 850mm. For larger spans refer to Table
Clearance around box	Shall be a maximum of 10mm
Even cut in each sheet	The cutout for the FyreBOX in each sheet shall be equal +/- 20mm

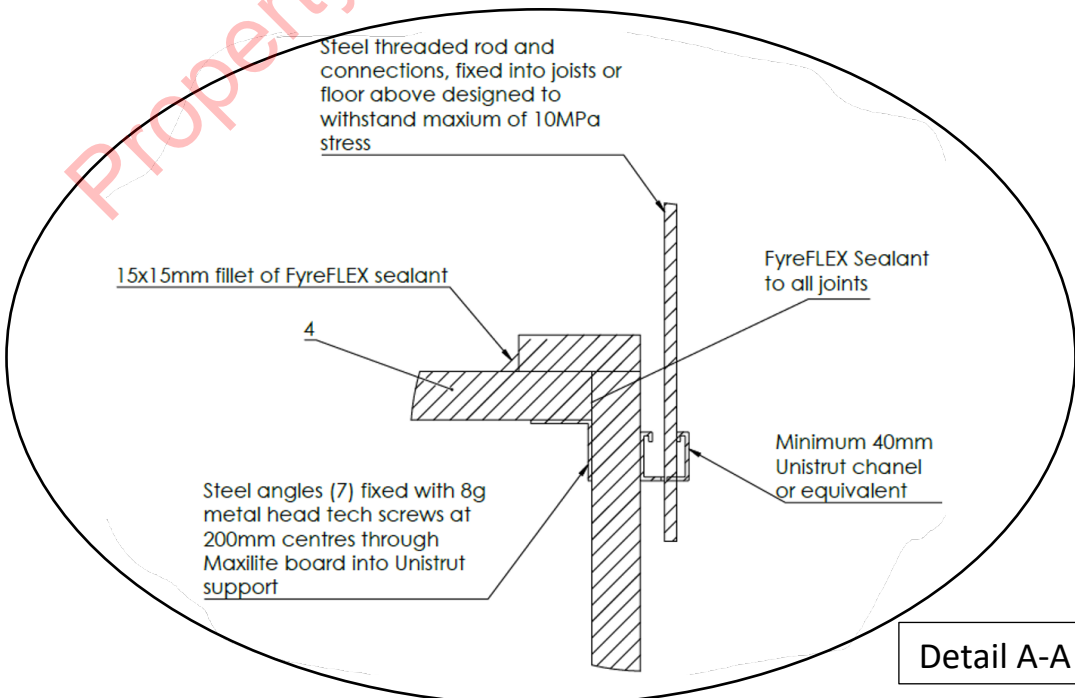
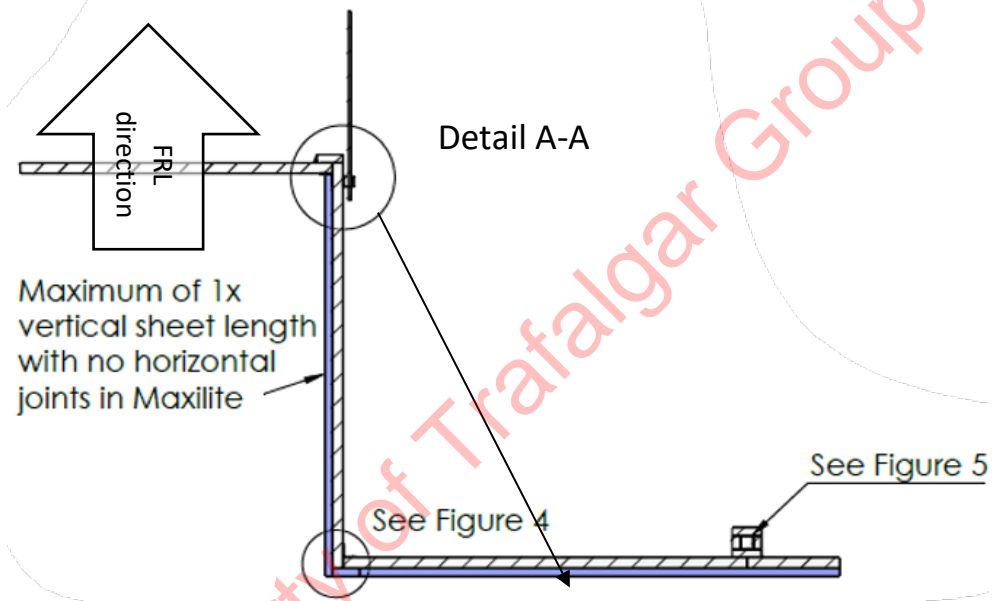
Figure 9b: Openings in minimum 60mm thick Maxilite board with an opening for FyreBOX

Span L (m)	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8
FyreBOX Maxi 350	0.15	0.15	0.15	0.15	0.15	0.15	0.16	0.18
FyreBOX Maxi 550	0.15	0.15	0.15	0.17	0.19	0.21	0.23	0.26
FyreBOX Maxi 650	0.15	0.15	0.17	0.19	0.22	0.24	0.27	0.3
FyreBOX Maxi 750	0.15	0.17	0.2	0.22	0.25	0.28	0.31	0.35
FyreBOX Maxi 1100	0.21	0.24	0.27	0.31	0.34	0.39	0.43	0.49





**Figure 10: Two layered Maxilite corners and fixing detail**



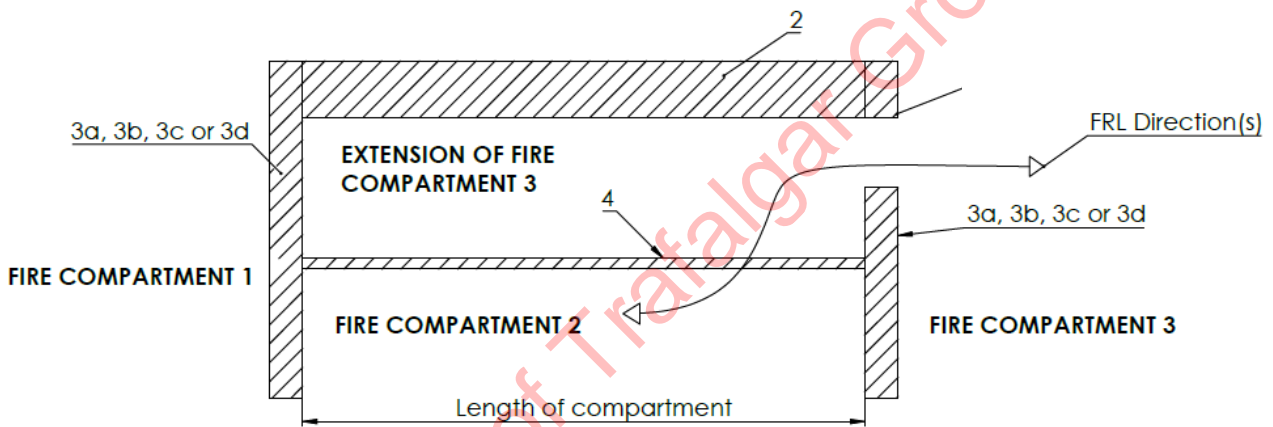
**Figure 11: Supported joint for Z-shaped forms of constructions**

### 3.3 Maxilite ceiling system

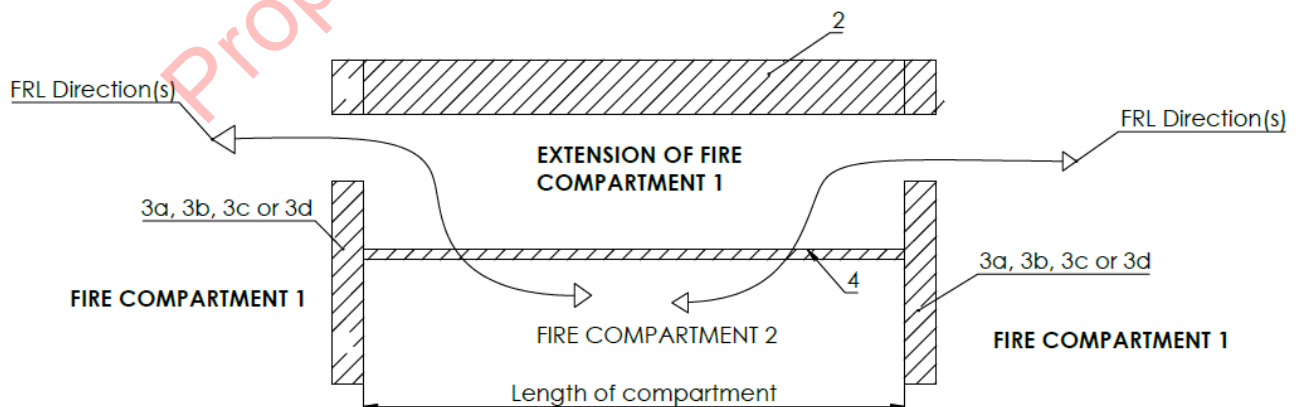
The proposed construction shall be for a Maxilite ceiling membrane based on the ceiling membrane tested in FSH 2076 subject to the following variations;

- The fire exposure is from either side of a Maxilite ceiling (element 4) in two primary cases where separation involves two or three compartments as shown in Figures 12 and 13
- The construction of the Maxilite ceiling (element 4) shall comprise
  - Be non-trafficable and non-loadbearing
  - Either one or more sheets of up to 2040mm long x 1220mm wide x minimum 60mm thick Grey Maxilite board (made from 2 x 30mm or 2 x 40mm or 1 x 60mm layer of Maxilite board)
  - One or more sheets of up to 1500mm long x 1000mm wide x minimum 60mm thick White Maxilite board (made from 2 x 30mm or 2 x 40mm or 1 x 60mm layer of Maxilite board)
  - Any fixings to be a minimum of 50mm away from Maxilite board edge or to be nominally centered on the steel angle
  - Maxilite board can be angle fixed to vertical support construction as shown in Figure 15
  - Maxilite board can be angle fixed to vertical support construction as shown in Figure 17
  - The vertically orientated side of the board can only comprise a single board from top to bottom (i.e. only vertical joints are allowed between two vertically orientated boards)
  - In one, two or three-sided forms of construction as shown in Figures 14a, 14b and 14c.
  - The inclusion of Plastic Skeleton Connectors made from LDPE between metal angles shown in Figures 26a-26d
- It is required the floor (element 2) shall be of fire-rated construction and have the required FRL without the assistance of the ceiling (element 4) or wall (element 3a, 3b, 3c or 3d) and provide the required support for the ceiling (element 4). Where the ceiling (element 4) requires support from the floor (element 2) above, the support rods shall be protected for the full FRL period or designed for full fire exposure
- Variation to the protection of structural steel elements supporting the ceiling.
- The system may include services that penetrate
  - Wall (element 3a, 3b, 3c or 3d) and Maxilite ceiling (element 4) as shown in Figures 12, 14a, 14b, and 14c.
    - Services shall be protected at the Maxilite ceiling (element 4) with systems listed in Sections 3.7 and 3.8
    - Services shall be protected at the wall (element 3a, 3b, 3c or 3d) between Fire compartment 1 and fire compartment 2 with systems listed in Section 3.7
    - Services through the wall (element 3a, 3b, 3c or 3d) between fire compartment 2 and fire compartment 3 may pass through untreated openings in the wall (element 3a, 3b, 3c or 3d)
  - Wall (element 3a, 3b, 3c or 3d) and Maxilite ceiling (element 4) as shown in Figures 13, 14a, 14b, and 14c.
    - Services shall be protected at the Maxilite ceiling (element 4) with systems listed in Section 3.8
    - Services through the wall (element 3a, 3b, 3c or 3d) between fire compartment 1 and the extension of fire compartment 1 may pass through untreated openings in the wall (element 3a, 3b, 3c or 3d)
- The system may include services that
  - May pass through untreated openings in one or both of the walls (element 3a, 3b, 3c or 3d) from one fire compartment to another fire compartment only
  - The permissible services are listed in Tables 2, 3, 6, 8 and 10
  - Maxilite ceiling (element 4) shall not support the weight of any service penetrations. All services shall be supported independently of the ceiling.
  - Services shall be spaced by a minimum of 40mm

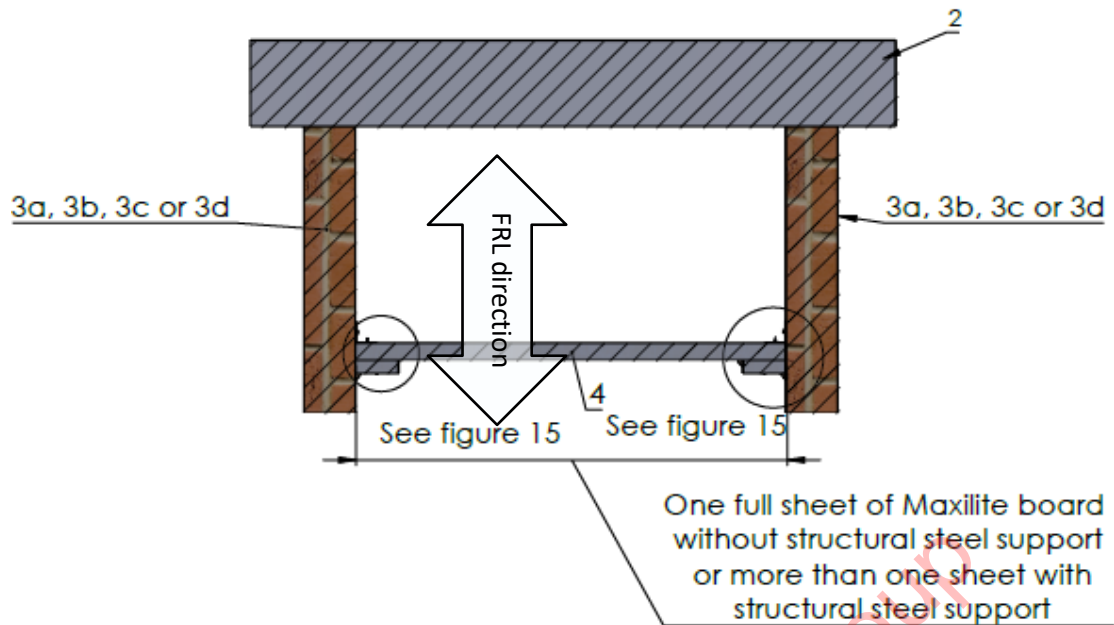
- The general arrangement of this system is shown in Figures 12, 13, 14a, 14b, and 14c, examples of construction details are shown in Figures 5-11, 15 – 17, and 34.
- Penetration details are shown in Sections 3.7 and 3.8 of this report.
- The inclusion of 15mm thick x 100mm wide Corex Board (900kg/m<sup>3</sup>) as a cover strip option in place of 9mm Orbit board for up to 120 minute applications.
- Inclusion of access panel in the Maxilite ceiling (element 4) as per Figures 60a, 60b, 61 and 62
  - Maximum aperture in Maxilite support construction size of 600mmx600mm
  - The Access panels must be mounted into 1x 60mm or 2x 30mm white or grey Maxilite boards regardless of application
  - Installed at least 300mm away from the edge of any Maxilite sheet and may be installed across a joint centrally, where the maximum cut-out in the Maxilite construction is maximum of 300mm as per Figure 62 and Table 11a. Joint to be cover with a cover strip as per Figure 21b
  - Where Access panel is larger than 500mm x 500mm, Maxilite part of the floor/roof ceiling or ceiling system shall be reinforced with Unistrut around the access panel opening as per Figure 60b



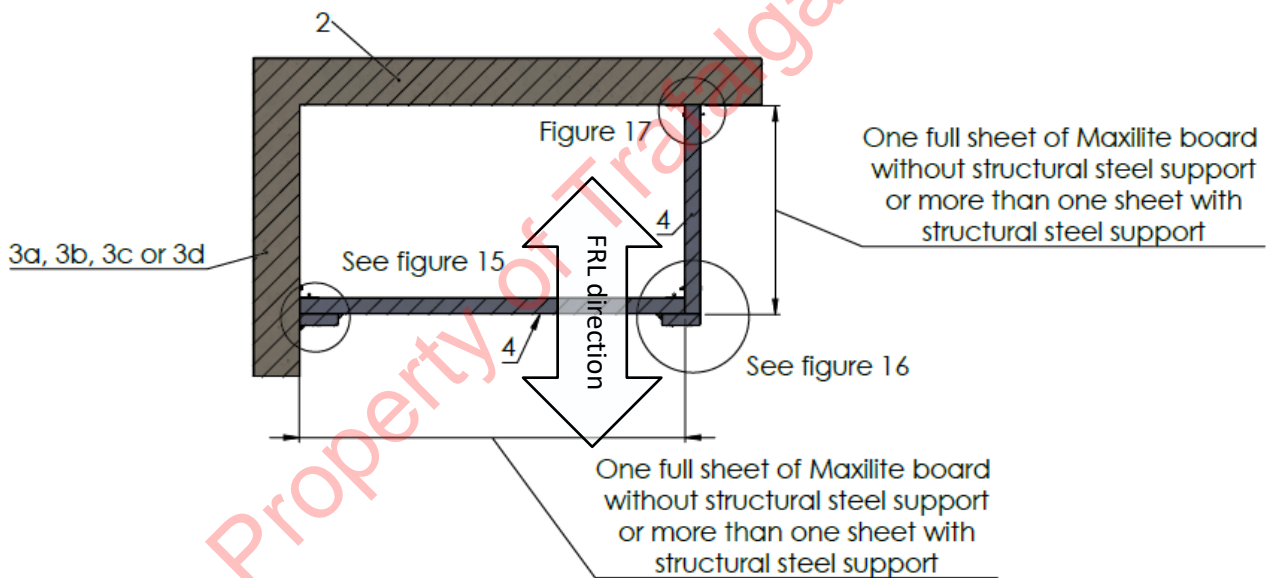
**Figure 12: Maxilite as a Ceiling system – elevation section view  
(Fire from above AND below Maxilite ceiling)**



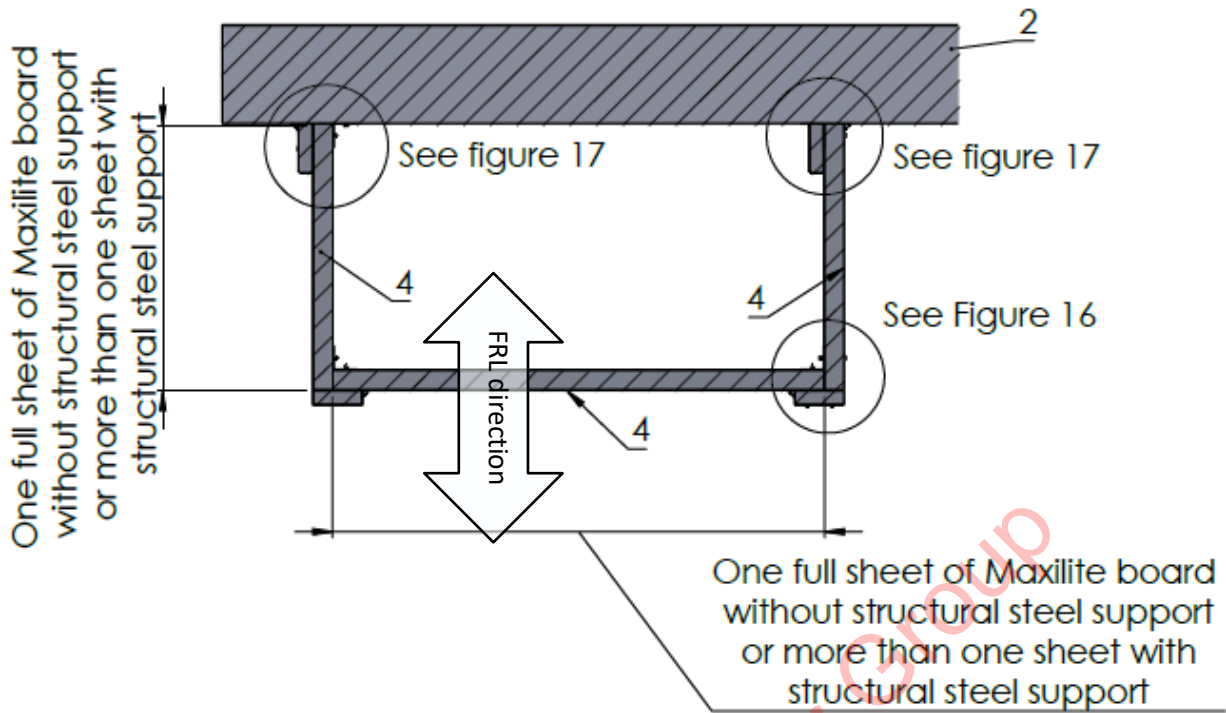
**Figure 13 – Maxilite as a Ceiling system – elevation section view  
(Fire from above AND below Maxilite ceiling )**



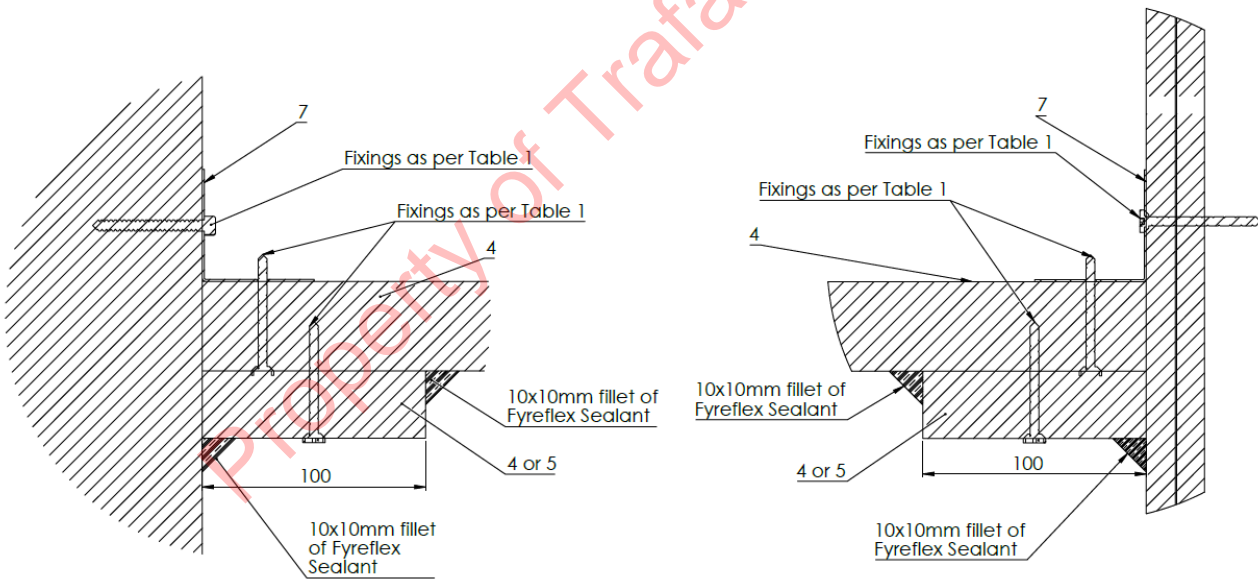
**Figure 14a – One sided ceiling system with concrete slab floor- section view  
(Fire from above AND below Maxilite ceiling)**



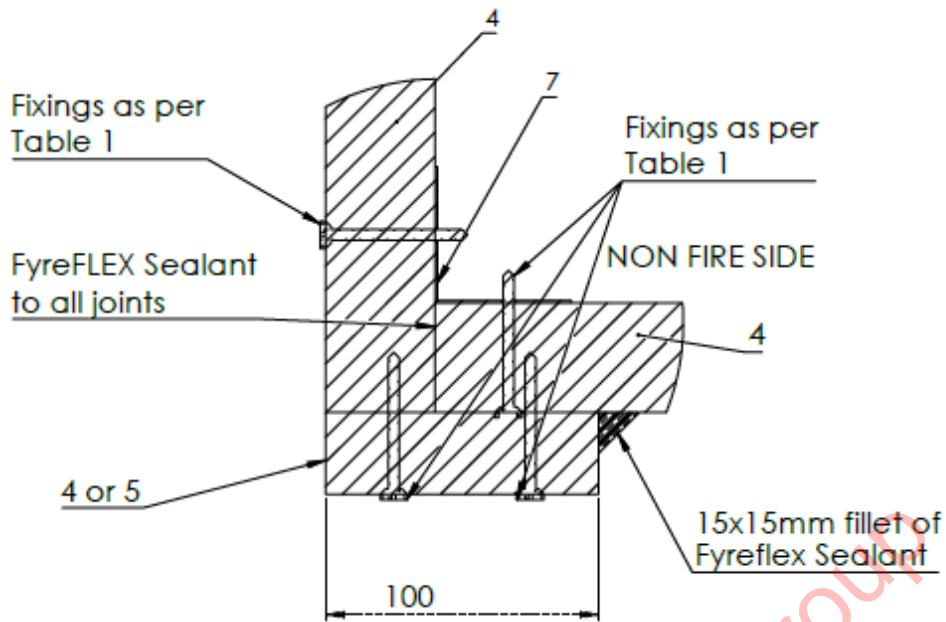
**Figure 14b – Two sided ceiling system with concrete slab floor- section view  
(Fire from above AND below Maxilite ceiling)**



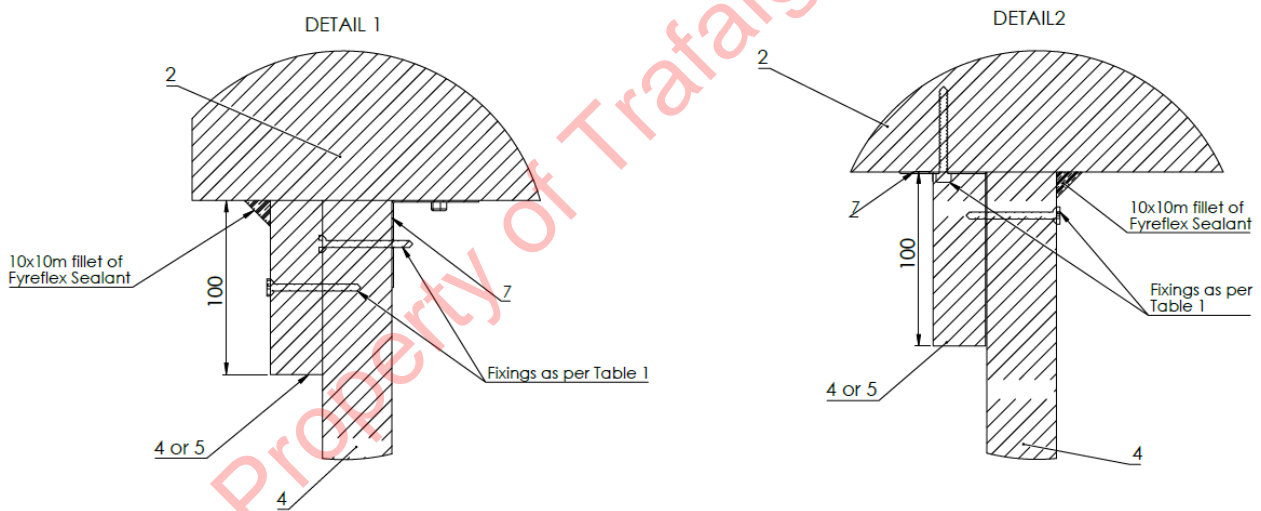
**Figure 14c – Three sided ceiling system with concrete slab floor- section view  
(Fire from above AND below Maxilite ceiling)**



**Figure 15: Maxilite as a ceiling system corner junction details – section view  
(Fire from above AND below Maxilite ceiling)**



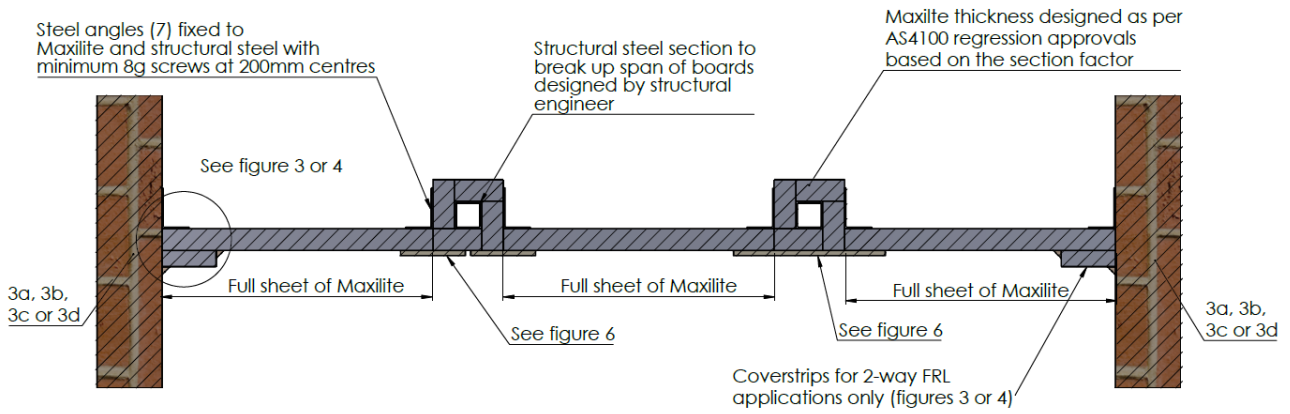
**Figure 16: Maxilite as a ceiling system corner junction details – section view (Fire from above AND below Maxilite ceiling)**



**Figure 17: Maxilite as a ceiling system corner junction details – section view (Fire from either side of Maxilite ceiling)**

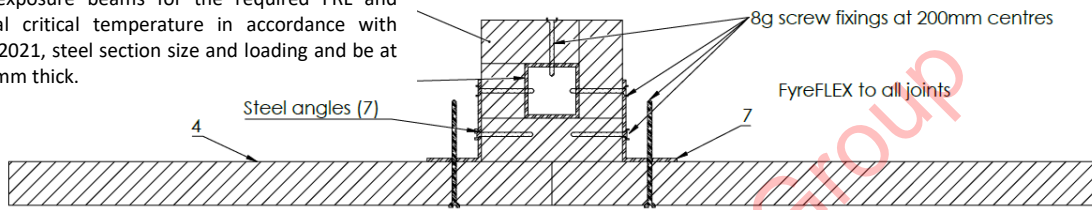
For a Structural steel section with or without support rods supporting the Maxilite ceiling only the thickness of protection shall be based on a test or assessment for 3 side exposure beams for the required FRL and structural critical temperature in accordance with AS4100-2021, steel section size and loading and be at least 40mm thick.





For a Structural steel section with or without support rods supporting the Maxilite ceiling only the thickness of protection shall be based on a test or assessment for 3 side exposure beams for the required FRL and structural critical temperature in accordance with AS4100-2021, steel section size and loading and be at least 40mm thick.

**Alternate modular joint detail:**



**Figure 17a: Support structure with or without support rods for floor-ceiling or roof-ceiling system (fire from above and below)**

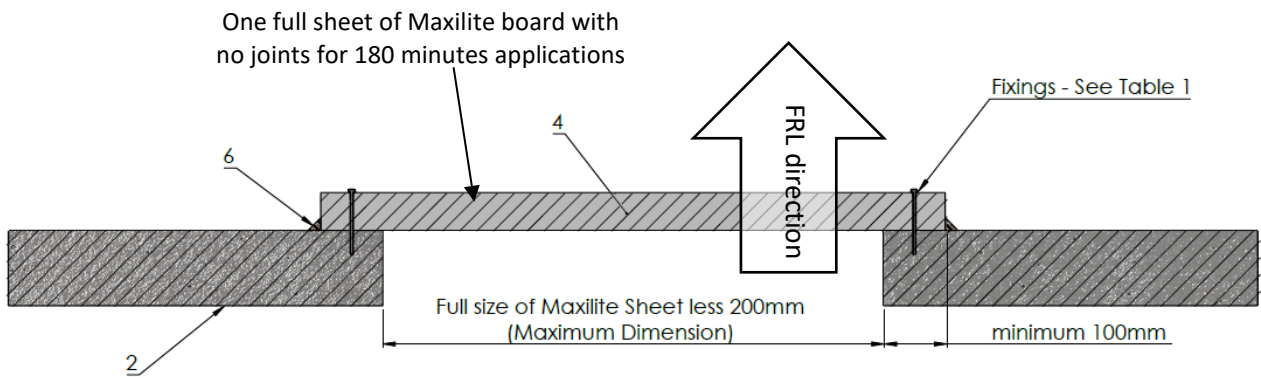
Property of Trafalgar Group

## 3.4 Maxilite as a flat penetration seal in a wall or floor

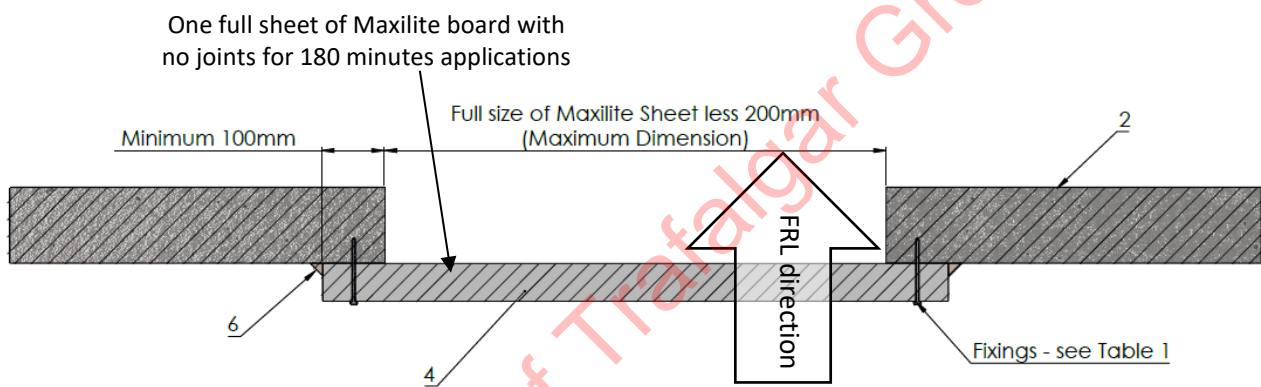
The proposed construction shall be a Maxilite penetration seal based on reference to the ceiling membrane materials tested in FSH 2076 subject to the following variations;

- Wall and floor separating elements supporting the penetration seals shall be supported by a test, assessment or appropriate design to achieve the required FRL when including an opening.
- The penetration seal shall comprise a minimum of 60mm thick Maxilite board (made from 2 x 30mm or 2 x 40mm or 1 x 60mm layers of grey or white Maxilite board).
- For 120-minute applications
  - Maxilite boards either butt up to the opening or overlap the opening in walls and floors
  - The size of the opening is up to 1.62m<sup>2</sup> with or without joints
  - Where flat boards are face fixed over an aperture in walls or floors (overlapping by 100mm) with a joint, no cover strip at the butt joint is required
  - Where flat boards are fitted within apertures in walls or floors, cover strips at the butt joint are required
  - Refer to Figures, 18, 18a, 19, 20, 21, 21a, 21b and 6
- For 180-minute applications
  - Maxilite boards shall overlap the opening in walls and floors
  - When butt joint or cuts in the board are permitted introduced, two layers of min. 30mm Maxilite boards to be arranged in the manner as shown in Figure 21c Aperture shall be covered with a single sheet up to up to 1.62m<sup>2</sup> in size
  - Refer to Figures 18, 19, 21c
- For 240-minute applications
  - Where Maxilite board shall only be installed on top of a slab where the fire is from below only.
  - When butt joint or cuts in the board are introduced, two layers of min. 30mm Maxilite boards to be arranged in the manner as shown in Figure 21c
  - Aperture shall be covered with a single sheet up to up to 1.62m<sup>2</sup> in size
  - Refer to Figure 18, 21c
- Maxilite board can be fixed to support construction as shown in Figures 18 – 23
- All services passing through the wall shall be supported independently of the Maxilite board.
- General construction as shown in Figures 9, 18-23
- Penetrations in Maxilite board shall be limited to the zone shown in Figure 34
- Services shall be spaced by a minimum of 40mm
- Penetration details are shown in Sections 3.7 and 3.8 of this report.





**Figure 18: Maxilite flat seal overlapping an opening in the slab on the unexposed side**



**Figure 18a: Maxilite flat seal overlapping an opening in slab on the exposed side**

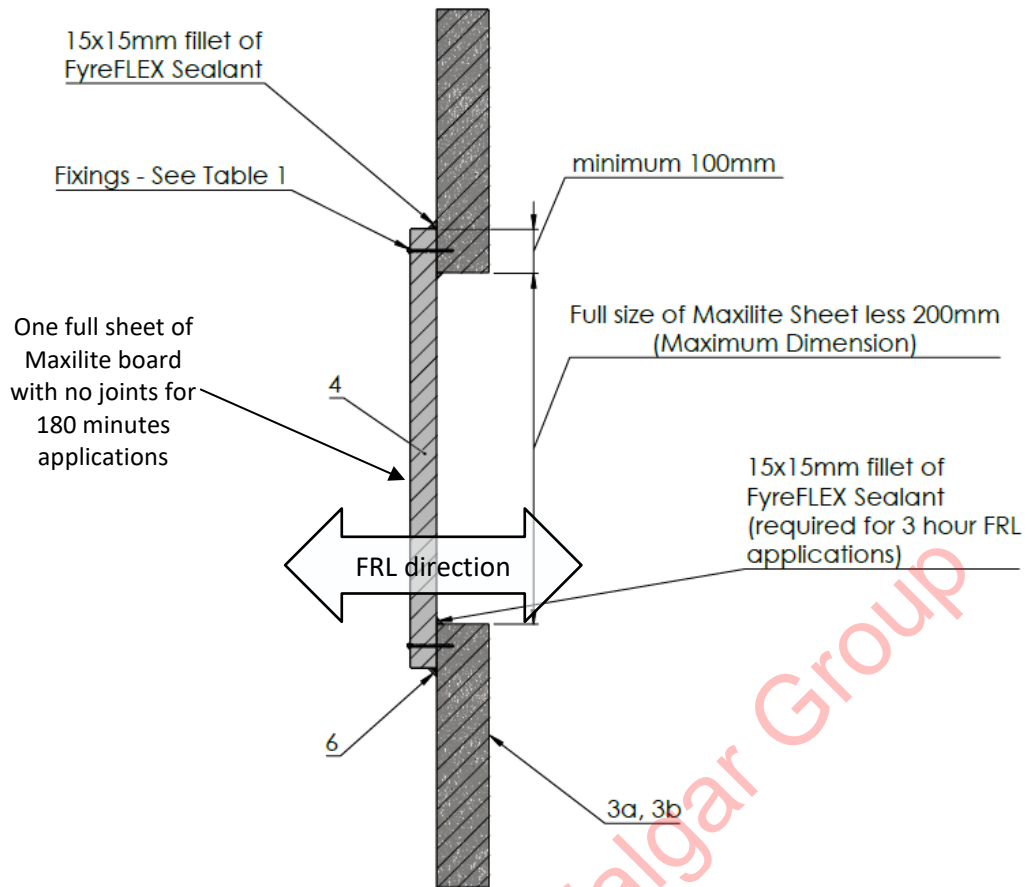


Figure 19: Maxilite flat seal overlapping an opening in solid masonry/concrete wall or Hebel wall

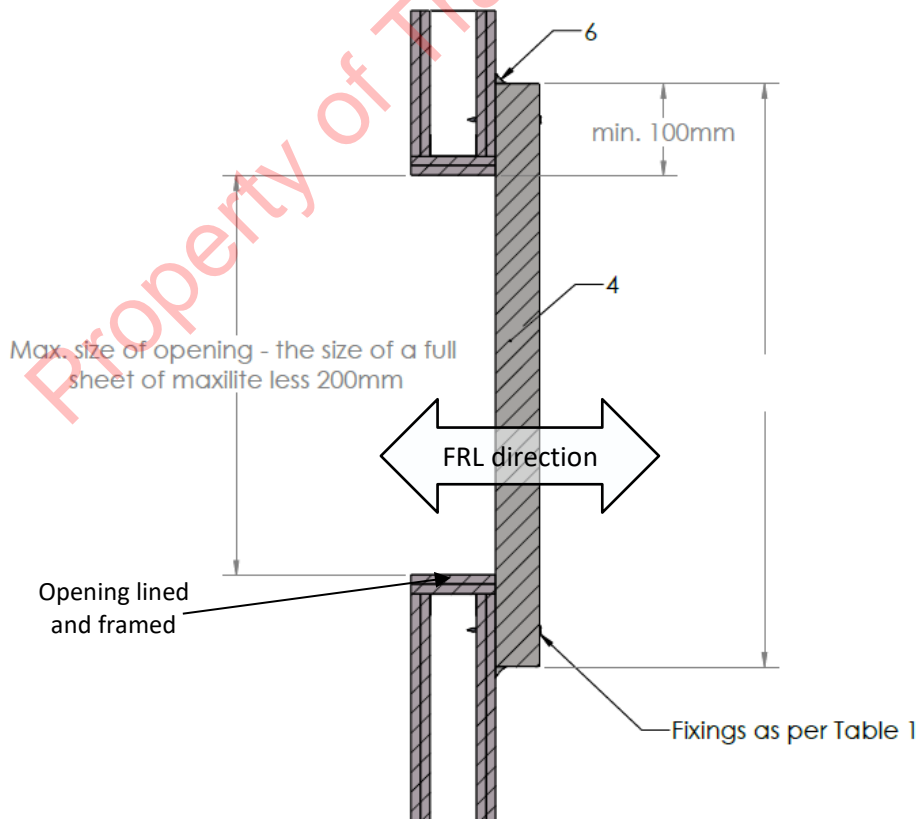
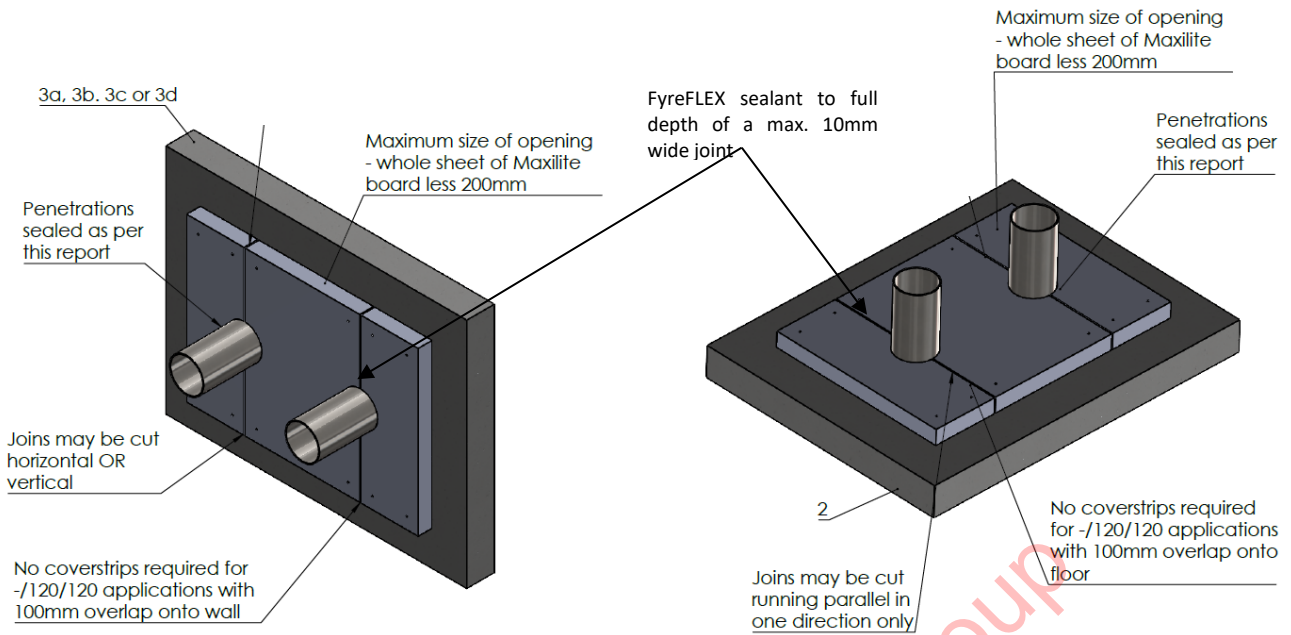
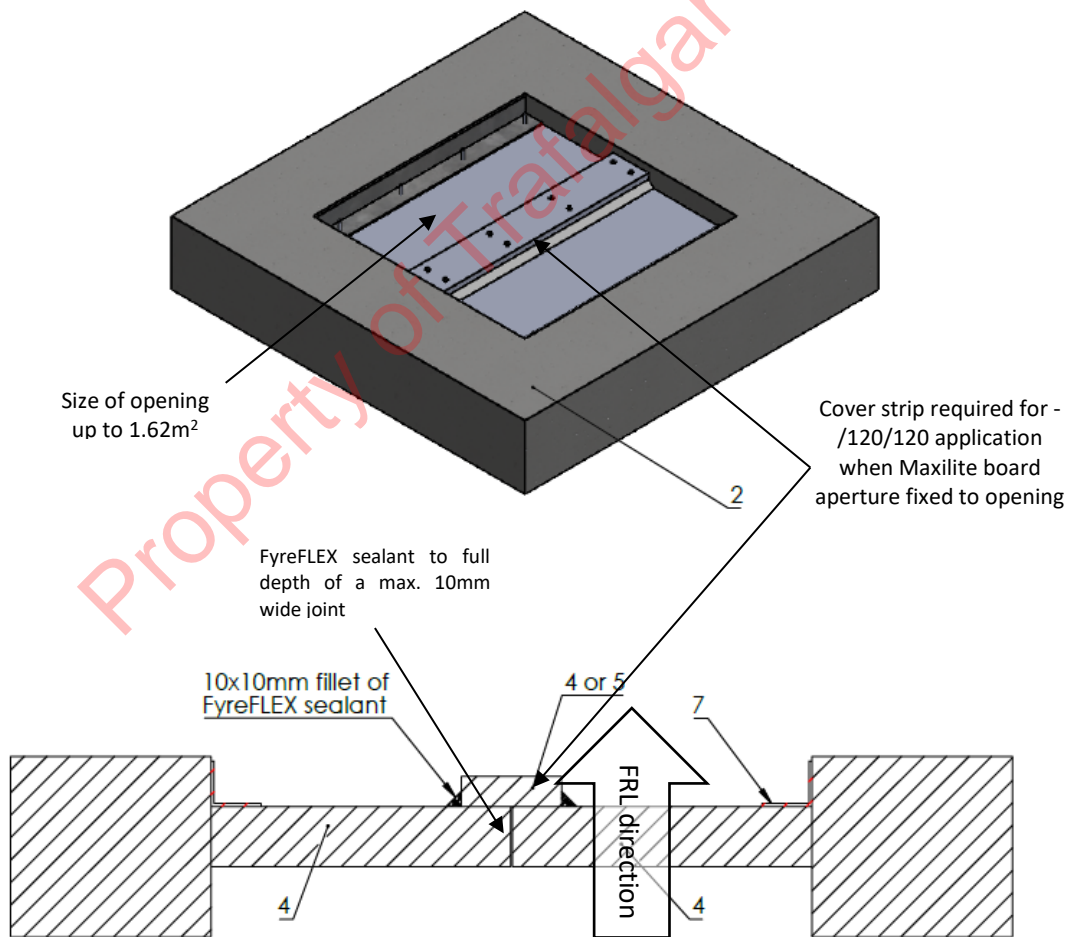


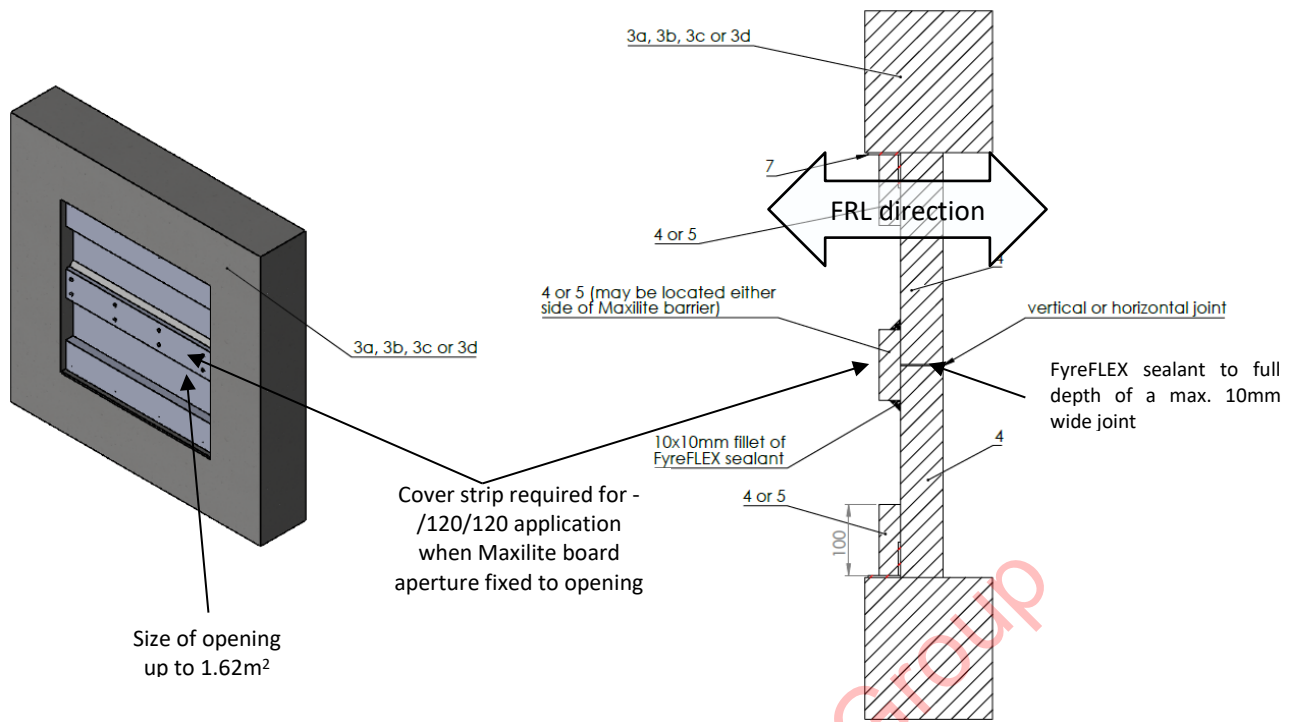
Figure 20: Maxilite flat seal overlapping an opening in Plasterboard stud walls and Plasterboard shaft walls



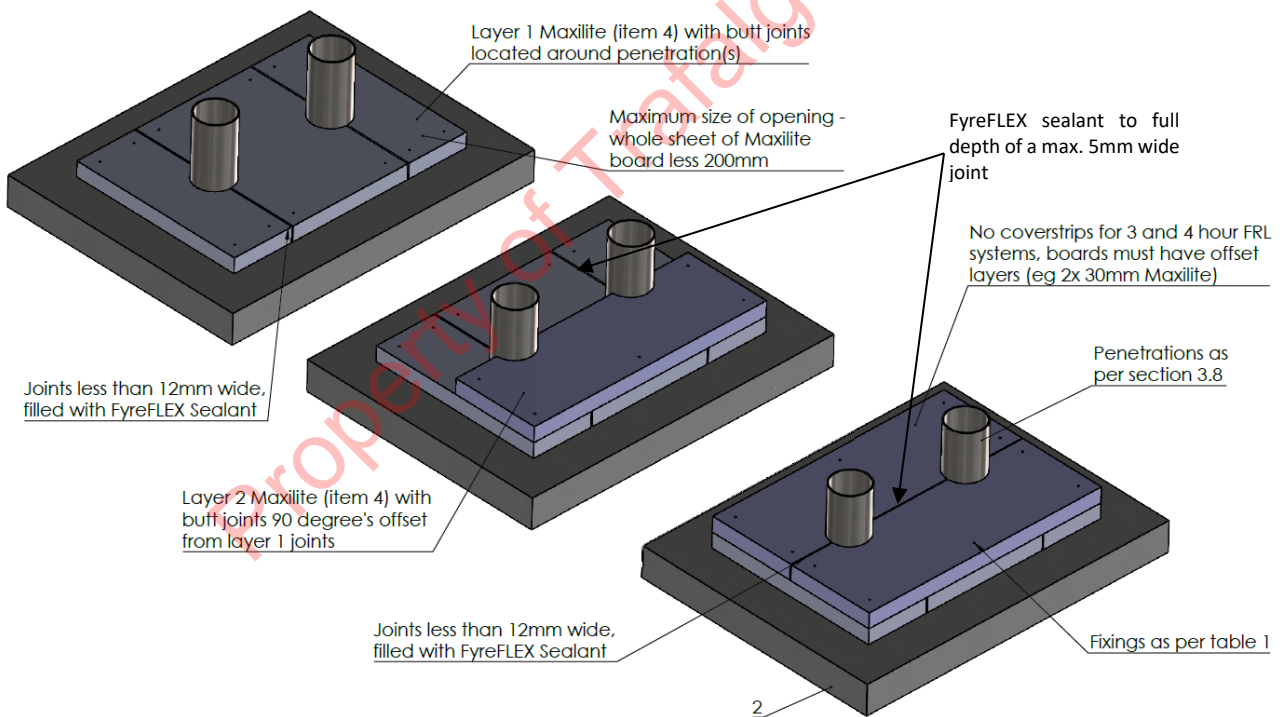
**Figure 21: Maxilite flat seal when face fixed to walls and floors – isometric view**



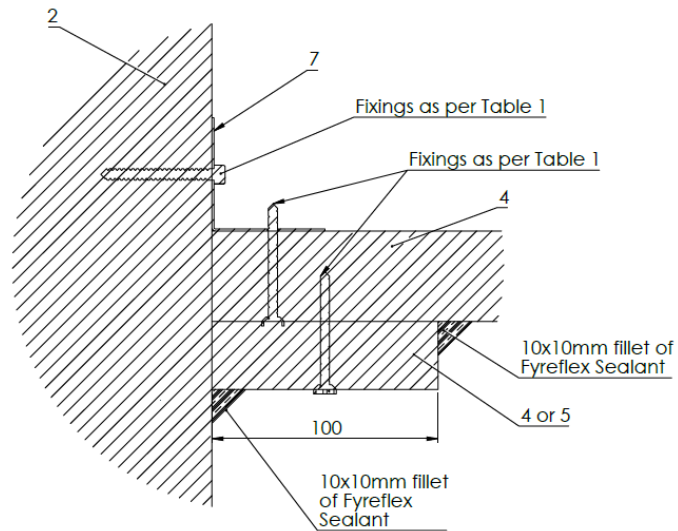
**Figure 21a: Maxilite flat seal when aperture fixed to floors – isometric and section view**



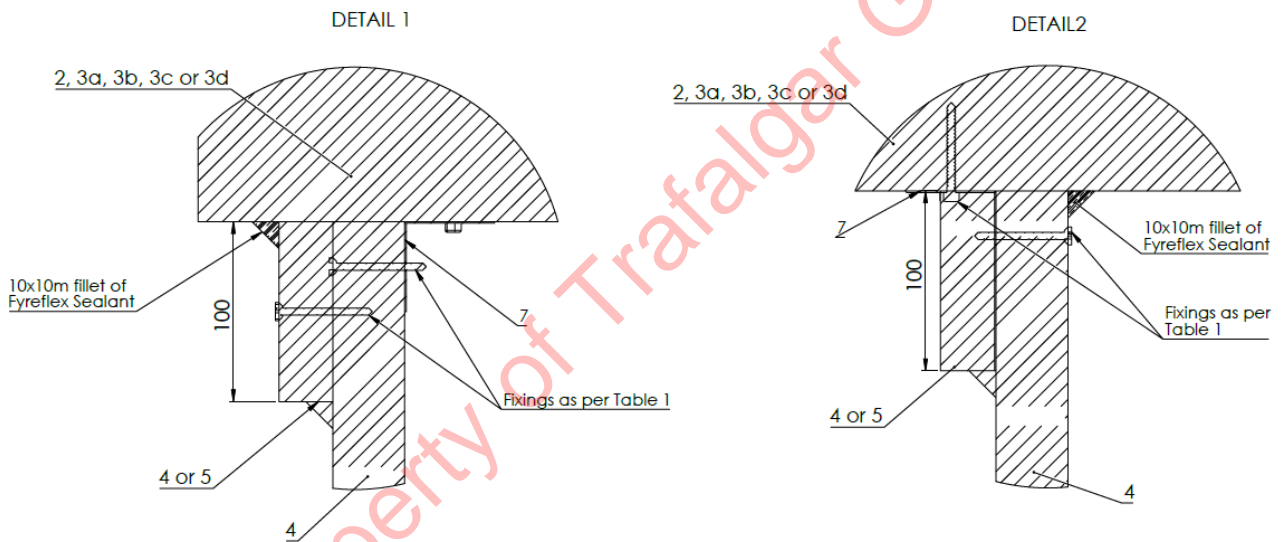
**Figure 21b: Maxilite flat seal when aperture fixed to walls – isometric and section view**



**Figure 21c: Maxilite flat seal with butt joints in the board when aperture fixed to walls or floors – isometric and section view**



**Figure 22: Maxilite flat seal filling aperture by butting up to a slab opening**

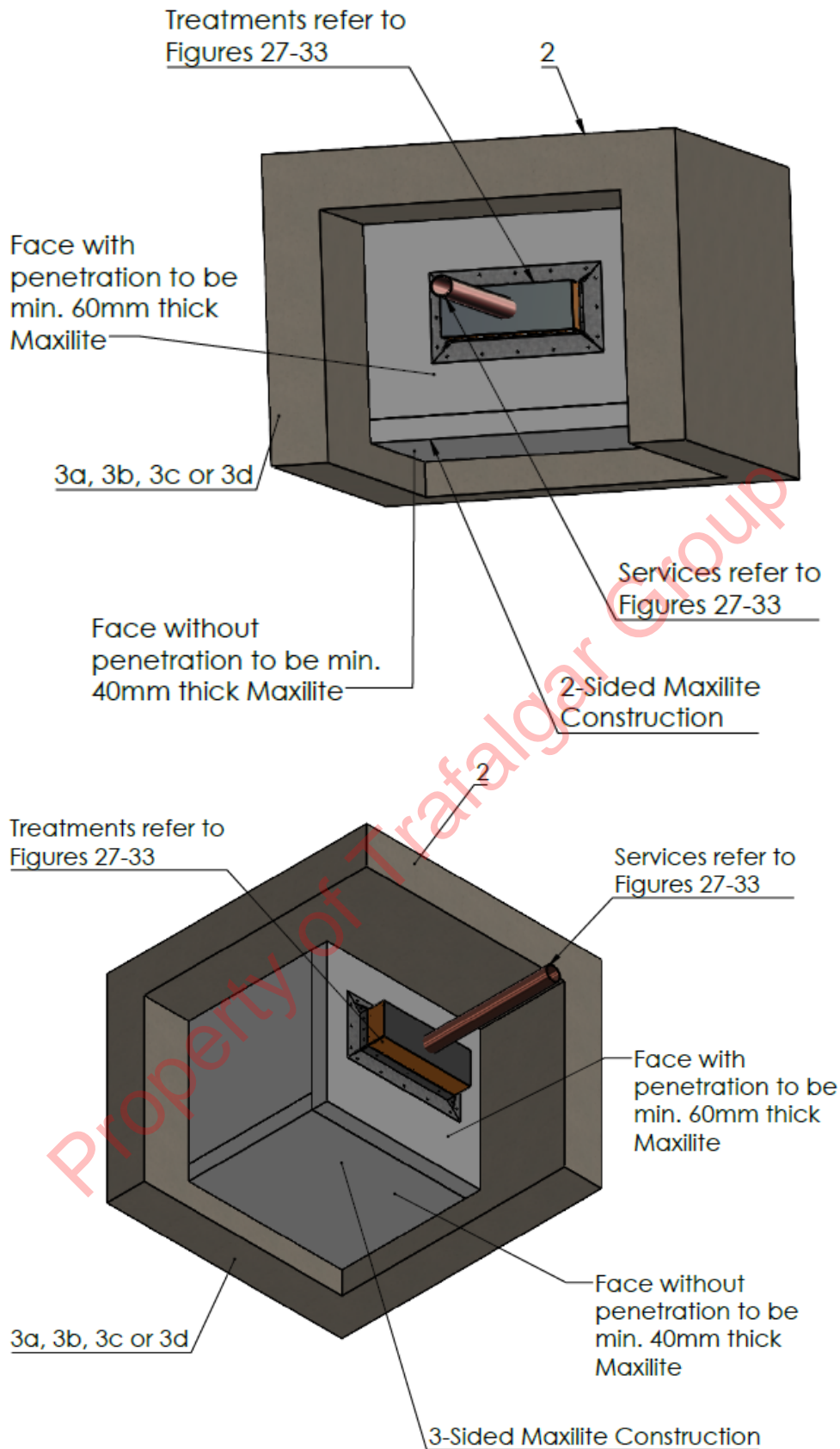


**Figure 23: Maxilite flat seal filling aperture by butting up to a wall opening**

## 3.5 Maxilite as a boxout construction

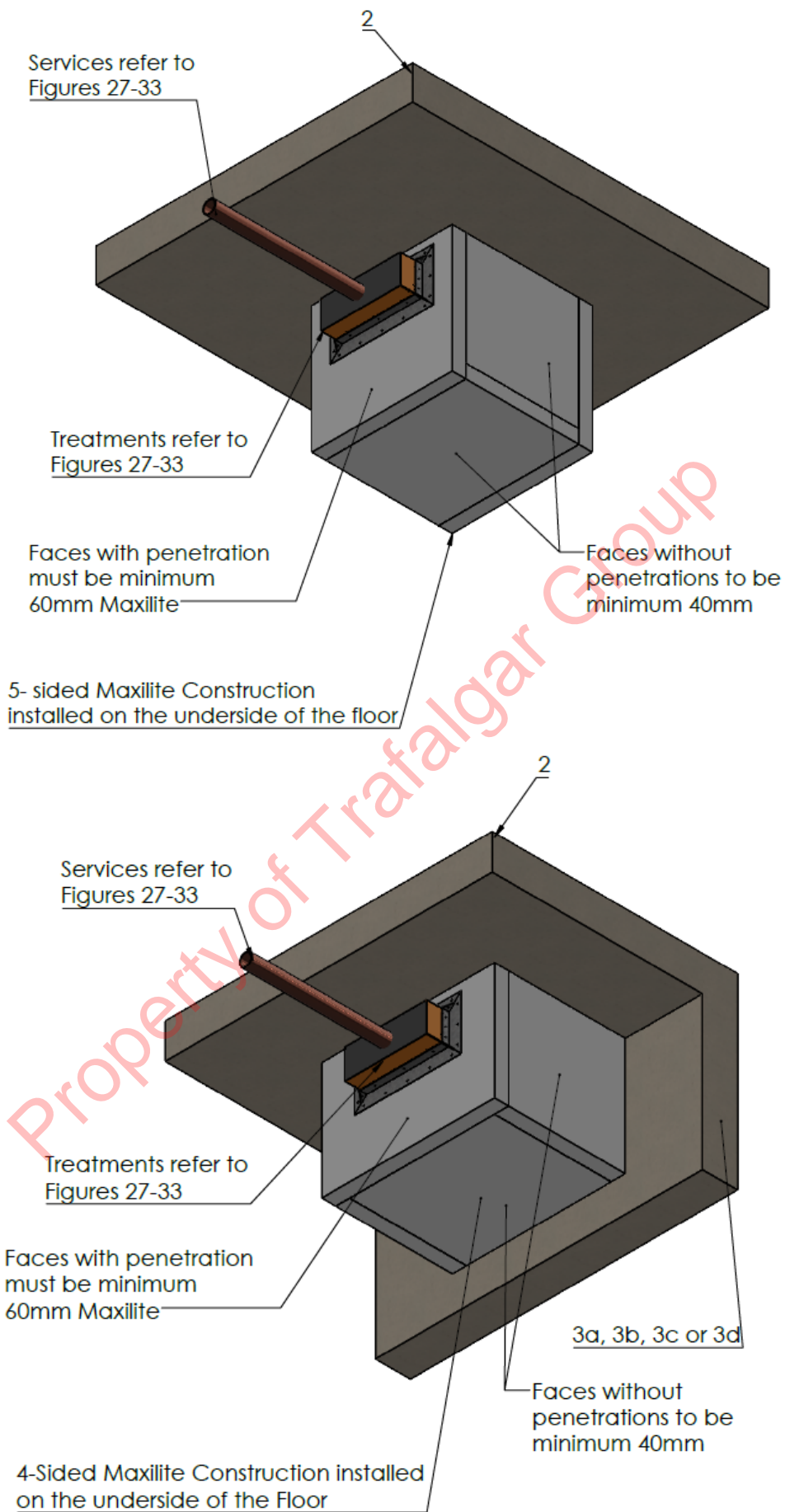
The proposed construction shall be for Maxilite box out penetration seal based on reference to the ceiling membrane materials tested in FSH 2076 subject to the following variations;

- Wall and floor separating elements supporting the penetration seals shall be supported by a test, assessment or appropriate design to achieve the required FRL when including an opening
- The Maxilite boxout construction shall comprise
  - Located on the underside of the slab, not on top of the slab
  - A minimum of 60mm thick grey or white Maxilite board (made from 2 x 30mm or 2 x 40mm or 1 x 60mm layers of Maxilite board) for the face with penetrations
  - A minimum of 40mm thick grey or white Maxilite board (made from 2 x 30mm or 1 x 40mm layers of Maxilite board) for the face without penetrations
  - The size of each face allowed is limited to an area of no greater than 2.32m<sup>2</sup> with or without joints for -/120/120.
  - Angles shall be positioned inside the box only
  - Cover strips shall be outside of the box only
  - Where 2 sheets of Maxilite are used it is required at least one sheet is staggered at the corner.
  - The inclusion of Plastic Skeleton Connectors made from LDPE between metal angles shown in Figures 26a-26d
- Generally, services that penetrate the boxout shall be supported independently of the Maxilite board, whether penetrating on the vertical or the horizontal face of the box. This includes services listed in Tables 3 – 11
- Where services that penetrate the boxout are of minimal weight, they may be supported by Maxilite board only, these include
  - Copper and steel pipes ≤ 32mm OD
  - Threaded rod ≤ 10mm OD
  - Up to 2 x CAT 6 cables
  - Up to 2 x Firesense cables
  - Up to 2 x TPS cables
  - Up to 1 bundle of 100 strand telecommunication cables
  - FyreBOX per Table 7 and Table 11
- Penetrations in Maxilite board shall be limited to the zone shown in Figure 34
- Services shall be spaced by a minimum of 40mm
- Penetration details are shown in Sections 3.7 and 3.8 of this report.
- The proposed types of boxout construction and the relevant services and exposure directions are outlined in Sections 3.5.1 – 3.5.4.



**Figure 24: 2 and 3 sided boxout configuration – isometric view**





**Figure 25: 4 and 5 sided boxout configuration – isometric view**





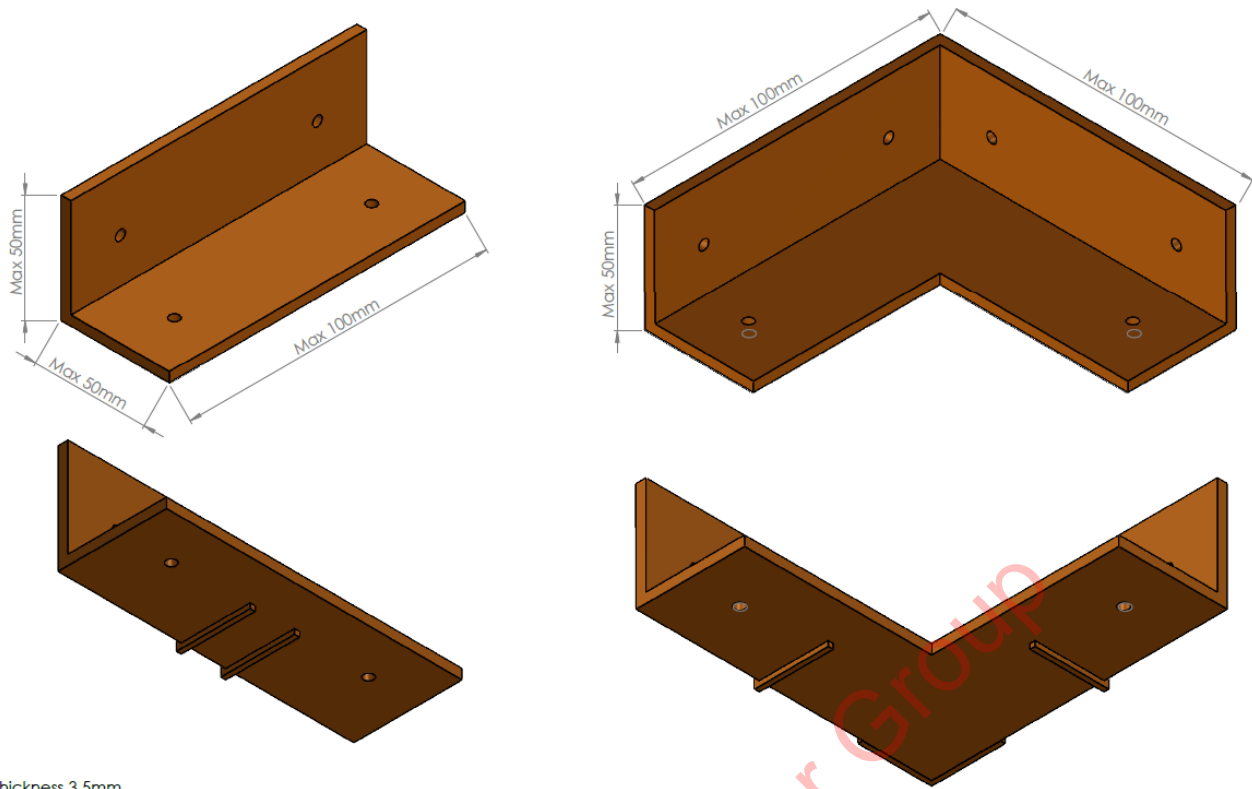


Figure 26b: Details of LDPE plastic skeleton connectors

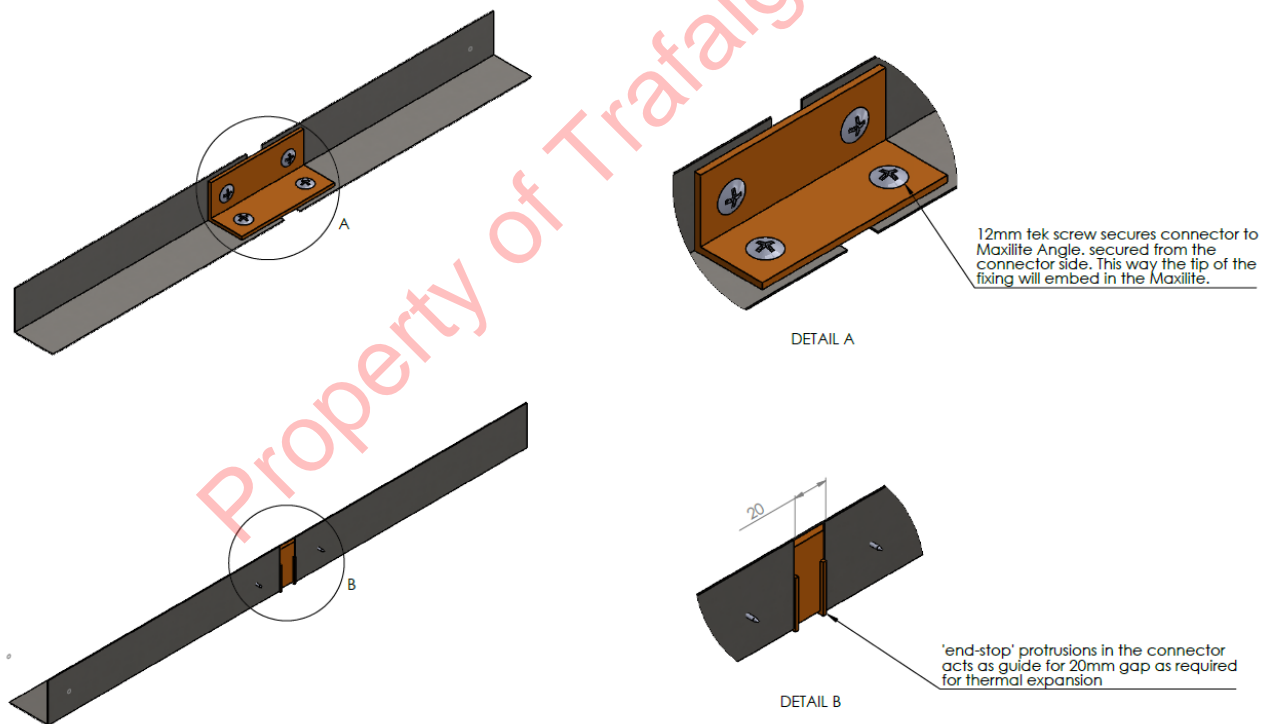


Figure 26c: Type 1 LDPE plastic skeleton connectors

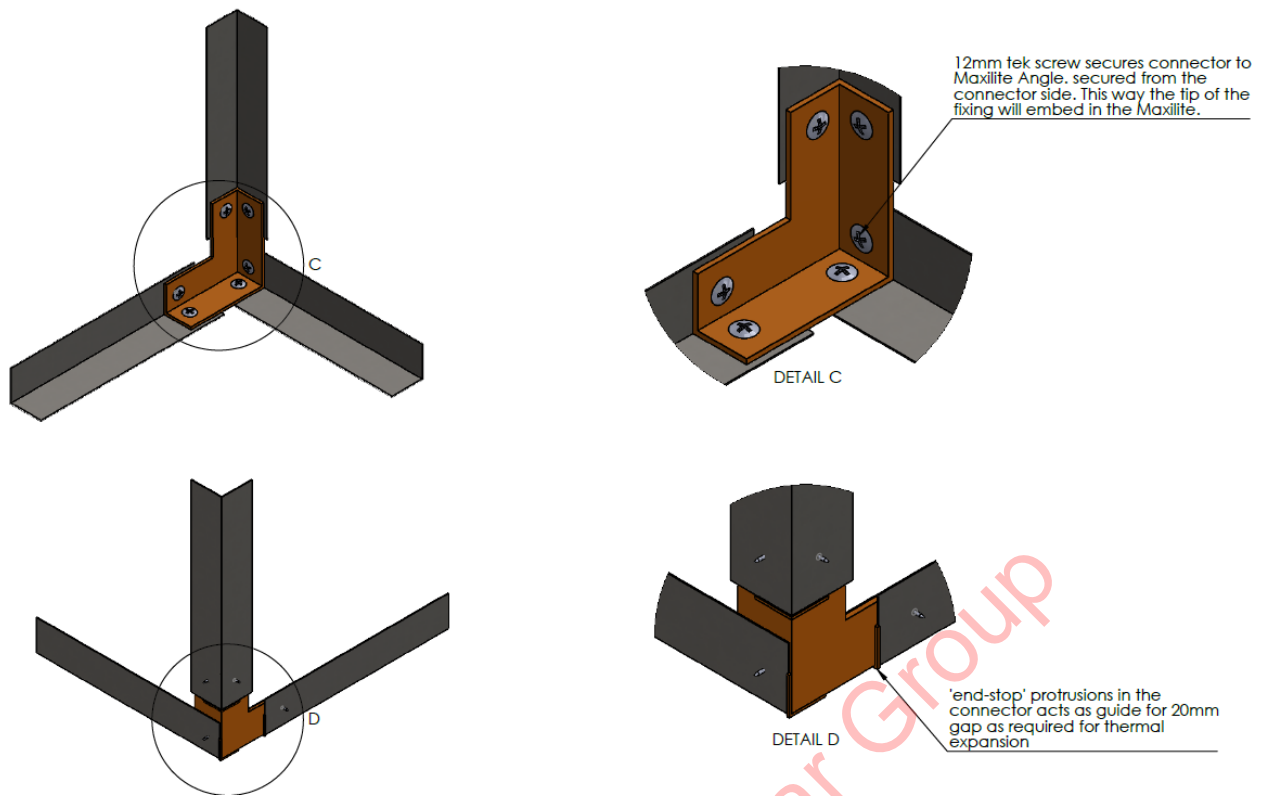
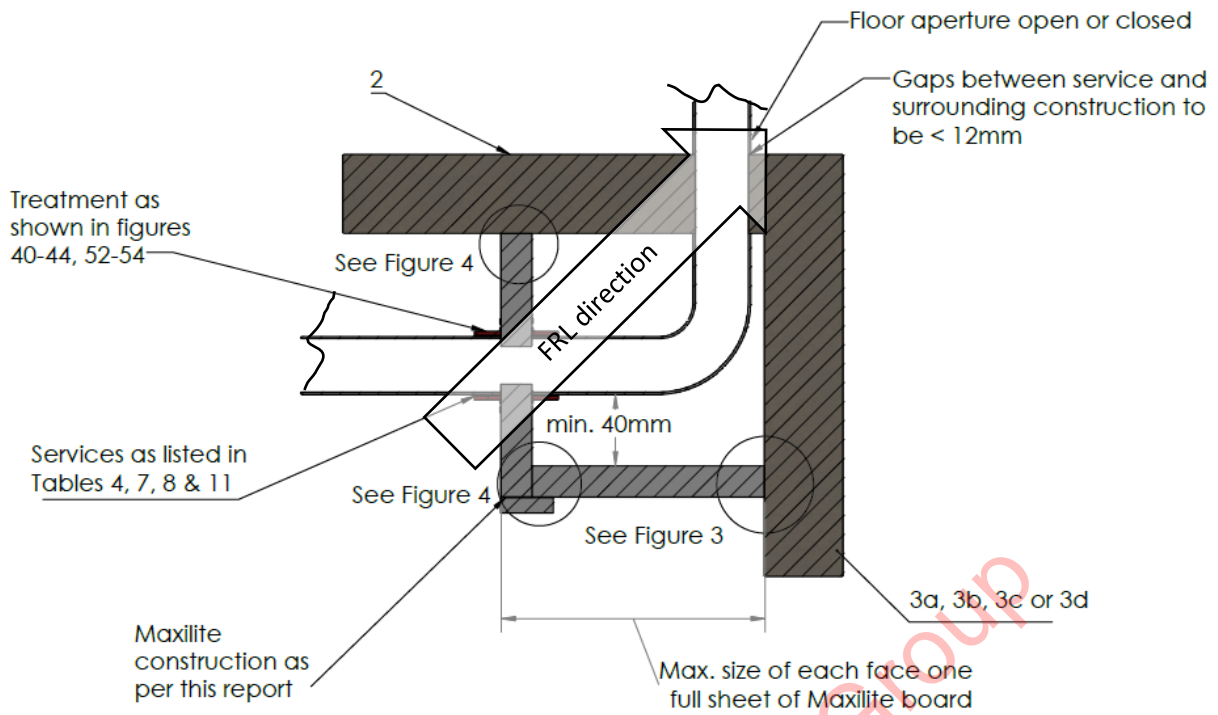


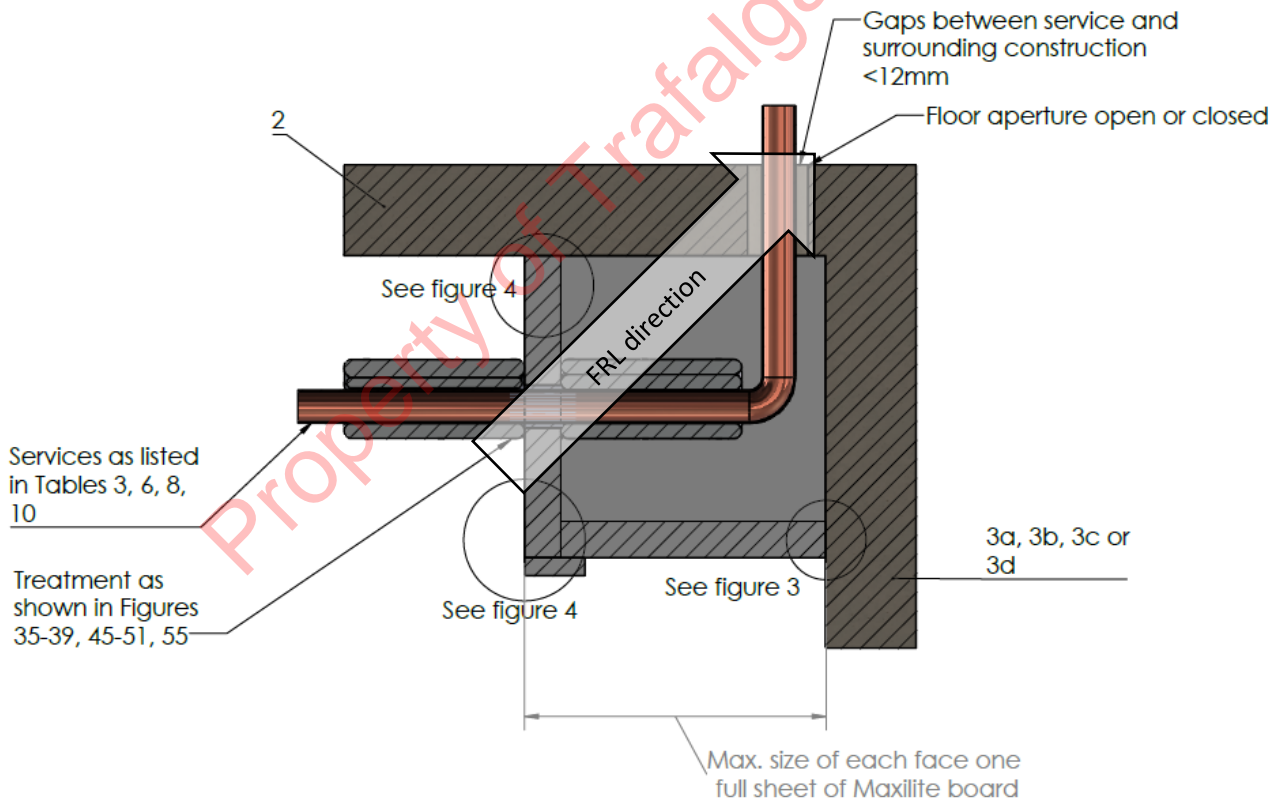
Figure 26d: Type 2 LDPE plastic skeleton connectors

### 3.5.1 BOXOUT CONSTRUCTION ATTACHED TO THE UNDERSIDE OF A SLAB WITH PENETRATIONS

- Floor applications with a Maxilite boxout on the underside of the floor.
  - Services are protected with sealant and wrap as per Figure 28
  - Services protected with fire collars or FyreBOX as per Figure 27
- Fire exposure is from the underside of the boxout
- Penetrations are allowed in a minimum of 60mm thick vertical or horizontal faces of Maxilite box construction (made from 2 x 30mm or 2 x 40mm or 1 x 60mm layers of grey or white Maxilite board)
- Faces of Maxilite box construction without penetrations may be 40mm thick or greater
- Aperture width between services and floor openings to be less than 12mm wide
- Services shall be spaced by a minimum of 40mm
- Example of a complex arrangement of services within a boxout construction as shown in Figure 33a
- The relevant configuration Figures are shown in Figures 9, 10, 24-26, 27-28, 33a



**Figure 27: Boxout construction under a slab penetrated by plastic pipe or FyreBOX – section view**



**Figure 28: Boxout construction under a slab penetrated by metal pipes, cable trays and metal rods wrapped with Twrap/Fyrewrap – section view**

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Figure 29

## 3.5.2 BOXOUT CONSTRUCTION ATTACHED TO A WALL WITH PENETRATIONS

- Wall applications with a Maxilite boxout on one side of the wall
  - Services protected with sealant, wrap, fire collars or FyreBOX as per Figure 30
- Fire exposure is from one side only
- Penetrations are allowed in a minimum of 60mm thick vertical or horizontal faces of Maxilite box construction (made from 2 x 30mm or 2 x 40mm or 1 x 60mm layers of grey or white Maxilite board)
- Faces of Maxilite box construction without penetrations may be 40mm thick or greater
- Aperture width between services and wall openings to be less than 12mm wide
- Services shall be spaced by a minimum of 40mm
- Example of a complex arrangement of services within a boxout construction as shown in Figure 33a
- The relevant configuration Figures are shown in Figures 9, 10, 24-26, 33a and 30

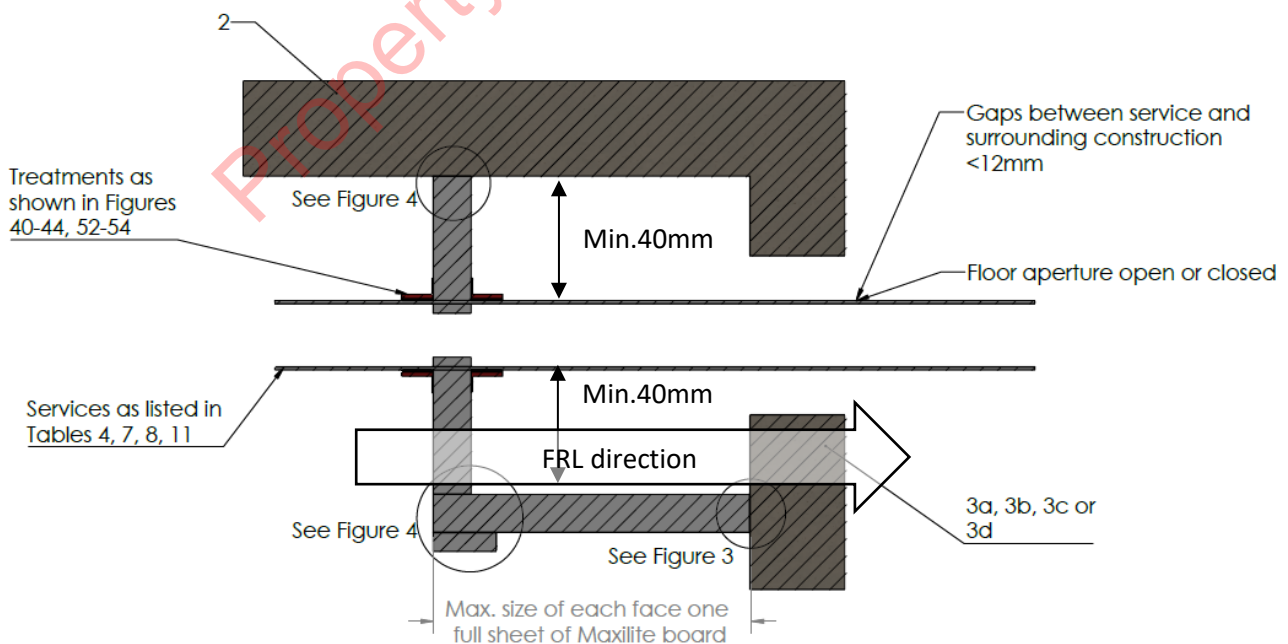
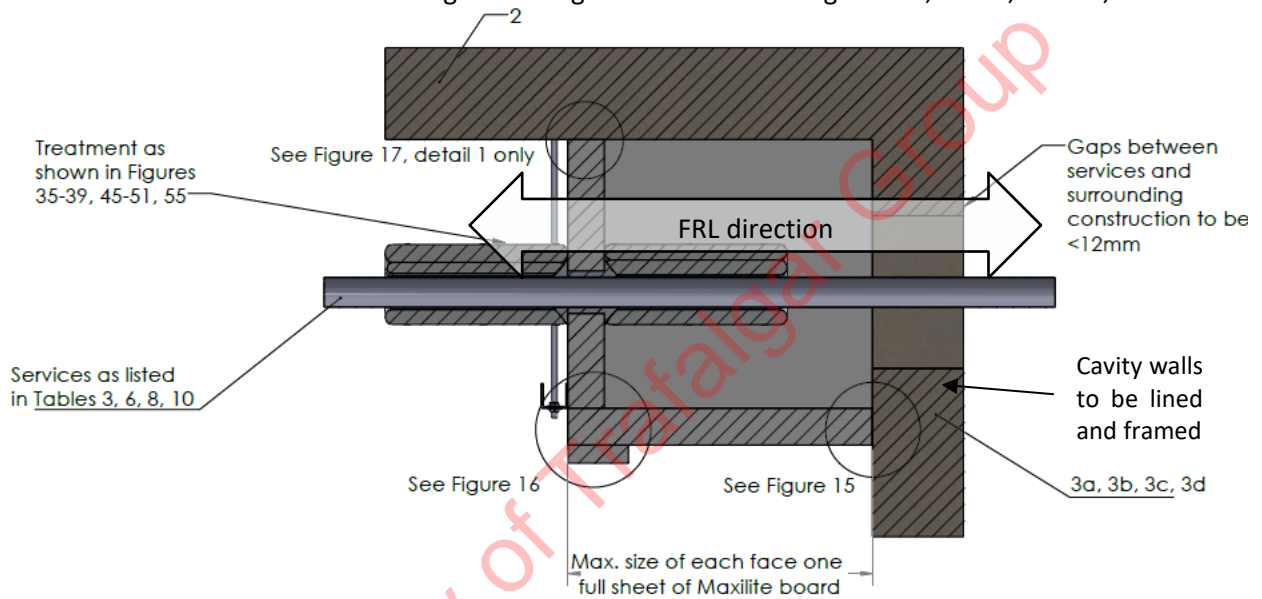


Figure 30: Box out construction protecting a wall penetrated by plastic pipe – section view

### 3.5.3 BOXOUT CONSTRUCTION ATTACHED TO A WALL WITH PENETRATIONS

- Wall applications with a Maxilite boxout on one side of the wall
  - Services protected with sealant and wrap only
- Fire exposure is from either side of the wall
- Penetrations are allowed in a minimum of 60mm thick vertical or horizontal faces of Maxilite box construction (made from 2 x 30mm or 2 x 40mm or 1 x 60mm layers of grey or white Maxilite board)
- Faces of Maxilite box construction without penetrations may be 40mm thick or greater
- Aperture width between services and wall openings to be
  - Either less than 12mm wide as per Figure 31
- Services shall be spaced by a minimum of 40mm
- Example of a complex arrangement of services within a boxout construction as shown in Figure 33a
- The relevant configuration Figures are shown in Figures 10, 24-26, and 31, 33a



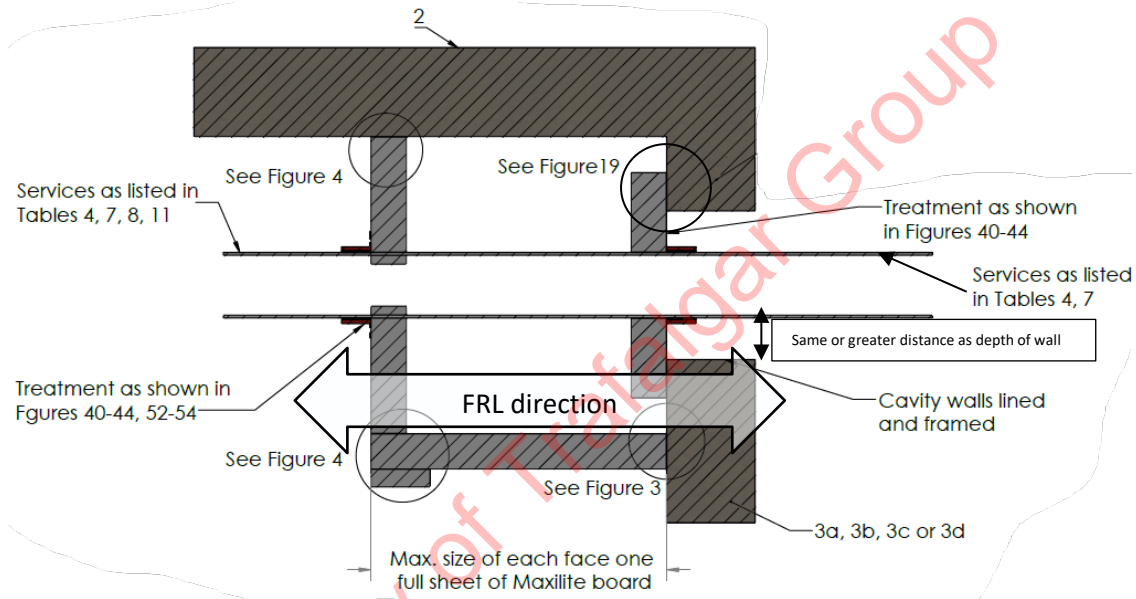
**Figure 31: Boxout construction protecting a wall penetrated by metal pipes, cable trays and metal rods wrapped with Twrap/Fyrewrap – section view**

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**Figure 32**

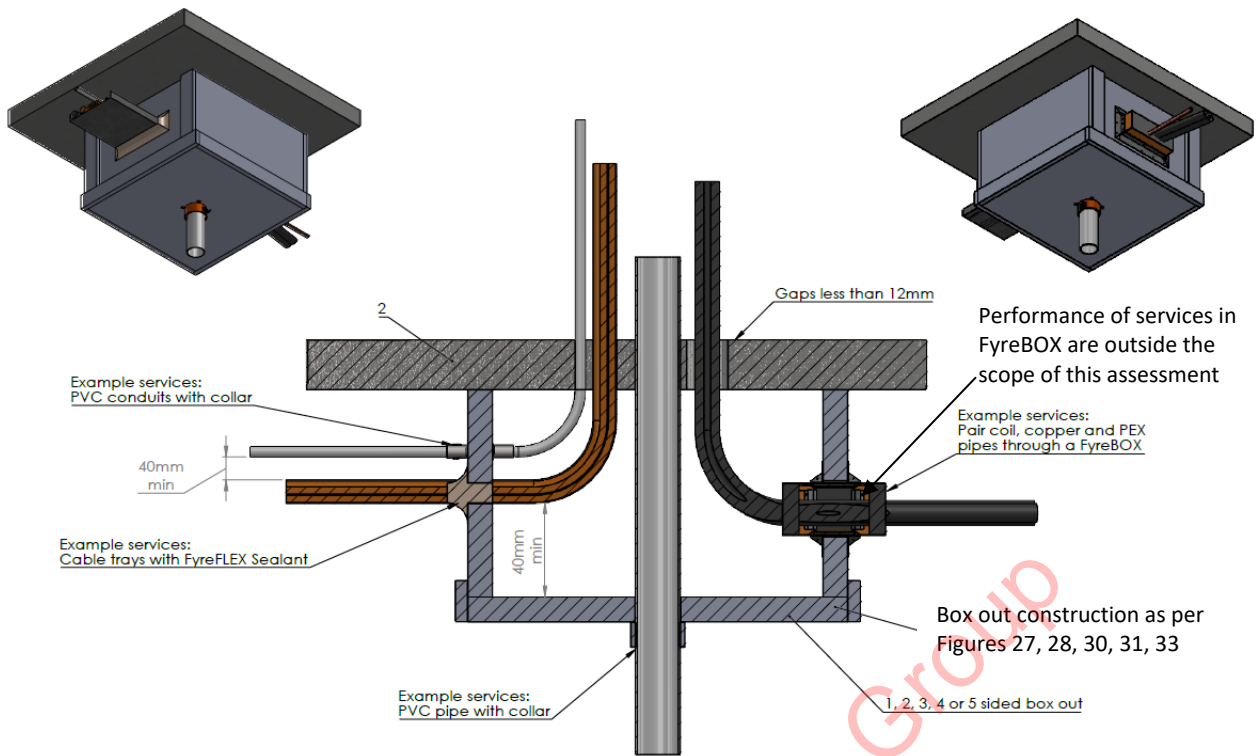
### 3.5.4 BOXOUT CONSTRUCTION ATTACHED TO A WALL WITH PENETRATIONS

- Wall applications with a Maxilite boxout on one side of the wall
  - Services protected with fire collars or FyreBOX
- Fire exposure is from either the box side or the wall side
- Penetrations are allowed in a minimum of 60mm thick vertical or horizontal faces of Maxilite box construction (made from 2 x 30mm or 2 x 40mm or 1 x 60mm layers of grey or white Maxilite board)
- Faces of Maxilite box construction without penetrations may be 40mm thick or greater
- Aperture width between services and wall openings to have the same or greater distance as the depth of the wall
- Services shall be spaced by a minimum of 40mm
- Example of a complex arrangement of services within a boxout construction as shown in Figure 33a
- The relevant configuration Figures are shown in Figures 9, 10, 24-26, and 33, 33a



**Figure 33: Boxout construction protecting a wall penetrated by plastic pipes – section view**

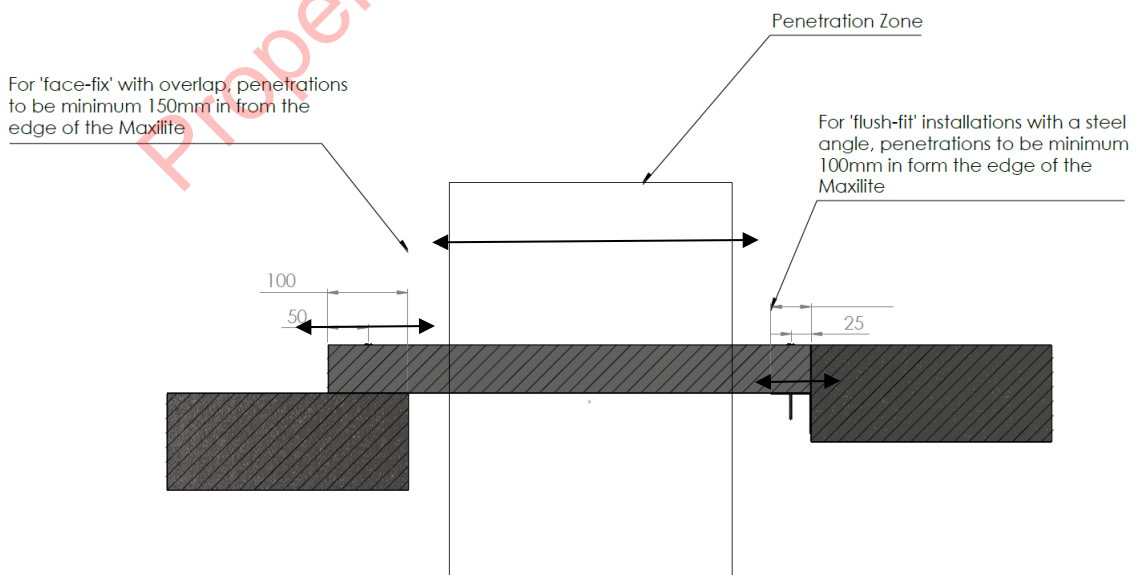




The FRL of this detail is the least FRL of the boxout and services that penetrate it.

**33a – Example of complex configuration of Maxilite boxout construction**

### 3.6 Limitations on the location of services and fixings in Maxilite sheets



**Figure 34: Penetration zone in relation to the edge of the board and fixing/angles – section view**

### 3.7 Penetrations in vertical Maxilite penetration seals

The proposed construction shall be for services penetrating the vertical faces of a Maxilite as described in Sections 3.2-3.5 of this report and subject to the following variations:

- The minimum thickness of the Maxilite board shall be a total of 60mm
- Inclusion of services as shown in Tables 2-7 and Figures 35-45, 56-58
- Sealant to the full depth of the Maxilite penetration seal
- The gap between penetration and the Maxilite penetration seal is shown in Tables 2-7
- Minimum 40mm separations between service penetrations
- Twrap around services to overlap itself by 50mm, held in place with aluminium foil tape and tied off with min 4.6mm wide stainless steel cable ties
- Inclusion of 100mm width Maxilite pad around pipe penetrations where specified in Tables 2-7
- Inclusion of Fyrewrap (38-mm thick Fyrewrap Elite 1.5 ceramic fibre blanket (aluminium faced) with a density of 96 kg/m<sup>3</sup>) as an option for Twrap (25-mm thick Twrap fire blanket (aluminium faced) with a density of 160 kg/m<sup>3</sup>)
- Inclusion of a LVH 44 intumescent grille in Maxilite as described in Sections 3.2 of this report as per Figures 45a and 45b
  - It is required that the LVH 44 shall be tested or assessed as an air transfer grille in accordance with AS 1530.4-2014 section 10 to achieve the required FRL when exposed to fire from either side when installed in a wall
  - The maximum LVH 44 size shall be 600mmx600mm
  - Gaps between LVH 44 and Maxilite board to be max. 10mm wide and filled with FyreFLEX sealant to the full depth
  - LVH 44 shall be fixed to one side of Maxilite via steel mounting angle flange of 50mm wide x 25mm high x 0.9mm size and 8g x 50mm screws at maximum 200mm centres. Fixings must also be installed 100mm from each corner of the damper cell as per Figure 45a.
  - LVH 44 grille shall be installed at least 300mm away from the edge of any Maxilite sheet and may be installed across a joint centrally, where the maximum cut-out in the Maxilite construction is 300mm as per Figure 45b and Table 7a. Joint to be cover with a cover strip as per Figure 21b

**Table 2: Specification of copper pipe for up to 180 minute integrity performance**

Pipe	Pipe OD (mm)	Pipe wall thickness (mm)	Twrap length each side	Maxilite pad 100mm width around the penetration	The gap between pipe and Maxilite board (mm)	Figure
Copper	DN19	19	450mm	No	≤ 20mm	37
	DN25	25.4				
	DN30	31.75				
	DN40	38.10				
	DN50	50.8				
	DN65	63.5	600mm	Yes		38
	DN80	76.2				
	DN100	101.6				
	DN125	127	1100mm with an additional 300mm layer	Yes		39
DN150	152.4	2.03				

**Table 3: Specification of steel pipe for up to 180 minute integrity performance**

Pipe		Pipe OD (mm)	Pipe wall thickness (mm)	Twrap length each side	Maxilite pad 100mm width around penetration	The gap between pipe and Maxilite board (mm)	Figure
Steel	NB25	33.7	2	450mm	No	≤ 20mm	37
	NB32	42.4	2				
	NB40	48.3	2.3				
	NB50	60.3	2.3				
	NB65	76.1	2.3	450mm	No		38a
	NB80	88.9	2.6				
	NB100	114.3	3.2	600mm	Yes		38a
	NB125	139.7	3				
NB150	165.1	3					

**Table 3a: Specification of steel pipe for up to 90 minute integrity performance**

Pipe		Pipe OD (mm)	Pipe wall thickness (mm)	Twrap length each side	Maxilite pad 100mm width around penetration	The gap between pipe and Maxilite board (mm)	Figure
Steel	NB25	33.7	2	300mm	No	≤ 20mm	37
	NB32	42.4	2				
	NB40	48.3	2.3				
	NB50	60.3	2.3				

**Table 4: Specification of uPVC pipe**

Minimum Maxilite board thickness (mm)	Fyrechoke collar on each side of Maxilite (mm)	PVC pipe DWV size	PVC pipe OD (mm)	PVC pipe wall thickness (mm)	The gap between pipe and Maxilite board (mm)	Figure
60	25	DN 25	26.8	1.8	≤ 5mm	40
	32	DN 32	32	2.3		
	40	DN 40	43.4	2		
	50	DN 50	55.8	2.3		
	65	DN 65	69	2.9		
	80	DN 80	83	3.1		
	100	DN 100	110	3.4		
90 (100mm width of 30mm Maxilite board around penetration for a localised increase in thickness)	100	DN 100	110	3.4		41

**Table 5: Specification of Pex and Pex-al-Pex pipes**

Pipe material	Pipe OD (mm)	Pipe wall thickness (mm)	The gap between the pipe and the edge of the Maxilite opening (mm)	Additional pad of 30mm thick Maxilite required	Twrap length each side	Figure
Pex Al Pex pipes	20	2.1	≤ 5mm	No	N/A	43
Pex pipes	20	2.1		No	N/A	42

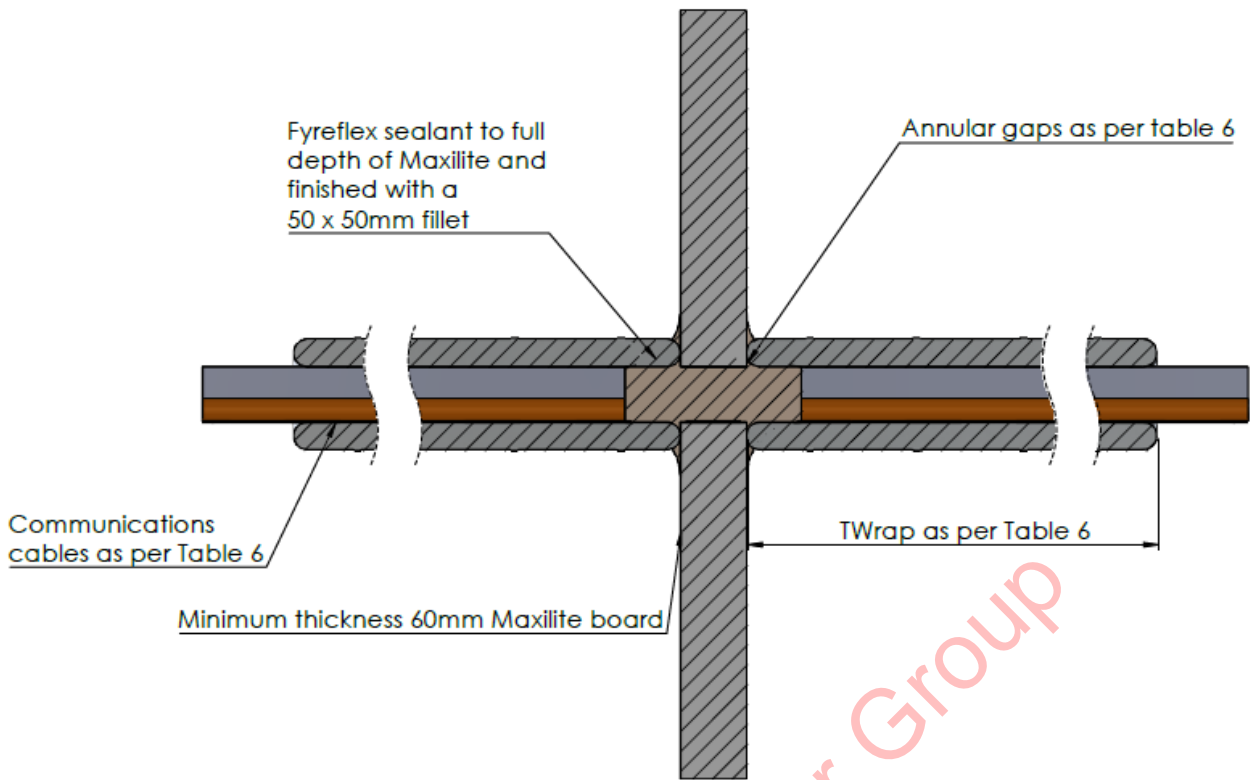
**Table 6: Specification of other services**

Services	Details of service	Twrap length each side	The gap between service and Maxilite board (mm)	Figure
Appendix D1 power cables with cable tray	All PVC and XLPE insulated and PVC sheathed power cables with copper conductors	300mm	5-20mm	35
CAT 6 cables	Up to 20 cables CAT 6305 Category 6 UTP cable 4/23 AWG PVC	300mm	≤ 5mm	36
TPS cables	Up to 4 cables 2.5mm <sup>2</sup> 2C+E electrical cables	300mm	≤ 5mm	
Firesense cables	Up to 20 cables Firesense-TPS-1.5-2CT-ELV-Fire-Light Duty	300mm	≤ 5mm	
Eltech VRF cables	Up to 8 cables 7mm diameter with 1.5mm diam copper conductors (part # ELT7501P)	300mm	≤ 5mm	36a
Steel threaded rod	Up to 10mm OD rod	200mm	≤ 5mm	45
Air transfer grille	Up to 600mm x 600mm LVH 44	No wrap, Mesh on each side	≤ 10mm	45a, 45b

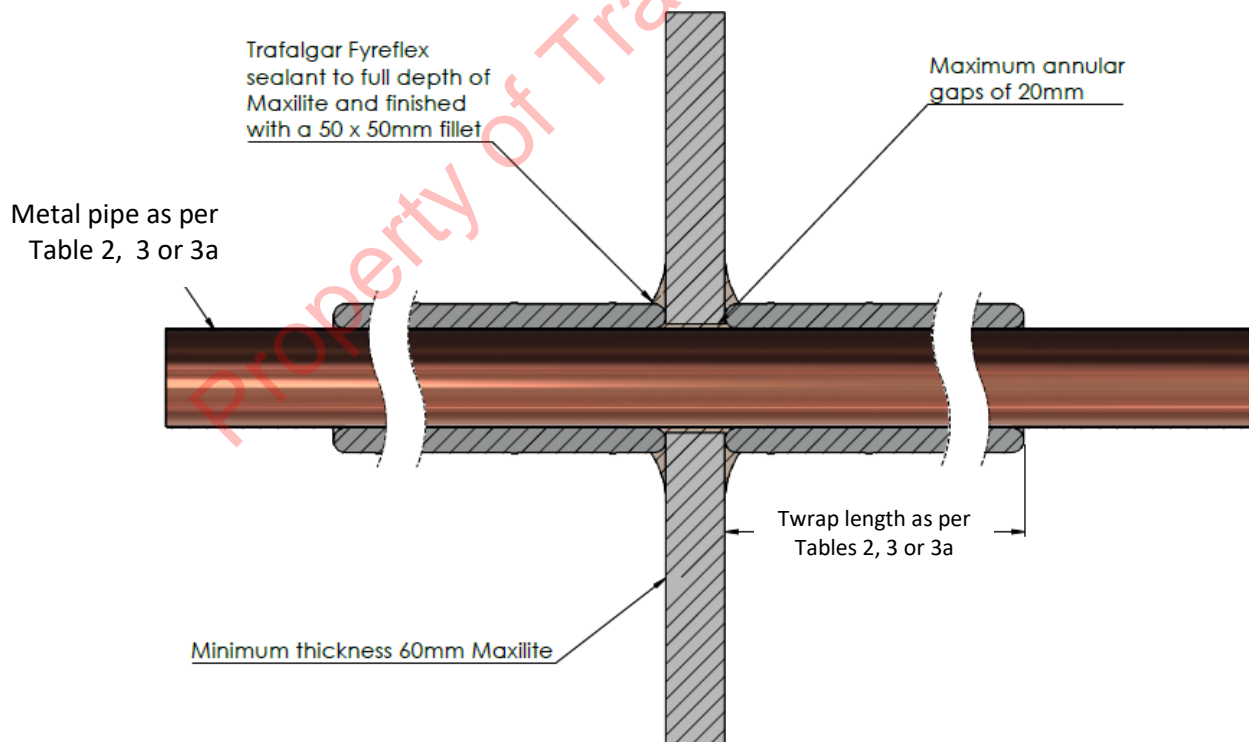
**Table 7: Specification of FyreBOX designs**

Services	Details of service	The gap between FyreBOX and Maxilite board (mm)	Distance between edge of opening and edge of sheet W1, W2	Figures
Trafalgar FyreBOX	Maxi 350 – 350W x 125H x 250D Maxi 550 – 550W x 125H x 250D Maxi 650 – 650W x 125H x 250D Maxi 750 – 750W x 125H x 250D Maxi 1100 – 1100W x 125H x 250D Mini 100 square – 102H x 102W x 250D Mini 100 round – 100mm diameter x 250D Mini 150 round – 150mm diameter x 250D	≤ 10mm	150mm	9 and 44

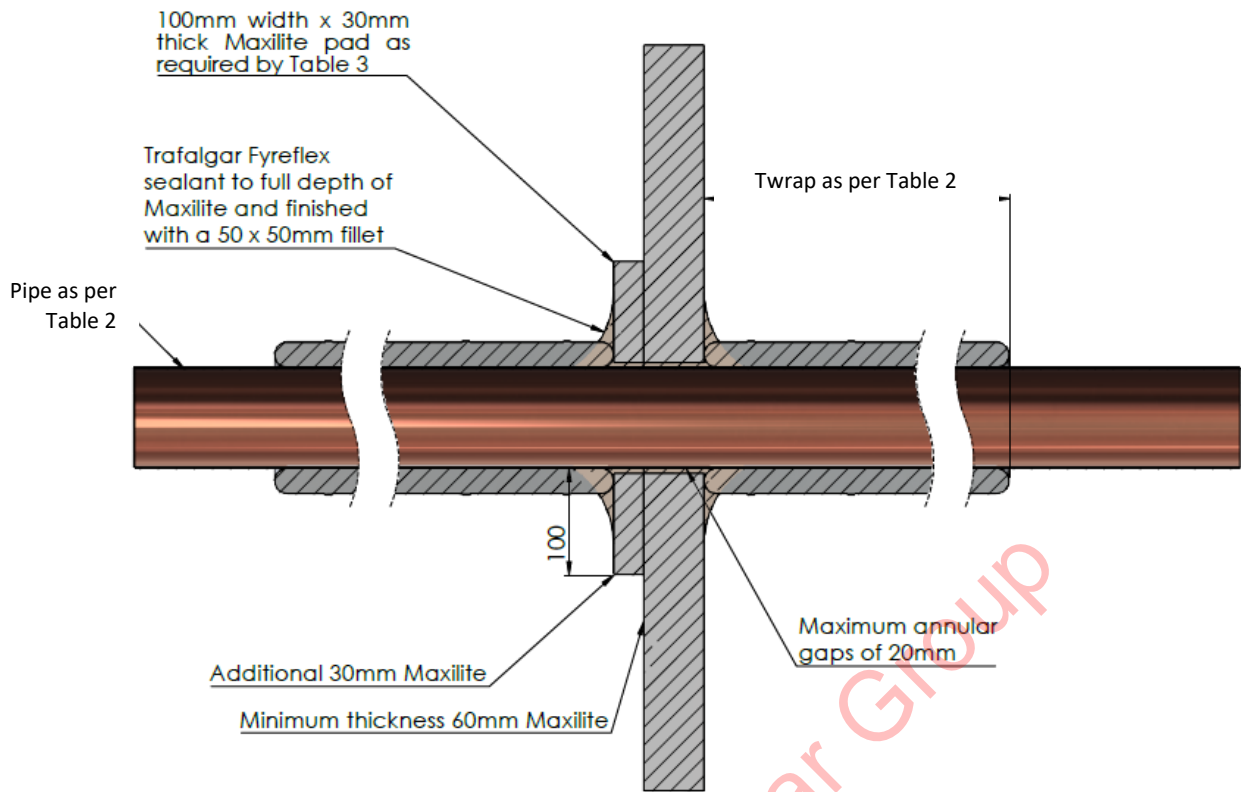




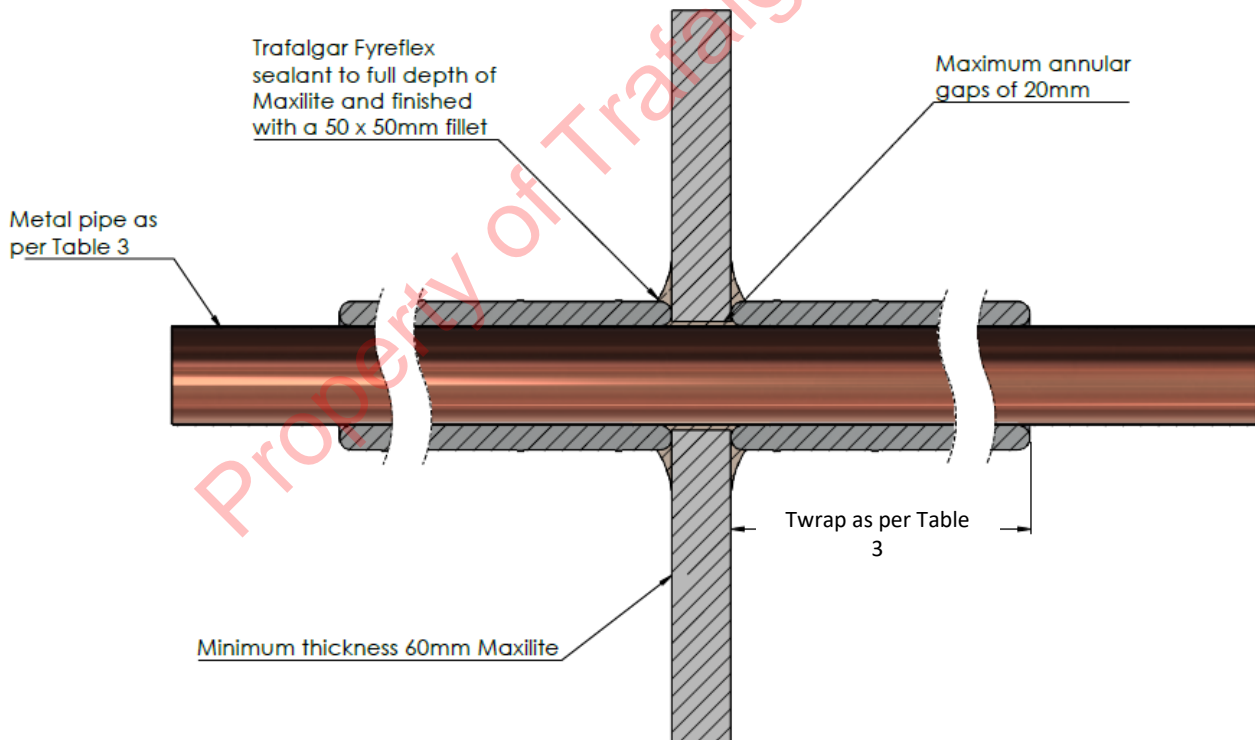
**Figure 36a: VRF cables through vertical Maxilite penetration seal**



**Figure 37: ≤50mm copper or steel pipe through vertical Maxilite penetration seal**



**Figure 38:  $\leq 100$ mm copper pipe through vertical Maxilite penetration seal**



**Figure 38a:  $\leq 150$ mm steel pipe through vertical Maxilite penetration seal**



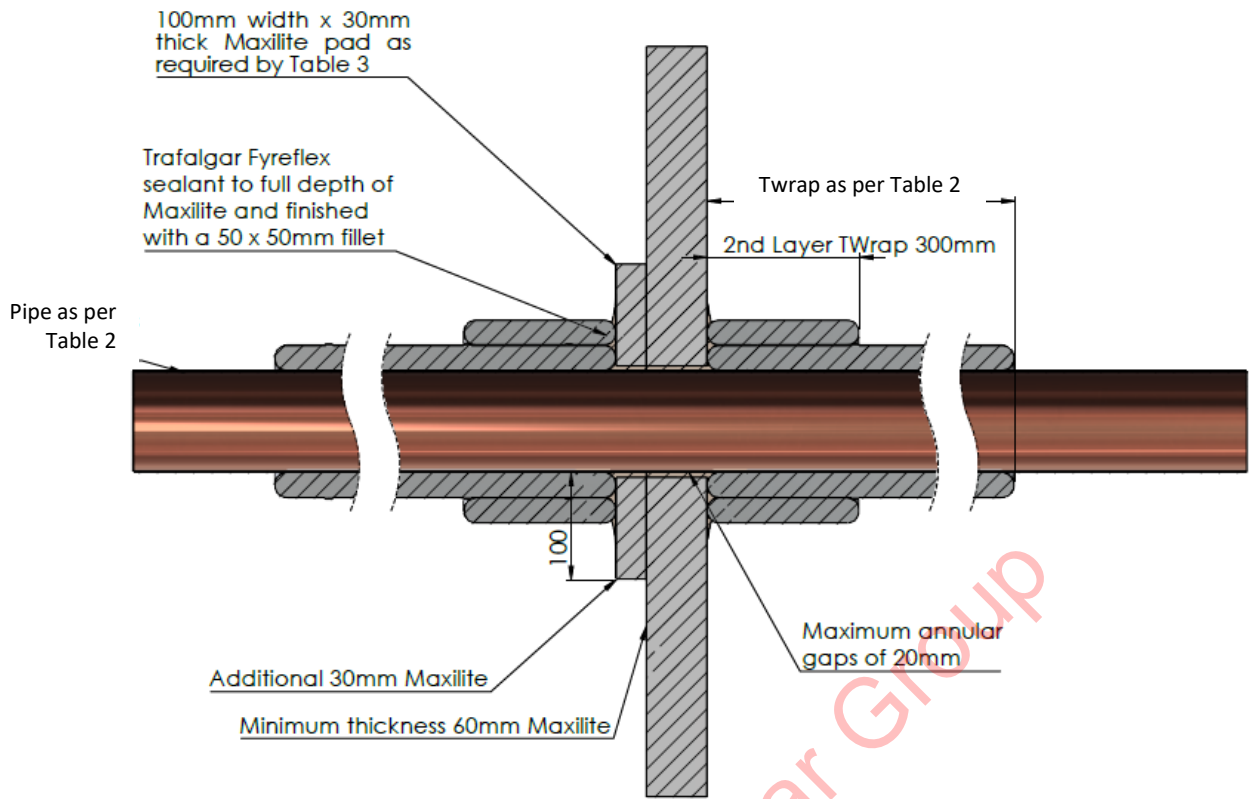


Figure 39:  $\leq 150\text{mm}$  copper pipe through vertical Maxilite penetration seal

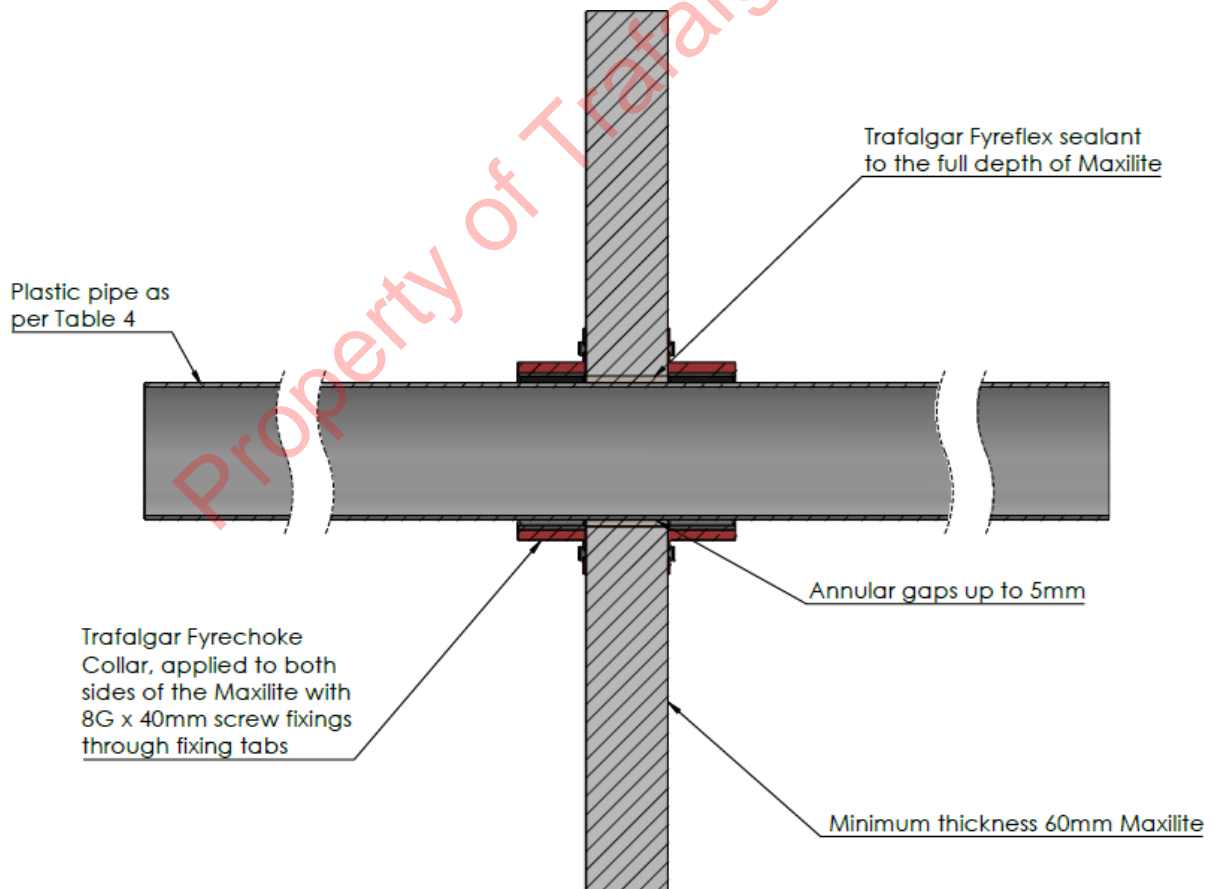
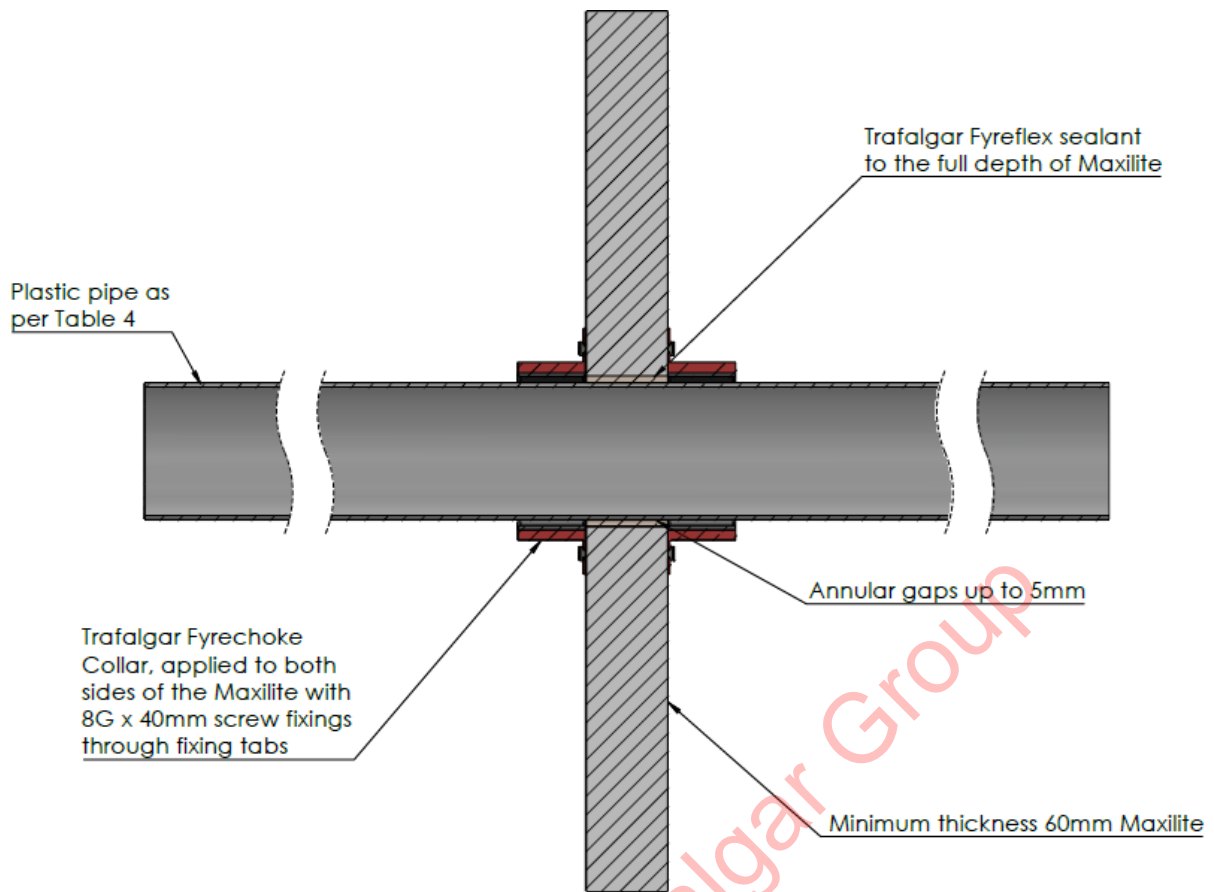
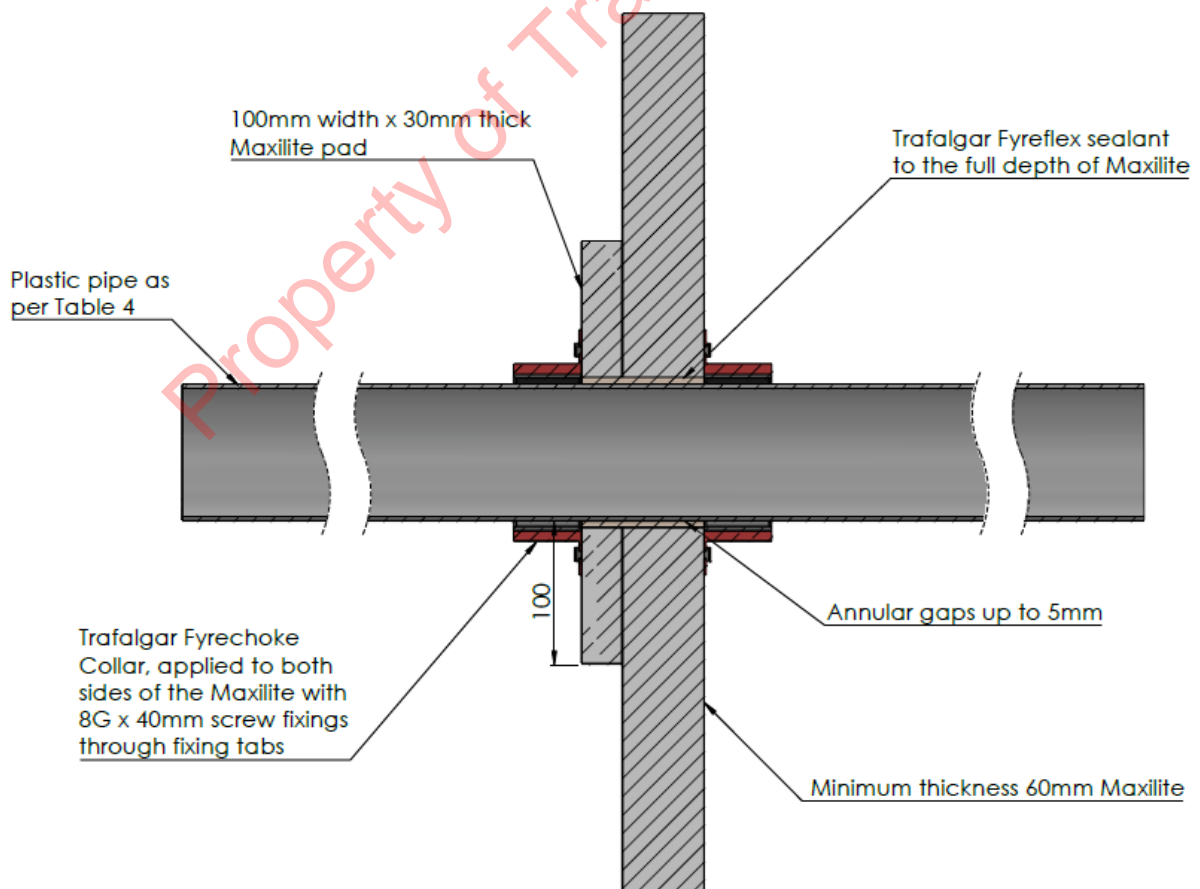


Figure 40:  $\leq 80\text{mm}$  PVC pipe through vertical Maxilite penetration seal



**Figure 40a: 100mm PVC pipe through vertical Maxilite penetration seal**



**Figure 41: ≤150mm PVC pipe through vertical Maxilite penetration seal**

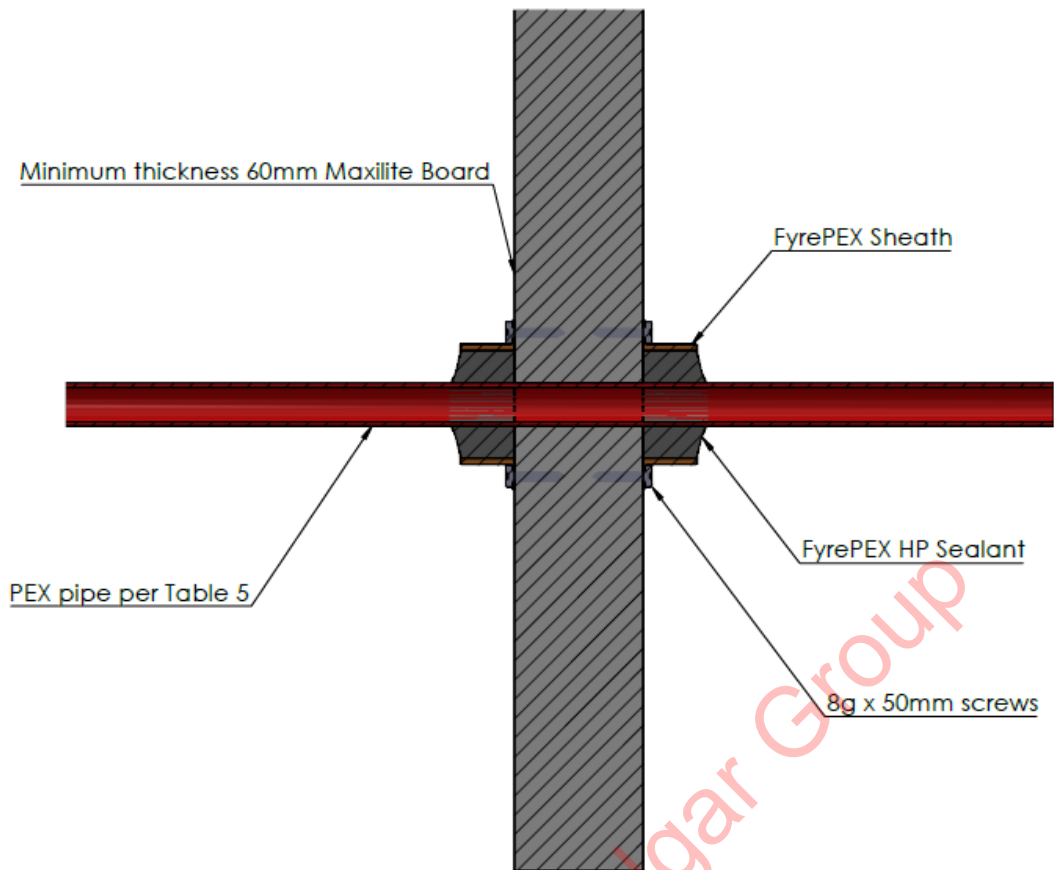


Figure 42: PEX pipe through vertical Maxilite penetration seal

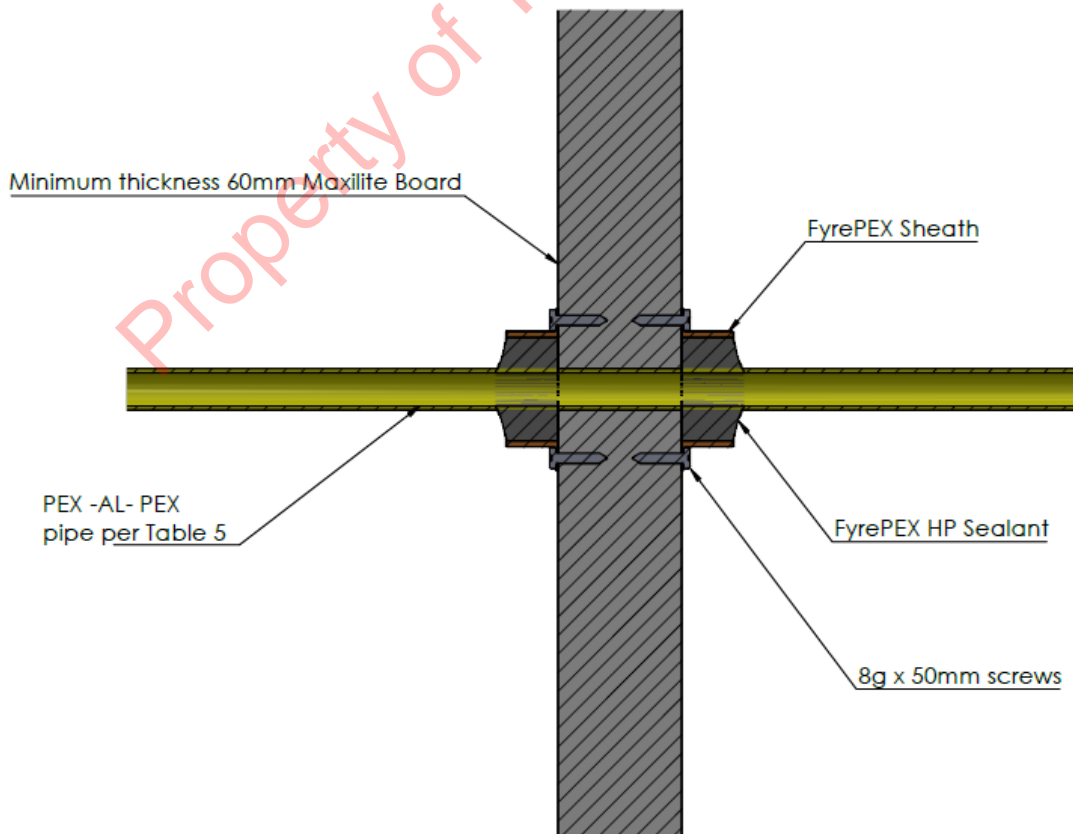


Figure 43: Pex-Al-Pex pipe through vertical Maxilite penetration seal

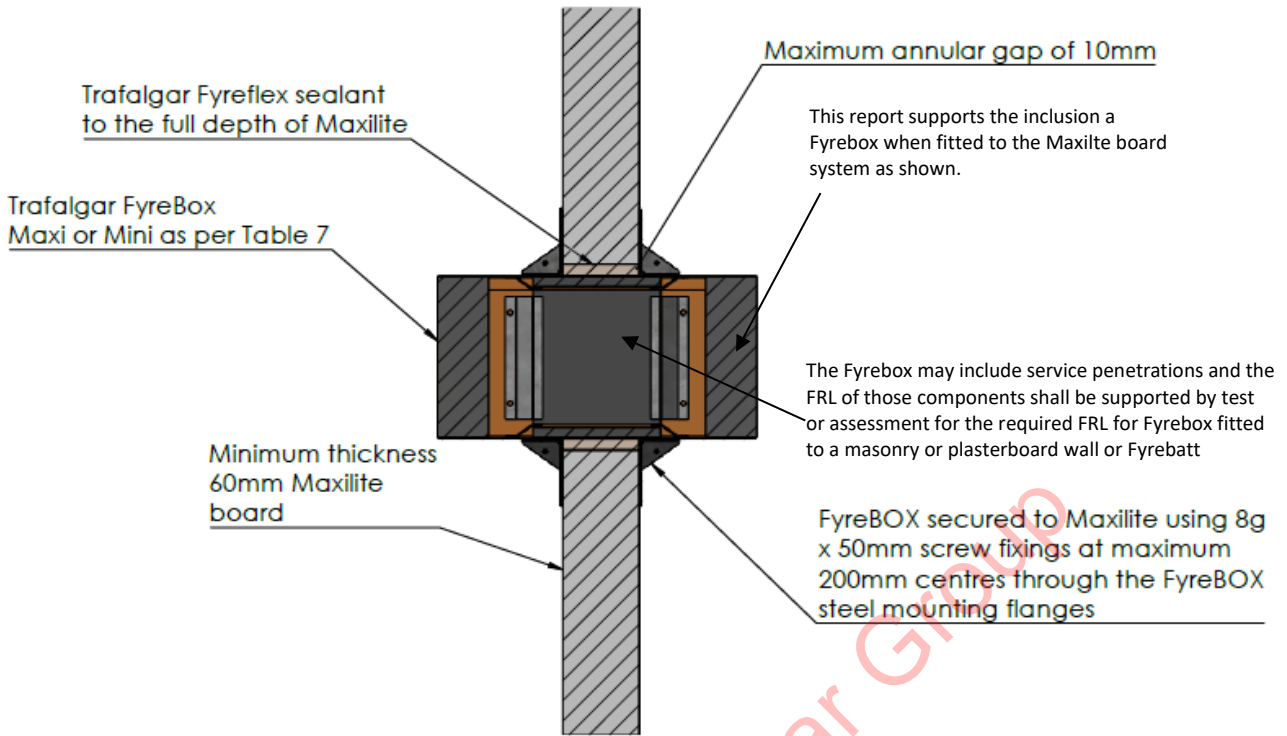


Figure 44: FyreBOX through vertical Maxilite penetration seal

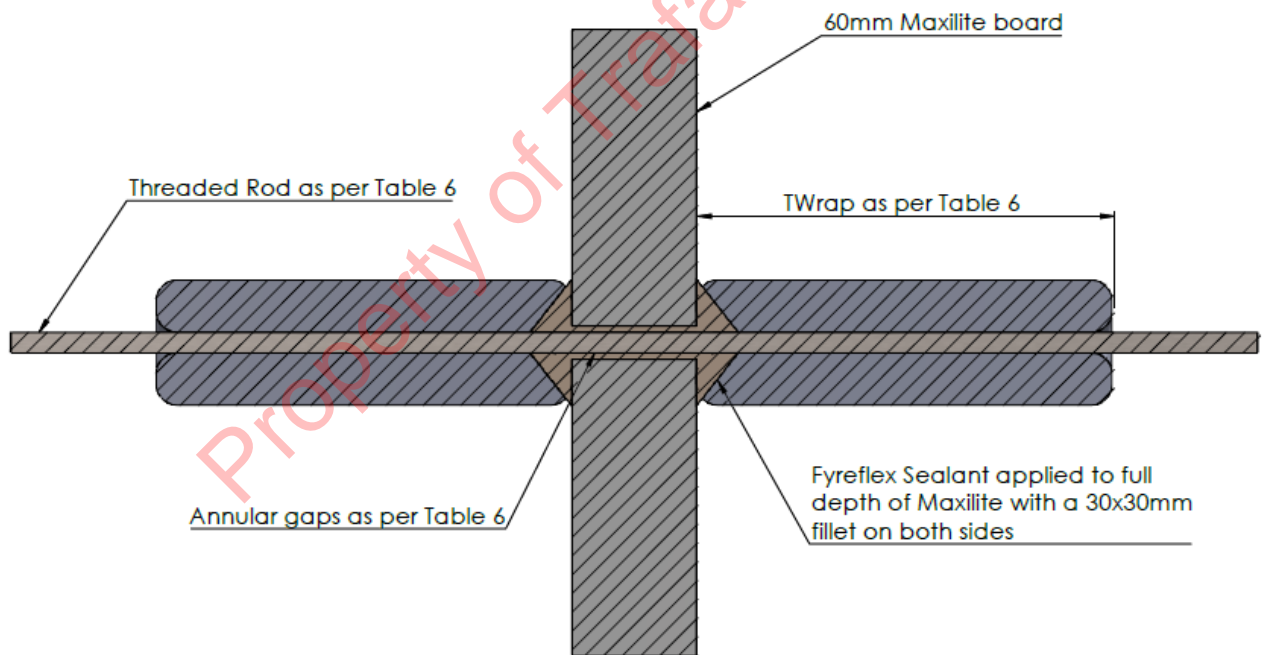
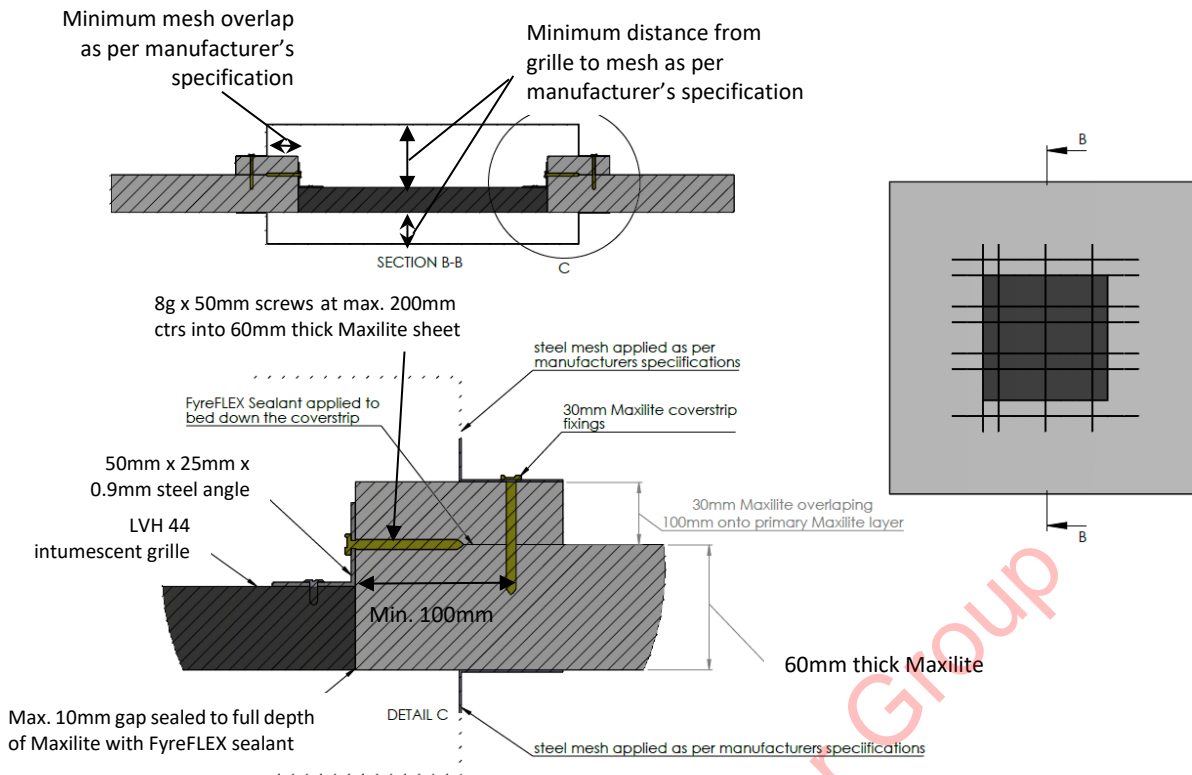
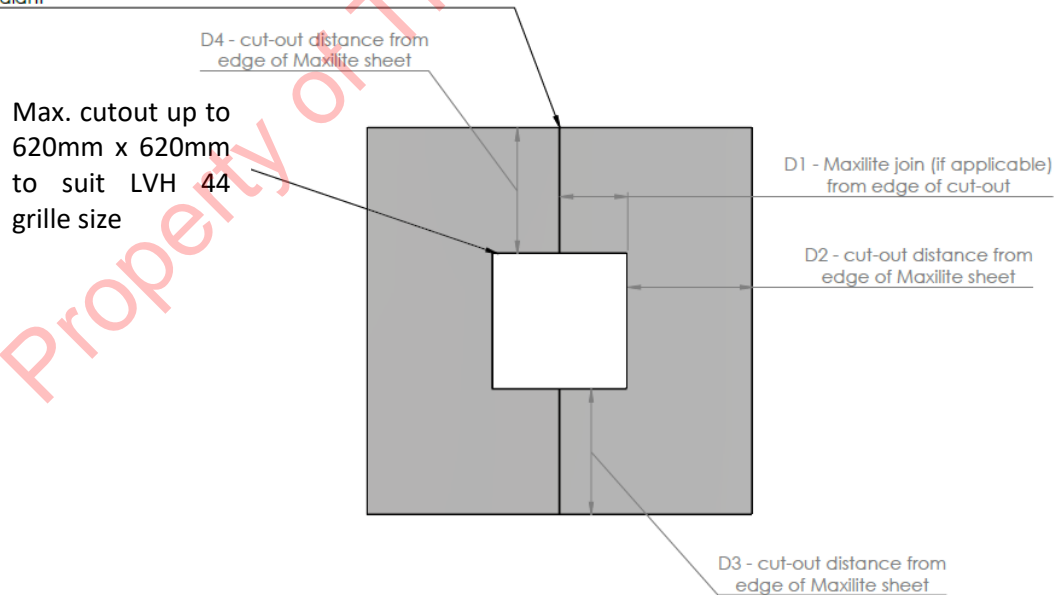


Figure 45: Threaded steel rod through vertical Maxilite penetration seal



**Figure 45a: Air transfer grille(intumescent damper) through vertical Maxilite penetration seal**

With or without a join in the Maxilite, if join is required to be covered by a coverstrip as per section 3.2/3.3 (as applicable), then coverstrip is to terminate at the access panel, with the but joint between the cover strip and the Maxilite in the access opanel channel sealed with FyreFLEX Sealant



**Figure 45b: LVH 44 in Maxilite— cut out limitations**

**Table 7a - Residual Sections**

<b>D1</b>	Maximum 0.31m
<b>D2, D3 and D4</b>	Minimum 0.3m

### 3.8 Penetrations in horizontal Maxilite penetration seal

The proposed construction shall be for services penetrating the horizontal faces of a Maxilite as described in sections 3.2-3.5 of this report and subject to the following variations:

- Minimum thickness of Maxilite board to be a total of 60mm
- Inclusion of services as shown in Tables 8-11 and Figures 46-58
- Sealant to the full depth of the Maxilite penetration seal
- The gap between penetration and the Maxilite penetration seal is as shown in Tables 8-11
- Minimum 40mm separations between service penetrations
- Twrap around services to overlap itself by 50mm, held in place with aluminium foil tape and tied off with min 4.6mm wide stainless steel cable ties
- Inclusion of a 100mm width Maxilite pad around pipe penetrations where specified in Tables 8-11
- Inclusion of Fyrewrap (38-mm thick Fyrewrap Elite 1.5 ceramic fibre blanket (aluminium faced) with a density of 96 kg/m<sup>3</sup>) as an option for Twrap (25-mm thick Twrap fire blanket (aluminium faced) with a density of 160 kg/m<sup>3</sup>)

**Table 8: Specification of copper and steel pipe for up to 120 minute applications**

Pipe	Pipe OD (mm)	Pipe wall thickness (mm)	Twrap length top side of Maxilite	Maxilite pad 100mm width around penetration	The gap between pipe and Maxilite board (mm)	Figure
Copper	DN19	19	600mm	No	≤ 20mm	49
	DN25	25.4				
	DN30	31.75				
	DN40	38.10				
	DN50	50.8	800mm with an additional 300mm layer	No		50
	DN65	63.5				
	DN80	76.2				
	DN100	101.6				
DN125	127	1500mm with an additional 300mm layer	Yes	51		
DN150	152.4					
Steel	NB25	33.7	450mm	No	≤ 20mm	49
	NB32	42.4				
	NB40	48.3				
	NB50	60.3				
	NB65	76.1	450mm	No		50a
	NB80	88.9				
	NB100	114.3				
	NB125	139.7				
NB150	165.1	3	900mm with an additional 300mm layer	Yes	51	

**Table 8a: Specification of copper and steel pipe for up to 90 minute applications**

Pipe		Pipe OD (mm)	Pipe wall thickness (mm)	Twrap length top side of Maxilite	Maxilite pad 100mm width around penetration	The gap between pipe and Maxilite board (mm)	Figure
Copper	DN19	19	1.22	450mm	No	≤ 20mm	49
	DN25	25.4	1.22				
	DN30	31.75	1.22				
	DN40	38.10	1.22				
	DN50	50.8	1.22	600mm	No		50a
	DN65	63.5	1.22				
	DN80	76.2	1.63				
	DN100	101.6	1.63				
DN125	127	1.63	1500mm with an additional 300mm layer	Yes	51		
DN150	152.4	2.03					
Steel	NB25	33.7	2	300mm	No	≤ 20mm	49
	NB32	42.4	2				
	NB40	48.3	2.3				
	NB50	60.3	2.3				
	NB65	76.1	2.3	450mm	No		50a
	NB80	88.9	2.6				
	NB100	114.3	3.2				
	NB125	139.7	3				
NB150	165.1	3	900mm with an additional 300mm layer	Yes	51		

**Table 9: Specification of uPVC pipe**

Minimum Maxilite board thickness (mm)	Fyrenchoke collar on each side of Maxilite (mm)	PVC pipe DWV size	PVC pipe OD (mm)	PVC pipe wall thickness (mm)	The gap between pipe and Maxilite board (mm)	Figure
60	25	DN 25	25	1.9	≤ 5mm	52
	32	DN 32	36.2	2		
	40	DN 40	43	2.2		
	50	DN 50	56	2.8		
	65	DN 65	69	2.8		
	80	DN 80	83	3.3		
90 (100mm width of 30mm Maxilite board around penetration for a localised increase in thickness)	100	DN 100	110	3.4	≤ 5mm	53



**Table 9a: Specification of Pex and Pex-al-Pex pipes**

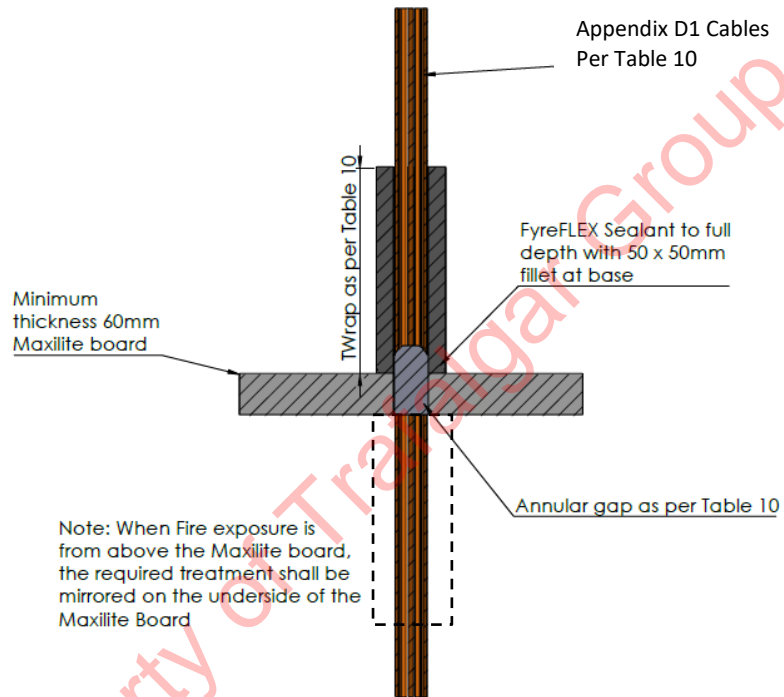
Pipe material	Pipe OD (mm)	Pipe wall thickness (mm)	The gap between the pipe and the edge of the Maxilite opening (mm)	Additional pad of 30mm Maxilite required	Twrap length on unexposed side	Figure
Pex Al Pex	25	2.5	20 ± 3mm	Yes	450mm	55a
Pex	25	2.5		Yes	450mm	

**Table 10: Specification of other services**

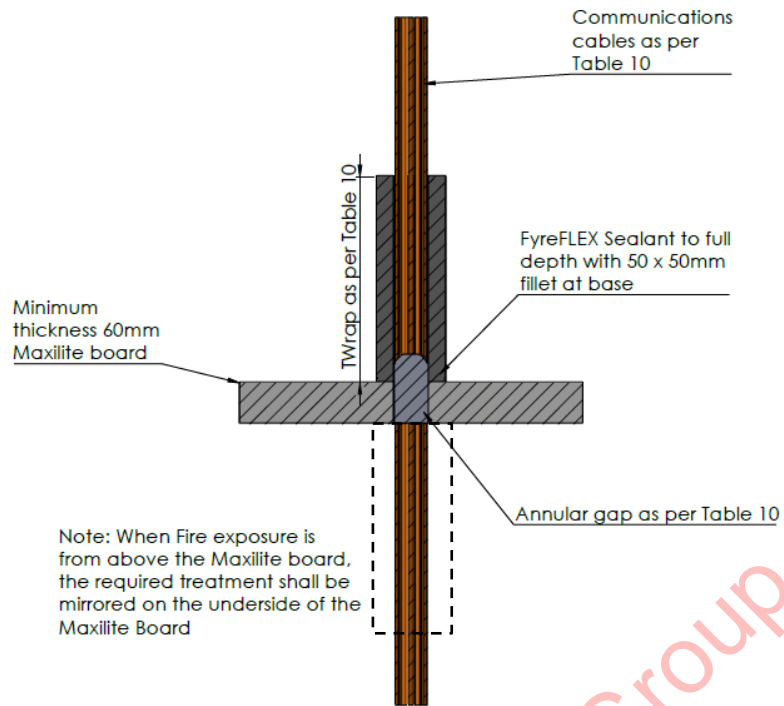
Services	Details	Twrap length top side of Maxilite	Maxilite pad 100mm width around penetration	The gap between service and Maxilite board (mm)	Figure
Appendix D1 power cables with cable tray	All PVC and XLPE insulated and PVC sheathed power cables with copper conductors	450mm	No	≤ 30mm	46
Telecommunication cables	Up to 24 bundles of 100 strand telecommunication cables, Maximum 15mm in diameter with PVC sheathing and insulation	600mm	No	≤ 5mm	47
Other cables are supported by cable trays	3 x 16mm OD 3C+E power cables 6 x 100 strand telecom, each approximately 15mm diameter. 1x 46mm OD single-core power 1x 29mm OD 3C+E power All cables were PVC sheathed and insulated	450mm	No	≤ 5mm	48
Steel threaded rod	Up to 10mm OD	200mm	No	≤ 5mm	55
CAT 6 cables	Up to 20 cables CAT 6305 Category 6 UTP cable 4/23 AWG PVC	300mm	No	≤ 5mm	47
Firesense cables	Up to 20 cables Firesense-TPS-1.5-2CT-ELV-Fire-Light Duty	300mm	No	≤ 5mm	
Eltech VRF cables	Up to 8 cables 7mm diameter with 1.5mm diam copper conductors (part # ELT7501P)	300mm	No	≤ 5mm	47a

**Table 11: Specification of FyreBOX designs**

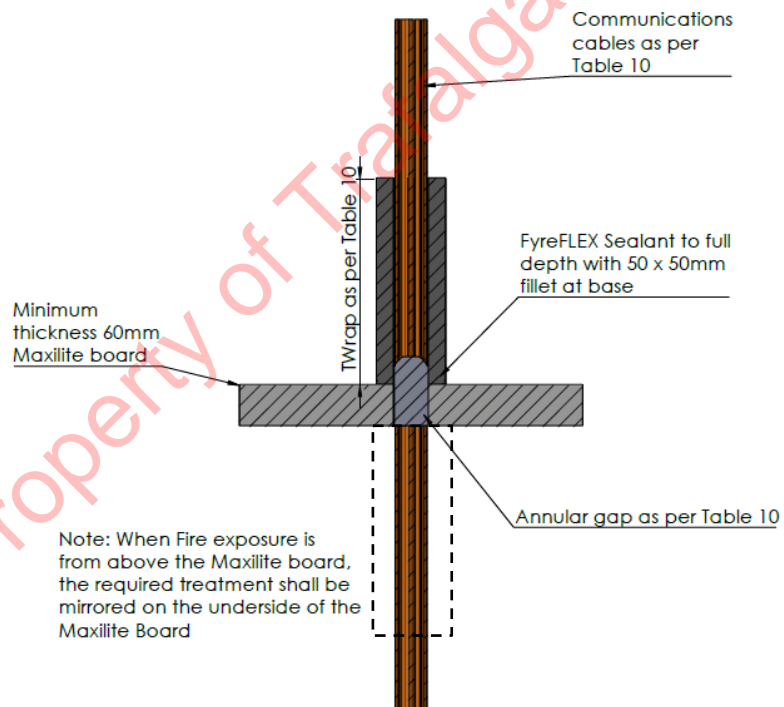
Services	Details of service	The gap between FyreBOX and Maxilite board (mm)	Distance between edge of opening and edge of sheet W1, W2	Figures
Trafalgar FyreBOX	Maxi 350 – 350W x 125H x 250D Maxi 550 – 550W x 125H x 250D Maxi 650 – 650W x 125H x 250D Maxi 750 – 750W x 125H x 250D Maxi 1100 – 1100W x 125H x 250D Mini 100 square – 102H x 102W x 250D Mini 100 round – 100mm diameter x 250D Mini 150 round – 150mm diameter x 250D	≤ 10mm	150mm	9a and 54



**Figure 46: Appendix D1 Power cables through horizontal Maxilite penetration seal (cable tray not shown)**



**Figure 47: Firesense and CAT 6 cables through horizontal Maxilite penetration seal**



**Figure 47a: VRF cables through horizontal Maxilite penetration seal**

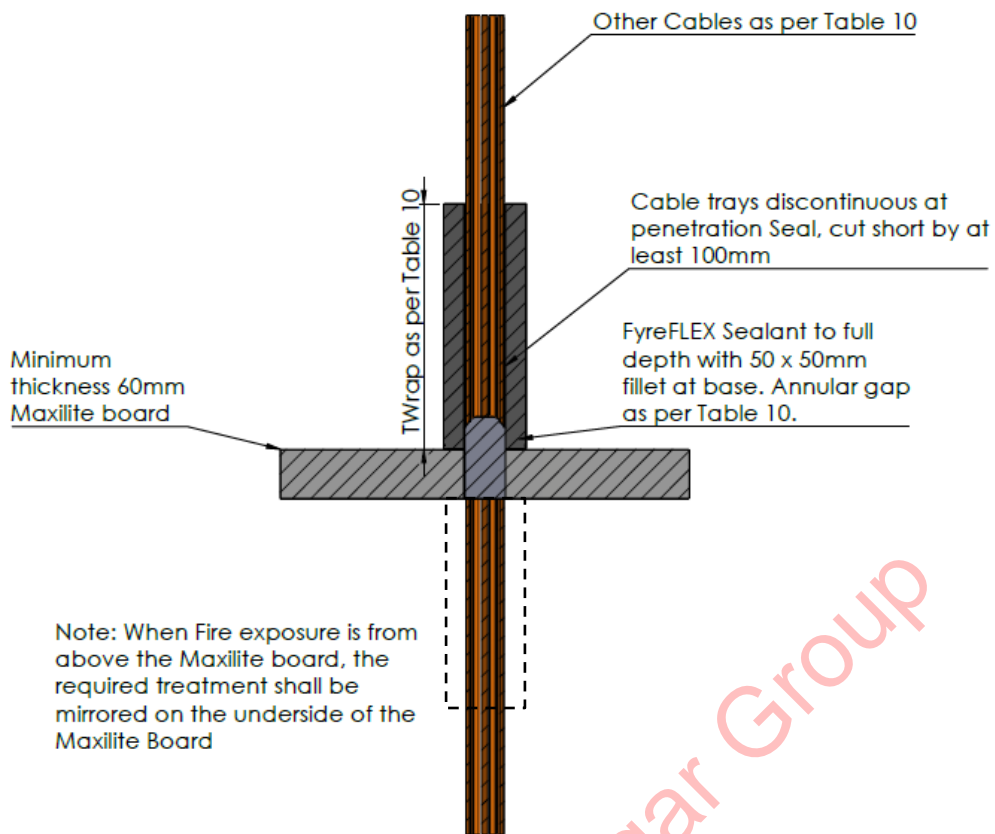


Figure 48: Other cables supported by cable trays through horizontal Maxilite penetration seal

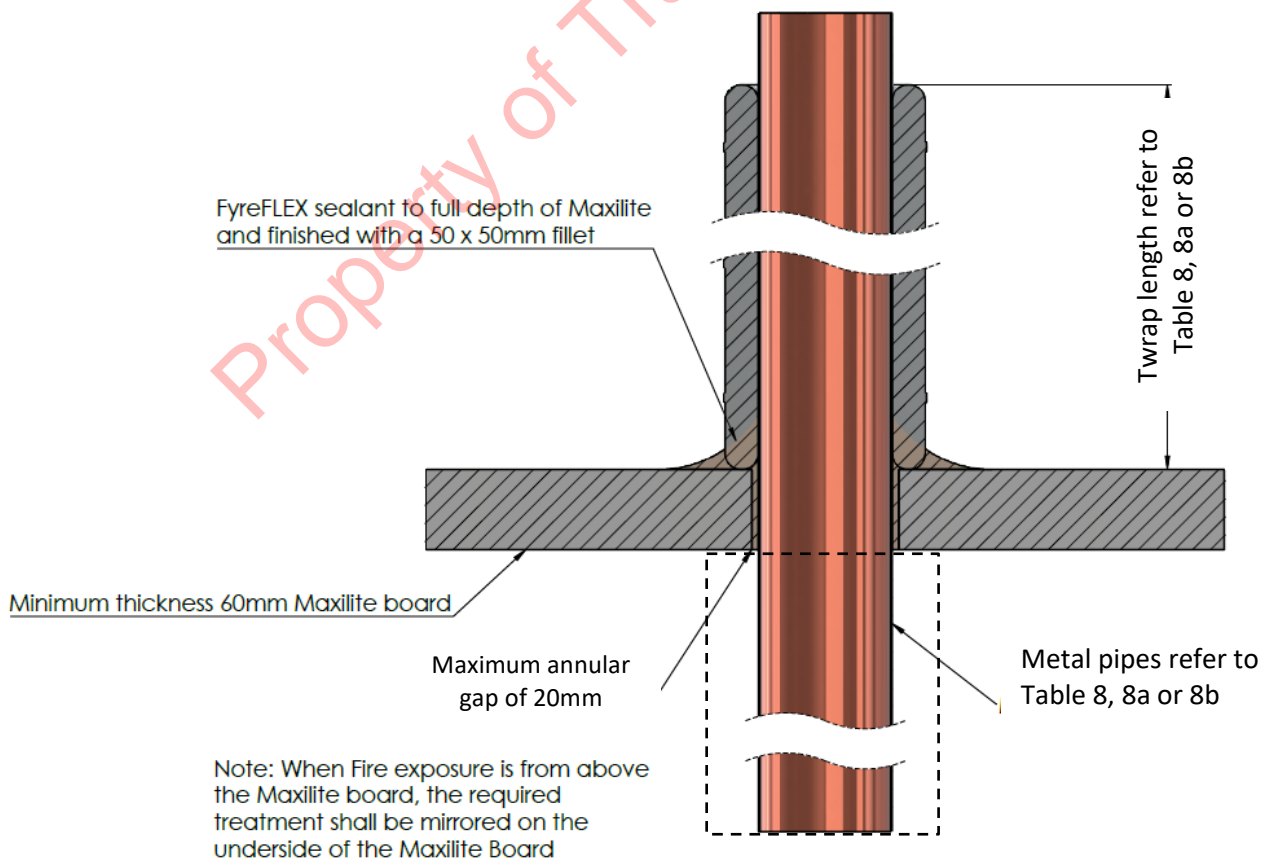
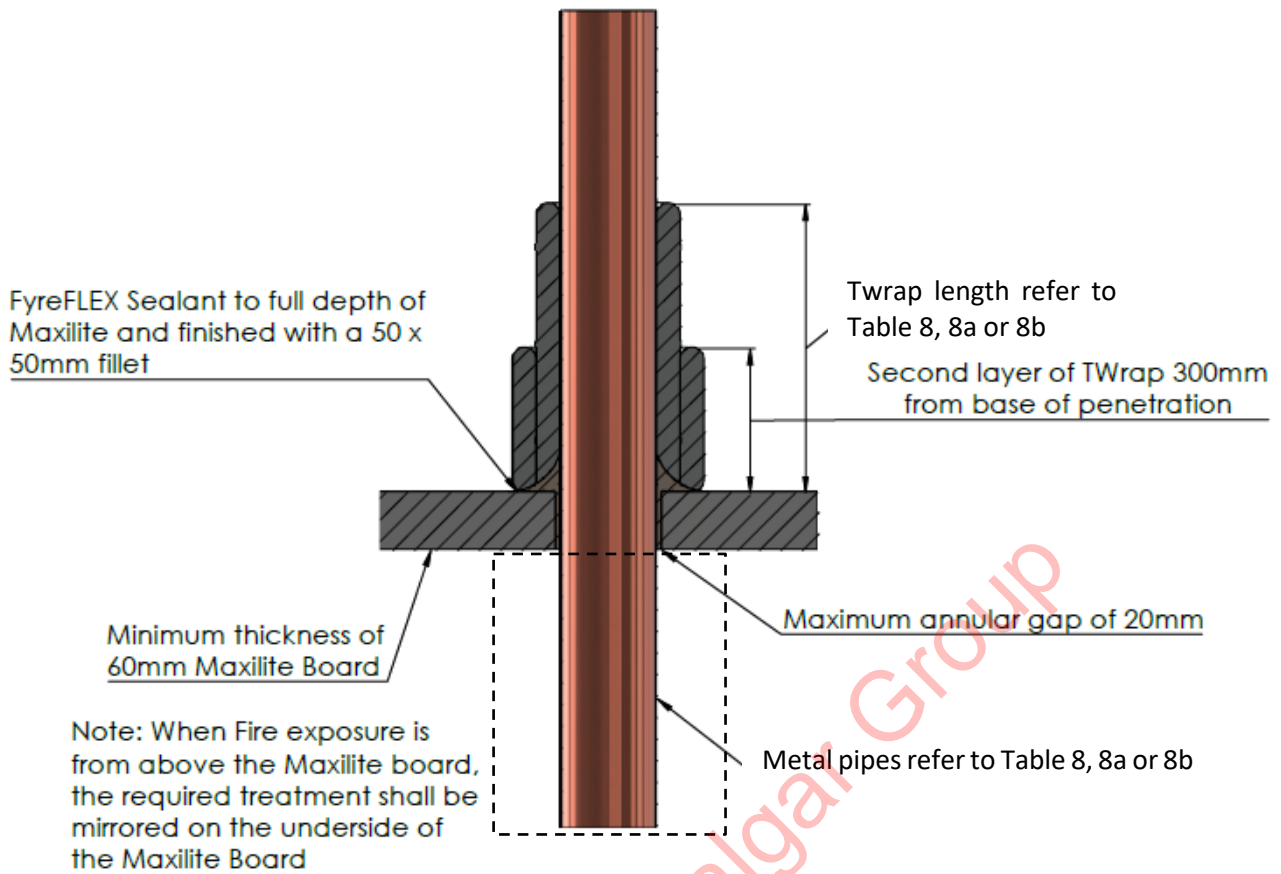
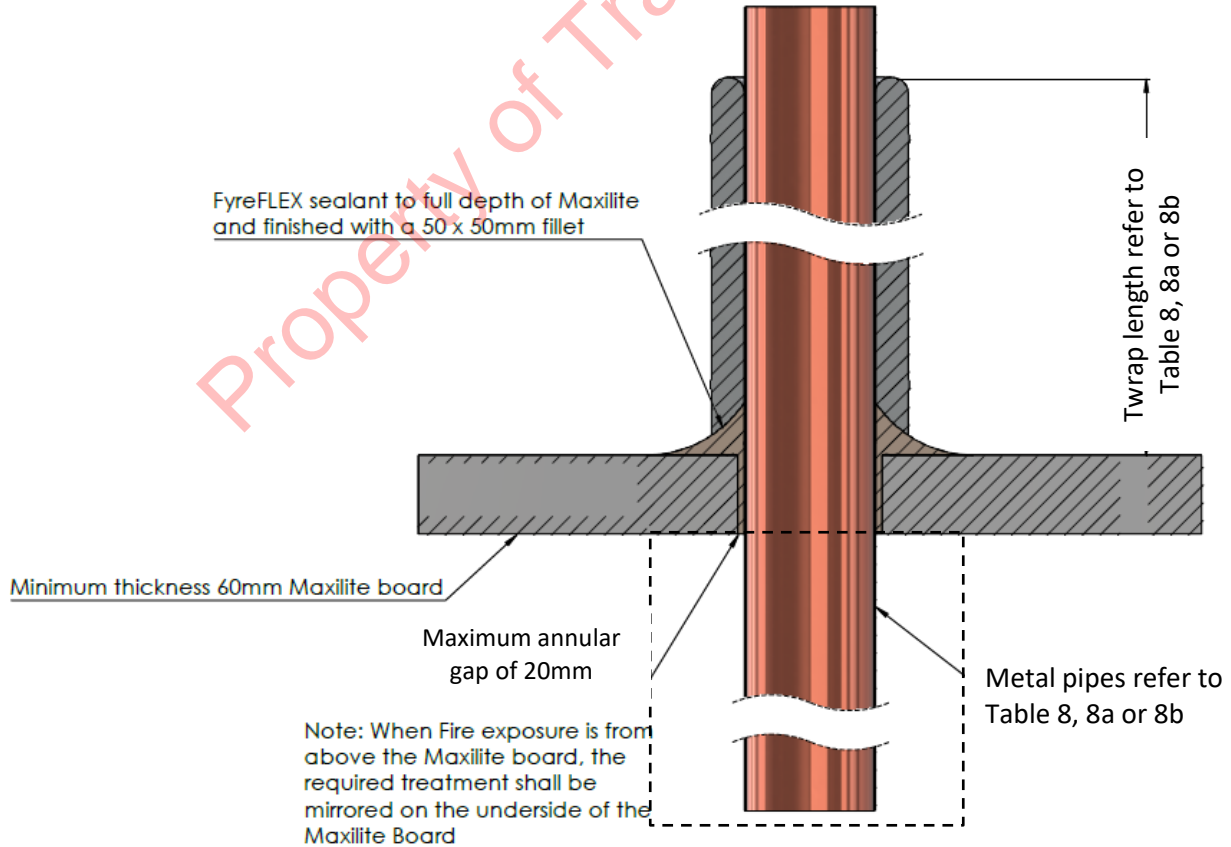


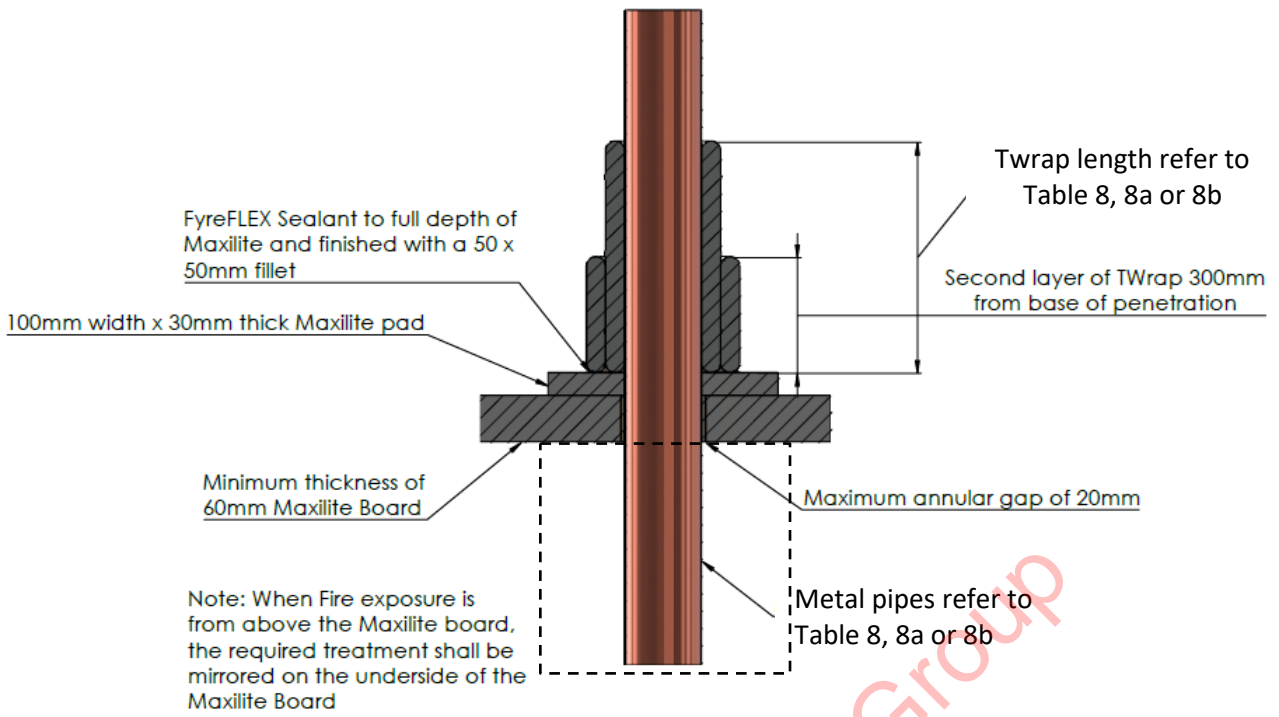
Figure 49: ≤50mm copper or steel pipe through horizontal Maxilite penetration seal



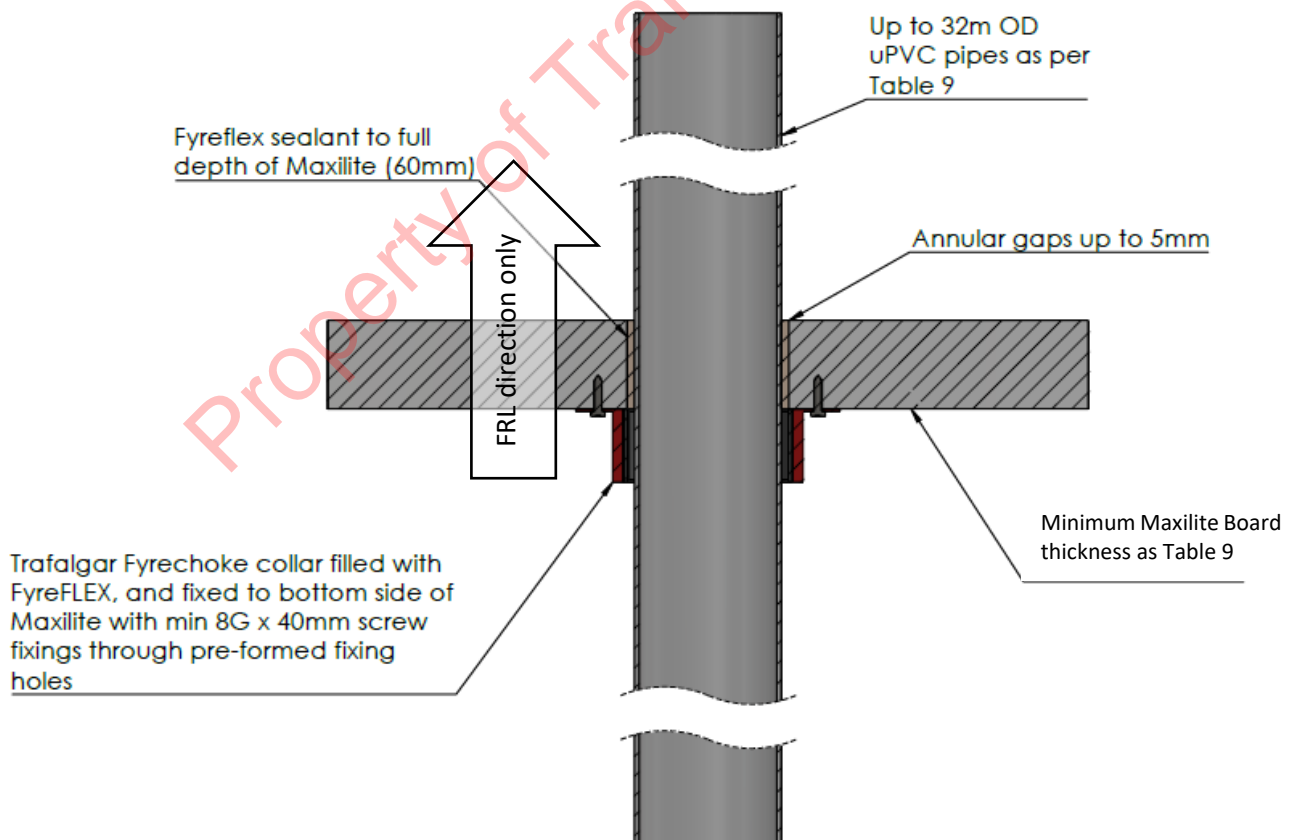
**Figure 50: ≤100mm copper pipe through horizontal Maxilite penetration seal**



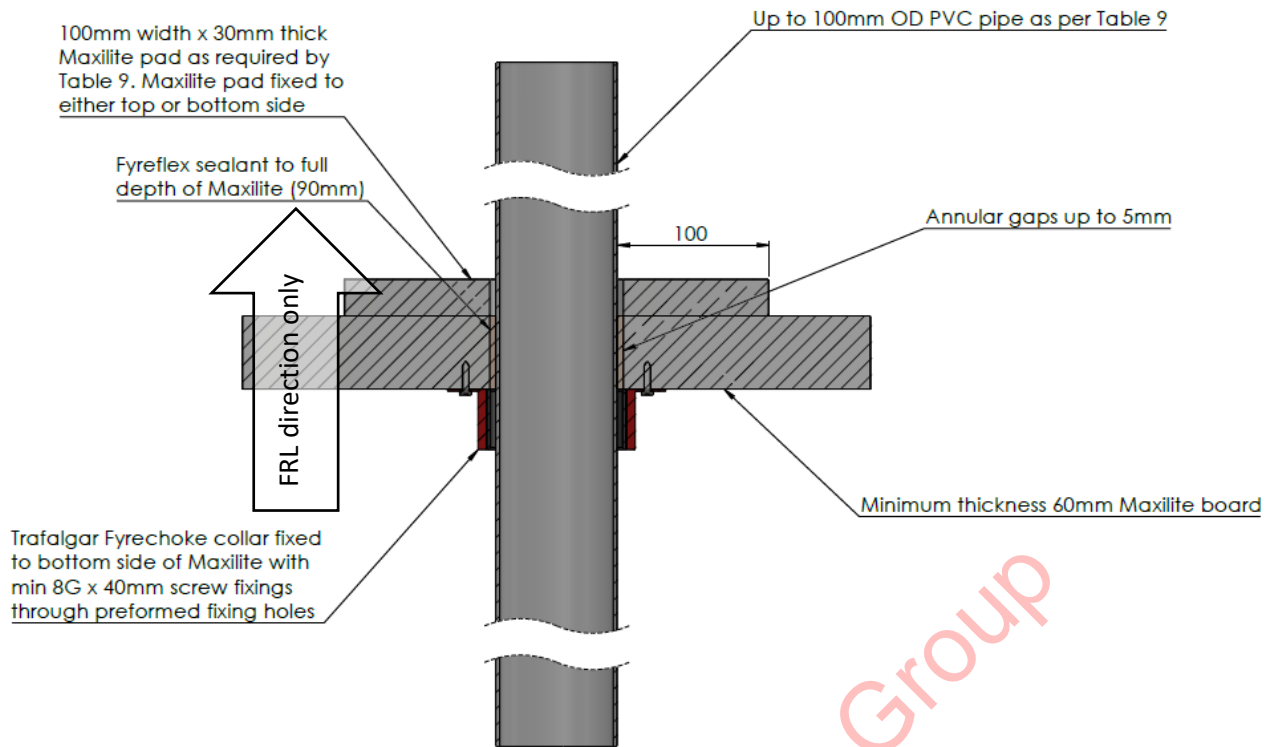
**Figure 50a: 100mm copper or steel pipe through horizontal Maxilite penetration seal**



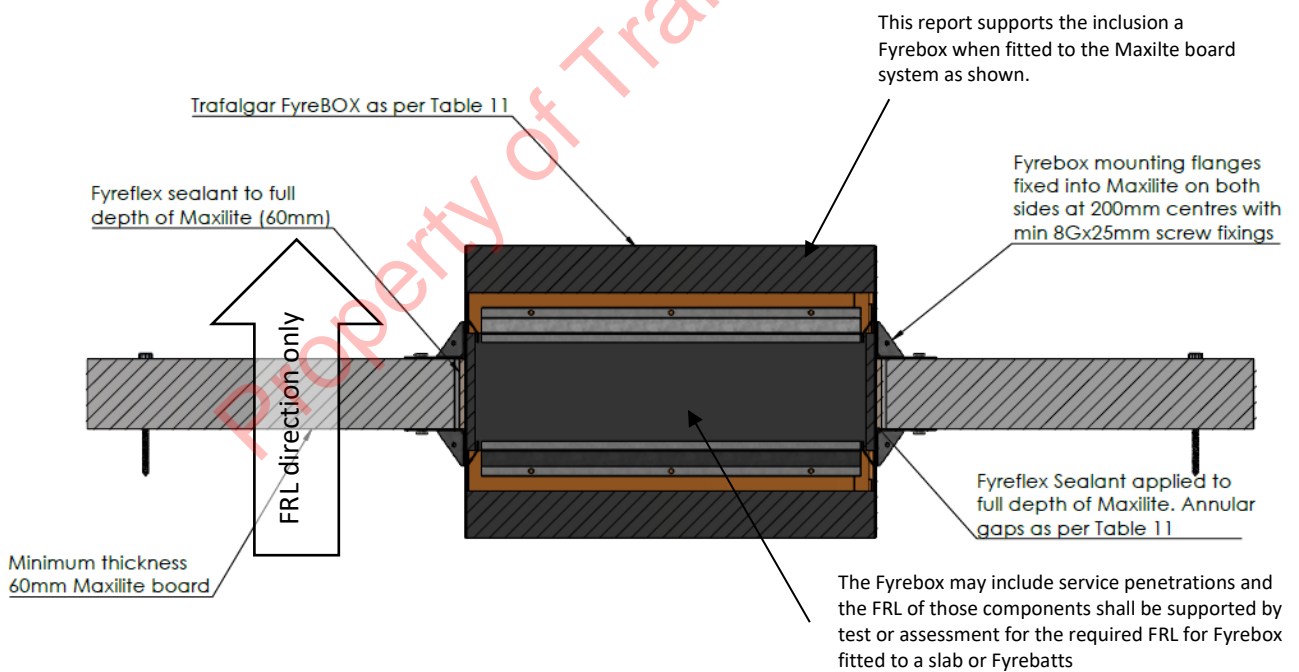
**Figure 51:  $\leq 150\text{mm}$  copper or steel pipe through horizontal Maxilite penetration seal**



**Figure 52: Up to 32mm OD uPVC pipe through horizontal Maxilite penetration seal**

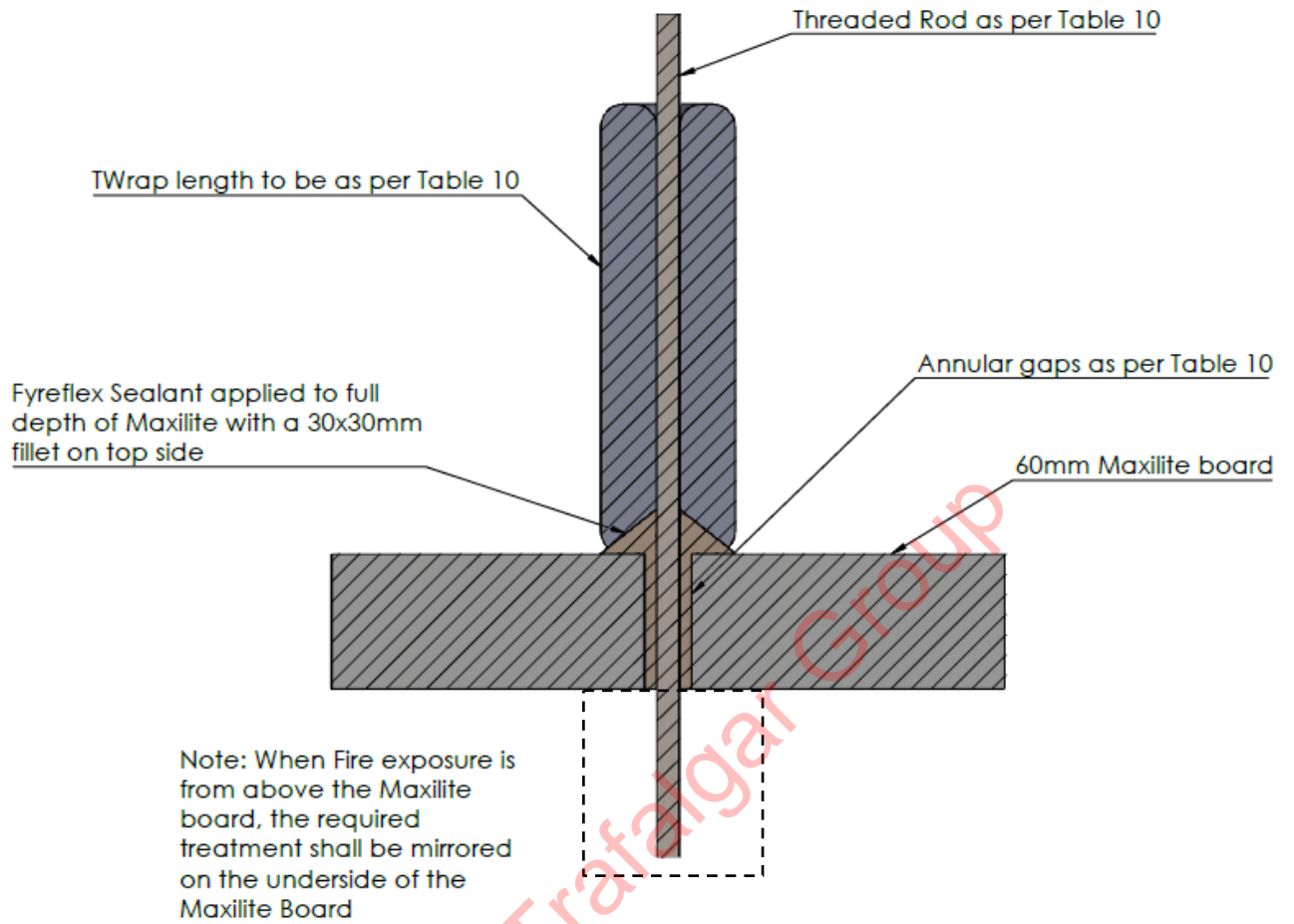


**Figure 53: Up to 100mm OD PVC pipe through horizontal Maxilite penetration seal**



**Figure 54: FyreBOX through horizontal Maxilite penetration seal**





**Figure 55: Threaded steel rod through horizontal Maxilite penetration seal**

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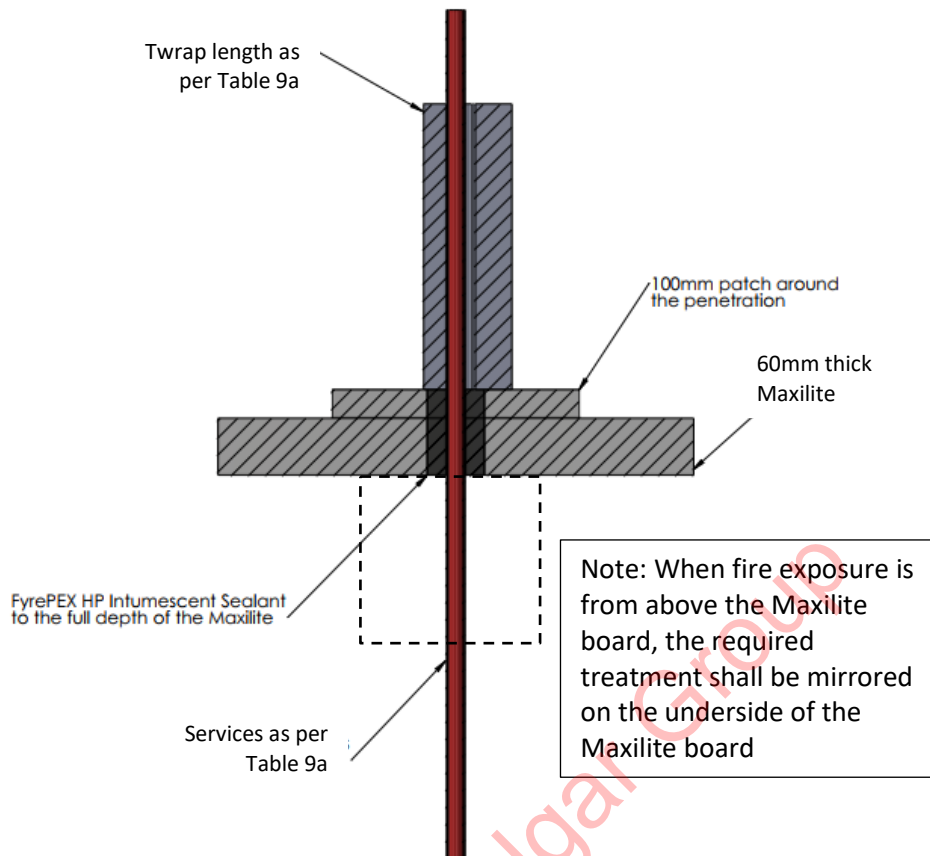


Figure 55a: Pex or Pex-Al-Pex pipe through horizontal Maxilite penetration seal

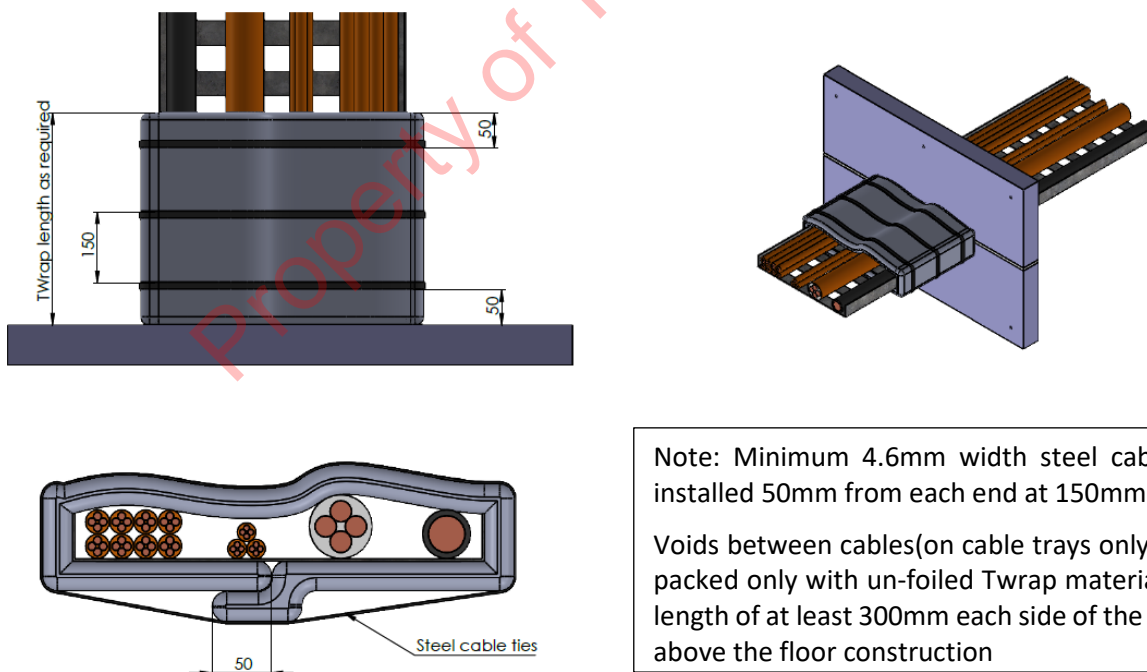
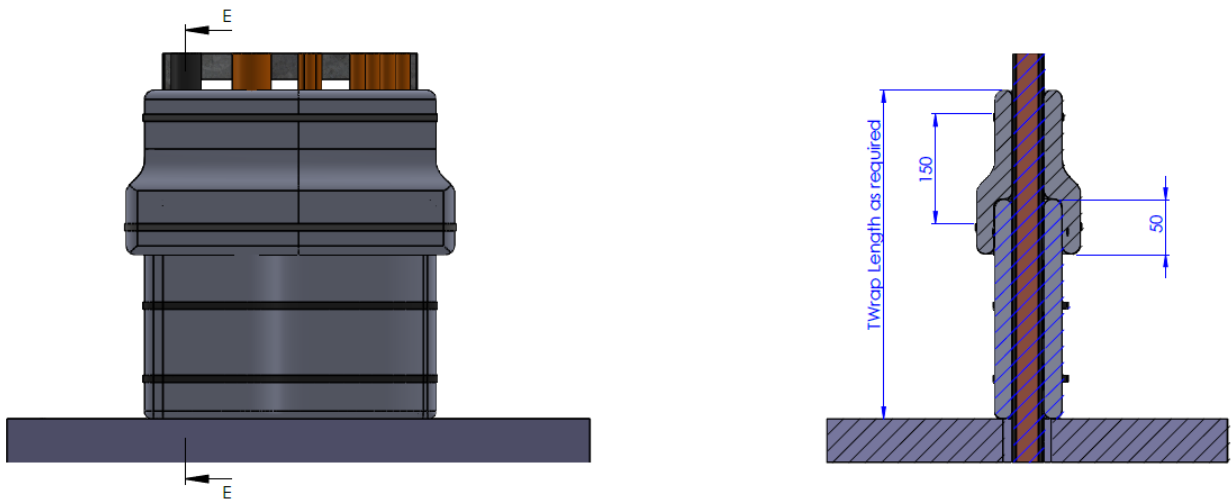


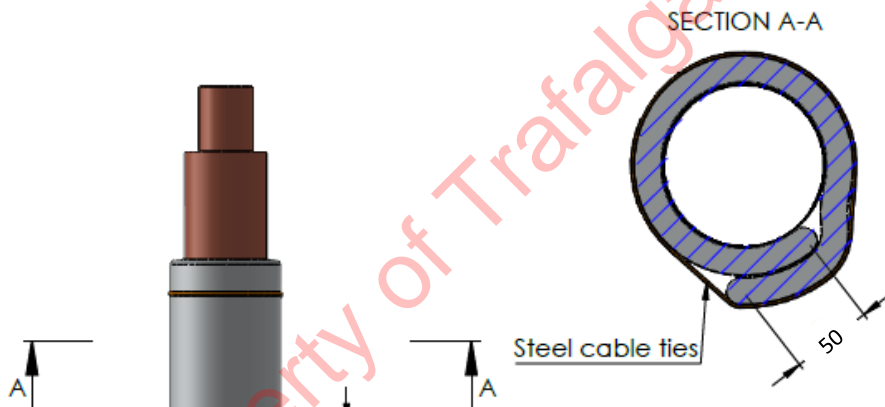
Figure 56: Generic detail of single length of Twrap detail around services



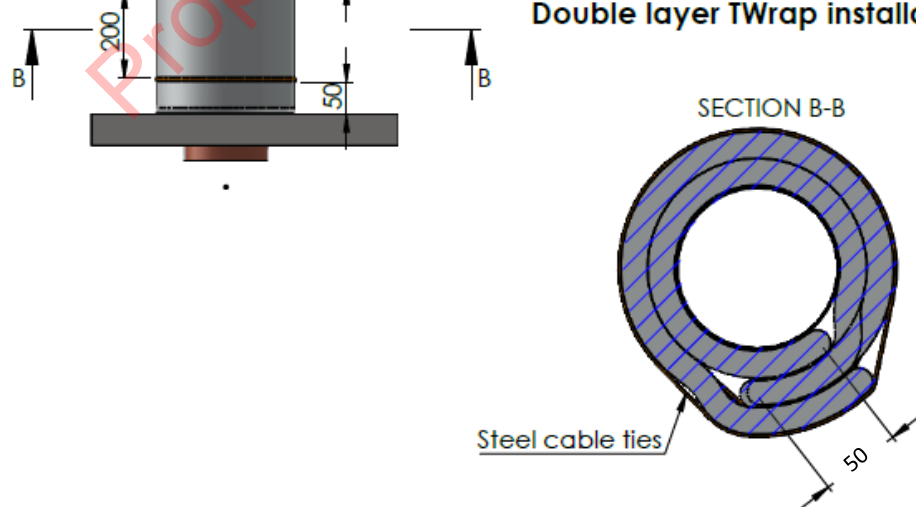
Note: Minimum 4.6mm width steel cable ties installed 50mm from each end at 150mm ctrs.  
 Voids between cables (on cable trays only) to be packed only with un-foiled Twrap material for a length of at least 300mm each side of the wall or above the floor construction

**Figure 57: Generic detail of multi-length of Twrap detail around services**

**Single layer TWrap installation**



**Double layer TWrap installation**

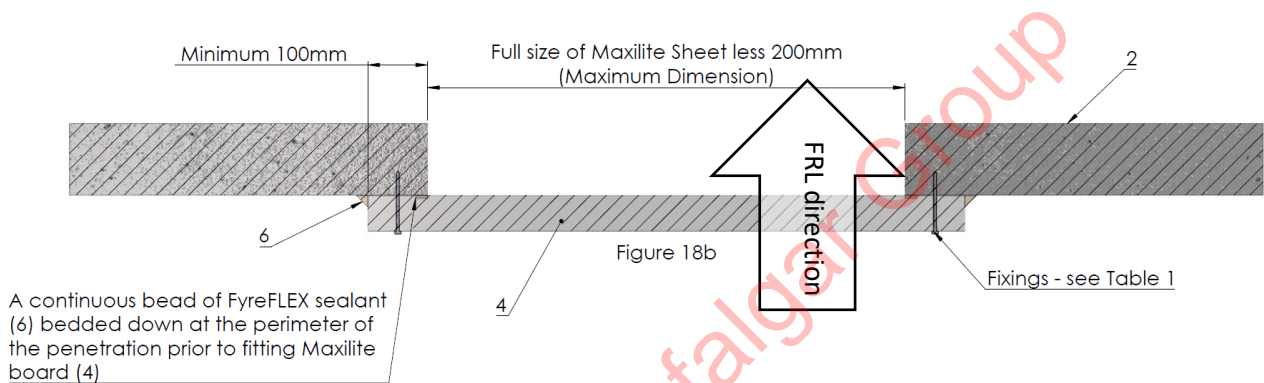


**Figure 58: Generic detail of multi-layer Twrap around services**

### 3.9 Maxilite as a flat seal in a floor

The proposed construction shall be a Maxilite penetration seal based on reference to the ceiling membrane materials tested in FSH 2076 subject to the following variations;

- Floor separating elements supporting the penetration seals shall be supported by a test, assessment or appropriate design to achieve the required FRL when including an opening.
- The Maxilite seal shall comprise a minimum of 40mm thick grey or white Maxilite board.
- Size of opening in the floor to be max. 1.8m long and area less than 1.62m<sup>2</sup>
- No joints allowed in Maxilite board
- No penetrations allowed in the board
- Fire exposure from below only
- Refer to Figure 59



**Figure 59: Maxilite flat seal overlapping an opening in the slab on the exposed side**

### 3.10 Maxilite access panel

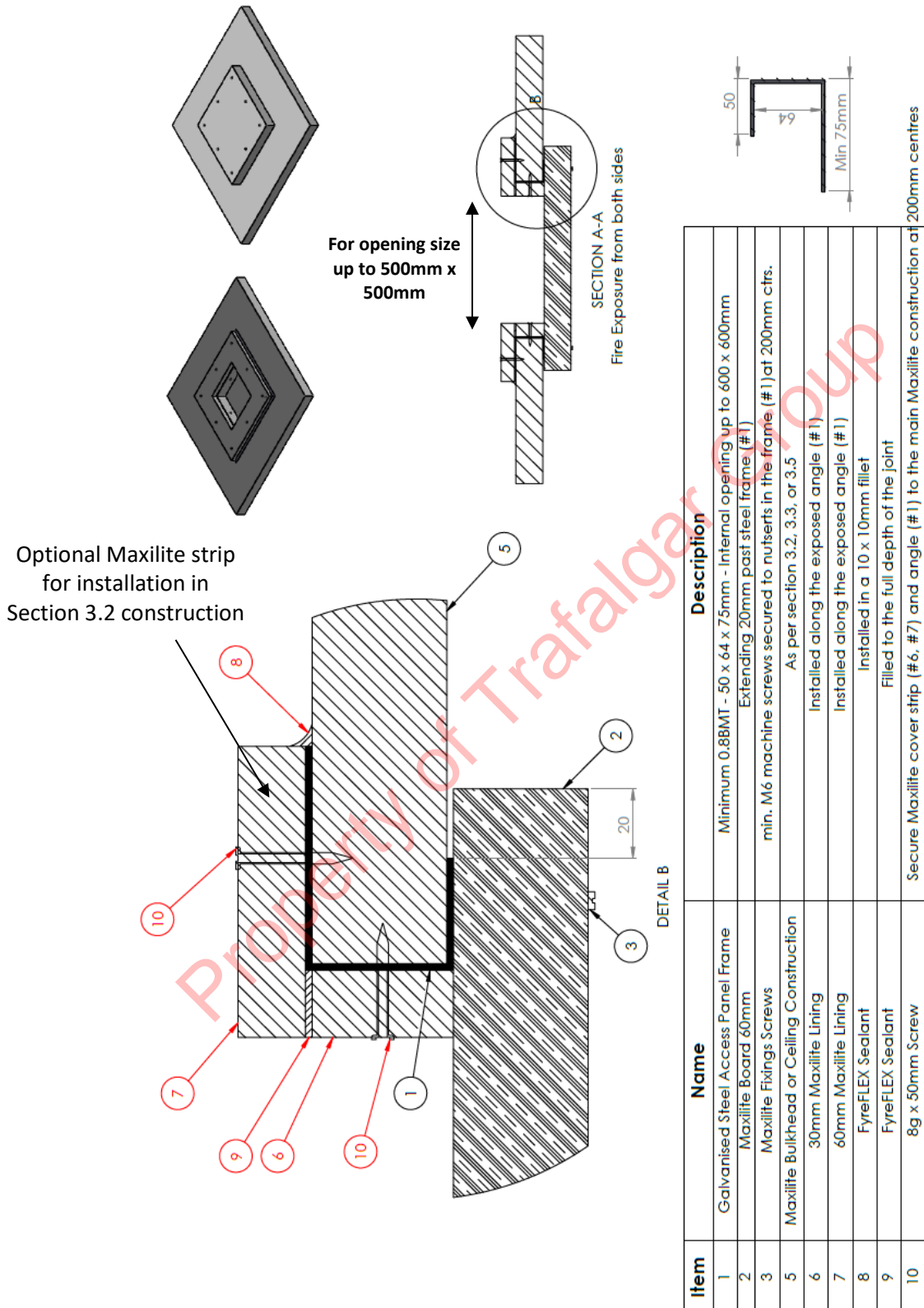


Figure 60a: Maxilite access panel in Maxilite floor/roof ceiling or ceiling system – unreinforced configurations

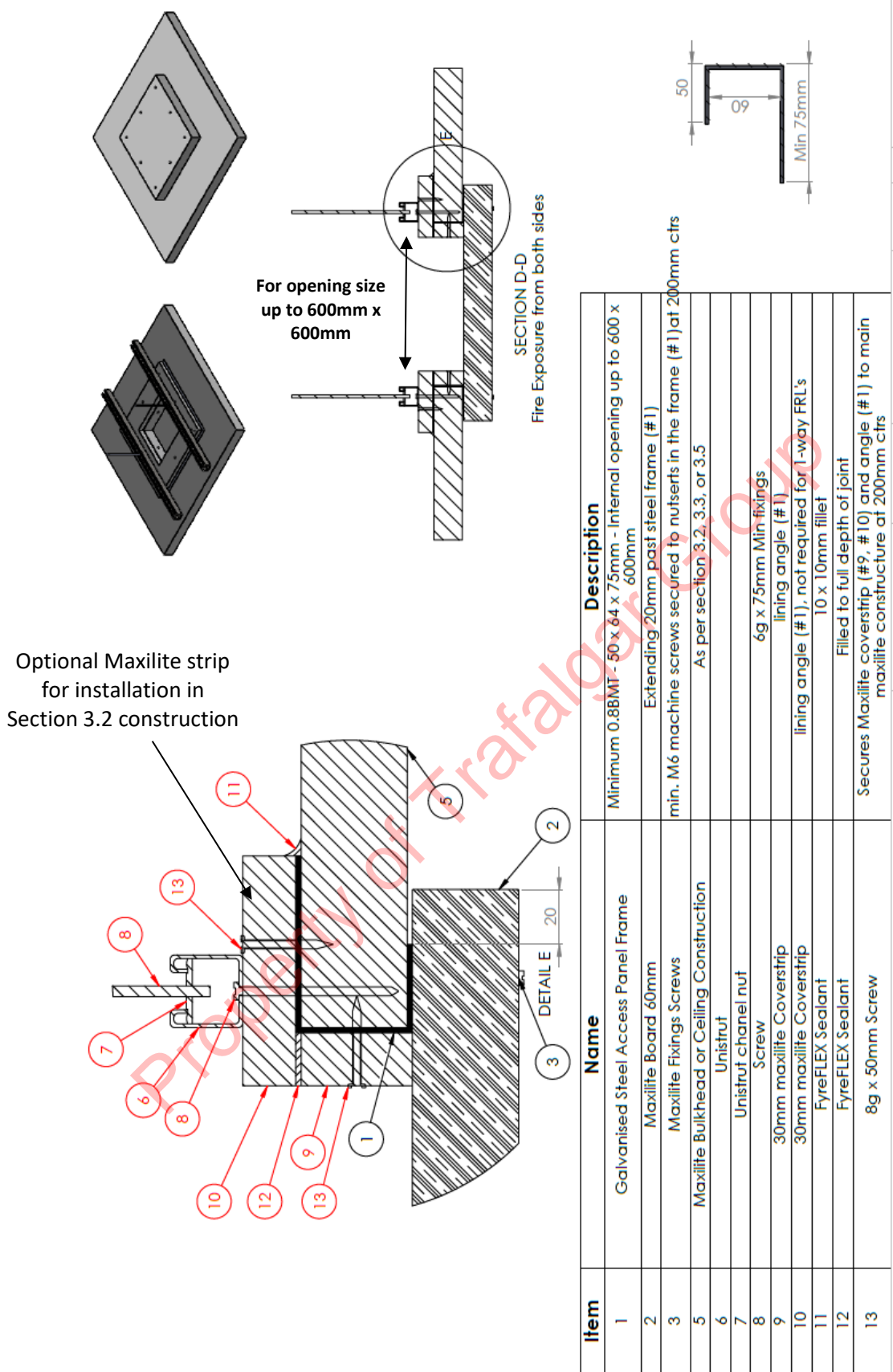
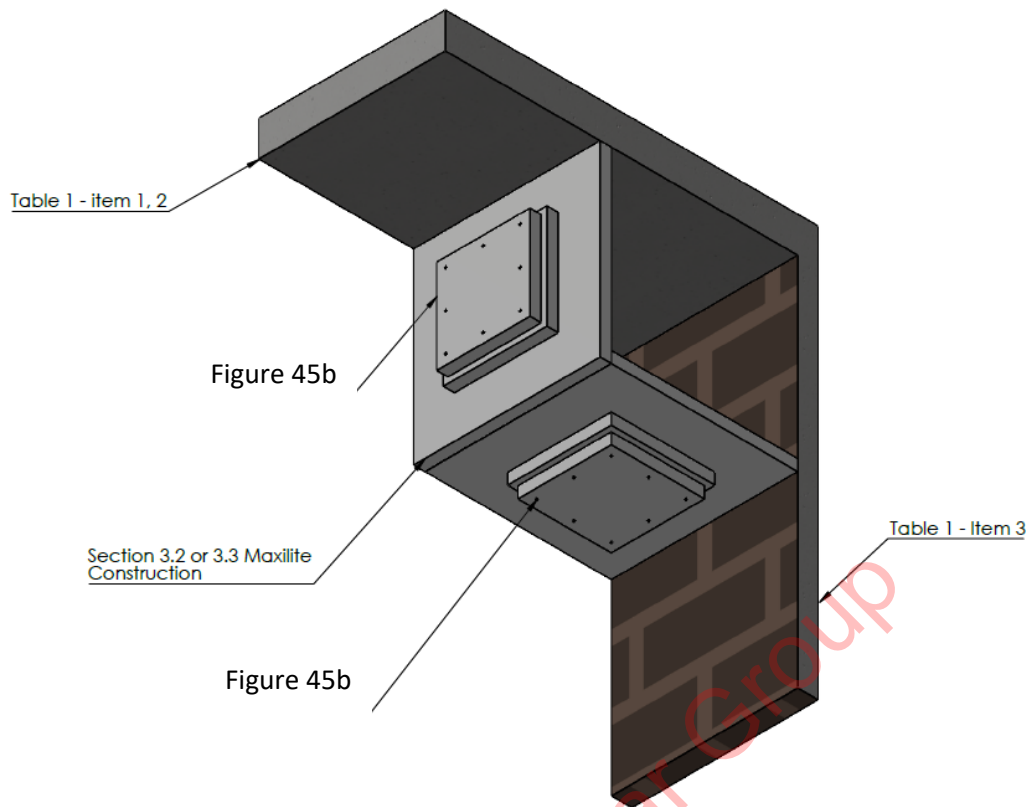
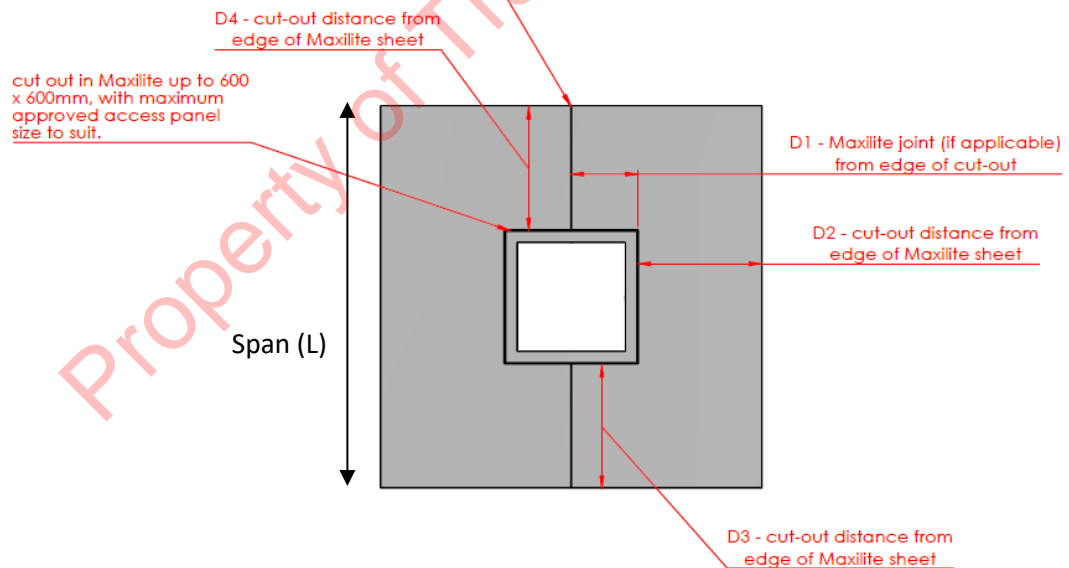


Figure 60b: Maxilite access panel in Maxilite floor/roof ceiling or ceiling system – reinforced configurations



**Figure 61: Maxilite access panel – in vertical and horizontal configurations configuration**

With or without a joint in the Maxilite. If joint is required, it is to be covered by a cover strip as per section 3.2/3.3, then cover strip is to terminate at the access panel, with the butt joint between the cover strip and the Maxilite in the access panel channel sealed with FyreFLEX Sealant



**Figure 62: Openings in minimum 60mm thick Maxilite board with an opening for access panel. Maximum one between two sheets only.**

**Table 11a - Residual Sections for various spans of Maxilite ceiling away from support and Maxilite access panel up to 500mm x 500mm as per Figure 60a when openings not reinforced**

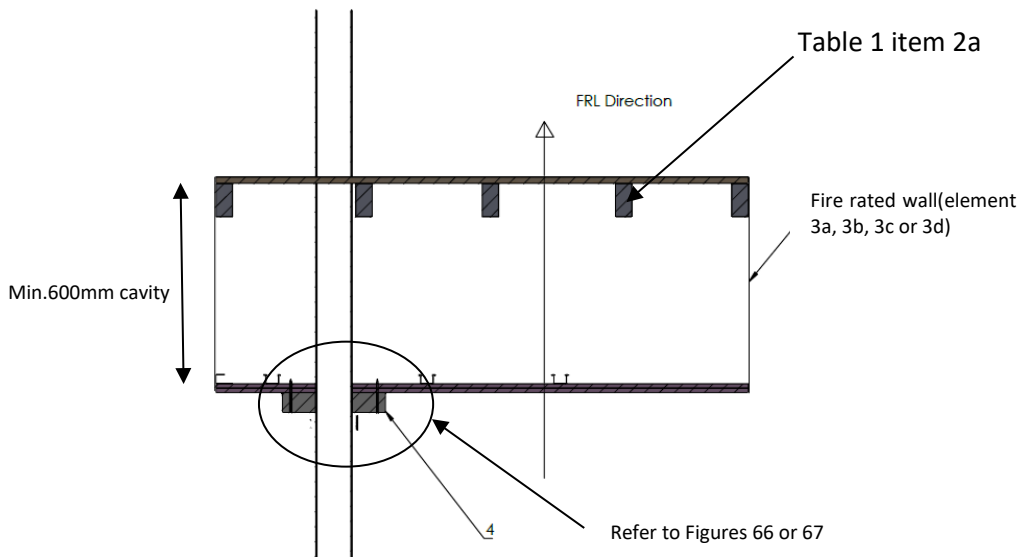
Span L (m)	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8
D1 – up to 250mm	0.2	0.23	0.25	0.3	0.32	0.35	0.4	0.45
D2, D3 and D4	Min 0.3m							



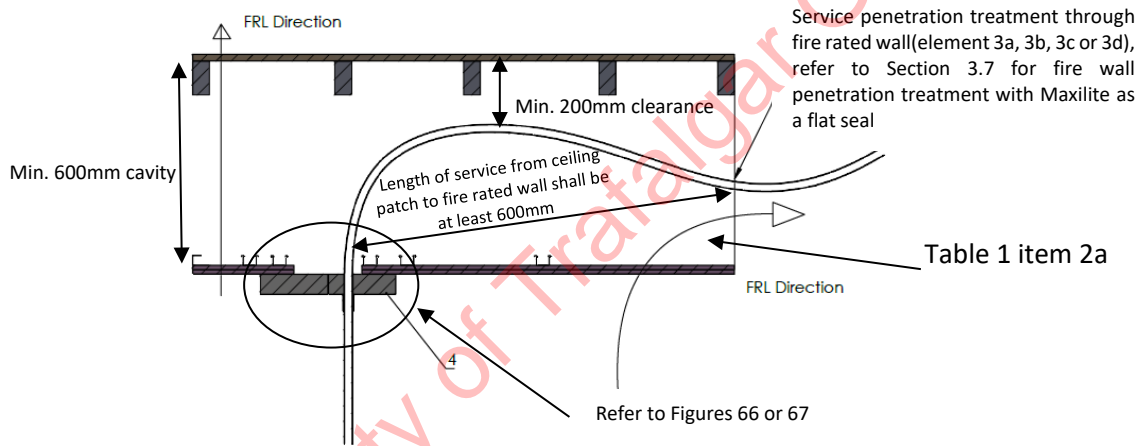
## 3.11 Maxilite as a flat seal in a floor ceiling system where RIFS is required

The proposed construction shall be for Maxilite floor-ceiling system as tested in FSH 2076 subject to the following variations;

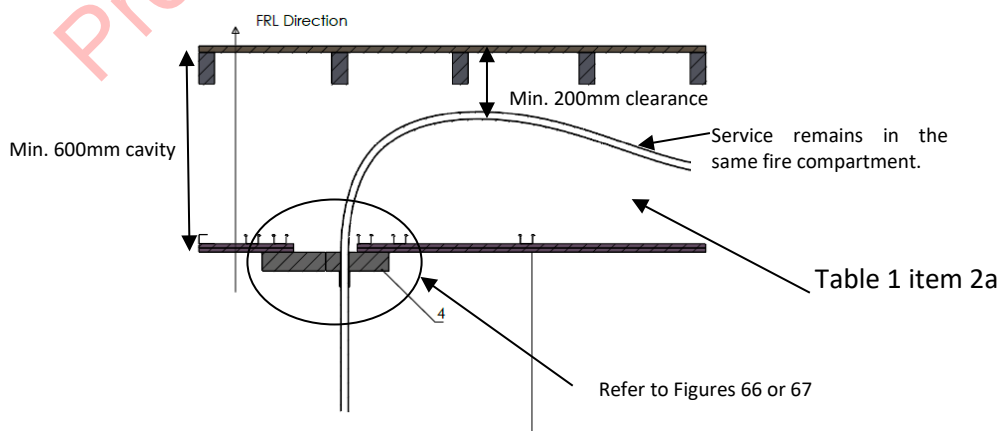
- The fire exposure is either
  - from below the plasterboard ceiling to the top of the floor as shown in Figures 63 and 65, or
  - also, from below the plasterboard ceiling to the unexposed side of the fire rated wall (element 3a, 3b, 3c or 3d) as shown in Figure 64
- Floor/roof – ceiling separating elements supporting the penetration seals shall be supported by a test, assessment or appropriate design to achieve the required FRL and RISF when including an opening.
- It is required that the walls (element 3a, 3b, 3c or 3d) shall have the required FRL without the assistance of the plasterboard ceiling and provide the required support to the floor ceiling system (element 2a)
- Variation to the protection of structural steel elements supporting the ceiling.
- Only the floor-ceiling or roof-ceiling system with patching of the plasterboard lining with a minimum of 60mm thickness Maxilite can be penetrated by services. It may include services that penetrate
  - Unexposed face of roof/floor ceiling construction (element 2a) and Maxilite patch in the lining of ceiling construction (element 4) as shown in Figure 63.
    - Services shall be protected at the Maxilite patch (element 4) with systems listed in Tables 12, 13 and 14
    - The gap between the roof/floor ceiling system and services shall be sealed on the unexposed side of the roof/floor ceiling system with at least a 15mm fillet of Trafalgar FyreFLEX sealant
  - Maxilite patch in the lining of ceiling construction (element 4) and Wall (element 3a, 3b, 3c or 3d) as shown in Figure 64
    - Services shall be protected at Maxilite ceiling (element 4) with systems listed in Tables 12, 13 and 14
    - Services shall be protected at the wall (element 3a, 3b, 3c or 3d) systems listed in Section 3.7
    - Length of service from ceiling patch to fire rated wall shall be at least 550mm
  - Maxilite patch in the lining of ceiling construction (element 4) only as shown in Figure 65.
    - Services shall be protected at the Maxilite patch (element 4) with systems listed in Tables 12, 13 and 14
    - Service shall remain in the same fire compartment
  - The Maxilite patch can either be one of the following based on design
    - A patching of an oversized holes in plasterboard lining of a floor ceiling system as shown in Figure 66 or
    - A local thickening of the ceiling system with a tightly cut hole in the floor/roof ceiling system as shown in Figure 67
  - The gap between underside of Maxilite and service shall be sealed with full depth Trafalgar FyreFLEX sealant and finished off with a 30mm x 30mm fillet of Trafalgar FyreFLEX sealant
  - Plasterboard lining of the floor/roof ceiling system (element 2a) nor Maxilite patch shall not support the weight of any service penetrations. All services shall be supported from above independently of the ceiling.
  - Services shall be spaced by a minimum of 40mm



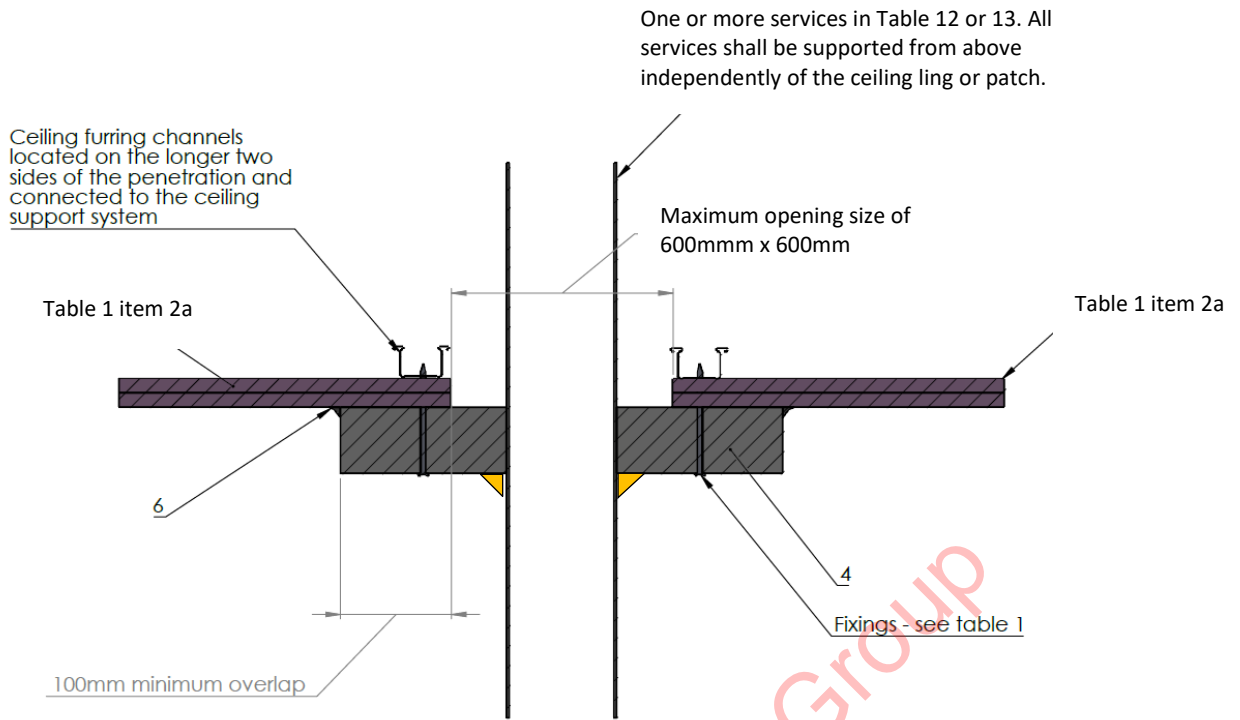
**Figure 63: Maxilite (item 4) as patch in a plasterboard floor/roof-ceiling system with service through to top of system – elevation section view (fire exposure from below only)**



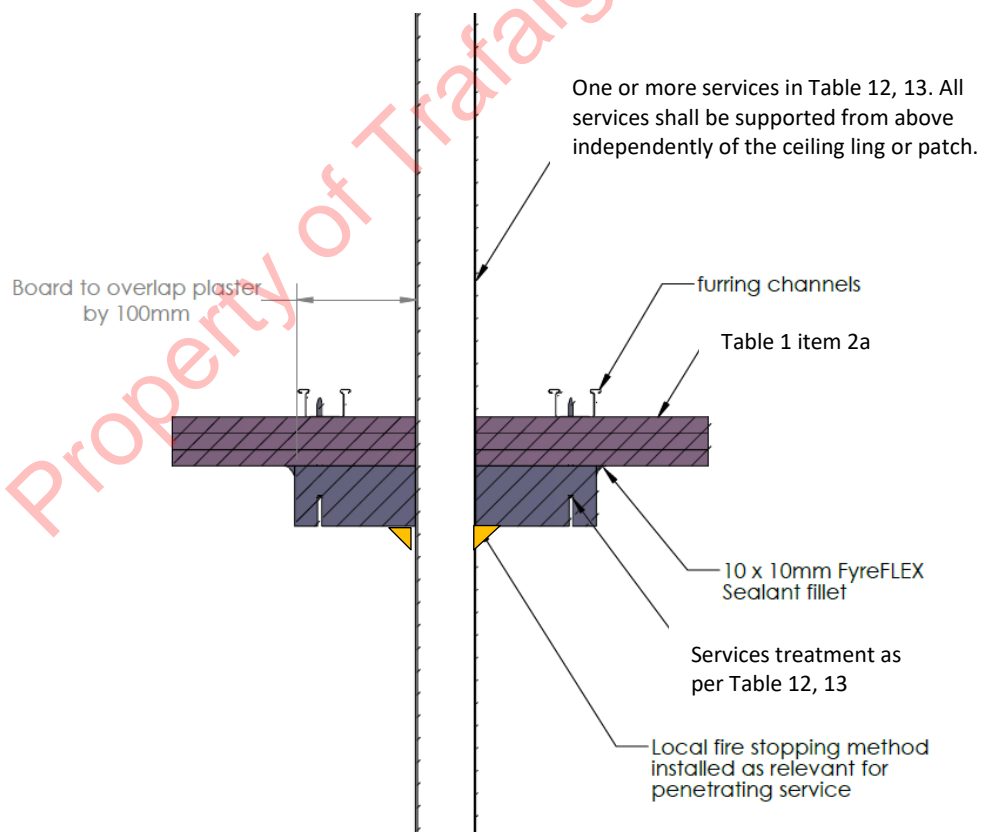
**Figure 64: Maxilite (item 4) as patch in a plasterboard floor/roof-ceiling system with service through to other side of fire wall – elevation section view (fire exposure from below only)**



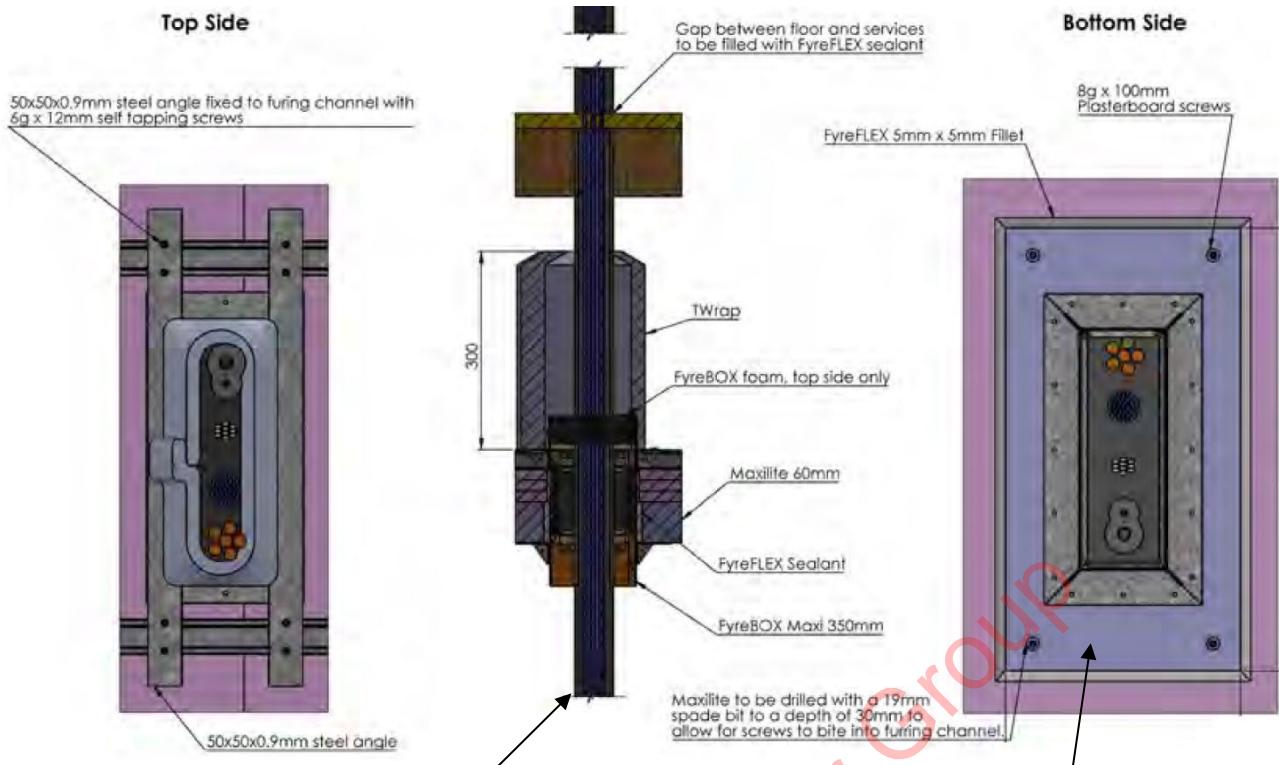
**Figure 65: Maxilite (item 4) as patch in a plasterboard floor/roof-ceiling system with service in same fire compartment – elevation section view (fire exposure from below only)**



**Figure 66: Maxilite (item 4) as an oversized patch in a plasterboard floor-ceiling or roof-ceiling system**



**Figure 67: Maxilite (item 4) for barrier thickening in a plasterboard floor-ceiling or roof-ceiling system**



The Fyrebox may include service penetrations and the FRL of those components shall be supported by test or assessment for the required FRL for Fyrebox fitted to a slab or Fyrebatts

This report supports the inclusion a Fyrebox when fitted to the ceiling system with a Maxilite thickening patch as shown.

**Figure 68: Maxilite (item 4) for barrier thickening in a plasterboard floor-ceiling or roof-ceiling system with Fyrebox**

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**Table 12: Specification of various services through a floor ceiling system(section 3.11) either locally thickened with or has oversized holes patched with Maxilite board as per Table 1 item 2a**

Maxilite Patch	Services	Twrap length top side of Maxilite	Sealant	Maximum hole in ceiling lining	The gap between service and Maxilite board or ceiling lining	Figures
60 minute floor/roof ceiling system	Up to 20 x CAT6 cable, 10 x 10mm TPS cables, 7 x 19mm OD 3C+E power cables with cable tray	Top of Maxilite:  300mm Twrap with 2 foil tape, and 50mm overlap	Full depth Maxilite board with 30mm x 30mm Fyreflex sealant fillet on fire side	600mm x 600mm	5-50mm	66, 67
	Up to 20 X CAT6 cable				≤ 5mm	
	Up to 10 x 10mm TPS cables				≤ 5mm	
	Up to 7 x 19mm OD 3C+E power cables				≤ 5mm	
120 minute floor/roof ceiling system	Up to 8 x CAT 6 cable				≤ 5mm	

**Table 13: Specification of copper and steel pipe through a floor ceiling system(section 3.11) either locally thickened with or has oversized holes patched with Maxilite board as per Table 1 item 2a**

Pipe	Pipe OD (mm)	Pipe wall thickness (mm)	Twrap length top side of Maxilite (mm)	Maximum hole in ceiling lining	Sealant	The gap between service and Maxilite board or ceiling lining	Figure
Copper	DN19	19	450mm	600mm x 600mm	Full depth Maxilite board with 30mm x 30mm Fyreflex sealant fillet on fire side	≤ 5mm	66, 67
	DN25	25.4					
	DN30	31.75					
	DN40	38.10					
	DN50	50.8					
Steel	NB25	33.7	300mm	600mm x 600mm	Full depth Maxilite board with 30mm x 30mm Fyreflex sealant fillet on fire side	≤ 5mm	66, 67
	NB32	42.4					
	NB40	48.3					
	NB50	60.3	450mm				
	NB65	76.1					
	NB80	88.9					
	NB100	114.3	3.2				

**Table 14: Specification of Fyrebox through a floor ceiling system(section 3.11) either locally thickened with or has oversized holes patched with Maxilite board as per Table 1 item 2a**

Maxilite Patch	Trafalgar FyreBOX	Twrap length top side of Maxilite	Sealant	Maximum hole in ceiling lining	The gap between service and Maxilite board or ceiling lining	Figures
60 minute floor/roof ceiling system	Maxi 350 – 350W x 125H x 250D Maxi 550 – 550W x 125H x 250D Maxi 650 – 650W x 125H x 250D Maxi 750 – 750W x 125H x 250D	Top of Maxilite: 300mm Twrap with 2 foil tape, and 50mm overlap	Full depth Maxilite board with 30mm x 30mm Fyreflex sealant fillet on fire side	Size of Fyrebox + 10mm	≤ 5mm	68
120 minute floor/roof ceiling system	Maxi 1100 – 1100W x 125H x 250D Mini 100 square – 102H x 102W x 250D Mini 100 round – 100mm diameter x 250D Mini 150 round – 150mm diameter x 250D					

## 4 Referenced Standards

Standards:

- AS 1530.4 – 2014 sections 10 and 4      Methods for fire tests on building materials, components and structures Part 4: Fire resistance tests of elements of building construction – Sections 4 and 10 as appropriate horizontal separating elements and penetration seals
- AS 4072.1 – 2005 Amdt 1      Components for the protection of openings in fire-resistant separating elements, Part 1: Service penetrations and control joints.

## 5 Conclusion

On the basis of the analysis presented in this report, it is the opinion of this Accredited Testing Laboratory that the tested prototypes described in Section 2 when varied as described in Section 3 will achieve the performance below when submitted to a test in accordance with the test methods referenced in Section 4, and subject to the requirements of section 7, the validity of section 8 and limitation of section 9.

**Table 15: Fire resistance of Maxilite as a part of a floor-ceiling or roof-ceiling system (fire from below) in accordance with AS 1530.4 -2014 section 4**

Maxilite colour	Total Maxilite Thickness	Construction Figures and Tables	FRL	RISF (Excluding penetrations)	Allowable services
Grey	30mm	Table 1	120/120/120	30 minutes	Refer to Tables 19 and 20
	40mm			30 minutes	
	60mm			60 minutes	
White	30mm	Figures 1-11, 34, 26a-26d		30 minutes	
	40mm			60 minutes	
	60mm			60 minutes	

**Table 16: Fire resistance of Maxilite as a ceiling system (fire from above or below) in accordance with AS 1530.4 -2014 section 4 clause 4.1.2 (e)and (f)**

Maxilite	Construction Figures and Tables	FRL	RISF (Excluding penetrations)	Allowable services
1 x 60mm or 2 x 30mm or 2 x 40mm thick grey Maxilite	Table 1  Figures 6-11, 12 – 17a, 34, 26a-26d	-/120/120	60 minutes	Refer to Tables 19 and 20
1 x 60mm or 2 x 30mm or 2 x 40mm thick white Maxilite			60 minutes	

**Table 17: Fire resistance of Maxilite as a flat penetration seal in various support constructions in accordance with AS 1530.4 -2014 section 10**

Maxilite	Support construction type	Maximum opening size	Figures and Junction details	FRL	Allowable services
1 x 60mm or 2 x 30mm or 2 x 40mm thick grey or white Maxilite	Masonry / Concrete walls	Maximum 1.8m long and maximum area 1.62m <sup>2</sup>	Figure 19, 21c, 34,	-/180/180	Refer to Tables 19 and 20
			Figures 9, 19, 21, 21b, 23, 34,	-/120/120	
	Concrete floors		Figure 18, 21c, 34,	-/240/240	
			Figures 6, 9, 18, 18a, 21, 21a, 22, 34,	-/120/120	
			Figures 6, 9, 20, 21, 21b, 23, 34,	-/120/120	
Hebel AAC /Walsc AAC walls	Figures 6, 9, 19, 21, 21b, 23, 34,	-/90/90			

**Table 18: Fire resistance of Maxilite boxout constructions in various support constructions in accordance with AS 1530.4 -2014 section 10**

Maxilite thickness	Support construction type	Maximum size per face of Maxilite	Figures and Junction details	FRL	Allowable services
1 x 60mm thick Maxilite or 2 x 30mm thick Maxilite or 2 x 40mm thick Maxilite)	Slab with Masonry / Concrete walls	Maximum 2m long and maximum area 2.32m <sup>2</sup>  (Non-penetration face can have Min. 40mm thick Maxilite)	Figures, 3, 4, 6 – 10, 16, 19, 24-34	-/120/120	Refer to Tables 19 and 20
	Slab with Plasterboard lined stud walls/ plasterboard shaft walls			-/120/120	
	Slab with Hebel AAC /Walsc AAC walls			-/90/90	
	Slab only (boxout construction under the slab)			-/120/120	



**Table 19: Fire Resistance of the service penetrations in vertical Maxilite fitted to support construction of the required FRL in accordance with AS 1530.4 -2014 section 10**

Maxilite thickness	Type of passive fire protection	Figures and Tables	FRL				
			System in Section 3.2 Table 15	System in Section 3.3 Table 16	System in Section 3.4 Table 17	System in Section 3.5, Table 18 Figures 27, 30, 33	System in Section 3.5 Table 18 Figures 28, 31
			(Non-penetration face can have Min. 40mm thick Maxilite)				
1 x 60mm thick Maxilite or 2 x 30mm thick Maxilite or 2 x 40mm thick Maxilite	Maxilite, Twrap/ Fyrewrap and FyreFLEX sealant	Figures 34, 35, 56-58 Table 6	-/120/120	-/120/120	-/180/120	NA	-/120/120
		Figures 34, 36, 56-58 Table 6			-/120/120		
		Figures 34, 36a, 56-58 Table 6			-/120/120		
		Figures 34, 37, 56-58 Tables 2, 3			-/180/120		
		Figures 34, 38, 56-58 Tables 2, 3			-/180/120		
		Figures 34, 38a, 56-58 Table 3			-/180/120		
		Figures 34, 39, 56-58 Table 2			-/180/120		
	Figures 34, 45, 56-58 Table 6	-/120/120	-/120/120	-/180/180	NA	-/120/120	
	Figures 34, 37, 56-58 Table 3a	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	
	Figures 34, 60-62 Table 11a	-/120/120	-/120/120	NA	NA	NA	
FyreBOX, intumescent collars, air transfer grilles, Fyreplex sealant	Figures 34, 40a, Table 4	-/120/90	NA	-/120/90	-/120/90	NA	
	Figures 34, 40, 41 Table 4	-/120/120		-/120/120	-/120/120		
	Figures 34, 42, Table 5	-/120/30		-/120/30	-/120/30		
	Figures 34, 43, Table 5	FRL at perimeter of FyreBOX -/120/30		FRL at perimeter of FyreBOX -/120/30	FRL at perimeter of FyreBOX -/120/30		
	Figures 34, 44, Table 7	-/120/120		NA	NA		
	Figures 34, 45a, 45b Tables 6, 7a	-/120/120		NA	NA		

**Table 20: Fire Resistance of the service penetrations in horizontal Maxilite fitted to support construction of the required FRL in accordance with AS 1530.4 -2014 section 10**

Maxilite thickness	Type of passive fire protection	Figures and Tables	FRL				
			System in Section 3.2 Table 15	System in Section 3.3 Table 16	System in Section 3.4 Table 17	System in Section 3.5, Table 18 Figures 27, 30, 33	System in Section 3.5 Table 18 Figures 28, 31
			(Non-penetration face can have Min. 40mm thick Maxilite)				
1 x 60mm thick Maxilite or 2 x 30mm thick Maxilite or 2 x 40mm thick Maxilite	Maxilite, Twrap/ Fyrewrap and FyreFLEX sealant	Figures 34, 46, 56-58 Table 10	-/120/120	-/120/120	-/240/120	NA	-/120/120
		Figures 34, 47, 56-58 Table 10			-/120/120		
		Figures 34, 47a, 56-58 Table 10			-/120/120		
		Figures 34, 48, 56-58 Table 10			-/120/120		
		Figures 34, 49, 56-58 Table 8			-/240/120		
		Figures 34, 50, 56-58 Table 8			-/180/120		
		Figures 34, 50a, 56-58 Table 8			-/240/120		
		Figures 34, 51, 56-58 Table 8			-/180/120		
		Figures 34, 49-51, 56-58 Table 8a			-/90/90		
	Figures 34, 55, 56-58 Table 10	-/120/120	-/120/120	-/180/180	NA	-/120/120	
	Figures 34, 60-62 Table 11a	-/120/120	-/120/120	NA	NA	NA	
	FyreBOX, intumescent collars, Fyreplex sealant	Figures 34, 52 Table 9	-/120/120	NA	-/120/120	-/120/120	NA
		Figures 34, 53 Table 9	-/120/60		-/180/60	-/120/60	
Figures 34, 54 Table 11		FRL at perimeter of FyreBOX -/120/-	FRL at perimeter of FyreBOX -/120/-		FRL at perimeter of FyreBOX -/120/-		
Figures 34, 55a, 56-58 Table 9a		-/120/120	NA		-/120/120	-/120/120	

**Table 21: Fire Resistance of the service penetrations in horizontal Maxilite fitted to floor construction of the required FRL in accordance with AS 1530.4 -2014 section 10**

Maxilite	Support construction type	Maximum opening size	Figures	FRL
1 x 40mm thick Maxilite	Concrete floors	Maximum 1.8m long and maximum area 1.62m <sup>2</sup>	Figures, 18, 34, 59	-/120/120

**Table 22: Fire Resistance of the service penetrations in horizontal Maxilite as a patch for plasterboard floor/roof-ceiling system of the required FRL in accordance with AS 1530.4 -2014 section 10**

Maxilite thickness	Figures and Tables	FRL		RISF
		60 minutes system in Section 3.11	120 minutes system in Section 3.11	
1 x 60mm thick Maxilite or 2 x 30mm thick Maxilite or 2 x 40mm thick Maxilite	Figures 56-58, 63-67 Tables 12 and 13	-/60/60	-/120/120	60 minutes

**Table 23: Fire Resistance of the service penetrations in horizontal Maxilite as a patch for plasterboard floor/roof-ceiling system of the required FRL in accordance with AS 1530.4 -2014 section 10**

Maxilite thickness	Figures and Tables	FRL		RISF
		60 minutes system in Section 3.11	120 minutes system in Section 3.11	
1 x 60mm thick Maxilite or 2 x 30mm thick Maxilite or 2 x 40mm thick Maxilite	Figures 63-65, 68 Table 14	FRL at perimeter of FyreBOX -/60/-	FRL at perimeter of FyreBOX -/120/-	RISF on the ceiling lining and wrap around the Fyrebox  60 minutes

## 6 Direct Field of Application of Results

The results of this assessment apply to penetrations in walls when exposed to fire from one or either side based on design. In addition, for roof-ceiling, floor-ceiling, flat seals in the floor when exposed to fire from below only and for ceilings when exposed to fire from below only or on either side based on design.

## 7 Requirements

It is required that the following support constructions:

- Plasterboard lined steel stud wall
- Plasterboard shaftwall
- Masonry/Concrete wall
- Concrete slabs
- Hebel AAC /Walsc AAC wall
- Floor/ceiling or roof/ceiling system

shall be supported by a suitable and relevant test or assessment to achieve the required FRL as a wall or floor as appropriate when incorporating an aperture.

It is required Lorient LVH 44 grille be tested in a wall and achieve the required FRL in accordance with AS 1530.4 -2014 section 10.

Unless specified otherwise in this report it is required that all penetrating services including trays shall be supported independently by the Maxilite barrier on each side of the barrier.

Any variations concerning size, constructional details, loads, stresses, edge or end conditions that are other than those identified in this report, may invalidate the conclusions drawn in this report.

## 8 Term of Validity

This assessment report will lapse on 31<sup>st</sup> May 2027. Should you wish us to re-examine this report with a view to the possible extension of its term of validity, would you please apply to us three to four months before the date of expiry. This Division reserves the right at any time to amend or withdraw this assessment in the light of new knowledge.

## 9 Limitations

The conclusions of this assessment report may be used to directly assess the fire resistance performance under such conditions, but it should be recognised that a single test method will not provide a full assessment of the fire hazard under all fire conditions.

Because of the nature of fire resistance 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 report does not provide an endorsement by CSIRO of the actual products supplied to the industry. The referenced assessment can therefore only relate to the actual prototype test specimens, testing conditions and methodology described in the supporting data, and does not imply any performance abilities of constructions of subsequent manufacture.

This assessment is based on information and experience available at the time of preparation. The published procedures for the conduct of tests and the assessment of test results are the subject of constant review and improvement, and it is recommended that this report is reviewed on or, before, the stated expiry date.

The information contained in this assessment report shall not be used for the assessment of variations other than those stated in the conclusions above. The assessment is valid provided no modifications are made to the systems detailed in this report. All details of construction should be consistent with the requirements stated in the relevant test reports and all referenced documents.

# Appendix A Supporting Test Data

## A.1 Fire Research Laboratories Report NI 2689

On 7 July 1989, Fire Research Laboratories conducted a fire test in accordance with AS1530.4-1985 on a 75mm E core panel penetrated by various penetrations and protected with FyreFLEX.

The test construction comprised a lightweight concrete slab approximately 2.9m x 1.9m, 115mm thick with a central opening 2.13m x 1m wide. The opening was penetrated by a variety of services and the fire stopped by an E-core floor panel system in combination with FyreFLEX sealant and Fyrechoke Type 3 collars. The E-core floor panel system was fitted after the services were positioned in the opening.

Only specimens F, H and L are discussed in the report. Their construction and performance are summarized below in Table A2.

## A.2 Applicability of AS 1530.4 – 1985 test data to AS 1530.4 -2014

The referenced fire resistance tests NI2689 were conducted in accordance with AS 1530.4– 1985, which differs from AS 1530.4–2014. These variations and their potential effect on the fire resistance performance of the referenced test specimen are discussed below.

### *Furnace Temperature Regime*

The specified specimen heating rate in AS 1530.4–1985 is given by:

$$T_t - T_0 = 345_{\log}(8t+1)$$

Where;

$T_t$  = Furnace temperature at time  $t$ , in degrees Celsius.

$T_0$  = Initial furnace temperature, in degrees Celsius, not less than 10°C nor more than 40°C.

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

The furnace heating regime in fire resistance tests conducted in accordance with AS 1530.4–2014 follows the same trend as that in AS 1530.4–1985.

### *Furnace Thermocouples*

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

The furnace thermocouples specified in AS 1530.4-1985 are type K but they can be exposed, substantially enclosed or fully enclosed.

The positioning of furnace thermocouples from the exposed face of the specimen at the start of the fire resistance test was required to be between 75mm and 300mm in AS 1530.4-1985. In AS 1530.4-2014 the distance is required to be 100mm ± 10mm.

With reference to the construction tested and the position of the thermocouples within the furnace when tested, it is considered that the minor variation in the location of the furnace thermocouples relative to the exposed face of the specimen would not significantly affect the insulation performance of the specimens.

### *Furnace Pressure*

The furnace pressure required by AS 1530.4-1985 is not nominated, however, the standard required

the pressure to be measured at a level of 100mm from the underside of the horizontal specimen.

It is a requirement of AS 1530.4-2014 that for horizontal elements, the furnace shall be operated such that a pressure of 20Pa is established at a position 100 mm below the underside of the test specimen above that of the laboratory atmosphere.

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 +3Pa for 10 minutes of test time, the minor variation in furnace pressure is not expected to have significantly affected the outcome of the referenced fire resistance test.

The specimens referenced in NI1089 and NI2689 maintained integrity for the duration of the test. Therefore, the minor difference in furnace pressure will not affect the outcome of the test result.

The specimen referenced in NI3089 maintained integrity for 228 minutes of the test. Therefore, the minor difference in furnace pressure will not affect the outcome of the test result for up to 228 minutes.

#### *Specimen mounting*

The mounting of specimens differs slightly between AS 1530.4-2014 and AS 1530.4-1985.

AS 1530.4-1985 requires penetration services to be mounted such that it protrudes no less than 2000mm away from the furnace and no less than 100mm into the furnace.

AS 1530.4-2014 requires penetration services to be installed so that it projects a minimum of 500 mm on each side of the supporting construction, of which at least 200 mm shall extend beyond the extremities of the penetration sealing system.

The specimens in NI2689 were protruding 2000mm away from the furnace and 500mm into the furnace and had 500mm specimen extended beyond the extremities of the penetration sealing system.

The AS 1530.4-2014 configuration is more onerous than the AS 1530.4-1985 specification and as such the results are not suitable for the direct assessment of insulation performance the result shall be examined on a case by case basis.

#### *Specimen Thermocouples*

The specimen thermocouple positions differ slightly between AS 1530.4-2014 and AS 1530.4-1985. The difference would not have affected the outcome of the test if tested in accordance with AS 1530.4-2014.

#### *Integrity Criteria*

The integrity criteria differ slightly between AS 1530.4-2014 and AS 1530.4-1985. For AS 1530.4-2014 the penetration shall be deemed to have failed the integrity when;

- a) Flaming occurs or
- b) when a 6mm x 150mm gap gauge can pass through the specimen.
- c) Failed cotton pad

The integrity criteria for AS 1530.4-1985 deem a penetration to have failed integrity if a crack or fissure opens during the test that allows the passage of hot gases or flames or when flaming occurs at the unexposed face of the specimen for a period exceeding 10 seconds duration.

When tested in NI2689 cracks and fissures did not form for up to 120 minutes. Therefore, the cotton pad criteria, therefore, do not apply for up to 120 minutes.

#### *Insulation Criteria*

The insulation criteria differ slightly between AS 1530.4-2014 and AS 1530.4-1985. For AS 1530.4-2014 the penetration shall be deemed to have failed the insulation when;

- a) The thermocouple located on the specimen or the separating element exceeds the initial temperature by more than 180° K.

- b) For cable penetrations, if during the test, fissuring of the insulating materials occurs, exposing conductors before the temperature rise measured on the cables has exceeded 180° K and the temperature of the exposed conductors shall be measured by a roving thermocouple, provided that the fissure is wider than 12 mm. This temperature shall be used in the determination of the insulation rating.

AS 1530.4-1985 deems the penetration to have failed insulation when the thermocouple located on the specimen or the separating element exceeds the initial temperature by more than 180°K or reaches a temperature higher than 220°C.

#### *Application of Test Data*

On the basis of the discussion above, it is concluded that the results obtained from the referenced fire resistance tests conducted in accordance with AS 1530.4-1985 can be applied to an assessment of the integrity and insulation performance of metal pipes and cable penetration of the referenced tests if tested in accordance with AS 1530.4-2014.

### A.3 Branz Report FR 3981

On 20 June 2008, Branz, NZ conducted a fire test in accordance with AS 1530.4-2005 on a nominally 120 mm thick concrete slab which was built into a concrete lined specimen holder and positioned on top of a 3 m x 4 m horizontal furnace. There were a total of 21 specimens. Specimen T comprised A 900 mm x 350 mm rectangular hole through the concrete and was covered by a 2 x 30mm thick layer of Maxilite board on the exposed side. The Maxilite penetration seal was penetrated by 5 services.

Only specimens C, K and T (a) and (c) are discussed in this assessment report. Their construction and performance are summarized below in Tables A1 and A2.

### A.4 Applicability of AS 1530.4 – 2005 test data to AS 1530.4 -2014

#### *General*

The test FR 3981 was conducted in accordance with AS 1530.4-2005. This standard differs from AS 1530.4-2014 and the significance of these differences relevant to Section 10 for penetrations are discussed below.

#### *Temperature regime*

The furnace heating regime and the parameters outlining the accuracy of control of the furnace temperature in AS 1530.4-2005 are the same as that in AS 1530.4-2014.

#### *Furnace pressure*

The furnace pressure conditions for AS 1530.4-2005 and AS 1530.4-2014 are the same.

#### *Specimen mounting*

The differences in the AS 1530.4-2005 and AS 1530.4-2014 requirements for specimen mounting are editorial and not significant to the test specimens tested in this case.

#### *Specimen thermocouple arrangements*

The specimen thermocouple arrangements for the referenced tests are not appreciably different between AS 1530.4-2005 and AS 1530.4-2014.

#### *Application of cotton pad*

The differences in the AS 1530.4-2005 and AS 1530.4-2014 in regard to the application of the cotton pad have been considered and it is confirmed these differences would not have affected the fire integrity performance of the referenced tests.



### *Criteria for failure*

The criteria for the referenced tests are not appreciably different between AS 1530.4-2005 and AS 1530.4-2014.

### *Conclusion*

Based on the above it is confirmed the referenced test data in accordance with AS 1530.4-2005 can be used to assess performance in accordance with AS 1530.4-2014.

## A.5 Branz Report FP 6202

On 9 October 2017, Branz, NZ conducted a fire test in accordance with AS 1530.4-2014 on twelve penetrations through a 2 hour steel-framed plasterboard wall. The wall was constructed from a 64 mm steel stud frame with 2 layers of 13 mm fire rated plasterboard on each side, giving an overall thickness of 116 mm. Openings were made in the wall for specimens 1, 4 and 12. Specimen 4 was a local fire stopping element containing a further seven specimens. The openings were lined with 2 layers of 13 mm fire rated plasterboard to maintain the fire rating of the element.

Only specimens 5- 11 are discussed in the report. Their construction and performance are summarized below in Table A2.

## A.6 Branz Report FP 6251

On 10 October 2017, Branz, NZ conducted a fire test in accordance with AS 1530.4-2014 on six penetrations through a symmetrical 2 hour steel-framed plasterboard wall. The wall was constructed from a 64 mm steel stud frame with two layers of 13 mm USG Boral Firestop plasterboard on each side, giving an overall thickness of 116 mm. Openings were made in the wall for specimens 1 to 4. Specimen 4 was a 60 mm thick Maxilite panel, providing local fire stopping for a further two penetrations. The openings were lined with two layers of 13 mm fire rated plasterboard to maintain the fire rating of the element.

Only specimens 4, 5 and 6 are discussed in this assessment report. Their construction and performance are summarized below in Tables A1 and A2.

## A.7 Exova Warringtonfire Report EWFA 51894700.1

On 13 April 2018, Exova Warrington Fire, VIC conducted a fire test in accordance with AS 1530.4-2014 on a 175mm thick concrete slab penetrated by various pipes and cables protected by Trafalgar FyreBOX Maxi and FyreBOX Mini, FyreBOX Cast-in penetration protection systems.

The test assembly comprised a nominal 1200mm long × 1200mm wide × 180mm thick concrete floor system. An 800mm × 375mm opening was located on the north section of the floor system. A 1000mm × 575mm × 60mm thick Maxilite board was installed on top of the opening.

Only specimen 1 and the support construction of the Maxilite board butt joint detail are discussed in this assessment report. Their construction and performance are summarized below in Tables A1 and A2.

## A.8 Exova Warringtonfire Report FRT 180357.1

On 8 October 2018, Exova Warrington Fire, VIC conducted a fire test in accordance with AS 1530.4-2014 on a section of a 75mm thick Hebel wall system with 11 varying service penetrations.

Only the support construction Maxilite board to Hebel wall perimeter detail is discussed in this assessment report. Its construction and performance are summarized below in Table A1.

## A.9 Exova Warringtonfire Report FRT 180392.1

On 27 November 2018, Exova Warrington Fire, VIC conducted a fire test in accordance with AS 1530.4-2014 on a 116mm thick plasterboard wall system penetrated by 10 varying penetration services.

Only specimens A, B and F are discussed in the report. Their construction and performance are summarized below in Table A2.

## A.10 Exova Warringtonfire Report FRT 180323.3

On 29 November 2018, Exova Warrington Fire, VIC conducted a fire test in accordance with AS 1530.4-2014 on a 78mm thick Speedpanel wall system penetrated by 18 services across 15 systems.

Only specimens L and G are discussed in this assessment report. Their construction and performance are summarized below in Tables A1 and A2.

## A.11 Exova Warringtonfire Report FRT 190292.1

On 16 January 2020, Exova Warrington Fire, VIC conducted a fire test in accordance with AS 1530.4-2014 on a 175mm thick concrete slab penetrated by various services.

Only specimens E1, E2 and E4 are discussed in the report. Their construction and performance are summarized below in Table A2.

## A.12 CSIRO Report FSP 1753

On 9 June 2016, CSIRO North Ryde conducted a fire test in accordance with AS 1530.4-2014 on five (5) service installations penetrating a 75-mm thick Hebel AAC panel wall system protected by various Trafalgar Fire passive fire stopping systems.

The wall system comprised a 75-mm thick Hebel autoclaved aerated concrete (AAC) panel wall system with an established fire resistance level (FRL) of -/90/90 as detailed in CSIRO test report FSV 0979. The top of the wall specimen incorporated a 150-mm thick reinforced concrete slab to simulate the soffit of a floor slab.

Only specimen 4 is discussed in the report. Its construction and performance are summarized below in Table A2.

## A.13 CSIRO Report FSP 1795

On 14 March 2016, CSIRO North Ryde conducted a fire test in accordance with AS 1530.4-2014 on four (4) service installations penetrating a 75-mm thick Hebel wall system protected by a combination of Trafalgar Fire passive fire stopping systems.

Only specimen 2 is discussed in the report. Its construction and performance are summarized below in Table A2.

## A.14 CSIRO Report FSP 1907

On 8 June 2018 CSIRO North Ryde conducted a fire test in accordance with AS 1530.4-2014 on a 1000 mm x 1000 mm Maxilite bulkhead containing various joint and perimeter details mounted centrally within a 1000-mm square opening in a 260 mm thick concrete slab.

The specimen's construction and performance are summarized below in Table A1 and the below table.

Specimen ID	Specimen details	Integrity	Insulation
1	Tapered board joint (0-5mm) behind a cover strip with FyreFLEX sealant	121NF	121NF
2	Tapered board joint (5-10mm) behind a cover strip without FyreFLEX sealant	55	31
3	Perimeter detail with steel angles and FyreFLEX sealant	121NF	60
4	Perimeter detail with steel angles and 30mm Maxilite cover strip	121NF	31

## A.15 CSIRO Report FSP 1913

On 10 July 2018 CSIRO North Ryde conducted a fire test in accordance with AS 1530.4-2014 on a 1200-mm x 1200-mm x 75-mm thick Hebel AAC panel wall system penetrated by two (2) FyreBOX Maxi sealing systems.

The wall system was constructed using two 600-mm wide Hebel AAC wall panels incorporating a tongue and groove vertical joint down the centre of the wall.

Only specimen 2 and the support construction of the Maxilite board to Hebel wall perimeter detail are discussed in this assessment report. Their construction and performance are summarized below in Tables A1 and A2.

## A.16 CSIRO Report FSP 1989 Rev.A

On 14 March 2019 CSIRO North Ryde conducted a fire test in accordance with AS 1530.4-2014 on an 1150-mm x 1150-mm x 60-mm thick Maxilite ceiling board (grey) fire stopping system penetrated by seven (7) service pipe penetrations.

Only specimens 1, 2, 5, 6, and 7 are discussed in the report. Its construction and performance are summarized below in Table A2.

## A.17 CSIRO Report FSP 1991 Rev.A

On 12 March 2019 CSIRO North Ryde conducted a fire test in accordance with AS 1530.4-2014 on two 1180-mm x 460-mm x 60-mm thick Maxilite boards, one grey (Grey) and one white in colour. Both boards incorporated a 25-mm wide x 305-mm long slot cut across at the centre line of each board type. The slot in each board was loosely filled with a ceramic fibre blanket material to prevent leakage of hot gases from the furnace chamber.

Both board types were supported along the short edges on top of 100-mm wide x 60-mm Maxilite packers and were unrestrained and free to deflect along the long edges. Gaps between the two boards and between the boards and the specimen frame were sealed with a ceramic fibre blanket.

Both the Grey and White Maxilite specimen was able to maintain integrity for 260 minutes with an applied dead load of 21.75kg at the centre of the board.

The following observations were made during the fire test:

Time into the test	Observations
60 minutes	No apparent change to the specimens.
180 minutes	Both boards appear to have deflected in towards the furnace.
240 minutes	No apparent change to the specimens.
242 minutes	A dead load of 2.9 kg was applied to the centre of both specimens, with no structural failure.
244 minutes	The dead load of 5.8 kg was applied to the centre of both specimens, with no structural failure.
253 minutes	The dead load of 11.75 kg was applied to the centre of both specimens, with no structural failure.
257 minutes	The dead load of 16.75 kg was applied to the centre of both specimens, with no structural failure.
260 minutes	The dead load of 21.75 kg was applied to the centre of both specimens, with no structural failure.
263 minutes	The dead load of 31.75 kg was applied to the centre of the grey (Grey) board, a crack has developed from the end of the slot to the edge of the board, and structural failure is noted.
265 minutes	Test Terminated.

## A.18 FSP 2016

On 27 April 2020 CSIRO North Ryde conducted a fire test in accordance with AS 1530.4-2014 on an 1150-mm x 1150-mm x 60-mm thick Maxilite ceiling board (Grey) fire stopping system penetrated by seven (4) service pipe penetrations.

Specimens 1, 2, 3 and 4 are discussed in the report. Their construction and performance are summarized below in Table A2.

## A.19 CSIRO Report FSP 2146

On the 17<sup>th</sup> of September 2020., CSIRO North Ryde conducted a fire test in accordance with AS 1530.4-2014 on four service penetrations installed through a 150-mm thick concrete slab. Specimens 1 and 3 are discussed in the report. Their construction and performance are summarized below in Table A2.

## A.20 Branz Report FP 11935-001a.1

On 14 August 2019, Branz, NZ conducted a fire test in accordance with AS 1530.4-2014 on a nominally 2,200 mm high by 1,000 mm wide by 116 mm thick steel stud wall lined with two layers of 13 mm thick USG Boral Firestop plasterboard on each face.

The wall was provided with two 550 mm x 550 mm apertures and fitted with seven pipe and cable penetrations. The upper aperture was lined on the unexposed face with a layer of 60 mm thick Maxilite board and included one cable tray and two copper pipe penetrations. 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 penetration.

Only specimens 1-3 and the joint detail and perimeter detail of the upper aperture are discussed in the report. Their construction and performance are summarized below in Tables A1 and A2.

## A.21 Warringtonfire Report FRT200397 R1.2

On 22 December 2020, Warrington Fire, VIC conducted a fire test that was stated to be in accordance with AS 1530.4-2014 on a 78mm Speedpanel wall penetrated by various services and protected with Trafalgar products.

Upon close inspection of FRT200397 R1.2 and its test photos, it was found that various services in this report were not reported in compliance with AS 1530.4-2014 and that specimens are placed in close proximity to each other.

However, the subject of this assessment, Specimen 10, was reported correctly and can thus be used in this assessment. Its construction and performance are summarized below in Table A2. The proximity issue will be addressed in Appendix B.

## A.22 Warringtonfire Report FRT220112

On 11 August 2022, Warringtonfire, VIC conducted a fire test in accordance with AS 1530.4-2014 on a section of a stud lined Corex wall penetrated by various services.

## A.23 Exova Warringtonfire EWFA 51288000.2

On 22 September 2017, Exova Warringtonfire, VIC conducted a fire test in accordance with AS 1530.4-2014 on a 75mm thick Hebel wall penetrated by various services and protected with Trafalgar products.

Specimens C1, C2, and C3 are discussed in the report. Their construction and performance are summarized below in Table A2.

## A.24 Table A1: Summary of support construction related test data

Report	Support construction	Fixing method	Sealant (H x W) (mm)	Maxilite board	Services	Integrity (minutes)	Insulation (minutes)	Comments
FR 3981 (K)	120mm thick concrete slab	M10 x 100mm masonry anchor 50mm in from each corner	10 x 10 Lorient intumescent sealant on unexposed side	30mm White Maxilite on fire side	320 x 220mm opening in slab 100mm overlap	241 NF	90 (max. temp.)	
FR 3981 (C)	120mm thick concrete slab	M13 x 100mm masonry anchor at 200mm cuts. 50mm in from the edge.		2 x 30mm White Maxilite board	2 x 30mm White Maxilite board with 10mm wide butt joint filled with 10mm deep mastic	195	159(max. temp. on butt joint)	TC 121 on top of 10mm wide butt joint At 195 minutes, a glow was visible at the butt joint.
FP 6251 (4)	2x13mm Firestop on each side of 64mm stud	8g x 100mm screw at max. 200mm ctrs into steel framing of the opening.	10 x 10 on the exposed side.	60mm Grey Maxilite on fire side	570 x 365mm opening in plasterboard-framed 100mm overlap penetrations in board	122NF	122NF (max. temp.)	

Report	Support construction	Fixing method	Sealant (H x W) (mm)	Maxilite board	Services	Integrity (minutes)	Insulation (minutes)	Comments
FRT 180323.3 (L)	78mm thick vertical Speedpanel	12g x 65mm metal screw at 350mm cts and 150mm cts	15 x 15 on unexposed side	40mm Grey Maxilite on non-fire side	500 x 405mm opening in Speedpanel-framed  100mm overlap	103	64(max. temp.) <60(Avg. temp.)	Integrity failure due to flaming at top of the board at mid width. Insulation failure at the centre of the board
EWFA 518947 00.1	175mm Concrete slab	M6 x 100mm masonry anchor at 400mm cts. For fixing Maxilite to slab.  8g x 40mm countersunk screw at 200mm cts. For fixing orbit board to Maxilite	Sealant filled butt joint	60mm Grey Maxilite on non-fire side	Butt joint is covered by 9mm orbit board  penetrations in board	240	133(max. temp.)	TC failed near Orbit board covering butt joint, all other TC on Maxilite near slab perimeter did not fail for 240 minutes.
FRT 180357.1 (F)	75mm single caged Hebel	10g x 100mm bugle head plasterboard screw at 250mm cts.	15 x 15 on the exposed side	60mm Grey Maxilite on fire side	250mm x 325mm hole in 75mm Hebel  100mm overlap  Penetrations in board	121	89(max. temp.)	Perimeter detail discussed only
FSP 1907	260mm thick concrete slab	6 x 40mm masonry anchors  And  12g x 65mm plasterboard screw	Nominal FyreFLEX sealant to the interface of Maxilite board and concrete	40mm thick Grey Maxilite on the fireside	1000mm x1000mm hole in the slab  Fixed to angles	120	120 (Max. Temp. Maxilite) 43 (Avg. Temp. Maxilite) 31-121 (Joint and perimeter details)	50 x 50 x 0.9mm steel angle to concrete at 500mm centres and to Maxilite at 200mm ctrs
FP 6202 (4)	2x13mm Firestop on each side of 64mm stud	10g x 100mm passivated steel bugle head plasterboard screw at 200mm cts	10 x 10 applied to wall and Maxilite	60mm Grey Maxilite on fire side	600 x 410mm hole in plasterboard wall  100mm overlap  Penetrations in board	122 NF	122NF (max. temp.)	TC 53 at 171°C rise at 120 minutes.
FSP 1913(2)	75mm single caged Hebel	10g x 100mm plasterboard screw at 350mm ctrs and 200mm cts	15 x 15 on unexposed side	60mm White Maxilite on non-fire side	550 x 250mm hole in 75mm Hebel  100mm overlap Penetrations in board	121NF	121NF	Perimeter detail only

Report	Support construction	Fixing method	Sealant (H x W) (mm)	Maxilite board	Services	Integrity (minutes)	Insulation (minutes)	Comments
FSP 1991	Test frame	NA	NA	60mm White and grey Maxilite on non-fire side	1180-mm x 4960-mm with slot cut in the board	240F	240NF	Weighted test
FP 11935-001a.1	2x13mm Firestop on each side of 64mm stud	10g x 100mm steel screw at 150mm cts.	Sealant filled joint and 15 x 15 fillet applied between Maxilite and plasterboard wall	60mm Grey Maxilite on non-fire side	675 x 675mm hole in plasterboard wall – framed 125mm overlap 5mm joint between Maxilite Penetrations in board	180NF	180NF	TC 25 at Maxilite joint only had 141°C temperature rise at 180 minutes TC 22 Failed on the plasterboard wall at 170 minutes TC 23 on the Maxilite board was max. 41°C rise at 180 minutes. Centre of the board at 172°C rise at 180 minutes.

A.25 Table A2: Summary of test data related to penetrations

Report	Support construction	Depth of FyreFLEX	Fillet (H x W) (mm)	Other protections	Services	Integrity (minutes)	Insulation (minutes)
NI 2689 (F)	75mm thick horizontal E core panel	Full depth in 6mm annular gap	50 x 50 on Non-fire side	None	6 x 4 bundle of 100 strand Telecom cables, 15mm Dia. With PVC sheathing and insulation	123NF	NA
NI 2689 (H)	75mm thick horizontal E core panel	30 depth in 20mm annular gap	50 x 50 on Non-fire side	2x25mm layers of Insugard	200mm x 2.3mm Copper	123NF	118 (on support construction)
NI 2689 (L)	75mm thick horizontal E core panel	Full depth in 6mm annular gap	50 x 50 Non-fire side	None	380mm Tray with 3 x 16mm OD 3C+E power cables. 6 x 100 strand telecom. Cables approximately 15mm Dia. 1x 46mm OD single core power, 1x 29mm OD 3C+E power. All were PVC sheathed and insulated	123NF	NA



Report	Support construction	Depth of FyreFLEX	Fillet (H x W) (mm)	Other protections	Services	Integrity (minutes)	Insulation (minutes)
FR 3981 (T(a))	2 x 30mm thick horizontal White Maxilite board	Full depth is less than 5mm annular gap	None	Abesco SS micro collar 25 mm on the exposed side	25mm OD x 1.9mm wall thickness PVC pipe	120NF	120NF
FR 3981(c)	2 x 30mm thick horizontal White Maxilite board	Full depth is less than 5mm annular gap	None	Abesco SS micro collar 32mm on the exposed side	36mm OD x 2mm wall thickness PVC pipe	120NF	120NF
FP 6202 (6)	60mm thick vertical Grey vertical Maxilite board	15mm depth in less than 5mm annular gap	None	65mm Fyrechoke collar on each side	69mm OD x 2.9mm wall thickness PVC pipe	122 NF	122 NF
FP 6202 (7)	60mm thick vertical Grey vertical Maxilite board	15mm depth in less than 5mm annular gap	None	50mm Fyrechoke collar on each side	55.8mm OD x 2.3mm wall thickness PVC pipe	122 NF	122 NF
FP 6202 (9)	60mm thick vertical Grey vertical Maxilite board	15mm depth in less than 5mm annular gap	None	25mm Fyrechoke collar on each side	26.8mm OD x 1.8mm wall thickness PVC pipe	122 NF	122 NF
FP 6202 (10)	60mm thick vertical Grey vertical Maxilite board	15mm depth in a 6 mm annular gap	None	32mm Fyrechoke collar on each side	32mm OD x 2.3mm wall thickness PVC pipe	122 NF	122 NF
FP 6202 (11)	60mm thick vertical Grey vertical Maxilite board	15mm depth in less than 5mm annular	None	40mm Fyrechoke collar on each side	43.4mm OD x 2mm wall thickness PVC pipe	122 NF	122 NF
FP 6251(6)	60mm thick vertical Grey vertical Maxilite board	Full depth is less than 5mm annular	None	80mm Fyrechoke collar on each side	83mm OD x 3.1mm wall thickness PVC pipe	122 NF	122 NF
FP 6251(6)	60mm thick vertical Grey vertical Maxilite board	Full depth is less than 5mm annular	None	100mm Fyrechoke collar on each side	110mm OD x 3.4mm wall thickness PVC pipe	122 NF	107 (failed on Maxilite)
FP 6202 (5)	60mm thick vertical Grey vertical Maxilite board	Fyrepex Full depth in less than 5mm annular	None	65mm diameter x 25mm deep steel sheath filled to full depth with Fyrepex sealant	20mm OD x 2.1mm wall thickness Pex pipe	122 NF	122 NF

Report	Support construction	Depth of FyreFLEX	Fillet (H x W) (mm)	Other protections	Services	Integrity (minutes)	Insulation (minutes)
FP 6202 (8)	60mm thick vertical Grey vertical Maxilite board	Fyreplex Full depth in less than 5mm annular	None	65mm diameter x 25mm deep steel sheath filled to full depth with Fyreplex sealant	20mm OD x 2.1mm wall thickness Pex Al Pex pipe	122 NF	49 (failed on pipe)
FP 11935-001 (1)	60mm thick vertical Grey Maxilite board	Full depth in 5mm annular gap	50 x 50 Each side before wrap	Twrap 1 layer at 420mm length on the exposed face, 1 layer at 600mm length on the unexposed face	100 x 1.65mm wall thickness copper pipe	180 NF	88 (Failed on Maxilite)
FP 11935-001 (2)	60mm thick vertical Grey Maxilite board	Full depth in 5mm annular gap	50 x 50 Each side before wrap	Twrap 2 layers at 420mm length on the exposed face 1 layer at 1100mm length and 2nd layer at 300mm on the unexposed face	150 x 1.8mm wall thickness copper pipe	180 NF	104 (Failed on Maxilite)
FP 11935-001 (3)	60mm thick vertical Grey Maxilite board	Full depth in 5-20mm annular gap	50 x 50 Each side before wrap	300mm Twrap each side	Appendix D1 cables on 300mm wide x 47mm deep cable tray	180 NF	144
EWFA 518947 00.1(1)	60mm thick horizontal Grey Maxilite board	Full depth in 10mm annular gap	None	2 x 30 x 50mm angle on all four sides of FyreBOX	FyreBOX Maxi protecting 10 x Flat 2.5mm <sup>2</sup> TPS power cable 10 x Cat 6e UTP Ethernet data cables 40mm copper pipe 25mm PVC conduit 32mm pex 16mm pex 32mm Pex al pex 16mm Pex al pex 50mm stainless steel pipe with EPS insulation	138	12
FRT 180392.1 (A)	116mm plasterboard lined stud wall	Full depth of plaster in 5-annular gap	50 x 50 Each side before wrap	350mm Twrap each side (100mm overlap)	50.8mm OD x 1.22mm wall thickness copper pipe	130NF	130NF
FRT 180392.1 (B)	116mm plasterboard lined stud wall	Full depth of plaster in 5-annular gap	50 x 50 Each side before wrap	300mm Twrap each side (no overlap)	50.8mm OD x 1.22mm wall thickness copper pipe	130NF	116

Report	Support construction	Depth of FyreFLEX	Fillet (H x W) (mm)	Other protections	Services	Integrity (minutes)	Insulation (minutes)
FRT 180392.1 (F)	116mm plasterboard lined stud wall	Full depth of plaster in 6-annular gap	15 x 15 Each side before wrap	400mm Twrap each side	114.65mm OD x 4.58mm wall thickness steel pipe	130NF	130NF
FRT 180323 (G)	78mm thick vertical Speedpanel	Full depth of remaining 30mm hole	30 x 30 Each side	None	2 x CAT6 cables 2 x 2.5mm <sup>2</sup> 2C+E electrical cables 2 x Firesense TPS cables	121 NF	121 NF
FSP 1753 (4)	75mm thick vertical Hebel panel	20mm depth in 8.5 mm annular gap	15 x 15 each side	300mm Twrap each side	48mm OD x 3.5mm thick steel pipe	121 NF	121 NF
FSP 1795 (2)	75mm thick vertical Hebel panel	15mm depth in 5 mm annular gap	30 x 30 each side	None	2 x 6.3mm CAT6 cables 2 x TPS cables	96	96
FSP 1913 (2)	60mm thick vertical White Maxilite board	Full depth in 10mm annular gap	None	2 x 30 x 50mm angle on all four sides of FyreBOX	Blank FyreBOX Maxi 350	121NF	35
FSP 1989 (1)	60mm thick horizontal White Maxilite	15mm depth	15 x 15 Non fireside	Fyrechoke collar on exposed side	110mm OD x 3.4mm wall thick PVC pipe	241NF	73
FSP 1989 (2)	60mm thick horizontal White Maxilite	15mm depth	15 x 15 Non fireside	Fyrechoke collar on exposed side	83mm OD x 3.3mm wall thick PVC pipe	241NF	151
FSP 1989 (5)	60mm thick horizontal White Maxilite	15mm depth	15 x 15 Non fireside	Fyrechoke collar on exposed side	69mm OD x 2.8mm wall thick PVC pipe	241NF	124
FSP 1989 (6)	60mm thick horizontal White Maxilite	15mm depth	15 x 15 Non fireside	Fyrechoke collar on exposed side	56mm OD x 2.8mm wall thick PVC pipe	241NF	103
FSP 1989 (7)	60mm thick horizontal White Maxilite	15mm depth	15 x 15 Non fireside	Fyrechoke collar on exposed side	43mm OD x 2.2mm wall thick PVC pipe	241NF	92

Report	Support construction	Depth of FyreFLEX	Fillet (H x W) (mm)	Other protections	Services	Integrity (minutes)	Insulation (minutes)
FRT 190292.1 (E1)	60mm thick horizontal White Maxilite	Full depth in 20-30mm annular gap	50 x 50 Non fireside	450mm Twrap on the unexposed side Loose mineral wool was used to fill the gap between wrap and service.	Appendix D1 cables on 315mm wide x 50mm deep cable tray	241NF	154 (on Maxilite next to Twrap)
FRT 190292.1 (E2)	60mm thick horizontal White Maxilite	Full depth in 19mm annular gap	30 x 30 non-fire side	800mm Twrap on the unexposed side	100 x 1.63mm wall thickness copper pipe	214	150 (on Twrap)
FRT 190292.1 (E3)	60mm thick horizontal White Maxilite	Full depth in the annular gap	30 x 30 non-fire side	1 <sup>st</sup> layer 1500mm and 2 <sup>nd</sup> layer 300mm of Twrap and 30mm White Maxilite collar on the unexposed side	150 x 1.63mm wall thickness copper pipe	28(flaming at first support)	138°C rise at 240min on 30mm White Maxilite
FRT 190292.1 (E4)	60mm thick horizontal White Maxilite	Full depth in 3mm annular gap	30 x 30 non-fire side	200mm Twrap on the unexposed side	M10 steel threaded rod	241NF	241NF
FSP 2106 (1)	60mm thick horizontal Grey Maxilite	Full depth in the annular gap	20 x 20 non-fire side	1 <sup>st</sup> layer 1500mm and 2 <sup>nd</sup> layer 300mm of Twrap and 30mm Grey Maxilite collar on the unexposed side with	DN150 x 2mm wall thickness copper pipe	230(flame between wrap)	240 (30mm Maxilite) 138°C rise on 30mm Grey Maxilite at 186min. 194 (Twrap) 216 (pipe)
FSP 2106 (2)	60mm thick horizontal Grey Maxilite	Full depth in the annular gap	20 x 20 non-fire side	600mm Twrap on the unexposed side	DN100 x 1.8mm wall thickness copper pipe	241NF	97(pipe) 108(wrap) 120 (Maxilite)
FSP 2106 (3)	60mm thick horizontal Grey Maxilite	Full depth in the annular gap	20 x 20 non-fire side	300mm Twrap on the unexposed side	DN 50 x 1.2mm wall thickness copper pipe	241NF	72(pipe) 164(wrap) 235 (Maxilite board)
FSP 2106 (4)	60mm thick horizontal Grey Maxilite	Full depth in annular gap	20 x 20 Non fireside	300mm Twrap on unexposed side	10CAT6, 10 Firesense TPS,	241NF	138 (sealant) 187 (Maxilite board)

Report	Support construction	Depth of FyreFLEX	Fillet (H x W) (mm)	Other protections	Services	Integrity (minutes)	Insulation (minutes)
FSP 2146 (1)	150mm concrete slab	60	30 x 30 Non fireside	600 Fyrewrap unexposed side	100mm x 1.6mm copper	142	133
FSP 2146 (4)	150mm concrete slab	60	30 x 30 Non fireside	600 Twrap unexposed side	100mm x 1.6mm copper	92	82
FRT 210025 H(1)	150mm concrete slab	60	50 x 50 Non fireside	450 Twrap unexposed side	113mm x 4.8mm steel	240NF	143 (Maxilite board)
FRT2003 97 R1.2 (10)	78mm SpeedPanel wall	120	50 x 50	300mm fire side 450mm non fire side	150mm x 4.9mm steel	241NF	119(pipe) 213(batt) 231(wrap)
EWFA 512880 00.2 (C1)	75mm Hebel wall	0	0	FyrePEX sealant to 60mm depth on unexposed side	25mm x 2.5mm Pex B PN 16 pipe	121NF	10
EWFA 512880 00.2 (C1)	75mm Hebel wall	0	0	FyrePEX sealant to 60mm depth on unexposed side	25mm x 3.5mm Pex A PN 20 pipe	121NF	121NF
EWFA 512880 00.2 (C1)	75mm Hebel wall	0	0	FyrePEX sealant to 60mm depth on unexposed side	25mm x 2.5mm Pex A Pex pipe	121NF	40

## A.26 Table A3: Summary of test data related to penetrations in floor/roof ceiling system

Test Report	Plasterboard Ceiling Specification	Service	Opening in the separating element	Maxilite	Service	Annular gap	Local Fire Stopping*	Sealant	FRL and RISF
RTL FT 1522.01 Specimen 4(1)	1 x 13mm & 1 x 16mm plasterboard with a 600mm cavity	350mm Cable Tray	600 x 200mm	Maxilite 60mm white, installed from below with 100mm overlap. Fixed into furring channels.	20 x CAT6 cable, 10 x 10mm TPS cables, 7 x 19mm OD 3C+E power cables	5-50mm	Top of Maxilite: 300mm Twrap with 2 foil tape, and 50mm overlap	30mm x 30mm Fyreflex sealant fillet and full depth Maxilite board	-/60/60 60min RISF
RTL FT 1553.2 Specimen 1	3 x 16mm plasterboard with a 550mm cavity	1D- NB100 Steel Pipe	350 x 500mm	Maxilite 60mm grey, installed from below with 100mm overlap. Fixed into furring channels.	100mm x 4.25mm steel pipe	≤ 5mm	Top of Maxilite: 450mm Twrap with 2 foil tape, and 50mm overlap	30mm x 30mm Fyreflex sealant fillet and full depth Maxilite board	- /120/120 60min RISF
		1E- ND50 Copper pipe			50mm x 1.3mm copper pipe	≤ 5mm			
		1F- 8 x CAT6 cables			8 x CAT 6 data cable	≤ 5mm			

## A.27 CSIRO Report FSH 2076

On 16 October 2019 CSIRO North Ryde conducted a fire test in accordance with AS 1530.4-2014 on a suspended bulkhead ceiling system comprising various Maxilite board types and joint details, protecting a steel framed floor system. A summary of temperature performance is shown in Tables A3 and A4 below.

Table A3: thermal performances of various Maxilite board detail

Specimen details	The thickness of the Maxilite board	Time to exceed 250 deg C – RISF	Time to exceed average temperate rise failure (140 K)	Time to exceed maximum temperature rise failure (180 K)
Detail 1 - Covered SHS cover strip over Maxilite A&C	30mm White Maxilite	Not applicable	Not applicable	116 minutes
Detail 2 - Covered SHS cover strip over Maxilite D&E	40mm White Maxilite	Not applicable	Not applicable	126 minutes

Detail 3 - Unexposed face of Maxilite C Ceiling (S13-17)	30mm Grey Maxilite	41 minutes	25 minutes	28 minutes
Detail 4 - Unexposed face of Maxilite A Ceiling (S24)	30mm White Maxilite	No data	No data	No data
Detail 5 - Unexposed face of Maxilite B Ceiling (S26-32)	30mm White Maxilite	44 minutes	31 minutes	34 minutes
Detail 6 - Unexposed face of Maxilite D Ceiling (S33)	40mm White Maxilite	132 minutes	Not applicable	110 minutes
Detail 7 - Unexposed face of Maxilite E Ceiling (S35-39)	40mm White Maxilite	63 minutes	44 minutes	50 minutes
Detail 8 - Unexposed face of Maxilite F Ceiling (S43-47)	40mm Grey Maxilite	57 minutes	31 minutes	35 minutes
Detail 9 - Unexposed face of Maxilite J Ceiling (S58-63)	40mm Grey Maxilite	46 minutes	36 minutes	35 minutes
Detail 10 - Unexposed face of Maxilite K Ceiling (S64-68)	40mm Grey Maxilite	46 minutes	30 minutes	34 minutes
Detail 11 - Unexposed face of Maxilite L Ceiling (S69-73)	40mm White Maxilite	68 minutes	45 minutes	53 minutes
Detail 12 - Unexposed face of Maxilite M Ceiling (S74-78)	40mm White Maxilite	68 minutes	46 minutes	53 minutes
Detail 13 - Unexposed face of Maxilite I Ceiling (S79-81)	40mm White Maxilite	79 minutes	49 minutes	58 minutes
Detail 14 - Unexposed face of Maxilite H Ceiling (S83-87)	40mm White Maxilite	71 minutes	47 minutes	55 minutes
Detail 15 - Unexposed face of Maxilite G Ceiling (S88-94)	40mm Grey Maxilite	54 minutes	31 minutes	35 minutes
Detail 16 - Unexposed face of Maxilite N Ceiling (S95-97)	40mm Grey Maxilite	74 minutes	33 minutes	38 minutes

**Table A4: thermal performances of various butt joint details**

Joints between Board	Maxilite board types	TC	Butt joint/Cover strip detail	Time to exceed maximum temperature rise failure (180 K)
On Maxilite C – 15-mm from butt Joint with Maxilite B midspan	30mm Grey	D18	5mm with 9mm orbit board exposed side	44
On Maxilite C – 15-mm from the Cover strip and Joint with A & B	30mm Grey	S21	5mm with 9mm orbit board exposed side	52
On Maxilite C – 15-mm from butt Joint with Maxilite D midspan	30mm Grey	S19	5mm with 30mm White Maxilite exposed side	76
On Maxilite C – 15-mm from the Cover strip and joint with D & E	30mm Grey	S20	5mm with 30mm White Maxilite exposed side	85
On Maxilite E – 15-mm from butt Joint with Maxilite C midspan	40mm White	S40	5mm with 30mm White Maxilite exposed side	82



Joints between Board	Maxilite board types	TC	Butt joint/Cover strip detail	Time to exceed maximum temperature rise failure (180 K)
On Maxilite E – 15-mm from butt Joint with Maxilite F midspan	40mm White	S42	5mm with 30mm Grey Maxilite exposed side	128
On Maxilite F – 15-mm from butt Joint with Maxilite E midspan	40mm Grey	S48	5mm with 30mm Grey Maxilite exposed side	75
On Maxilite F – 15-mm from the Cover strip and Joint with D & E	40mm Grey	S49	5mm with 30mm Grey Maxilite exposed side	92
On Maxilite F – 15-mm from steel angle and with wall mid span South	40mm Grey	S50	Free edge approx. 5-10mm With 15mm fillet of sealant	54
On Maxilite I – 15-mm from the cover strip and Maxilite H midspan	40mm White	S82	30mm Grey Maxilite unexposed side	NA
Detail 8 - Unexposed face of Maxilite F Ceiling	On steel angle horizontal leg mid span North	S52		60
Detail 7 – Unexposed face of Maxilite E Ceiling	On steel angle vertical leg mid span North	S53		NA
Detail 3 - Unexposed face of Maxilite C Ceiling	On steel angle horizontal leg mid span North	S54		55
Detail 5 - Unexposed face of Maxilite E Ceiling	On steel angle vertical leg mid span North	S55		53
Detail 15- Unexposed face of Maxilite G Ceiling	On Maxilite G – 15-mm from the cover strip and South midspan	S98	10-20mm gap covered by 30mm White Maxilite strip	38
	On steel angle (over G) horizontal leg mid span North next to the wall.	S99		99
	On steel angle (over joint G and H) horizontal leg North next to the wall.	S100		94
Detail 14 - Unexposed face of Maxilite H Ceiling	On Maxilite H – 15-mm from angle South midspan	S101		68
	On Maxilite H - 15-mm from cover strip South midspan	S102		56
Detail 13 - Unexposed face of Maxilite I Ceiling	On Maxilite I - 15-mm from cover strip South midspan	S103	10-15mm gap covered by 30mm Grey Maxilite strip	59
	On Maxilite I – 15-mm from angle South midspan	S104		71
Detail 14 - Unexposed face of Maxilite H Ceiling	On steel angle (over H) vertical leg mid	S105		130

Joints between Board	Maxilite board types	TC	Butt joint/Cover strip detail	Time to exceed maximum temperature rise failure (180 K)
	span North next to the wall.			
Detail 13 - Unexposed face of Maxilite I Ceiling	On steel angle (over l) vertical leg mid span North next to the wall.	S106		135

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# Appendix B Analysis of Variations

## B.1 Maxilite board as a floor-ceiling or roof ceiling system

### General system assessment method

This assessment relating to the assessment of floor ceilings, roof ceilings and ceilings only, is based on the relevant insulation criteria of AS 1530.4-2014, which are the average and maximum temperature rise.

This assessment additionally relates to the assessment of penetration seals and boxed arrangements of penetration seal elements that are generally small and fixed to the face of a wall or the underside of a floor. In this case, the insulation criteria of AS 1530.4-2014 section 10 are applied, being maximum temperature rise only.

The results are summarised in Section 5 of this report and it is made clear which section of AS1530.4-2014 has been used to determine the fire resistance performance stated.

### System performance

The proposed Maxilite floor-ceiling or roof-ceiling system shall be evaluated under the integrity and insulation criteria relevant to the constructions outlined in AS 1530.4 – 2014 Section 4 clause 4.3.4 and clause 4.3.6. The FRL is applied through the Maxilite ceiling membrane to the top of the floor or roof system above the Maxilite ceiling membrane. The resistance to incipient spread (RISF) is not normally required for this type of application. The proposed construction is shown in Figures 1-11 and 34.

It is required that

- The fire exposure is from below the Maxilite ceiling (element 4) to the top of the floor (element 1 or 2)
- The construction of the Maxilite ceiling (element 4) shall comprise
  - Either one or more sheets of up to 2040mm long x 1220mm wide x 30mm, 40mm or 60mm thick Grey Maxilite board or
  - One or more sheets of up to 1500mm long x 1000mm wide x 30mm, 40mm or 60mm thick White Maxilite board
  - Any fixings to be a minimum of 50mm away from Maxilite board edge or to be nominally centered on the steel angle
  - Maxilite board can be angle fixed to vertical support construction as shown in Figure 3
  - Maxilite board can be angle fixed to vertical and horizontal support construction as shown in Figure 4
  - The vertically orientated side of the board can only comprise a single board from top to bottom (i.e. only vertical joints are allowed between two vertically orientated boards)
  - The inclusion of Plastic Skeleton Connectors made from LDPE between metal angles shown in Figures 26a-26d
- It is required that the structural steel section supporting the Maxilite boards (Figure 5a and 5b) with or without support rods, have a  $H_p/A$  less than that for a 50x50x3 SHS and be designed in accordance with AS 4100-2021 for a structurally critical temperature of 340°C for Figures 5a and 5b for up to 120 minutes.
- The walls (element 3a, 3b, 3c or 3d) shall have the required FRL without the assistance of the ceiling (element 4) and provide the required support to the floor (element 1 or 2) and Maxilite ceiling (element 4)
- The floor (element 1) may be non-fire-rated construction and designed to support the ceiling (element 4) or services as required by design.
- The floor (element 2) shall be of fire-rated construction and have the required FRL without the assistance of the ceiling (element 4) and provide the required support for the ceiling (element 4).

The proposed construction is a floor ceiling or roof ceiling system that comprises one or more layers of Maxilite board with a minimum of 30, 40 or 60mm thickness, spanning across walls under a fire rated or non-fire rated floor structure as shown in Figure 1.

The proposed construction and the related junction details only differ from the tested construction in FSH 2076 in the following manner:

- The inclusion of a floor or roof construction with independent FRL independent of the Maxilite ceiling
- The inclusion of floor or roof construction above with or without independent FRL

The floor structure tested in FSH 2076 comprised mostly steel joists with a single timber joist spaced at 450mm centres and topped with 15mm thick compressed fibre cement floor sheeting. The side of the floor structure in the plenum space was exposed. The distance from the bottom of the steel joist to the face of the Maxilite board was around 300mm. The unexposed face of the floor structure did not fail integrity or insulation for at least 120 minutes. The bottom face of the timber joist measured a sharp rise in temperature at 131 minutes due to the formation of a large opening in the Maxilite ceiling below. At 120 minutes, the underside of the timber joint measured a temperature of 207°C. The ceiling air temperature above the 40mm white Maxilite board E and the 40mm grey Maxilite board F was 233°C at 120 minutes, which is a 208°C temperature rise. The ceiling air temperature above the 40mm white Maxilite board C and the 30mm grey Maxilite board D was 205°C at 120 minutes, which is a 180°C temperature rise.

The significance of FSH 2076 demonstrated that a mix of 30mm and 40mm grey and white Maxilite ceiling hung and spanned across various distances, are able to keep the plenum space between the floor structure and the ceiling cool for at least 120 minutes. With the addition of any floor/roof system with or without the required FRL independent of the Maxilite ceiling, the unexposed side of the floor/roof system would be able to maintain structural adequacy, integrity and insulation for up to 120 minutes when exposed to fire from below the Maxilite ceiling.

#### ***Inclusion of 15mm thick Corex Board as cover strip***

The proposed construction comprises replacing 9mm Orbit board with min. 15mm thick x 100mm wide Corex Board (900kg/m<sup>3</sup>) as a cover strip for up to 120 minute applications.

With reference to FRT220112, a section of 40mm thick Corex solid wall was penetrated with various services. When exposed to fire, the Corex board was able to remain intact on the fire side for the 120 minutes duration of the test.

This gives confidence that when fixed to the proposed construction as a cover strip, the Corex board will remain in place on the fire and non fire side for up to 120 minutes.

Based on the above, it is expected that the 15mm thick Corex board will not detrimentally affect the performance of the proposed system discussed above for up to 120 minutes.

#### **Resistance to Incipient Spread of fire**

The RISF criteria in section 4 require that the perimeter and joint details of a ceiling not exceed a temperature rise of 250°C temperature.

With reference to FSH 2076, at 120 minutes the underside of the timber joint closest to the Maxilite ceiling measured a temperature of 207°C. The Maxilite surface temperatures are shown in Table B1 below.

**Table B1: RISF performance of Maxilite ceiling tested in FSP 2076 away from joints and junctions**

Maxilite	Time to failure(minutes)					
	White Maxilite			Grey Maxilite		
	30mm	40mm	60mm	30mm	40mm	60mm
AS 1530.4 – 2014 Clause 4.9.1 RISF maximum temperature exceeds 250°C	44 minutes	63 -71 minutes	NA	41 minutes	46 -74 minutes	NA

Based on the performance of the 30mm and 40mm Grey and White Maxilite board, it is reasonably conservative to expect the increase in board thickness from 40mm to 60 mm is sufficient to give confidence that the 60mm thick Grey and White Maxilite will achieve a RISF of up to 60 minutes.

***The RISF performance of White and Grey boards Junction Figure 4 - AS 1530.4 – 2014 Section 4***

The proposed construction in Figure 4 Detail A was tested in FSH 2076, where a 40mm vertical grey Maxilite board butted up to a 30mm horizontal grey Maxilite board. The thermocouple measuring the inside unexposed angle TC 54 was reading a temperature rise of 192°C at 120 minutes.

The proposed construction would all have either the same or thicker Maxilite board on the vertical faces or a thicker Maxilite board on the horizontal faces of this junction detail. It is therefore expected that the measured temperature would be similar to or less than that tested in FSH 2076.

Based on the above, it is expected that the proposed construction will achieve a RISF of up to 60 minutes when tested in accordance with AS 1530.4 – 2014.

***The RISF performance of White and Grey boards details Figures 3 and 4 - AS 1530.4 – 2014 Section 4***

The proposed construction in Figure 3 was tested in FSH 2076, with the 30mm grey Maxilite board to wall junction able to remain under 250°C for 59 minutes.

The proposed 30mm, 40mm and 60mm thick white Maxilite board and 40mm and 60mm thick grey Maxilite board are expected to be able to improve the insulation performance of this junction.

The proposed construction in Figure 4b is similar to Figure 3b except for the minimum 40mm thick Maxilite board is hung vertically instead of spanning horizontally. It is expected that with the same fixing of the angle to the slab above and similar sealant details, the angle or the Maxilite board on the unexposed side would perform similarly to that in Figure 3.

Based on the above, it is expected that the proposed construction will achieve a RISF of up to 30 and 60 minutes based on design when tested in accordance with AS 1530.4 – 2014.

***The RISF performance of White and Grey boards Figure 6 - AS 1530.4 – 2014 Section 4***

The proposed system with 30mm or 40mm grey and white Maxilite board butt joint cover by 30mm Maxilite board or 9mm thick orbit board was tested FSH 2076. The RISF performance of these junctions is shown in Table B1 above.

Based on the performance of the 30mm and 40mm Grey and White Maxilite board, it is conservative to expect that the 60mm thick Grey and White Maxilite will achieve a RISF of up to 60 minutes.

The proposed 15mm thick Corex board cover strip has a density of 900kg/m<sup>3</sup> which is in between that of the tested 30mm Maxilite board at 330kg/m<sup>3</sup> or 9mm thick orbit board at 1015kg/m<sup>3</sup>. By observation of the board density and thickness, it is expected that the proposed 15mm thick Corex board will be able to provide thermal resistance that's between the Maxilite board and the orbit board. Therefore, it is expected that it allow the proposed construction to achieve the same RISF as when covered with Maxilite board or orbit board

Based on the above, the proposed construction will be able to achieve the performance as per Table B2 when tested in accordance with AS 1530.4 – 2014.

**Table B2: Maxilite ceiling performance**

Criteria in accordance with AS 1530.4 -2014 Section 4	White Maxilite			Grey Maxilite		
	30mm	40mm	60mm	30mm	40mm	60mm
FRL	120/120/120					
RISF (minutes)	30	60	60	30	30	60

**Inclusion of service penetrations in the system**

The proposed floor-ceiling or roof-ceiling system shall have a minimum of 60mm thickness across all the entire face of the Maxilite ceiling membrane which can be penetrated by services. It may include services that penetrate the system in the following cases

- a) Wall (element 3a, 3b, 3c or 3d) and Maxilite ceiling (element 4) as shown in Figures 1 and 2a.
  - o Services shall be protected at the wall (element 3a, 3b, 3c or 3d) and Maxilite ceiling (element 4) with systems listed in Sections 3.7 and 3.8
  - o Floor/roof may be non-fire rated (element 1) or fire rated (element 2)
- b) Non-fire-rated roof/floor construction (element 1) and Maxilite ceiling (element 4) Figures 1 and 2a.
  - o Services shall be protected at the Maxilite ceiling (element 4) with systems listed in Section 3.8
  - o The gap between the roof/floor (element 1) and services shall be sealed at the unexposed side of the roof/floor (element 1) with at least a 15mm fillet of Trafalgar FyreFLEX sealant
- c) Floor construction with the required FRL (element 2) and Maxilite ceiling (element 4) as shown in Figures 1, 2b, 2c, 2d
  - o Services shall be protected at the floor (element 2) and Maxilite ceiling (element 4) with systems listed in Section 3.8
- d) Maxilite ceiling (element 4) only as shown in Figures 1, 2a, 2b, 2c, 2d
  - o Services shall be protected at the Maxilite ceiling (element 4) with systems listed in Section 3.8
  - o The floor or roof construction above the ceiling may be non-fire-rated (element 1) or fire rated (element 2)

It is required that

- Maxilite ceiling (element 4) shall not support the weight of any service penetrations. All services shall be supported from above independently of the ceiling.
- Services shall be spaced by a minimum of 40mm

**Case a)**

It is required the floor ceiling/roof ceiling is bounded by fire resistant wall construction (element 3a, 3b, 3c or 3d ). It is also required that the penetration in the Maxilite ceiling membrane is treated with the required fire protection treatment when fire exposure is from below. The performance of the service penetrations through horizontal Maxilite boards will be dealt with in Section B.6.

Therefore, the proposed system in Figures 1 and 2a would be similar to the tested system in FSH 2076 except the plenum space now contains services that may potentially increase the plenum space air temperature. Given the margin of the insulation of the tested floor system in FSH 2076 and the required 200mm clearance, it is expected proposed fire rated or non-fire rated floor/roof system will still be able to maintain insulation for 120 minutes.

### Case b)

The proposed construction is similar to case a) except the floor/roof structure is penetrated by the services. It is also required that the penetration in the Maxilite ceiling membrane is treated with the required fire protection treatment when fire exposure is from below. The performance of the service penetrations through horizontal Maxilite boards will be dealt with in Section B.6.

Provided that the gap between the services and the roof/floor structure is sealed with the proposed 15mm fillet of sealant, it is expected that the unexposed side of the floor or roof construction will be able to maintain insulation for at least 120 minutes.

### Case c)

It is required that the penetration in the floor construction with the required FRL is treated with the required fire protection treatment when fire exposure is from below. It is also required that the penetration in the Maxilite ceiling membrane is treated with the required fire protection treatment when fire exposure is from below. The performance of the service penetrations through horizontal Maxilite boards will be dealt with in Section B.6.

Therefore, the proposed system would be similar to the tested system in FSH 2076 except the plenum space now contains services that may potentially increase the plenum space air temperature. Given the margin of the insulation of the tested floor system in FSH 2076, and the required 200mm clearance, it is expected proposed fire rated floor/roof system will still be able to maintain insulation for 120 minutes.

### Case d)

It is required that the penetration in the Maxilite ceiling membrane is treated with the required fire protection treatment when fire exposure is from below. The performance of the service penetrations through horizontal Maxilite boards will be dealt with in Section B.6.

Therefore, the proposed system would be similar to the tested system in FSH 2076 except the plenum space now contains services that may potentially increase the plenum space air temperature. Given the margin of the insulation of the tested floor system in FSH 2076 and the required 200mm clearance, it is expected proposed fire rated or non-fire rated floor/roof system will still be able to maintain insulation for 120 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014.

## B.2 Maxilite board as a ceiling system

The proposed Maxilite ceiling system shall be evaluated under integrity and insulation criteria relevant to the constructions outlined in AS 1530.4 – 2014 Section 4 clause 4.3.7. The FRL is applied through the Maxilite ceiling membrane only. The proposed construction is shown in Figures 12-14, 5-11, 15 – 17 and 33.

It is required that

- The fire exposure is from either side of a Maxilite ceiling (element 4) in two primary cases where separation involves two or three compartments as shown in Figures 12 and 13
- The construction of the Maxilite ceiling (element 4) shall comprise
  - Be non-trafficable and non-loadbearing
  - Either one or more sheets of up to 2040mm long x 1220mm wide x minimum 60mm thick Grey Maxilite board (made from 2 x 30mm or 2 x 40mm or 1 x 60mm layer of Maxilite board)
  - One or more sheets of up to 1500mm long x 1000mm wide x minimum 60mm thick White Maxilite board (made from 2 x 30mm or 2 x 40mm or 1 x 60mm layer of Maxilite board)



- Any fixings to be a minimum of 50mm away from Maxilite board edge or to be nominally centered on the steel angle
- Maxilite board can be angle fixed to vertical support construction as shown in Figure 15
- Maxilite board can be angle fixed to vertical and horizontal support construction as shown in Figure 16
- The vertically orientated side of the board can only comprise a single board from top to bottom (i.e., only vertical joints are allowed between two vertically orientated boards)
- In one, two or three-sided forms of construction as shown in Figures 14a, 14b and 14c.
- The inclusion of Plastic Skeleton Connectors made from LDPE between metal angles shown in Figures 26a-26d
- It is required the floor (element 2) shall be of fire-rated construction and have the required FRL without the assistance of the ceiling (element 4) or wall (element 3a, 3b, 3c or 3d) and provide the required support for the ceiling (element 4). Where the ceiling (element 4) requires support from the floor (element 2) above, the support rods shall be protected for the full FRL period or designed for full fire exposure
- It is required that the structural steel section supporting the Maxilite boards (Figure 17a ) with or without support rods, have a Hp/A less than that for a 50x50x3 SHS and be designed in accordance with AS 4100-2021 for a structurally critical temperature of 340°C for Figure 17a for up to 120 minutes.

#### **System performance when the fire is from below the Maxilite ceiling**

The proposed construction is a ceiling membrane that comprises one or more layers of Maxilite board with a minimum of 60mm thickness spanning across walls under a fire rate floor structure as shown in Figures 12 and 13. Fire exposure is from below the Maxilite ceiling.

The proposed construction and the related junction details only differ from the tested construction in FSH 2076 in the following manner:

- The replacement of the tested floor system with a floor (element 2) that is of fire-rated construction and have the required FRL without the assistance of the ceiling (element 4) or wall (element 3a, 3b, 3c or 3d) and provide the required support for the ceiling (element 4)

#### ***General integrity performance of Maxilite ceiling system away from joints***

With reference to FSH 2076, a fire test in accordance with AS 1530.4-2014 was conducted on a suspended bulkhead ceiling system comprising various Maxilite board types and joint details, protecting a steel framed floor system. The largest span of White Maxilite tested was 1500mm x 1000mm and the largest span of Grey Maxilite tested was 2000mm x 1160mm.

It was observed that Maxilite board B which comprised a 1500mm x 1000mm x 30mm horizontally orientated White Maxilite was able to remain intact at the end of the 136 minute test. Maxilite boards M and L were 1500mm x 1000mm x 40mm vertically orientated White Maxilite was also able to remain intact.

It was observed that the Maxilite board E which comprised 40mm White Maxilite boards was in between the two Grey Maxilite boards C and F which collapsed, and therefore was pulled apart partially due to their connections rather than due to its own weakness.

The above test demonstrated that the 30mm and 40mm White Maxilite boards, when under tension either through being suspended vertically or spanned horizontally, were able to remain intact and not form gaps for up to 120 minutes.

It was also observed that vertically orientated Maxilite boards J and K which comprised 1500mm x 1200mm x 40mm thick Grey Maxilite boards were also able to remain intact by the end of the 136 minute test.

However, Maxilite board C which comprised 1185mm x 1142mm x 30mm Grey Maxilite board and Maxilite Board F which comprised 1185mm x 1142mm x 40mm Grey Maxilite board as well as Maxilite board G which comprised a 2000mm x 1160mm x 40mm thick Grey Maxilite all collapse by the end of the test.

It is observed that the thermocouple S54 measuring the steel angle raised rapidly after 125 minutes. It is observed that the thermocouples S56 and S57 measuring the ceiling air temperature above joint C&E and E&F respectively both raised rapidly after 130 minutes.

From the temperature profile of the 30mm Grey Maxilite (Detail 3) thermocouples, is evident that the 30mm Grey Maxilite board started to break up around 130 minutes, with the quarter point thermocouples increasing rapidly in temperature followed by the other thermocouples at the perimeter and the joint between Maxilite board C&E.

All the other specimen's thermocouple temperatures raised after this point as the furnace gas was able to breach into the ceiling plenum space.

Based on the above, it can be established that 30mm Grey Maxilite was able to remain intact for up to 120 minutes before crack formation which led to the catastrophic failure at 130 minutes.

The proposed 60mm Maxilite was not tested in the full scale test. However, from comparing the performance of the 30mm and 40mm White Maxilite board in FSH 2076, it is apparent that a greater thickness allows the board to stay intact for longer.

Confidence for the structural capacity of the 60mm Maxilite is given in the pilot test FSP 1991 Rev.A. With reference to FSP 1991 Rev.A, the specimen comprised two 1180-mm x 460-mm x 60-mm thick horizontally orientated Maxilite boards, one Grey and one White in colour. Both boards incorporated a 25-mm wide x 305-mm long slot cut across at the centre line of each board type. The slot in each board was loosely filled with a ceramic fibre blanket material to prevent leakage of hot gases from the furnace chamber. Both board types were supported along the short edges on top of 100-mm wide x 60-mm Maxilite packers and were unrestrained and free to deflect along the long edges. Gaps between the two boards and between the boards and the specimen frame were sealed with a ceramic fibre blanket. A dead load was applied to the centre of each specimen after 240 minutes. Both the Grey and White Maxilite specimen was able to maintain integrity and insulation for 240 minutes. Both the White and Grey Maxilite board were able to maintain structural adequacy when a load of 21.75kg was applied to the centre of the board at 260 minutes.

This test demonstrated that despite the presence of weight on the board which would result in similar deflection and stress placed on the Maxilite board when tested in full size, the Grey and White Maxilite board were able to remain intact for at least 120 minutes when installed as a ceiling.

Based on the above, it is expected that the proposed size for the 60mm thick White and Grey Maxilite board will be able to remain intact and maintain integrity for up to 120 minutes based on the design when tested in accordance with AS 1530.4 -2014 section 4.

#### ***The general insulation performance of Maxilite ceiling away from joints***

The insulation criteria for the Maxilite board as a ceiling system in accordance with AS 1530.4 - 2014 Sections 4 clause 4.3.7 is when the average temperature rise of the Maxilite board exceeds 140°C and the maximum temperature rise of the Maxilite board exceeds 180°C.

Table B3 summarises the time to insulation failure for Grey and White Maxilite board in various tests in accordance with the temperature rise criteria of AS 1530.4 - 2014 Section 4.

**Table B3: Maxilite boards tested insulation performance in accordance with AS 1530.4 – 2014 Clause 2.13.3(a)**

Maxilite	Time to failure(minutes)					
	White Maxilite			Grey Maxilite		
	30mm	40mm	60mm	30mm	40mm	60mm
<b>Report</b>	FR 3981 K	NA	FSP 1991 Rev.A	NA	FSP 1907	FSP 1991 Rev.A
Average temperature rise exceeds 140°C	52	NA	213	NA	43	184
Average temperature rise exceeds 180°C	102	NA	265NF	NA	121NF	265NF

When installed as a ceiling system, the temperature on the Maxilite board will be hotter compared to when tested as an open to air system. With a larger margin on insulation, it is expected that 60mm White and grey Maxilite when tested as a ceiling system will be able to maintain insulation for up to 120 minutes. Table B4 below summarises the time to insulation failure for the Grey and White Maxilite board in accordance with the RISF criteria of AS 1530.4 - 2014 Section 4.

#### Resistance to Incipient Spread

For the ceiling system discussed above, since they meet the insulation criteria of under 180°K temperature rise at 120 minutes, they will also meet the RISF criteria of under 250°C at 60 minutes.

At 120 minutes, the underside of the timber joint closest to the Maxilite ceiling measured a temperature of 207°C. Based on the above, the proposed construction will be able to maintain integrity and insulation and RISF as per Table B4 when tested in accordance with AS 1530.4 – 2014.

**Table B4: Maxilite ceiling performance away from joints and junctions**

Criteria in accordance with AS 1530.4 -2014 Section 4	White Maxilite	Grey Maxilite
	Min. 60mm thick	Min. 60mm thick
FRL	-/120/120	
RISF (minutes)	60	60

#### **Integrity and insulation performance of White and Grey boards steel structural support - Figures 5 and 6.**

The proposed ceiling system construction comprises protected steel structural support joining more than 1 layer of 60mm thick Maxilite board as shown in Figure 5.

With reference to FSH 2076, Detail 1 comprised an 800-mm long, 50-mm x 50-mm x 3-mm square hollow section (SHS) protected by a Maxilite board supporting a joint between two 30-mm thick Maxilite White boards (A and B). The SHS was clad on all four sides as well as both ends using a 30-mm thick Maxilite White board and was suspended from the floor structure using two M10 threaded rods at 450-mm centres. The protected support was fixed to the Maxilite ceiling boards using 800-mm long x 80-mm x 50-mm x 0.9-mm galvanised steel angles located on each side of the support. The steel angle was screw fixed to the support and then the boards were fixed to the angle from the exposed side, using 8g x 65-mm long screws at nominal 200-mm centres.

This detail reached a maximum temperature rise of 180°K at 116 minutes. The specimen was still intact by the end of the 136 minutes.

With reference to FSH 2076, Detail 2 comprised an 800-mm long, 50-mm x 50-mm x 3-mm SHS protected by a Maxilite board supporting a joint between two 40-mm thick Maxilite White boards (D and E). The SHS was clad on all four sides as well as both ends using a 30-mm thick Maxilite White

board and was suspended from the floor structure using two M10 threaded rods at 450-mm centres. The protected support was fixed to the Maxilite ceiling boards using an 800-mm long x 80-mm x 50-mm x 0.9-mm galvanised steel angle located on each side of the support. The steel angle was screw fixed to the support and then the board were fixed to the angle from the exposed side, using 8g x 65-mm long screws at nominal 200-mm centres.

This detail reached a maximum temperature rise of 180°K at 126 minutes. The specimen was still intact by the end of the 136 minutes.

The above tests demonstrate that the proposed detail in Figure 5 would allow 30mm and 40mm thick White Maxilite board to remain suspended for 136 minutes without detrimentally affecting the structural capacity of the SHS that's holding the ceiling system together.

The proposed construction comprises the inclusion of a 60mm White and Grey Maxilite board in place of the 30mm grey Maxilite board and 40mm White Maxilite board. The thicker Maxilite board is expected to improve the insulation performance of the detail.

The proposed construction also comprises the joints in the Maxilite board to be sealed with FyreFLEX sealant and covered by a 9mm orbit board or 30mm Grey or White Maxilite board. It is expected that the additional protection over the joints will be able to improve the performance of the detail.

Based on the above, the proposed construction will not detrimentally affect the integrity and insulation performance of the construction discussed in Section B1 when tested in accordance with AS 1530.4 – 2014.

#### ***Integrity performance of White and Grey boards at joint details – Figures 15, 16, 17 and 7***

The proposed construction comprised 60mm thick Maxilite board with joint details as shown in Figures 15, 16, 17 and 7

The proposed details in Figures 15, 16 and 7 were tested with 30mm and 40mm thick White and Grey Maxilite board in FSH 2076 and were able to hold together without forming gaps for up to 120 minutes as shown by the steady temperature rises around these junctions for up to 130 minutes.

The proposed construction comprises the inclusion of a 60mm White and Grey Maxilite board in place of the 30mm and 40mm White and Grey Maxilite board. The thicker Maxilite board is expected to improve the rigidity of the junction detail and thus improve the integrity performance of the detail.

The proposed construction in Figure 17 is similar to Figure 15 except the 60mm thick board is hung vertically instead of spanning horizontally.

It is expected that when hanging vertically, the Maxilite board will be under tension, which may result in board cracking at the joints or across the board.

With reference to FSH 2076, 40mm thick x 1500mm long x 1200mm wide Grey Maxilite boards and 40mm thick x 1500mm long x 1100mm wide White Maxilite boards were hung vertically from Unistrut support.

From the thermocouple readings on these boards and at the top of the board junctions, it can be concluded that no joints opened up and the boards were able to remain intact for at least 120 minutes.

The proposed construction comprises the inclusion of a 60mm White and Grey Maxilite board in place of the 40mm White and Grey Maxilite board. The thicker Maxilite board is expected to improve the rigidity of the junction detail and thus improve the integrity performance of the detail.

Based on the above, it is expected that the proposed construction will not detrimentally affect the integrity performance of the 60mm thick Maxilite board for up to 120 minutes based on design when tested in accordance with AS 1530.4 – 2014.

#### ***The insulation performance of White and Grey boards Junction Figure 16 - AS 1530.4 – 2014 Section 4***

The insulation criteria in section 4 require that the perimeter and joint details of a ceiling not exceed a temperature rise of 180°K temperature.

The proposed construction in Figure 16 was tested in FSH 2076, where a 40mm vertical grey Maxilite board butted up to a 30mm horizontal grey Maxilite board. The thermocouple measuring the inside unexposed angle TC 54 was reading a temperature rise of 192°K at 120 minutes. The proposed construction would result in a 50-100% increase in Maxilite thickness, which would provide more insulation to the angle and thus allow the angle temperature to be below 180°K rise at 120 minutes.

Based on the above, it is expected that the proposed construction will not detrimentally affect the insulation performance of the proposed 60mm thick Maxilite ceiling system for up to 120 minutes based on when tested in accordance with AS 1530.4 – 2014.

#### ***The insulation performance of White and Grey boards details in Figures 15 and 17 - AS 1530.4 – 2014 Section 4***

The insulation criteria in section 4 require that the perimeter and joint details of a ceiling not exceed a temperature rise of 180°K temperature.

The proposed construction in Figure 15 is similar to Figure 16 except the Maxilite board is fixed to a more stable wall structure which would result in less stress at the junction. This would allow less gap formation at the junction leading to a cooler L-angle temperature.

The proposed construction in Figure 17 is similar to Figure 15 except the 60mm thick board is hung vertically instead of spanning horizontally. It is expected that with the same fixing of the angle to the slab above and similar sealant details, the angle or the Maxilite board on the unexposed side would perform similarly to that in Figure 15.

Based on the above, it is expected that the proposed construction will not detrimentally affect the insulation performance of the proposed 60mm thick Maxilite ceiling system for up to 120 minutes based on when tested in accordance with AS 1530.4 – 2014.

#### ***The insulation performance of White and Grey boards Figure 6 - AS 1530.4 – 2014 Section 4***

The insulation criteria in section 4 require that the joint and perimeter details of the ceiling not exceed 180°K temperature rise.

The proposed construction in Figure 6 with a minimum 30mm thick Maxilite board as a cover strip was tested in FSP 1907 specimen 1. The specimen comprised a 40mm Grey Maxilite board butt joint protected on the fireside with a 30mm strip of Grey Maxilite board and seal with sealant on the fireside and in the butt joint. The specimen was able to maintain integrity and insulation for 121 minutes without any signs of failure.

The proposed 60mm Maxilite would increase the insulation performance of this junction which would act to balance out the higher surface temperature of the board when tested in a ceiling space.

The proposed construction in Figure 6 with a minimum 9mm thick orbit board was tested in EWFA 51894700.1. The specimen comprised a 60mm Grey Maxilite board that had a butt joint that was covered on the unexposed side by a 100mm wide x 9mm thick orbit board which was fixed with 8g x 40mm long screws. The FyreFLEX sealant was applied to the underside of the orbit board. Thermocouple 17 which was located 25mm from the orbit board on the 60mm Grey Maxilite, measured an insulation failure at 133 minutes. Thermocouple 18 which was located on the orbit board did not fail insulation for the 240 minutes duration of the test.

The above tests show that the 9mm orbit board and the 30mm Grey Maxilite board strip are both able to allow a butt joint in the Maxilite board to maintain insulation for up to 120 minutes.

The proposed construction also comprises joints in the vertically orientated boards. It is expected that the joint detail would also be able to maintain insulation for up to 120 minutes.

Based on the above, it is expected that the proposed junction details will not detrimentally affect the insulation performance of the 60mm thick Maxilite ceiling for up to 120 minutes when tested in accordance with AS 1530.4 – 2014.

The proposed 15mm thick Corex board cover strip has a density of 900kg/m<sup>3</sup> which is in between that of the tested 30mm Maxilite board at 330kg/m<sup>3</sup> or 9mm thick orbit board at 1015kg/m<sup>3</sup>. By observation of the board density and thickness, it is expected that the proposed 15mm thick Corex board will be able to provide thermal resistance that's between the Maxilite board and the orbit board. Therefore, it is expected that it allow the proposed construction to achieve the same insulation performance as when covered with Maxilite board or orbit board.

Based on the above, it is expected that the proposed ceiling construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014.

### Resistance to Incipient Spread

For the joint details discussed above, since they meet the insulation criteria of under 180°K temperature rise at 120 minutes, they will also meet the RISF criteria of under 250°C at 60 minutes.

Based on the above, the proposed construction will be able to maintain RISF for up to 60 minutes when tested in accordance with AS 1530.4 – 2014.

### Structural adequacy of steel beams supporting the ceiling membrane

The proposed structure supporting the Maxilite ceiling(element 4) with or without suspension rods is shown in Figures 5a, 5b and 17a

With reference to FSH 2076, a fire test in accordance with AS 1530.4-2014 was conducted on a suspended bulkhead ceiling system with two protected 50 x 50 x 3 SHS sections. The temperatures measured in these sections are as shown below;

Detail # in FSH 2076	Steel Section	Maxilite Protection	The temperature at 120 minutes
1	50 x 50 x 3mm SHS	30mm white	340°C
2	50 x 50 x 3mm SHS	40mm white	200°C

With reference to the relative RISF results for each thickness of Grey and White Maxilite, it is considered reasonable and conservative that the above results for 30mm white Maxilite would apply to 30mm, 40mm and 60mm white and 40mm and 60mm grey Maxilite.

Detail 2 is more protected than detail 1 and as such, it is considered reasonable and conservative that had a 60mm white or grey Maxilite been used in Detail 1 or 2 a temperature of less than 340°C would have been reached.

With reference to AS 4100-2021 clause 12.8, the period of structural adequacy can be determined from a single test where specific criteria are met.



## 12.8 Determination of PSA from a single test

The PSA determined in accordance with AS 1530.4 from a single test may be applied without modification provided —

- (a) the fire protection system is the same as the prototype;
- (b) the fire exposure condition is the same as the prototype;
- (c) the fire protection material thickness is equal to or greater than that of the prototype;
- (d) the surface area to mass ratio is less than or equal to that of the prototype;
- (e) the conditions of support are the same as the prototype and the restraints are not less favourable than those of the prototype; and
- (f) the ratio of the design load for fire to the design capacity of the member is less than or equal to that of the prototype.

The proposed construction includes a requirement that the structural steel section supporting the Maxilite boards (Figures 5a, 5b and 17a ) with or without support rods, have a  $H_p/A$  less than that for a 50x50x3 SHS and be designed in accordance with AS 4100-2021 for a structurally critical temperature of 340°C for Figures 5a, 5b and 17a for up to 120 minutes.

By observation, it is confirmed that clauses 12.8 a) to f) are met by the proposed construction and the above requirement.

Based on the above, it is confirmed the proposed construction will maintain the support of the ceiling if tested in accordance with AS 1530.4-2014 for up to 120 minutes.

### **System performance when fire exposure is above Maxilite ceiling**

The proposed construction is a ceiling system that comprises one or more layers of Maxilite board with a minimum of 60mm thickness spanning across walls under a fire rate floor structure as shown in Figures 12 and 13. Fire exposure is from above the Maxilite ceiling.

When fire exposure is from above the ceiling, the heat and flame would come through openings in the wall from another fire compartment. Compared to when fire exposure is below the Maxilite ceiling, the fire exposure from above the ceiling would be less severe.

Therefore, for the majority of the details discussed for when fire exposure is below the Maxilite ceiling, its integrity and insulation performance would be applicable when fire exposure is above the Maxilite ceiling for up to 120 minutes.

The only exception is the direct exposure of the angles to the furnace heat when fire exposure is above the Maxilite ceiling. The angle is expected to thermally expand when heated and may cause the L junction between the Maxilite board to open up leading to earlier integrity and insulation failure.

With reference to FSH 2076, the angle was tested on the exposed side of the ceiling construction in a similar configuration and was able to maintain integrity for up to 120 minutes as demonstrated by the temperature profile of the thermocouples located near the top cover strips not showing any sudden spike in temperature near the L junction.

Based on the above, it is expected that the proposed ceiling construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014.

### **Inclusion of service penetrations in the system**

The proposed ceiling system shall have a minimum 60mm thick Maxilite ceiling membrane which can be penetrated by services. It may include services that penetrate the system in the following cases:

- a) Wall (element 3a, 3b, 3c or 3d) and Maxilite ceiling (element 4) as shown in Figures 12, 14a, 14b, and 14c.



- Services shall be protected at the Maxilite ceiling (element 4) with systems listed in Sections 3.7 and 3.8
- Services shall be protected at the wall (element 3a, 3b, 3c or 3d) between fire compartment 1 and fire compartment 2 with systems listed in Section 3.7
- Services through the wall (element 3a, 3b, 3c or 3d) between fire compartment 2 and fire compartment 3 may pass through untreated openings in the wall (element 3a, 3b, 3c or 3d)
- b) Wall (element 3a, 3b, 3c or 3d) and Maxilite ceiling (element 4) as shown in Figures 13, 14a, 14b, and 14c.
  - Services shall be protected at the Maxilite ceiling (element 4) with systems listed in Section 3.8
  - Services through the wall (element 3a, 3b, 3c or 3d) between fire compartment 1 and the extension of fire compartment 1 may pass through untreated openings in the wall (element 3a, 3b, 3c or 3d)

It is required that the services

- May pass through untreated openings in one or both of the walls (element 3a, 3b, 3c or 3d) from one fire compartment to another fire compartment only
- The permissible services are listed in Tables 3, 6, 8 and 10
- Maxilite ceiling (element 4) shall not support the weight of any service penetrations. All services shall be supported independently of the ceiling.
- Services shall be spaced by a minimum of 40mm

In both case a) and case b) it is assumed that the penetration in the Maxilite ceiling is treated with the required treatment when fire exposure is from below. The performance of the service penetrations through Maxilite boards will be dealt with in Sections B.5 and B.6.

The proposed construction would also require a fire attack from above the Maxilite board. It is required that the proposed service treatment methods for horizontal Maxilite detailed in Section 3.8 of this report be applied in a mirrored manner to the underside of the Maxilite board.

Provided that these services are protected with non-reactive passive fire protection materials which won't be affected by the lower heat exposure in its functionality, it is expected that the unexposed side of the Maxilite board and services will perform similarly when fire exposure is from below the Maxilite board.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014.

#### ***Plastic Skeleton Connectors***

The proposed variation comprise the use of Plastic Skeleton Connectors made from LDPE between metal angles shown in Figures 26a-26d.

The LDPE Plastic Skeleton Connectors acts to connect parts of the steel angles together during installation. It is expected that the low melting point of LDPE, at approximately 115°C, will soften in the early stage of heat exposure to the boxed out construction, and allow the angle to expand as required.

Based on the above, it is expected that the proposed variation will not detrimentally affect the integrity and insulation performance of the proposed construction for up to 120 minutes based on design when tested in accordance with AS 1530.4 – 2014.

## B.3 Maxilite board as a flat penetration seal

The proposed Maxilite flat penetration seal shall be evaluated under integrity and insulation criteria relevant to the constructions outlined in accordance with AS 1530.4-2014 Section 10. The proposed construction is shown in Figures 9, 18 – 23.

It is required that

- Wall and floor separating elements supporting the penetration seals shall be supported by a test, assessment or appropriate design to achieve the required FRL when including an opening.
- The penetration seal shall comprise a minimum of 60mm thick Maxilite board (made from 2 x 30mm or 2 x 40mm or 1 x 60mm layers of grey or white Maxilite board).
- For 120 minute applications
  - Maxilite boards either butt up to the opening or overlap the opening in walls and floors
  - The size of the opening is up to 1.62m<sup>2</sup> with or without joints
  - Where flat boards are face fixed over an aperture in walls or floors (overlapping by 100mm) with a joint, no cover strip at the butt joint is required
  - Where flat boards are fitted within apertures in walls or floors, cover strips at the butt joint are required
  - Refer to Figures, 18, 18a, 19, 20, 21, 21a, 21b and 6
- For 180 minute applications
  - Maxilite boards shall overlap the opening in walls and floors
  - When butt joint or cuts in the board are permitted introduced, two layers of min. 30mm Maxilite boards to be arranged in the manner as shown in Figure 21c aperture shall be covered with a single sheet up to up to 1.62m<sup>2</sup> in size
  - Refer to Figures 18, 19, 21
- For 240 minute applications
  - Where Maxilite board shall only be installed on top of a slab where the fire is from below only.
  - When butt joint or cuts in the board are permitted introduced, two layers of min. 30mm Maxilite boards to be arrange in the manner as shown in Figure 21c aperture shall be covered with a single sheet up to up to 1.62m<sup>2</sup> in size
  - Refer to Figure 18, 21c
- Maxilite board can be fixed to support construction as shown in Figures 15 – 21c
- All services passing through the wall shall be supported independently of the Maxilite board.
- General construction as shown in Figures 9, 18-23
- Penetrations in Maxilite board shall be limited to the zone shown in Figure 34
- Services shall be spaced by a minimum of 40mm

### ***Integrity performance of White and Grey Maxilite penetration seal away from joints***

The proposed Maxilite penetration seal construction comprises one complete sheet of Maxilite board covering an opening in a concrete/masonry wall, plasterboard lined stud wall, Hebel wall systems or in a concrete slab.

With reference to FSH 2076, a fire test in accordance with AS 1530.4-2014 was conducted on a suspended bulkhead ceiling system comprising various Maxilite board types and joint details, protecting a steel framed floor system. The largest span of White Maxilite tested was 1500mm x 1000mm and the largest span of Grey Maxilite tested was 2000mm x 1160mm.

As discussed above in Section B1, the 30mm and 40mm Grey and White Maxilite Board demonstrated their ability to remain intact for up to 120 minutes away from the joints.

The proposed 60mm Maxilite was not tested in the full scale test. However, from comparing the performance of the 30mm and 40mm White Maxilite board, it is apparent that a greater thickness allows the board to stay intact for longer.

Confidence for the structural capacity of the 60mm Maxilite is given in the pilot test FSP 1991 Rev.A. With reference to FSP 1991 Rev.A, the specimen comprised two 1180-mm x 460-mm x 60-mm thick horizontally orientated Maxilite boards, one Grey and one White in colour. Both boards incorporated a 25-mm wide x 305-mm long slot cut across at the centre line of each board type. The slot in each board was loosely filled with a ceramic fibre blanket material to prevent leakage of hot gases from the furnace chamber. Both board types were supported along the short edges on top of 100-mm wide x 60-mm Maxilite packers and were unrestrained and free to deflect along the long edges. Gaps between the two boards and between the boards and the specimen frame were sealed with a ceramic fibre blanket. A dead load was applied to the centre of each specimen after 240 minutes. Both the Grey and White Maxilite specimen was able to maintain integrity and insulation for 240 minutes. Both the White and Grey Maxilite board were able to maintain structural adequacy when a load of 21.75kg was applied to the centre of the board at 260 minutes.

This test demonstrated that despite the presence of weight on the board which would result in similar deflection and stress placed on the Maxilite board when tested in full size, the Grey and White Maxilite board were able to remain intact for at least 240 minutes when covering an opening.

Based on the above, it is expected that the proposed size for the 60mm thick White and Grey Maxilite board will be able to remain intact and maintain integrity for up to 240 minutes based on design when tested in accordance with AS 1530.4 -2014.

***The insulation performance of White and Grey Maxilite boards away from joints – AS 1530.4 – 2014 Section 10***

The proposed construction comprises White and Grey coloured Maxilite boards with a thickness of 60mm.

With reference to test report FSP 1991 Rev.A, the specimen comprised two 1180-mm x 460-mm x 60-mm thick horizontally orientated Maxilite boards, one Grey and one White in colour. Both boards incorporated a 25-mm wide x 305-mm long slot cut across at the centre line of each board type. The slot in each board was loosely filled with a ceramic fibre blanket material to prevent leakage of hot gases from the furnace chamber. Both board types were supported along the short edges on top of 100-mm wide x 60-mm Maxilite packers and were unrestrained and free to deflect along the long edges. Gaps between the two boards and between the boards and the specimen frame were sealed with a ceramic fibre blanket. Both the Grey and White Maxilite specimen was able to maintain a maximum temperature rise of less than 180°C for 240 minutes.

This demonstrated that the White and Grey Maxilite were similar in insulation performance. The Grey Maxilite plateaued at around 80 minutes while the White Maxilite plateaued at 150 minutes towards 170°C. Neither White nor Grey showed any integrity weakness for up to 240 minutes. It can be concluded that up to 150 minutes White Maxilite performs slightly better than Grey Maxilite in terms of insulation performance.

Based on the above, it is expected that the 60mm White and Grey Maxilite will be able to maintain a maximum temperature rise of less than 180°C for up to 240 minutes when tested in accordance with AS 1530.4 -2014.

***The insulation performance of White and Grey boards overlapping a concrete slab – Figure 18 – AS 1530.4 – 2014 Section 10***

The insulation criteria in section 10 require that the penetration seal not exceed 180°C temperature rise.

***Board on the non-fire side as shown in Figure 18***

The proposed construction comprises a full sheet of Maxilite board 60mm thick fixed to the top side of the slab opening and sealed with a 15mm fillet of FyreFLEX sealant on the outer perimeter of the board as shown in Figure 18.

With reference to EWFA 51894700.1 Penetration 1 which comprised a 60mm thick x 1000mm long x 575mm wide grey board covering an 800mm x 375mm opening. The board was fixed to the unexposed side of a 175mm thick slab with M6 x 100mm masonry anchors at 400mm centres. 10mm x 10mm FyreFLEX sealant sealed on the external perimeter on the non-fire side.

The thermocouples which measured the perimeter of the Maxilite board 25mm from the concrete were able to maintain insulation for up to 240 minutes. No integrity failure was observed at the perimeter of the board for 240 minutes duration of the test.

It is observed that White Maxilite generally performs better in insulation performance than Grey Maxilite.

Therefore, the insulation performance of the Grey Maxilite board and White Maxilite board when it is installed on the unexposed side of the slab.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation at the perimeter seal for up to 240 minutes when tested in accordance with AS 1530.4 – 2014. A summary of the insulation performance of the Maxilite board is shown in Table B4.

#### Board on fireside as shown in Figure 18a

The proposed construction comprises a full sheet of Maxilite board of 60mm thickness fixed to the underside of the slab opening and sealed with a 15mm fillet of FyreFLEX sealant on the outer perimeter of the board as shown in Figure 18a.

With FR 3981 specimen C, two layers of 30mm thick White Maxilite board total of 60mm thick x 1200mm long x 600mm wide were installed in a 120mm thick concrete slab covering a 1000mm x 400mm hole. The board was fixed to the exposed side of the slab with M12 x 100mm masonry anchors at 200mm centres. Sealant sealed on the internal perimeter on the non-fire side.

Thermocouple 89 which measured the perimeter of the board 25mm from the concrete reached a maximum temperature rise of more than 180°C at 189 minutes into the test. No integrity failure was observed at the perimeter of the board for 241 minutes duration of the test.

It was observed in FSP 1991 that White Maxilite performs better than Grey Maxilite by approximately 15 minutes in terms of insulation performance up to 120 minutes.

It was observed in FSP 1991 that White Maxilite performs similarly to Grey Maxilite in terms of insulation performance after 120 minutes. It is expected that the 60mm Grey Maxilite will achieve at least 120 minutes of insulation performance at the perimeter.

The proposed construction comprises sealant on the outer perimeter of the board instead of the inner perimeter of the opening. It is expected that this will function in a similar to prevent the venting of furnace gas.

Based on the above, with a margin of 69 minutes in insulation performance, it is expected that the proposed construction will be able to maintain integrity and insulation at the perimeter seal for up to 120 minutes when tested in accordance with AS 1530.4 – 2014. A summary of the insulation performance of the Maxilite board is shown in Table B4.

#### ***Perimeter performance of White and Grey boards overlapping a masonry/concrete wall - Figure 19 – AS 1530.4 – 2014 Section 10***

##### Fire on the side opposite to the overlap as shown in Figure 19

The proposed construction comprises a full sheet of Maxilite board 60mm thick fixed to the wall with fire on the opposite side of the board overlap and sealed with a 15mm fillet of FyreFLEX sealant on the outer perimeter of the board and the inner perimeter of the opening as shown in Figure 19.

The proposed Figure 19 is similar to figure 18 except the board is orientated in a vertical position. It is expected that with the same fixing and sealant detail, the above discussions for Figure 18 are applicable to Figure 19 when fire exposure is on the side opposite the board overlap.

Fire on side of the overlap as shown in Figure 19

The proposed construction comprises a full sheet of Maxilite board 60mm thick fixed to the wall with fire on side of the board overlap and sealed with a 15mm fillet of FyreFLEX sealant on the outer perimeter of the board and the inner perimeter of the opening as shown in Figure 19.

With FR 3981 specimen C, two layers of 30mm thick White Maxilite board total of 60mm thick x 1200mm long x 600mm wide were installed in a 120mm thick concrete slab covering a 1000mm x 400mm hole. The board was fixed to the exposed side of the slab with M12 x 100mm masonry anchors at 200mm centres. The sealant is sealed on the internal perimeter of the opening.

Thermocouple 89 which measured the perimeter of the board 25mm from the concrete opening reached a maximum temperature rise of more than 180°C at 189 minutes into the test. No integrity failure was observed at the perimeter of the board for 241 minutes duration of the test.

It is expected that the addition of the sealant from the internal perimeter on the opening to the outer board perimeter will result in a more effective seal. It is expected the thermocouples on the board 25mm from the inner perimeter of the opening will be able to maintain insulation performance for up to 180 minutes.

It was observed in FSP 1991 that White Maxilite performs similarly to Grey Maxilite after 150 minutes. It is expected that the 60mm Grey Maxilite will also achieve at least 180 minutes of insulation performance at the perimeter.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation at the perimeter seal for up to 180 minutes when tested in accordance with AS 1530.4 – 2014. A summary of the insulation performance of the Maxilite board is shown in Table B4.

**Table B4: Summary of the insulation performance of whole Maxilite board installed in masonry/concrete wall or concrete slab**

Location	Maximum Maxilite board size	Insulation performance (minutes)		Integrity (minutes)	FRL
		White Maxilite	Grey Maxilite	White/Grey Maxilite	
		60mm	60mm	60mm	
Board performance away from joints	NA	240	240	240	NA
At the perimeter as per Figure 19		180	180	240	NA
<b>Overall performance of Maxilite board with perimeter details shown in Figure 19</b>	1000mm x 1000mm	<b>180</b>	<b>180</b>	<b>240</b>	<b>60mm</b> -/180/180
At perimeter as per Figure 18		240	240	240	NA
<b>Overall performance of Maxilite board with perimeter details shown in Figure 18</b>	1000mm x 1000mm	<b>240</b>	<b>240</b>	<b>240</b>	<b>60mm</b> -/240/240
At perimeter as per Figure 18a		180	120	240	NA

Location	Maximum Maxilite board size	Insulation performance (minutes)		Integrity (minutes)	FRL
		White Maxilite	Grey Maxilite	White/Grey Maxilite	
		60mm	60mm	60mm	
Overall performance of Maxilite board with perimeter details shown in Figure 18a	1000mm x 1000mm	180	120	240	<u>60mm</u> -/120/120

**Perimeter performance of White and Grey boards overlapping plasterboard lined walls – Figure 20 - AS 1530.4 – 2014 Section 10**

The insulation criteria in Section 10 require that the penetration seal not exceed 180°K temperature rise.

The proposed construction comprises a full sheet of Maxilite board of a total of 60mm thick fixed to the fireside or non-side of plasterboard lined wall opening and sealed with a 15mm fillet of FyreFLEX sealant on the outer perimeter of the board and the inner perimeter of the opening as shown in Figure 20.

With reference to FP 6251 (4), a layer of 60mm thick x 770mm wide x 565mm high Grey Maxilite board was fixed to the exposed side of a 570mm wide x 365mm high opening in plasterboard lined wall with 10g screws at 200mm centres into the steel stud frame. 10mm FyreFLEX sealant was applied at the outer perimeter of the board. The Maxilite board did not reach a maximum temperature rise of greater than 180°K for the 122 minutes duration of the test. There was no integrity failure associated with the perimeter of the penetration seal for up to 122 minutes.

With reference to FP 6202 (4), a layer of 60mm thick x 800mm wide x 610mm high Grey Maxilite board was fixed to the exposed side of a 600mm wide x 410mm high opening in plasterboard lined wall with 10g screws at 200mm centres into the steel stud frame. 10mm FyreFLEX sealant was applied at the outer perimeter of the board. The Maxilite board did not reach a maximum temperature rise of greater than 180°K for the 122 minutes duration of the test. There was no integrity failure associated with the perimeter of the penetration seal for up to 122 minutes.

With reference to FP 11935-001a.1, a layer of 60mm thick x 800mm wide x 800mm high Grey Maxilite board was fixed to the unexposed side of a 675mm wide x 675mm high opening in plasterboard lined wall with 10g screws at 150mm centres into the steel stud frame. 15mm FyreFLEX sealant was applied at the outer perimeter of the board. The Maxilite board did not reach a maximum temperature rise of greater than 180°K for the 180 minutes duration of the test. The thermocouple on the sealant between the Maxilite board and the plasterboard measured a maximum temperature rise of 180°K at 170 minutes. There was no integrity failure associated with the perimeter of the penetration seal for up to 180 minutes.

It was observed in FSP 1991 that White Maxilite performs better than Grey Maxilite by approximately 15 minutes in terms of insulation performance up to 120 minutes. Therefore, the insulation performance of Grey Maxilite can be applied to the White Maxilite

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation at the perimeter seal for up to 120 minutes when tested in accordance with AS 1530.4 – 2014. A summary of the insulation performance of the Maxilite board is shown in Table B5.

**Perimeter performance of White and Grey boards overlapping plasterboard shaft walls Figure 20 - AS 1530.4 – 2014 Section 10**

The insulation criteria in section 10 require that the penetration seal not exceed 180°K temperature rise.



The proposed construction comprises a full sheet of Maxilite board of a total of 60mm thick fixed to the fireside or non-fire side of a plasterboard shaft wall (CH-stud type only) opening and sealed with 15mm fillet of FyreFLEX sealant on the outer perimeter of the board and the inner perimeter of the opening as shown in Figure 20.

The proposed plasterboard shaft wall type is similar to the tested plasterboard wall as discussed above. It is expected that the deflection of the shaftliner wall would be similar to the plasterboard lined stud wall.

Therefore, it is expected that the fixity of the Maxilite board to the proposed wall types will be similar to the plasterboard lined wall such the fire resistance at this junction will be the same as that discussed above.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation at the perimeter seal for up to 120 minutes when tested in accordance with AS 1530.4 – 2014. A summary of the insulation performance of the Maxilite board is shown in Table B5.

**Table B5: Summary of the insulation performance of Maxilite board installed in plasterboard and plasterboard shaft walls.**

Location	Maximum Maxilite board size	Insulation performance (minutes)		Integrity (minutes)	FRL
		White Maxilite	Grey Maxilite	White/Grey Maxilite	
		60mm	60mm	60mm	
Board performance away from joints	800mm wide x 800mm high	240	240	240	NA
<b>Overall performance of Maxilite board with perimeter details shown in Figure 20</b>		<b>120</b>	<b>120</b>	<b>120</b>	<b><u>60mm</u> -/120/120</b>

**Perimeter performance of White and Grey boards overlapping a Hebel wall - Figure 19 - AS 1530.4 – 2014 Section 10**

The insulation criteria in section 10 require that the penetration seal not exceed 180°K temperature rise.

The proposed construction comprises a full sheet of Maxilite board of a total of 60mm thick fixed to the fireside or non-side of plasterboard lined wall opening and sealed with 15mm fillet of FyreFLEX sealant on the outer perimeter of the board and the inner perimeter of the opening as shown in Figure 19.

With FRT 180357.1 specimen F, a layer of 60mm thick x 450mm wide x 530mm high Grey Maxilite board was fixed to the exposed side of a 250mm wide x 325mm high opening in a 75mm thick single caged Hebel wall with 10g x 100mm screws at 250mm centres. 15mm FyreFLEX sealant was applied at the outer perimeter of the board. There was no integrity failure associated with the perimeter of the penetration seal for up to 121 minutes. One of the perimeter thermocouples of the board at the opening measured a temperature rise of greater than 180°K at 89 minutes.

The other perimeter thermocouple only reached a temperature rise of greater than 180°K at 118 minutes. The first failure at 89 minutes is then associated with hot gases instead of general board temperature. The proposed addition of intumescent to the inner perimeter of the opening will delay the temperature rise at this location and thus allow this location to maintain insulation for at least 90 minutes.

With FSP 1913 specimen 2, a layer of 60mm thick x 750mm wide x 450mm high White Maxilite board was fixed to the unexposed side of a 550wide x 250mm high opening in a 75mm thick single caged



Hebel wall with 10g x 100mm screws at 200 - 350mm centres. The opening was lined with a 75mm x 50 x 1.2mm slotted channel on all four sides. 15mm FyreFLEX sealant was applied at the outer perimeter of the board. There was no integrity failure associated with the perimeter of the penetration seal for up to 121 minutes.

Based on the observation of nonfireside fixing of Maxilite in a concrete slab and plasterboard wall discussed above, it is expected that the insulation performance of the Maxilite board, when fixed onto the unexposed side, is at least 30 minutes better than when it is fixed onto the fireside.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation at the perimeter seal for up to 90 minutes when tested in accordance with AS 1530.4 – 2014. A summary of the insulation performance of the Maxilite board is shown in Table B6.

**Table B6: Summary of the insulation performance of the whole Maxilite board installed in the Hebel wall**

Location	Maximum Maxilite board size	Insulation performance (minutes)		Integrity (minutes)	FRL
		White Maxilite	Grey Maxilite	White/Grey Maxilite	
		60mm	60mm	60mm	
Board performance away from joints		240	240	240	NA
<b>Overall performance of Maxilite board with perimeter details shown in Figure 19</b>	750mm wide x 450mm high	<b>90</b>	<b>90</b>	<b>120</b>	<b><u>60mm</u> -/90/90</b>

***Perimeter integrity performance of White and Grey boards butting up to an opening in a wall or a floor – Figures 22 and 23 - AS 1530.4 – 2014 Section 10***

The proposed construction comprised a 60mm thick Maxilite board fixed to an opening in the various walls that are orientated in the same manner as the proposed Figure 22 when exposed to fire from below and Figure 23 when exposed to fire from either side.

The proposed detail in Figure 22 was tested in FSH 2076 Detail 15 and was able to hold together without forming gaps for up to 120 minutes as shown by the steady temperature rises around these junctions for up to 130 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity at the perimeter seal for up to 120 minutes.

The proposed Figure 23 is similar to the proposed Figure 22 except the Maxilite board is orientated vertically instead of spanning horizontally.

It is expected that when hanging vertically, the Maxilite board will be under tension, which may result in board cracking at the joints or across the board.

With reference to FSH 2076, 40mm thick x 1500mm long x 1200mm wide Grey Maxilite boards and 40mm thick x 1500mm long x 1100mm wide White Maxilite boards were hung vertically from Unistrut support.

From the thermocouple readings on these boards and at the top of the board junctions, it can be concluded that no joints opened up and the boards were able to remain intact for at least 120 minutes.

The proposed construction comprises the inclusion of a 60mm White and Grey Maxilite board in place of the 40mm White and Grey Maxilite board. The thicker Maxilite board is expected to improve the rigidity of the junction detail and thus improve the integrity performance of the detail.

Based on the above, it is expected that the proposed construction will not detrimentally affect the integrity performance of the 60mm thick Maxilite board for up to 120 minutes based on design when tested in accordance with AS 1530.4 – 2014.

***Perimeter insulation performance of White and Grey boards butting up to an opening in a wall or a floor – Figures 22 and 23 - AS 1530.4 – 2014 Section 10***

The insulation criteria in section 10 require that the penetration seal not exceed 180°K temperature rise.

The proposed construction shown in Figure 22 is similar to the perimeter detail as tested in FSP 1907, specimen 3 except with the addition of a 30mm thick Maxilite strip on the fireside and the inclusion of a thicker 60mm thick Grey and White Maxilite fixed to a masonry/concrete wall with steel angle on non-fireside and sealant on the fireside.

With reference to FSP 1907, specimen 3 comprised a 40mm Grey Maxilite board fixed to a masonry opening with an angle on the unexposed side and sealant on the exposed side. The angle failed insulation at 60 minutes.

Specimen 4 comprised a 40mm Grey Maxilite board fixed to a masonry opening with an angle on the unexposed side and a 30mm thick strip of Grey Maxilite board on the exposed side. The angle failed insulation at 31 minutes.

The significance of the above test demonstrates that sealant is crucial in preventing hot gas from heating up the angle.

Also, it is expected that when a 30mm thick Maxilite strip or 9mm orbit board is added to the exposed side of specimen 3, it will provide up to 60 minutes of insulation performance so as to slow down the heating of the angle such that it will maintain insulation for up to 90 minutes.

The proposed variation included the 60mm thick Maxilite board with a 30mm Maxilite strip or 9mm orbit board. It is expected that the 50% increase in main Maxilite board thickness from 40mm to 60mm, combined with the additional 30mm Maxilite strip or 9mm orbit board, will still allow the angle on the unexposed side to maintain insulation for up to 120 minutes.

Based on the above, it is expected that the proposed construction will not detrimentally affect the insulation performance of the 60mm thick Maxilite board for up to 120 minutes when tested in accordance with AS 1530.4 – 2014.

The proposed Figure 23 is similar to the proposed Figure 22 except the Maxilite board is orientated vertically instead of spanning horizontally.

It is expected that the horizontal position puts more load on the fixings than when in a vertical position and so makes the junction shown in Figure 22 more onerous than that in Figure 23. Therefore, the above discussions are applicable to Figure 23.

Based on the above, it is expected that the proposed construction will not detrimentally affect the insulation performance of the 60mm thick Maxilite board for up to 120 minutes when tested in accordance with AS 1530.4 – 2014.

***Integrity and insulation performance of butt joints with no cover strip over face fixed White and Grey Maxilite boards - Figure 21 - AS 1530.4 – 2014 Section 10***

The proposed construction comprises a 60mm thick Maxilite board faced fixed to support construction and joined together in a 5 - 10mm wide butt joint that is fully filled with FyreFLEX sealant as per Figure 21.

These joints are not considered control joints, rather they are butt joints resulting from the practical installation of penetrations like cable trays.

#### *Butt joint when face fixed to a concrete floor*

With FR 3981 specimen C, two layers of 30mm thick White Maxilite board with a total of 60mm thickness and 1200mm long x 600mm wide were installed horizontally in a concrete slab covering a 1000mm x 400mm hole. The board had a 200mm long section of 10mm wide butt joint filled with 10mm deep mastic. The thermocouple No. 121 which was placed on the top of the butt joint measured insulation at 159 minutes into the test, and a red glow was observed at the joint at 195 minutes.

When tested to AS 1530.4 -2014, thermocouple 121 would not have been placed on the butt joint but next to it and therefore would have measured a cooler temperature.

With up to 15 minutes of margin on integrity and 39 minutes margin on insulation, it is expected that the Maxilite butt joint in the board will be able to maintain integrity for up to 180 minutes and insulation for up to 120 minutes when tested in accordance with AS 1530.4 -2014.

#### *Butt joint when face fixed to masonry/concrete wall*

The tested joint in FR 3981 specimen C was horizontally orientated. The furnace pressure imposed on a horizontally orientated specimen is 20Pa while the furnace pressure imposed on a vertically orientated specimen is between 15-20Pa depending on the location of the specimen. Therefore, the result for FR 3981 specimen C butt joint is also applicable to a vertically orientated specimen.

Based on the performance of the Grey Maxilite and White Maxilite discussed above, it is expected that the Grey Maxilite will be able to maintain integrity for up to 180 minutes and insulation for up to 120 minutes when tested in accordance with AS 1530.4 -2014.

#### *Butt joint when face fixed to a plasterboard wall*

With reference to FP 11935-001a.1, a layer of 60mm horizontally x 800mm high x 800 thick vertically orientated Grey Maxilite was installed on the non-fire side of a 675 x 675mm opening in a plasterboard stud wall with 10g x 100mm steel screw at 150mm ctrs. on the horizontal edge and 200mm on the vertical edge. The board had two sections of the butt joint that was normally 235mm long x 5mm wide and filled to full depth with FyreFLEX sealant. No integrity failure was associated with the joint for 180 minutes duration of the test. The joint was able to main insulation for 180 minutes duration of the test. However, it is observed that the location of the thermocouple on the Maxilite joint was not in the clear opening of the plasterboard opening, and so was a shield from the furnace by the plasterboard wall.

The above test demonstrated the deflection of the plasterboard wall would not open up the butt joint for up to 180 minutes.

Based on the above, it is expected that the Maxilite butt joint in the plasterboard will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 -2014.

#### *Butt joint when face fixed to Hebel wall*

The deflection of a 75mm thick Hebel wall for up to 90 minutes is similar to that of a plasterboard wall and therefore the results for the plasterboard wall discussed above can be applied to Hebel walls for up to 90 minutes.

Based on the above, and with 90 minutes margin in insulation, it is expected that the proposed construction will not detrimentally affect the integrity and insulation performance of the 60mm thick Maxilite board for up to 90 minutes based on design when tested in accordance with AS 1530.4 – 2014.

***Integrity and insulation performance of butt joints with a cover strip over aperture fixed White and Grey Maxilite boards - Figures 21a and 21b - AS 1530.4 – 2014 Section 10***

The proposed construction comprises a 60mm thick Maxilite board aperture fixed to support construction and joined together in a 5 - 10mm wide butt joint that is fully filled with FyreFLEX sealant and covered with a Maxilite or orbit board cover strip as per Figures 6, 21a and 21b.

When the aperture is fixed to an opening in a wall/floor, the Maxilite board joint is less stable compared to the face fixed board discussed above.

The proposed construction in Figures 6 and 21a was tested in FSP 1907 specimen 1. The specimen comprised a 40mm Grey Maxilite board aperture fixed to an opening in a slab and had a 0-5mm butt joint protected on the fireside with a 30mm strip of Grey Maxilite board and seal with sealant on the fireside and in the butt joint. The specimen was able to maintain integrity and insulation for 121 minutes without any signs of failure.

The proposed 60mm Maxilite board would increase the depth of sealant and therefore increase the insulation performance of this junction.

The proposed construction also comprises joints in the vertically orientated boards. It is expected that the joint detail would also be able to maintain integrity and insulation for up to 120 minutes when exposed to fire from either direction when tested in accordance with AS 1530.4 -2014.

Based on the above, it is expected that the proposed construction will not detrimentally affect the integrity and insulation performance of a minimum 60mm thick Maxilite board for up to 120 minutes based on design when tested in accordance with AS 1530.4 – 2014

***Integrity and insulation performance of butt joints with overlapping boards White and Grey Maxilite boards is face fixed - Figure 21c - AS 1530.4 – 2014 Section 10***

The proposed construction comprises two layers of minimum 30mm thick Maxilite board faced fixed to support construction and joined together in a 0-5mm wide butt joint that is fully filled with FyreFLEX sealant as per Figure 21c.

With reference to EWFA 51894700.1, the specimen comprised a 60mm Grey Maxilite board that had a butt joint that was covered on the unexposed side by a 100mm wide x 9mm thick orbit board which was fixed with 8g x 40mm long screws. The FyreFLEX sealant was applied to the underside of the orbit board. Thermocouple 18 which was located on the orbit board did not fail insulation for the 240 minutes duration of the test and measured a maximum temperature rise of 163°C. The 60mm Grey Maxilite board measured a maximum temperature rise of 155°C by the end of 240 minutes.

The significance of this result demonstrated that a 9mm orbit board when covering a joint in a 60mm thick Maxilite board, would allow the thermocouple on top of the board to be able to maintain insulation for up to 240 minutes.

It is expected that the proposed minimum 30mm thick Maxilite board when face fixed over the first layer of Maxilite board would function in the same manner.

The proposed construction also comprises the reduction of the first layer of the Maxilite board from 60mm to 30mm. This would reduce the sealant depth of the joint leading to earlier insulation failure. It is expected that the 17°C margin would allow for a 30mm reduction in sealant depth given the joint gap is small.

The proposed construction also comprises joints in the vertically orientated boards. It is expected that the joint detail would also be able to maintain integrity and insulation for up to 240 minutes when exposed to fire from either direction when tested in accordance with AS 1530.4 -2014.

Based on the above, it is expected that the proposed construction will not detrimentally affect the integrity and insulation performance of a minimum 60mm thick Maxilite board for up to 240 minutes based on design when tested in accordance with AS 1530.4 – 2014

### ***Increase in Maxilite board and opening size***

The proposed construction would also require the increase of board size to a full sheet of Maxilite overlapping 100mm on each side of the opening or aperture fixed within the opening. This would result in the Maxilite board being as large as 2000mm long x 1160mm wide for a 60mm thick Grey Maxilite board or 1500mm long x 1000mm wide for a 60mm thick White Maxilite board.

The increase in the size of the Maxilite board spanning over a larger opening may result in earlier integrity and insulation failure at either the perimeter junctions or the butt joint junctions.

When the Maxilite board overlaps an opening as a single sheet with or without butt joints, the board is expected to remain intact with self-weight for up to 240 minutes based on design.

Confidence is found in FSP 1991 where two 1180 x 460 x 60mm thick grey and white Maxilite board with a slot cut across at the centre line of each board was able to remain intact with self-weight for up to 240 minutes and with additional weight on board for up to 260 minutes.

When the Maxilite board overlaps an opening and has a butt joint or is fitted in an aperture with a strip covering a butt joint in the board, it is expected that the larger sheet size may result in the earlier formation of gaps at the perimeter or butt joints. However, given the stability of the Maxilite board demonstrated in FSP 1991, it is expected the increase in sheet size won't have a significant effect on the performance of the junction details for up to 120 minutes.

Based on the above, it is expected that the proposed construction would also be able to maintain integrity and insulation for up to 120 and 240 minutes based on design when tested in accordance with AS 1530.4 -2014.

## **B.4 Maxilite board as a boxout construction**

The proposed Maxilite boxout construction shall be evaluated under integrity and insulation criteria relevant to the constructions outlined in AS 1530.4-2014 Section 10. It is required that the floor support construction and the wall construction each have a tested or assessed FRL. The proposed construction is shown in Figures 24 -33.

It is required that

- Wall and floor separating elements supporting the penetration seals shall be supported by a test, assessment or appropriate design to achieve the required FRL when including an opening
- The Maxilite boxout construction shall comprise
  - Located on the underside of the slab, not on top of the slab
  - A minimum of 60mm thick grey or white Maxilite board (made from 2 x 30mm or 2 x 40mm or 1 x 60mm layers of Maxilite board) for the face with penetrations
  - A minimum of 40mm thick grey or white Maxilite board (made from 2 x 30mm or 1 x 40mm layers of Maxilite board) for the face without penetrations
  - The size of each face allowed is limited to an area of no greater than 2.32m<sup>2</sup> with or without joints for -/120/120.
  - Angles shall be positioned inside the box only
  - Cover strips shall be outside of the box only
  - Where 2 sheets of Maxilite are used it is required at least one sheet is staggered at the corner.
  - The inclusion of Plastic Skeleton Connectors made from LDPE between metal angles shown in Figures 26a-26d
- Generally, services that penetrate the boxout shall be supported independently of the Maxilite board, whether penetrating on the vertical or the horizontal face of the box. This includes services listed in Tables 3 - 11
- Where services that penetrate the boxout are of minimal weight, they may be supported by Maxilite board only, these include

- Copper and steel pipes  $\leq$  32mm OD
- Threaded rod  $\leq$  10mm OD
- Up to 2 x CAT 6 cables
- Up to 2 x Firesense cables
- Up to 2 x TPS cables
- Up to 1 bundle of 100 strand telecommunication cables
- FyreBOX as per Table 7 and Table 11
- Penetrations in Maxilite board shall be limited to the zone shown in Figure 34
- Services shall be spaced by a minimum of 40mm

The proposed Maxilite boxout construction shares many of the construction details as that for the ceiling systems discussed above. Therefore, the discussions for junction details for the ceiling system also apply to the boxout construction. A few differences will be discussed below.

**Figure 27-28 boxout construction without penetration**

The proposed construction comprises a 2, 3, 4 and 5 side boxed out configuration as shown in Figures 24-26, with penetration in the vertically or horizontally orientated Maxilite 60mm boards and then through the floor construction above, and exposure to fire from outside the box. The FRL is applied from outside the boxout construction to the top of the floor construction as per Figures 27-28.

The proposed boxout construction requires at least one section of the Maxilite board box to be attached to the concrete slab above. It is expected that when hanging vertically, the Maxilite board will be under tension, which may result in board cracking at the joints or across the board.

With reference to FSH 2076, 40mm thick x 1500mm long x 1200mm wide Grey Maxilite boards and 40mm thick x 1500mm long x 1100mm wide White Maxilite boards were hung vertically from Unistrut support.

From the thermocouple readings on these boards and at the top of the board junctions, it can be concluded that no joints opened up and the boards were able to remain intact for at least 120 minutes.

The proposed boxout construction requires at least one section of the Maxilite board box to be attached to the concrete slab above while the other sections of the Maxilite board are to be attached to a wall. When the wall deflects towards or away from the fire, it will destabilise the Maxilite to wall junction and Maxilite to Maxilite the corner detail resulting in earlier integrity failure.

With reference to FSH 2076, a multi-board Z shaped configuration of Maxilite ceiling as shown in Figure 11 was tested. The upper end of the Z shaped Maxilite ceiling was attached to a thick plasterboard wall while the lower part of the Z shaped Maxilite ceiling was attached to a masonry wall. The structure was able to remain intact for at least 120 minutes. It is expected that this tested multi-board Z shaped configuration would subject its joints to more force than the proposed single sheet boxed out configurations.

It is therefore expected that the proposed construction will be able to maintain integrity at the junction between the Maxilite board and the wall as well as from Maxilite to Maxilite for up to 120 minutes when exposed to the furnace from outside the Maxilite board.

Another critical detail associated with this type of construction is the performance of the board at the corner junctions, particularly when three angles interface at a corner as shown in Figure 26. When heated, these angles could expand and open up the joints leading to integrity failure.

With reference to FSH 2076, Detail 15, a similar junction detail was tested where a 30mm thick white Maxilite was butted up to a 40mm thick grey Maxilite board, and both butted up to a masonry wall. The gaps between the angles were around 20mm. At the end of the 136 minutes test, this corner was shown to be intact with minor cracks away from the corners.

These cracks may be due to the expansion rate of the steel angles, stretching the board at the fixing locations. The cracks may lead to a small amount of furnace gas through into the box.



The proposed construction comprises gaps between the service and surrounding construction to be less than 12mm and would therefore have its insulation performance measured on the top of the floor construction. Therefore, any small amount of furnace gas coming through the corner junction would not be expected to be able to result in any flaming or cotton pad failure at the floor opening. It is therefore expected that the proposed construction will be able to maintain integrity at the floor construction level for up to 120 minutes when exposed to a furnace from outside the Maxilite board.

Based on the above, it is expected the proposed boxout construction would allow the unexposed face of the floor construction to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 -2014.

#### **Figure 30 boxout construction without penetration**

The proposed construction comprises a 2, 3, 4 or 5 side boxed out configuration as shown in Figures 24-26, with penetration in the vertically or horizontally orientated 60mm Maxilite boards and then through the wall construction, and exposure to fire from outside the box. The FRL is applied from outside the boxout construction to the other side of the wall as per Figure 30.

The proposed Figure 30 is similar to the Figures 27-29 construction discussed above in its angle exposure and the location of insulation measurement. Therefore, the discussion above also applies to Figure 30.

Based on the above, it is expected the proposed boxout construction would allow the unexposed face of the wall construction to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 -2014.

#### **Figure 31 boxout construction without penetration**

The proposed construction comprises a 2, 3, 4 or 5 side boxed out configuration as shown in Figures 24-26, with penetration in the vertically or horizontally orientated 60mm Maxilite boards and then through the wall construction, and exposure to fire from either outside the box or from the other side of the wall. The FRL is applied from outside the boxout construction to the other side of the wall as per Figure 31.

When fire exposure is from the box side, the proposed Figure 31 is similar to the Figure 30 construction discussed above in its angle exposure and the location of insulation measurement. Therefore, the discussion above also applies to Figure 31.

When fire exposure is from the wall side, it is expected that the heat through the opening in the wall into the box would be less severe than when the angles are direct exposure to the furnace. Confidence in the ability of this junction to remain intact is found in FSH 2076 where a two angle junction is held together with two perpendicular 40mm thick grey Maxilite boards against a plasterboard wall. The angles were tested on the exposed side of the ceiling construction. This junction was able to maintain integrity for up to 120 minutes as demonstrated by the temperature profile of the thermocouples located near the top cover strips not showing any sudden spike in temperature near the junction.

Based on the above, it is expected the proposed boxout construction would allow the unexposed face of the wall construction to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 -2014.

#### **Figure 8 33 boxout construction without penetration**

The proposed construction comprises a 2, 3, 4 or 5 side boxed out configuration as shown in Figures 24-26, with penetration in the vertically or horizontally orientated 60mm Maxilite board on the box side and then through the wall construction opening protected with another 60mm thick Maxilite board, and exposure to fire from either outside the box or from the other side of the wall. The FRL is applied from outside the boxout construction to the other side of the wall as per Figure 33.

When fire exposure is from the wall side, it is expected that the 60mm thick Maxilite board on the wall opening will provide up to 120 minutes of integrity and insulation performance at the wall junction as discussed above in Section B3.



When fire exposure is from the box side, the proposed Figure 33 is similar to the Figure 30 construction discussed above in its angle exposure and the location of insulation measurement. The only difference is the additional 60mm thick Maxilite board on the wall opening which will provide up to 120 minutes of integrity and insulation performance at the wall junction.

Based on the above, it is expected the proposed boxout construction would allow the unexposed face of the wall construction to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 -2014.

#### **Figure 27-33 boxout construction with penetration**

The proposed construction comprises either reactive or non-reactive passive fire protection materials protecting services that penetrate the Maxilite boxout construction.

The reactive passive fire protection materials include

- Trafalgar Fyrechoke collar
- FyrePEX sealant
- Trafalgar FyreBOX

The non-reactive passive fire protection materials include

- Twrap/Fyrewrap with FyreFLEX sealant
- FyreFLEX sealant

The primary factor dictating whether this projection material will function is the amount of furnace exposure they receive when installed in the Maxilite boxout construction.

For the reactive passive fire protection materials proposed in the cases as shown in Figures 27, 30 and 33, the fire exposure on these fire protection materials is the same or more severe than a regular fire test which can aid the performance of these systems.

For Figures 27 and 30, the collar on the outside of the boxout construction would be exposed to the regular furnace condition while the collar inside the box would be activated earlier due to the hotter air temperature side of the boxout construction compared to laboratory temperatures in a regular test. This would aid the closure of the plastic pipes like uPVC, Pex and Pex-al-Pex pipes as well as services inside of a FyreBOX.

For Figure 33, it is expected that the collar on the outside of the boxout construction would be exposed to the regular furnace condition while the collar on the flat penetration seal would act to move the unexposed side pipe thermocouples further down the pipe resulting in a slight improvement of insulation performance.

For the non-reactive passive fire protection materials proposed in the cases as shown in Figures 28, 39, 31 and 32, the fire protection materials are not as impacted by shielding as the reactive passive fire protection materials, and so are expected to function in the same manner when fully exposed, partially exposed or shielding from the furnace heat. Although the fire exposure on these fire protection materials is the same or more severe than a regular fire test which can result in a hotter specimen, the measurement of the performance of services is further away from the site of penetration in the Maxilite board. This will improve the overall performance of services like non-insulated metal pipes, insulated metal pipes, cable trays and metal rods.

## **B.5 Inclusion of service penetrations in a vertical Maxilite penetration seal**

The proposed construction shall be for services penetrating the vertical faces of a Maxilite as described in sections 3.2-3.5 of this report and subject to the following variations:

- The minimum thickness of the Maxilite board shall be 60mm
- Inclusion of services as shown in Tables 2-7 and Figures 35-45
- Sealant to the full depth of the Maxilite penetration seal

- The gap between penetration and the Maxilite penetration seal is as shown in Tables 2-7
- Minimum 40mm separations between service penetrations
- Twrap around services to overlap itself by 50mm, held in place with aluminium foil tape and tied off with min 4.6mm wide stainless steel cable ties
- Inclusion of 100mm width Maxilite pad around pipe penetrations

#### ***Inclusion of Appendix D1 power cables***

The proposed construction comprises Appendix D1 power cables through Maxilite as shown in Figure 35.

With reference to FP 11935-001 specimen 3, a set of Appendix D 1 cable on a 300mm wide x 47mm deep cable tray penetrated a 60mm thick vertical Grey Maxilite board and was protected with 50mm x 50mm fillets on each side of the board and wrapped in 300mm length of Twrap on each side. The specimen did not fail integrity for 180 minutes and failed insulation at 144 minutes.

It was observed in FSP 1991 that White Maxilite performs better than Grey Maxilite board by approximately 15 minutes in terms of insulation performance up to 120 minutes. It is expected that the results for FP 11935-001, specimen 1 can be applied to the White Maxilite board.

Based on the above, it is expected that the proposed construction will be able to maintain integrity for 180 minutes and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005

#### ***Inclusion of communication cables***

The proposed construction comprises communication cables through Maxilite as shown in Figure 36.

With reference to FRT 180323 specimen G, 2 x CAT6 cables, 2 x 2.5mm<sup>2</sup> 2C+E electrical cables and 2 x Firesense TPS cables penetrated a 30mm hole in a 78mm thick Speedpanel wall. The penetration was protected with full depth of FyreFLEX sealant and a 30mm x 30mm fillet on each side of the wall. The specimen maintained integrity and insulation for 121 minutes without failure.

##### *Up to 4 x TPS cables*

The proposed variation comprises 4 x TPS cables (2 x 2.5mm<sup>2</sup> 2C+E electrical cables) in a 60mm Maxilite vertical penetration seal.

This variation would reduce the support construction thickness by 15mm, which will result in higher temperature measurement on the cables on the unexposed side due to a shorter conductive path from the furnace to the thermocouple measurement point on the unexposed side. However, the proposed 300mm length of Twrap to the cables on each side of the wall will provide thermo-insulation to the cables at the penetration and move the points of thermocouple measurement on the cables to 285mm further than that in 180323 specimen G. Also, the proposed increase of fillet size to 50mm on each side of the penetration will provide further protection to the penetration, minimising the flow of furnace gas through the penetration.

Confidence in the Grey or White Maxilite's ability to maintain insulation at the penetration is provided by FP 11935-001 specimen 3 which had more volume of copper wiring penetrating a 60mm thick Maxilite and was able to maintain insulation for 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005

##### *Up to 20 x Cat6e and Firesense cables*

The proposed variation comprises 20x CAT6e UTP data cables or 20 x Firesense in a 60mm Maxilite vertical penetration seal.

With reference to FSP 2106 specimen 4, 10x CAT6e UTP data cables and 10 x Firesense TPS 1.5mm<sup>2</sup> twin ore copper cables with a nominal 6mm diameter penetrated a nominal 80mm diameter opening in a 60mm thick Grey Maxilite board. The annular gap between the cables and the Maxilite board was sealed to full depth and finished with a 20 x 20mm fillet of FyreFLEX. The cables were then wrapped with 300mm of Twrap on each side, with a 50mm overlap on the longitudinal joint. The specimen

maintain integrity for 241 minutes of the test and failed insulation at 138 minutes on the sealant on the unexposed side.

Though tested in a horizontal orientation, its result is applicable to a vertical orientation as the furnace pressure in the horizontal orientation is slightly higher than when tested in a vertical orientation and so will induce earlier integrity failure if gap forms at the penetration seal.

The proposed variation would allow the cable to be wrapped on each side of the wall as well as have a greater size of fillet on each side of the wall. Both of these factors would allow the specimen to perform better than that tested in FSP 2106.

As discussed above, it is expected that White coloured Maxilite would perform slightly better thermally than Grey Maxilite, therefore it is expected that when testing White Maxilite, the proposed cable penetrations would also maintain insulation on the Maxilite board for up to 120 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005

#### *Up to 8 Eltech VRF cables*

The proposed construction comprises up to 6 Eltech VRF cables penetrating in a 60mm Maxilite board protected in the same manner as the Cat6e cables discussed above.

The proposed Eltech VRF cables are of similar construction to the tested CAT 6 cables in that it comprises stands of copper wire protected with PVC sheath and bundled inside PVC insulation, However, Eltech VRF cables are slightly larger in copper wire diameter and overall cable. Therefore, it is expected that the Eltech VRF cables are more conductive than the CAT 6 cables.

Since the proposed number of Eltech VRF cables is much less than that tested in FSP 2106 specimen 4, it is expected that the large margin in performance will allow these cables to perform in the same manner as the cables discussed above.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005.

#### ***Inclusion of copper pipes up to DN100 – up to 180 minutes integrity performance***

The proposed construction comprises copper pipes up to DN100 penetration through Maxilite as shown in Figure 38 with protection as per Tables 2 and 3.

With reference to FP 11935-001, specimen 1 comprised 101mm OD x 1.65mm wall thickness copper pipe penetrated a vertically orientated 60mm Grey Maxilite board. FyreFLEX sealants filled the 5mm annular gap to the full depth of the board. 50x50mm fillet of FyreFLEX sealant was applied to each side of the penetration. 420mm length of Twrap was applied to the exposed side of the pipe and 600mm length of Twrap was applied to the unexposed side of the pipe. The specimen maintain integrity for 180 minutes and failed insulation on the Maxilite board at 88 minutes. At 120 minutes, the temperature rise on the pipe 25mm away from the wrap was 160°C. The wrap's temperature rise at 120 minutes was only 170°C.

The proposed variation comprises a localised increase of Maxilite penetration seal thickness by 30mm, which is expected to provide an additional 60 minutes of insulation performance to the Maxilite board at the penetration, allowing the penetration to maintain an insulation performance of up to 120 minutes.

It was observed in FSP 1991 that White Maxilite performs better than Grey Maxilite board by approximately 15 minutes in terms of insulation performance up to 120 minutes. It is expected that the results for FP 11935-001, specimen 1 can be applied to the White Maxilite board.

FP 11935-001, specimen 1's test result may be applied to all copper pipes having outside diameters not greater than the tested diameter, and wall thicknesses, not more than the tested thickness as

these pipes would have less cross sectional area than that tested and so will have less material for conduction of heat from the furnace to the unexposed side.

With reference to FRT 180392.1, specimen F comprised a 114.65mm OD x 4.58mm wall thickness steel pipe penetrated a 116mm plasterboard lined stud wall. FyreFLEX sealants filled the 6mm annular gap to full depth on each side. 15x15mm fillet of FyreFLEX sealant was applied to each side of penetration and then a 400mm length of Twrap was applied on each side, with a 50mm overlap on the Twrap. The specimen maintained integrity and insulation for 130 minutes without failure. The pipe temperature rise at 120 minutes was only 159°C.

Based on a calculation, when the wall thickness is decreased to 60mm thick and the wrap length on each side of the wall is increased to 450mm length, the pipe temperature rise at 120 minutes will be a maximum of 165°C.

Based on the above, it is expected that the proposed construction will be able to maintain integrity for up to 180 minutes and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

#### ***Inclusion of steel pipes up to NB100 – up to 180 minutes integrity performance***

The proposed construction comprises steel pipes up to NB100 penetration through Maxilite as shown in Figure 38a with protection as per Table 3.

With reference to FRT 210025 specimen H(1) comprised 113mm OD x 4.8mm wall thickness steel pipe penetrated a horizontally orientated 60mm grey Maxilite board. FyreFLEX sealants filled the 13mm annular gap to the full depth of the board. 50x50mm fillet of FyreFLEX sealant was applied to the unexposed side of penetration and then a 450mm length of Twrap was applied to the unexposed side of the pipe. The specimen maintain integrity for 240 minutes and failed insulation on one location of the Maxilite board at 143 minutes.

Although tested, horizontally, the stiff nature of the metal pipe allows the result of FRT 210025 specimen H(1) to be applied when the Maxilite board is orientated vertically. The proposed construction would also have the wrap on the fire side which will act to slightly decrease the unexposed face pipe temperature.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 180 and 120 minutes respectively when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005.

#### ***Inclusion of copper and steel pipes up to DN50 - up to 180 minutes integrity performance***

The proposed construction comprises copper and steel pipes up to DN50 penetration through Maxilite as shown in Figure 37 with protection as per Tables 2 and 3.

With reference to FRT 180392.1, specimen B comprised a 50mm OD x 1.22mm wall thickness copper pipe penetrated a 116mm plasterboard lined stud wall. FyreFLEX sealants filled the 5mm annular gap to full depth on each side. A 15x15mm fillet of FyreFLEX sealant was applied to each side of penetration and then a 300mm length of Twrap was applied on each side, with no overlap of Twrap. The specimen maintain integrity for 240 minutes and failed insulation on one location of the wrap at 116 minutes. At 120 minutes, the temperature on the pipe 25mm away from the wrap was 143°C.

With reference to FRT 180392.1, specimen A comprised a 50mm OD x 1.22mm wall thickness copper pipe penetrated a 116mm plasterboard lined stud wall. FyreFLEX sealants filled the 5mm annular gap to full depth on each side. 15x15mm fillet of FyreFLEX sealant was applied to each side of penetration and then a 350mm length of Twrap was applied on each side, with a 100mm overlap on the Twrap. The specimen maintained integrity and insulation for 130 minutes without failure. The wrap temperature at 120 minutes was only 161°C.

Based on the comparison between FRT 180392.1, specimen A and B, it can be concluded that the failure of Specimen B wrap was due to the lack of overlap of Twrap and thus resulted in leakage of

furnace gas from the Twrap. If specimen B had a 100mm Twrap overlap, it is expected that the specimen would have maintained insulation for up to 120 minutes.

The proposed reduction of wall thickness from 116mm to 60mm thick would increase the temperature of the pipe on the unexposed side. However, with the additional 150mm of Twrap on each side of the wrap, the pipe temperature on the unexposed side will allow it to maintain insulation for 120 minutes based on a calculation.

Confidence in the ability of the Maxilite penetration seal to maintain insulation for 120 minutes is provided by the above discussion for DN100 copper pipes, which are larger and thus will radiate more heat through to the Maxilite support construction than the proposed 50mm copper pipes.

Based on the above, it is expected that all copper pipes up to DN50 will be able to maintain integrity for up to 180 minutes and insulation for up to 120 minutes.

FRT 180392.1, specimen B's test result may be applied to all copper pipes having outside diameters not greater than the tested diameter, and wall thicknesses not more than the tested thickness as these pipes would have less cross sectional area than that tested and so will have less material for conduction of heat from the furnace to the unexposed side.

Although the proposed steel pipe has greater wall thickness than the copper pipe, its lower thermal conductivity would allow it to performance similarly or better than the copper pipe of the same size.

Based on the above, it is expected that the proposed construction will be able to maintain integrity for up to 180 minutes and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

#### ***Inclusion of steel pipes up to DN50 – up to 90 minutes integrity performance***

The proposed construction comprises steel pipes up to DN50 penetration through Maxilite as shown in Figure 37 with protection as per Table 3a.

With reference to FRT 180392.1, specimen B comprised a 50mm OD x 1.22mm wall thickness copper pipe penetrated a 116mm plasterboard lined stud wall. FyreFLEX sealants filled the 5mm annular gap to full depth on each side. A 15x15mm fillet of FyreFLEX sealant was applied to each side of penetration and then a 300mm length of Twrap was applied on each side, with no overlap of Twrap. The specimen maintain integrity for 240 minutes and failed insulation on one location of the wrap at 116 minutes. At 120 minutes, the temperature on the pipe 25mm away from the wrap was 143°C.

The proposed reduction of wall thickness from 116mm to 60mm thick would increase the temperature of the pipe on the unexposed side. However, as steel have a lower thermal conductivity compared to copper as well as a 26 minute margin in insulation performance, it is expected the proposed construction will be able to maintain insulation for 90 minutes based on a calculation.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 90 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

#### ***Inclusion of copper pipes up to DN150 – up to 180 minutes integrity performance***

The proposed construction comprises copper pipes up to DN150 penetration through Maxilite as shown in Figure 39 with protection as per Table 2.

With reference to FP 11935-001, specimen 2 comprised 150mm OD x 1.8mm wall thickness copper pipe penetrated a vertically orientated 60mm Grey Maxilite board. FyreFLEX sealants filled the 5mm annular gap to the full depth of the board. 50x50mm fillet of FyreFLEX sealant was applied to each side of penetration. 2 layers of 420mm length of Twrap were applied to the exposed side of the pipe and 1100mm length of Twrap was applied to the unexposed side of the pipe with an additional 300mm length of Twrap on top of the first layer at the penetration. The specimen maintain integrity for 180 minutes and failed insulation on the Maxilite board at 104 minutes. At 120 minutes, the temperature

rise on the pipe 25mm away from the wrap was 145°C. The wrap's temperature rise at 120 minutes was only 145°C.

The proposed variation comprises a localised increase of Maxilite penetration seal thickness by 30mm, which is expected to provide an additional 60 minutes of insulation performance to the Maxilite board at the penetration, allowing the penetration to maintain an insulation performance of up to 120 minutes.

It was observed in FSP 1991 that White Maxilite performs better than Grey Maxilite board by approximately 15 minutes in terms of insulation performance up to 120 minutes. It is expected that the results for FP 11935-001, specimen 2 can be applied to the White Maxilite board.

Although the proposed steel pipes up to NB150 have cross sectional areas that are larger than the tested copper pipe, steel is much less conductive than copper. Therefore, it is expected that the slightly larger steel pipes will also be able to maintain insulation for up to 120 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity for up to 180 minutes and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

#### ***Inclusion of steel pipes up to NB150 - up to 180 minutes integrity performance***

The proposed construction comprises steel pipes up to NB150 penetration through Maxilite as shown in Figure 38a with protection as per Table 3.

With reference to FRT 200397 specimen A10, a 150mm diameter steel pipe with a wall thickness of 3.9mm penetrated 2 x 60mm thick Fyrebatts. FyreFLEX sealants filled the 12.5mm annular gap to the full depth of the batts. 50x50mm fillet of FyreFLEX sealant was applied to each side of the penetration. A layer of 450mm length of Twrap was applied to the unexposed side and a 300mm length of Twrap was applied to the unexposed side. The pipe was able to maintain integrity for 241 minutes duration of the test and failed insulation at 119 minutes on the pipe.

Upon close inspection of FRT200397 R1.2 and its test photos, it was found that this service was not reported in compliance with AS 1530.4-2014 and that specimens are placed in close proximity to each other. This would result in shielding of the specimens leading to cooler specimens compared to the standard spacing of specimens required by AS 1530.4 – 2014 section 10.

The proposed construction comprises 150mm more length of Twrap on the exposed side of the wall. This will compensate for proposed reduction in wall thickness by 60mm and the shielding experience by FRT200397 R1.2 specimen A10 and act to cool the pipe down on the unexposed side.

On balance, it is expected that the proposed construction will be able to maintain integrity for up to 180 minutes and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.



### ***Inclusion of PVC pipes***

The proposed construction comprises PVC pipe penetrations through Maxilite as shown in Figures 40 and 41.

With reference to FP 6202 and FSP 6251, various sizes of pipes penetrated a 60mm thick vertically orientated Grey Maxilite board and were protected with Fyrechoke collars on each side of the board. The results are summarised in Table B7 below.

**Table B7: PVC pipe penetration**

Report	Size of Fyrechoke collars on each side of Maxilite	PVC pipe penetrations	Integrity (minutes)	Insulation (minutes)
FP 6202 (9)	25mm	26.8mm OD x 1.8mm wall thickness	122 NF	122 NF
FP 6202 (10)	32mm	32mm OD x 2.3mm wall thickness	122 NF	122 NF
FP 6202 (11)	40mm	43.4mm OD x 2mm wall thickness	122 NF	122 NF
FP 6202 (7)	50mm	55.8mm OD x 2.3mm wall thickness	122 NF	122 NF
FP 6202 (6)	65mm	69mm OD x 2.9mm wall thickness	122 NF	122 NF
FP 6251(8)	80mm	83mm OD x3.1mm wall thickness	122 NF	122 NF
FP 6251(6)	100mm	110mm OD x 3.4mm wall thickness	122 NF	107 (failed on Maxilite)

The proposed constructions are mostly as tested, with the exception of the 100mm PVC pipe specimen.

The proposed localised increase of Maxilite penetration seal thickness for the 100mm pipe penetration by 30mm will provide an additional 60 minutes of insulation performance to the Maxilite board at the penetration. Therefore, it is expected that the proposed 100mm PVC pipe specimen will be able to maintain integrity and insulation for at least 120 minutes.

It also was observed in FSP 1991 that White Maxilite performs better than Grey Maxilite board by approximately 15 minutes in terms of insulation performance up to 120 minutes. It is expected that the results for FP 6202 and FSP 6251, can be applied to the White Maxilite board.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005.

### ***Inclusion of Pex and Pex-al-Pex pipe***

The proposed construction comprises Pex and Pex-Al-Pex pipes penetrating Maxilite as shown in Figures 42 and 43.

With reference to FP 6202 specimen 5, a 20mm OD Pex pipe penetrated a 60mm thick vertically orientated Grey Maxilite board and was protected with a 65mm diameter x 25mm deep steel sheath filled to full depth with Fyrepex sealant. The specimen was able to maintain integrity and insulation for 122 minutes.

With reference to FP 6202 specimen 8, a 20mm OD Pex Al pex pipe penetrated a 60mm thick vertically orientated Grey Maxilite board and was protected with a 65mm diameter x 25mm deep steel sheath filled to full depth with Fyrepex sealant. The specimen was able to maintain integrity for 122 minutes and insulation for 49 minutes.

It also was observed in FSP 1991 that White Maxilite performs better than Grey Maxilite board by approximately 15 minutes in terms of insulation performance up to 120 minutes. It is expected that the results for FP 6202 can be applied to the White Maxilite board. Also, it was observed in FSP 1991 that Grey Maxilite was 8°C cooler than the White Maxilite 30 minutes into the test.

Based on the above, it is expected that the proposed construction in Figure 42 will be able to maintain integrity and insulation for up to 120 minutes. It is also expected that the proposed construction in



Figure 43 will be able to maintain integrity for up to 120 minutes and insulation for 30 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

#### ***Inclusion of FyreBOX***

The proposed construction comprises a FyreBOX Maxi through Maxilite as shown in Figures 9a and 44.

With reference to FSP 1913 specimen 2, a blank FyreBOX Maxi 350 was installed in a 60mm thick vertically orientated White Maxilite board with its 10mm annular gap sealed to full depth with FyreFLEX sealant. 30mm x 50mm angles on all sides of the FyreBOX on each side of the wall. The specimen maintained integrity with no failure for 121 minutes and failed insulation at 35 minutes.

As discussed above, Grey and White Maxilite displayed similar integrity performances and structural capacity for up to 240 minutes. Therefore, it is expected that if FSP 1913 specimen 2 was installed in Grey Maxilite, it will also maintain integrity for up to 120 minutes at the perimeter of the FyreBOX and the Maxilite board.

With reference to FSP 1991 Rev. A, the Grey Maxilite board was 8°C actually cooler than the White Maxilite at 30 minutes into the test. Therefore, it is expected that if FSP 1913 specimen 2 was installed in Grey Maxilite, it will also maintain insulation for up to 30 minutes at the perimeter of the FyreBOX and the Maxilite board.

Based on the above, it is expected that the proposed construction will be able to maintain integrity for up to 120 minutes and insulation for up to 30 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005

#### ***Inclusion of steel threaded rod***

The proposed construction comprises a 10mm OD steel threaded rod through Maxilite as shown in Figure 45.

With reference to FRT 190292.1 specimen E4, an M10 steel threaded rod penetrated a 30mm hole in a 60mm thick horizontal orientated White Maxilite board. The penetration was protected with full depth of FyreFLEX sealant in the 3mm annular gap and a 30mm x 30mm fillet on each side of the wall as well as a 200mm length of Twrap on each side. The specimen maintained integrity and insulation for 241 minutes without failure. The highest thermocouple temperature measure on the specimen was on the Maxilite board, which reach 151°K rise at 241 minutes.

The reference test, though tested horizontally, can be applied to the steel rod when installed in a vertically orientated Maxilite board due to steel being able to conduct the same amount of heat whether vertically or horizontally.

The proposed variation of increasing the annular gap by 2mm will result in more sealant being present at the penetration and thus provide better insulation between the metal rod and the board. It is therefore expected that this variation will not cause any detrimental effect on the effectiveness of the seal for up to 240 minutes.

It was observed in FSP 1991 that the insulation performance of the White and Grey Maxilite board was the same at 240 minutes. It is expected that the results for FP 11935-001, specimen 1 can be applied to the Grey Maxilite board.

Furthermore, the proposed variation included a 200mm wrap on both sides of the steel rod, which will further cool the specimen from the fireside and lessen its radiation into the Maxilite support construction.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005

### ***Inclusion of LVH 44 grille***

The proposed construction comprises up to 600mm x 600mm LVH 44 grille penetrations through min.60mm thick Maxilite as shown in Figures 45a and 45b. The system is to be applied on the vertical Maxilite faces of the floor/roof ceiling system discussed in Section B1 only.

It is required Lorient LVH 44 grille be tested in a wall and achieve the required FRL in accordance with AS 1530.4 -2014 section 10.

It is expected that the grille will let through an initial amount of furnace heat in the first few minutes of test before the intumescent grille fully closes. However, it is expected that this flush of hot gas is not sufficient to heat up the cavity of the floor/roof ceiling system so as to result in a failure on the unexposed side.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005

## **B.6 Inclusion of service penetrations in horizontal Maxilite penetration seal**

The proposed construction shall be for services penetrating the horizontal faces of a Maxilite as described in sections 3.2-3.5 of this report and subject to the following variations:

- Minimum thickness of Maxilite board to be 60mm
- Inclusion of services as shown in Tables 8-11 and Figures 46-58
- Sealant to the full depth of the Maxilite penetration seal
- The gap between penetration and the Maxilite penetration seal is as shown in Tables 8-11
- Minimum 40mm separations between service penetrations
- Twrap around services to overlap itself by 50mm, held in place with aluminium foil tape and tied off with min 4.6mm wide stainless steel cable ties
- Minimum 100mm distance from penetrations to the edge of Maxilite board

### ***Inclusion of Appendix D1 power cables***

The proposed construction comprises Appendix D1 power cables through Maxilite as shown in Figure 46.

With reference to FRT 190292.1 specimen E1, a set of Appendix D1 cables on 315mm wide x 50mm deep cable tray penetrated a 60mm thick horizontally orientated White Maxilite board and was protected with 50mm x 50mm fillets on the exposed side of the board and then wrapped in 450mm length of Twrap. Loose mineral wool was used to fill the gap between wrap and service. The specimen did not fail integrity for 241 minutes and failed insulation at 154 minutes on the Maxilite board at the penetration.

It also was observed in FSP 1991 that White Maxilite performs better than Grey Maxilite board by approximately 15 minutes in terms of insulation performance up to 120 minutes. It is expected that the results for FRT 190292.1 specimen E1, which has a margin of 34 minutes, can be applied to the Grey Maxilite board so that it will maintain insulation for up to 120 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity for 240 minutes and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005

### ***Inclusion of telecommunication cables***

The proposed construction comprises telecommunication cables through Maxilite as shown in Figure 47.

With reference to NI 2689 specimen F, a 6 x 4 bundle of 100 strand telecommunication cables penetrated a 75mm E core panel. The penetration was protected with full depth of FyreFLEX sealant and finished off with a 50mm x 50mm fillet on the unexposed side. The specimen maintained integrity for 123 minutes without failure. The maximum sealant temperature measured around the cables at 120 minutes was 178°C.

The proposed variation would reduce the support construction thickness by 15mm which would result in a 15mm reduction in sealant depth around the cables. Since the sealant did not display deterioration at 120 minutes and its temperature was relatively low at 178°C, it is expected that a 15mm reduction in the depth of sealant in the annular gap would not detrimentally affect the integrity performance of the penetration.

The proposed variation would reduce the support construction thickness by 15mm which would result in an increase in temperature measured on the unexposed side of the cables. However, it is also proposed to add 600mm of Twrap on the unexposed side of the cables which will act to insulate the cables.

With reference to FRT 190292.1 specimen E1, which had Appendix D 1 cables penetrating a 60mm thick White Maxilite and wrapped in 450mm length of Twrap on the unexposed side. The largest cable, with a single core of 630mm<sup>2</sup>, was able to maintain insulation for 184 minutes.

The proposed telecommunication cables contain much less copper than the single-core cable. When wrapped in Twrap that's 150mm longer than the wrap on the single core cable, they will be able to maintain insulation for at least 120 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005.

#### ***Up to 20 x CAT6e and Firesense cables***

The proposed variation comprises 20x CAT6e UTP data cables or 20 x Firesense in a 60mm Maxilite vertical penetration seal.

With reference to FSP 2106 specimen 4, 10x CAT6e UTP data cables and 10 x Firesense TPS 1.5mm<sup>2</sup> twin core copper cables with a nominal 6mm diameter penetrated a nominal 80mm diameter opening in a 60mm Grey thick Maxilite board. The annular gap between the cables and the Maxilite board was sealed to full depth and finished with a 20 x 20mm fillet of FyreFLEX. The cables were then wrapped with 300mm of Twrap on each side, with a 50mm overlap on the longitudinal joint. The specimen maintain integrity for 241 minutes of the test and failed insulation at 138 minutes on the sealant on the unexposed side.

It is expected that when the cables are installed in a horizontal Maxilite and supported independently, its seal will act in a similar manner as that tested.

As discussed above, it is expected that White coloured Maxilite would perform slightly better thermally than Grey Maxilite, therefore it is expected that when tested in White Maxilite, the proposed cable penetrations would also maintain insulation on the Maxilite board for up to 120 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005.

#### ***Up to 8 Eltech VRF cables***

The proposed construction comprises up to 6 Eltech VRF cables penetrating in a 60mm Maxilite board protected in the same manner as the Cat6e cables discussed above.

The proposed Eltech VRF cables are of similar construction to the tested CAT 6 cables in that it comprises stands of copper wire protected with PVC sheath and bundled inside PVC insulation, However, Eltech VRF cables are slightly larger in copper wire diameter and overall cable. Therefore, it is expected that the Eltech VRF cables are more conductive than the CAT 6 cables.

Since the proposed number of Eltech VRF cables is much less than that tested in FSP 2106 specimen 4, it is expected that the large margin in performance will allow these cables to perform in the same manner as the cables discussed above.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005.

#### ***Inclusion of cable tray with various cables***

The proposed construction comprises telecommunication cables through Maxilite as shown in Figure 48.

With reference to NI 2689 specimen L, a 380mm cable tray with 3 x 16mm OD 3C+E power cables. 6 x 100 strand telecommunication cables, 1x 46mm OD single core power cable and 1x 29mm OD 3C+E power cable penetrated a 75mm thick horizontally orientated E core panel. The penetration was sealed to the full depth of the E-Core panel with FyreFLEX and finished off with 50x50mm of sealant fillet on the unexposed side. The specimen did not fail integrity for 123 minutes. The maximum sealant temperature measured around the cables at 120 minutes was 114°C.

The proposed variation would reduce the support construction thickness by 15mm which would result in a 15mm reduction in sealant depth around the cables. Since the sealant did not display any sign of deterioration at 120 minutes and its temperature was relatively low at 114°C, it is expected that a 15mm reduction in the depth of sealant in the annular gap would not detrimentally affect the integrity performance of the penetration.

The proposed variation would reduce the support construction thickness by 15mm which would result in an increase in temperature measured on the unexposed side of the cables and trays. However, it is also proposed to add 600mm of Twrap on the unexposed side of the cables which will act to insulate the cables.

With reference to FRT 190292.1 specimen E1, which had Appendix D1 cables penetrating a 60mm thick White Maxilite and wrapped in 450mm length of Twrap on the unexposed side. The largest cable, with a single core of 630mm<sup>2</sup>, was able to maintain insulation for 184 minutes.

The proposed telecommunication cables contain much less copper than the single core cable. When wrapped in Twrap that's 150mm longer than the wrap on the single core cable, they will be able to maintain insulation for at least 120 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005.

#### ***Inclusion of copper pipes up to DN100 - up to 180 minutes integrity performance***

The proposed construction comprises copper pipes up to DN100 penetration through Maxilite as shown in Figure 50 with protection as per Table 8.

With reference to FRT 190292.1, specimen E(2) comprised 101mm OD x 1.63mm wall thickness copper pipe penetrated a horizontally orientated 60mm White Maxilite board. FyreFLEX sealants filled the 19mm annular gap to the full depth of the board. 30x30mm fillet of FyreFLEX sealant was applied to the unexposed side of penetration and then an 800mm length of Twrap was applied to the unexposed side of the pipe. The specimen maintain integrity for 214 minutes and failed insulation on one location of the wrap at 150 minutes. At 120 minutes, the temperature on the pipe 25mm away from the wrap was 150°C. The wrap temperature at 120 minutes was only 172°C. The Maxilite board failed insulation at 189 minutes. Its temperature at 120 minutes was 155°C, which is a 134°K temperature rise.

The significance of FRT 190292.1, specimen E(2) demonstrated the integrity performance of up to 214 minutes for the seal around the 100mm OD copper pipe penetrating 60mm thick White Maxilite board.

Confidence in the performance of the Grey Maxilite board is offered by FSP 2016 specimen 2 where a 100mm diameter copper pipe penetrated a 60mm Maxilite grey board. When tested, the Grey Maxilite board was able to maintain 240 minutes of integrity performance and 120 minutes of insulation performance. The Twrap in FSP 2016 specimen 2 however failed insulation at 108 minutes into the test.

Therefore, the proposed extra layer of Twrap will allow the thermocouple on the Twrap to maintain insulation for at least another 12 minutes.

Based on the above, it is expected that all copper pipes up to DN100 will be able to maintain integrity and insulation for up to 240 and 120 minutes respectively.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 180 and 120 minutes respectively when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005.

#### ***Inclusion of copper pipes up to DN100 - up to 90 minutes integrity performance***

The proposed construction comprises copper pipes up to DN100 and penetration through Maxilite as shown in Figure 50a with protection as per Table 8a.

With reference to FSP 2106 specimen 2, it comprised a ND100 x 1.8mm thick copper pipe penetrated a horizontally orientated 60mm thick grey Maxilite board, with 600mm Twrap on the unexposed side. The annular gap was sealed to the full depth of the Maxilite board with FyreFLEX sealant and finished off with a 20mm fillet. The specimen was able to maintain integrity without failure for 241 minutes and failed insulation at 97 minutes on the pipe and 107 minutes on the wrap.

As discussed above, the white Maxilite will perform marginally better in insulation performance than the grey Maxilite.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 90 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

#### ***Inclusion of steel pipes up to NB100 – up to 240 minutes integrity performance***

The proposed construction comprises steel pipes up to NB100 penetration through Maxilite as shown in Figure 50a with protection as per Table 8.

With reference to FRT 210025 specimen H(1) comprised 113mm OD x 4.8mm wall thickness steel pipe penetrated a horizontally orientated 60mm grey Maxilite board. FyreFLEX sealants filled the 13mm annular gap to the full depth of the board. 50x50mm fillet of FyreFLEX sealant was applied to the unexposed side of penetration and then a 450mm length of Twrap was applied to the unexposed side of the pipe. The specimen maintain integrity for 240 minutes and failed insulation on one location of the Maxilite board at 143 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 240 and 120 minutes respectively when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005.

#### ***Inclusion of copper and pipes up to 50mm – up to 240 minutes integrity performance***

The proposed construction comprises copper pipes up to DN50 and steel pipes up to NB50 penetration through Maxilite as shown in Figure 49 with protection as per Table 8.

With reference to FSP 2106 specimen 3, it comprised a 50mm OD x 1.22mm thick copper pipe penetrated a horizontally orientated 60mm thick grey Maxilite board, with 300mm Twrap on the unexposed side. The 15mm annular gap was sealed to the full depth of the Maxilite board with FyreFLEX sealant and finished off with a 20mm fillet. The specimen was able to maintain integrity without failure for 241 minutes and failed insulation at 72 minutes.



It is expected the proposed increase of Twrap by 300mm on the unexposed side will allow the 50mm OD copper pipe to maintain insulation for up to 120 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity for up to 240 minutes and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

***Inclusion of copper pipes up to DN50 – up to 90 minutes integrity performance***

The proposed construction comprises copper pipes up to DN50 and steel pipes up to NB50 penetration through Maxilite as shown in Figure 49 with protection as per Table 8a.

With reference to FSP 2106 specimen 3, it comprised a 50mm OD x 1.22mm thick copper pipe penetrated a horizontally orientated 60mm thick grey Maxilite board, with 300mm Twrap on the unexposed side. The 15mm annular gap was sealed to the full depth of the Maxilite board with FyreFLEX sealant and finished off with a 20mm fillet. The specimen was able to maintain integrity without failure for 241 minutes and failed insulation at 72 minutes.

It is expected the proposed increase of Twrap by 150mm on the unexposed side will allow the 50mm OD copper pipe to maintain insulation for up to 90 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 90 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

***Inclusion of steel pipes up to NB50 – up to 90 minutes integrity performance***

The proposed construction comprises steel pipes up to NB50 penetration through Maxilite as shown in Figure 49 with protection as per Table 8a.

With reference to FSP 2106 specimen 3, it comprised a 50mm OD x 1.22mm thick copper pipe penetrated a horizontally orientated 60mm thick grey Maxilite board, with 300mm Twrap on the unexposed side. The 15mm annular gap was sealed to the full depth of the Maxilite board with FyreFLEX sealant and finished off with a 20mm fillet. The specimen was able to maintain integrity without failure for 241 minutes and failed insulation at 72 minutes.

The proposed steel pipe has a lower thermal conductivity compared to copper pipe of the same size, and so it is expected the proposed construction will be able to maintain insulation for 90 minutes

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 90 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

***Inclusion of copper pipes up to DN150 and steel pipes up to NB150 – up to 180 minutes integrity performance***

The proposed construction comprises copper pipes up to DN150 and steel pipes up to NB150 penetration through Maxilite as shown in Figure 51 with protection as per Table 8.

With reference to FSP 2106 specimen 1, a 150mm diameter copper pipe with a wall thickness of 2mm penetrated a 60mm thick horizontally orientated Grey Maxilite penetration seal and was protected with a 1500mm first layer of Twrap and a 300mm second layer of Twrap. It also had a 30mm Grey Maxilite board collar at the base of the penetration on the unexposed side. It flamed at 230 minutes between the two layers of wrap. The Twrap was able to maintain insulation for 194 minutes. The 30mm Grey Maxilite collar maintains insulation for 240 minutes and the pipe maintains insulation for 214 minutes.

With reference to FRT 190292.1 specimen E3, a 150mm diameter copper pipe with a wall thickness of 1.63mm penetrated a 60mm thick horizontally orientated White Maxilite penetration seal and was protected with a 1500mm first layer of Twrap and a 300mm second layer of Twrap. It also had a 30mm White Maxilite board collar at the base of the penetration on the unexposed side. It failed integrity

due to flaming at 38 minutes on the wrap at the support as the pipe burnt through by the furnace. The 30mm Maxilite collar only had a 138°K temperature rise at 240 minutes.

The significance of FRT 190292.1 specimen E3 shows that the 60mm White Maxilite board with a 30mm White Maxilite collar was able to maintain insulation for 240 minutes when penetrated by a 150mm copper pipe. It also showed that the 150mm pipe that's less than 2mm thick will be burnt through prior to 180 minutes.

Although the proposed steel pipes up to NB150 have cross sectional areas that are larger than the tested copper pipe, steel is much less conductive than copper. Therefore, it is expected that the slightly larger steel pipes will also be able to maintain integrity at the penetration seal for up to 180 minutes.

With reference to FRT 200397 R1.2 specimen A10, a 150mm diameter steel pipe with a wall thickness of 3.9mm penetrated 2 x 60mm thick Fyrebatts. FyreFLEX sealants filled the 12.5mm annular gap to the full depth of the batts. 50x50mm fillet of FyreFLEX sealant was applied to each side of the penetration. A layer of 450mm length of Twrap was applied to the unexposed side and a 300mm length of Twrap was applied to the unexposed side. The pipe was able to maintain integrity for 241 minutes duration of the test and failed insulation at 119 minutes on the pipe.

Upon close inspection of FRT200397 R1.2 and its test photos, it was found that specimen A10 was not reported in compliance with AS 1530.4-2014 and that specimens are placed in close proximity to each other. This would result in shielding of the specimens leading to cooler specimens compared to the standard spacing of specimens required by AS 1530.4 – 2014 section 10.

Though tested in a vertical orientation, the insulation result for FRT200397 R1.2 specimen A10 is applicable to horizontal orientation as the furnace severity requirement is the same for horizontal and vertically orientated tests.

The proposed construction comprises a 900mm length of wrap on the unexposed side of the slab. The total distance between the unwrapped pipe in the proposed construction is 150mm longer than that in FRT200397 R1.2 specimen A10. This will compensate for the shielding experience by FRT200397 R1.2 specimen A10 and act to cool the pipe down on the unexposed side.

Based on the above, on balance, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 180 and 120 minutes respectively when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005.

### ***Inclusion of PVC pipes***

The proposed construction comprises PVC pipe penetrations through Maxilite as shown in Figures 52 and 53.

With reference to FR 3981 and FSP 1989, various sizes of pipes penetrated a 60mm thick vertically orientated White Maxilite board and were protected with Fyrechoke collars on the exposed side of the board. The results are summarised in Table B8 below.

**Table B8: PVC pipe penetration**

Report	Size of FyreFLEX sealant fillet on the unexposed side (mm)	Size of Fire collars on exposed Maxilite	PVC pipe penetrations	Integrity (minutes)	Insulation (minutes)
FR 3981 (T(a))	None	Abesco SS micro collar 25 mm	25mm OD x 1.9mm wall thickness PVC pipe	187	157
FR 3981 (T(c))	None	Abesco SS micro collar 32 mm	36mm OD x 2mm wall thickness PVC pipe	160	140
FSP 1989 (7)	15 x 15	40mm Fyrechoke collar	43mm OD x 2.2mm wall thick PVC pipe	241NF	92
FSP 1989 (6)	15 x 15	50mm Fyrechoke collar	56mm OD x 2.8mm wall thick PVC pipe	241NF	103
FSP 1989 (5)	15 x 15	65mm Fyrechoke collar	69mm OD x 2.8mm wall thick PVC pipe	241NF	124



Report	Size of FyreFLEX sealant fillet on the unexposed side (mm)	Size of Fire collars on exposed Maxilite	PVC pipe penetrations	Integrity (minutes)	Insulation (minutes)
FSP 1989 (2)	15 x 15	80mm Fyrechoke collar	83mm OD x 3.3mm wall thick PVC pipe	241NF	151
FSP 1989 (1)	15 x 15	100mm Fyrechoke collar	110mm OD x 3.4mm wall thick PVC pipe	241NF	73

The proposed constructions are mostly as tested, with the exception of the 100mm PVC pipe specimen.

The proposed localised increase of Maxilite penetration seal thickness for the 100mm pipe penetration by 30mm will provide an additional 60 minutes of insulation performance to the Maxilite board at the penetration. Therefore, it is expected that the proposed 100mm PVC pipe specimen will be able to maintain integrity for 240 minutes and insulation for at least 60 minutes.

It was observed in FSP 1991 that White Maxilite performs better than Grey Maxilite by approximately 15 minutes in terms of insulation performance up to 120 minutes. It is expected that the Grey Maxilite will achieve at least 120 minutes of insulation when penetrated by FR3881 specimens T(a) and T(c). It is expected that the Grey Maxilite will achieve at least 60 minutes of insulation when penetrated by FSP 1989 specimens 1,2, 5, 6 and 7.

Based on the above, it is expected that the proposed construction in Figure 52 will be able to maintain integrity and insulation for up to 120 minutes and Figure 53 will be able to maintain integrity for 240 minutes and insulation for 60 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

#### ***Inclusion of Pex and Pex-al-Pex pipe***

The proposed construction comprises Pex pipe and Pex-Al-Pex pipes penetrating Maxilite as shown in Figures 55a.

With reference to EWFA 51288000.2 Specimen C1, C2 and C3, which comprised 25mm Pex A, Pex B and Pex Al Pex pipes penetrating a 75mm thick Hebel wall and protected locally with 60mm depth of Fyrepex sealant on the unexposed side. All of the specimens were able to maintain integrity for up to 121 minutes without any signs of failure.

It is expected that when the wall is rotated to a horizontal position with the pipes supported independently, the Fyrepex sealant will act in a similar manner as that tested in EWFA 51288000.2 and close off the pipe so as to not result in any integrity failures for 120 minutes.

The additional Maxilite padding and therefore increased depth of Fyreflex sealant will further act to close off the service penetration.

The proposed 450mm length of wrap on unexposed side will ensure the pipe temperature is below 180°C rise for at least 120 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005 when protecting services tested or assessed for floor applications in other separating elements.

#### ***Inclusion of steel threaded rod***

The proposed construction comprises a 10mm OD steel threaded rod through Maxilite as shown in Figure 55.

With reference to FRT 190292.1 specimen E4, an M10 steel threaded rod penetrated a 30mm hole in a 60mm thick horizontal orientated White Maxilite board. The penetration was protected with full depth of FyreFLEX sealant in the 3mm annular gap and a 30mm x 30mm fillet on each side of the wall as well as a 200mm length of Twrap on each side. The specimen maintained integrity and insulation for 241 minutes without failure. The highest thermocouple temperature measure on the specimen was on the Maxilite board, which reach 151°K rise at 241 minutes.

The proposed variation of increasing the annular gap by 2mm will result in more sealants being present at the penetration and thus provide better insulation between the metal rod and the board. It is therefore expected that this variation will not cause any detrimental effect on the effectiveness of the seal for up to 240 minutes.

It was observed in FSP 1991 that the insulation performance of the White and Grey Maxilite board was similar at 240 minutes. It is expected that the results for FP 11935-001, specimen 1 can be applied to the grey Maxilite board.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005.

The proposed construction comprises various FyreBOX installations in two sheets of 60mm Maxilite when in apertures in floors as shown in Figures 9a, and 9a and Figure 54

With reference to FSP 1913 specimen 2, a blank FyreBOX Maxi 350 was installed in a 60mm thick vertically orientated White Maxilite board with its 10mm annular gap sealed to full depth with FyreFLEX sealant. 30mm x 50mm angles on all sides of the FyreBOX on each side of the wall. The specimen maintained integrity with no failure for 121 minutes and failed insulation at 35 minutes.

With reference to FSP 1991 Rev. A, both the Grey and White Maxilite with a slot stimulating a cutout for a FyreBOX. When tested a load of 21.75kg was applied at 2 points 300mm apart and for a period of 260 minutes.

The proposed construction includes a cutout for the FyreBOX and loads the sheet at the edges of the cutout, therefore, producing a similar bending stress and loading arrangement to that tested in FSP 1991 Rev. A. Based on the above it is reasonable and conservative to limit the bending stress in the Maxilite sheet of the proposed designs to that when tested.

A calculation of the bending stress in the proposed designs was carried out and it verified this is less than when tested in FSP 1991 Rev. A. Based on this finding it is confirmed the proposed configuration of Maxilite can resist the weight of the Firebox, therefore, provide suitable support for the FyreBOX when protecting services tested or assessed for floor applications in other separating elements.

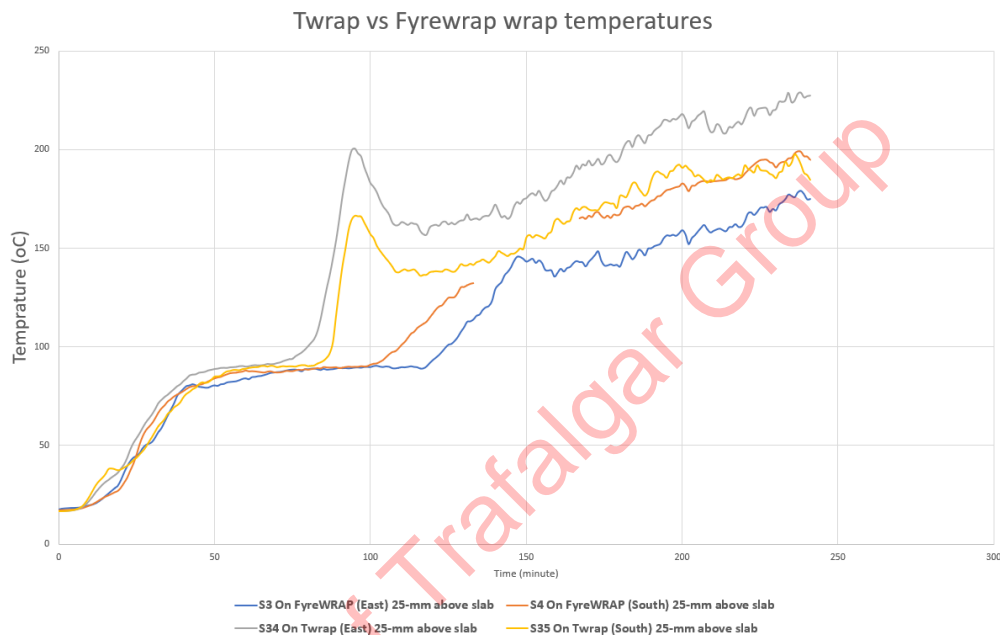
With reference to EWFA 51894700.1, a FyreBOX Maxilite 350 was installed on a 60mm thick horizontal Grey Maxilite board and tested with various cables through the box. It also had its 10mm annular gap sealed to full depth with FyreFLEX sealant and 30mm x 50mm angles on all sides of the FyreBOX on each side of the wall. It failed integrity at 138 minutes and insulation at 12 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity for up to 120 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005 when protecting services tested or assessed for floor applications in other separating elements.

## B.7 Optional use of Twrap and Fyrewrap

The proposed variation comprises the substitution of Fyrewrap (38-mm thick Fyrewrap Elite 1.5 ceramic fibre blanket (aluminium faced) with a density of 96 kg/m<sup>3</sup>) as an option for where Twrap (25-mm thick Twrap fire blanket (aluminium faced) with a density of 160 kg/m<sup>3</sup>) is used in the service penetrations proposed in this assessment.

With reference to FSP 2146 specimens 1 and 4, which comprised 100mm copper pipes wrapped either in 600mm length of Fyrewrap or Twrap respectively on the unexposed side of a 150mm thick concrete slab. Specimen 4, which was the pipe with Twrap flued at 86 minutes while specimen 1, which was the pipe with Fyrewrap flued at 138 minutes. Neither specimen showed any integrity failure associated with the wrap or penetration seal for up to 241 minutes duration of the test.



**Figure B1: Wrap temperatures in FSP 2146**

The test was designed to compare the performance of Fyrewrap and Twrap. The 100mm copper pipe was used as the pipe under each wrap.

With reference to Figure B1, prior to these pipes fluing, the insulation performance of the wraps was similar, with Twrap heating up slightly faster than Fyrewrap before they both plateaued in temperature rise to just under 100°K at around 50 minutes. During the fluing of the pipes, it was observed that Twrap also heated up faster than Fyrewrap as shown by the steeper gradient of the Twrap temperature peak. After fluing of the pipes, the Twrap and Fyrewrap temperature rise was again similar.

Therefore, it is reasonable and conservative to expect that if FSP 2146 specimen 4's copper pipe which flued, was wrapped with Fyrewrap, it would have also performed similarly to or marginally better than specimen 4 for up to 180 minutes.

With reference to FSP 2146, both Twrap and Fyrewrap have demonstrated their ability to not caused flaming for up to 240 minutes. Since a 100mm copper pipe was used as the standard heating element for the comparison of these wraps, its high rate of heat transfer ability allows the above comparisons to be applicable to other penetrations mentioned in this report.

Based on the above, it is expected that when the penetrations discussed in Sections B.5 and B.6 are wrapped with Fyrewrap instead of Twrap, it would not detrimentally affect the insulation performance of the proposed penetrations for up to 180 minutes and their integrity performance for up to 240 minutes when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 -2005.

## B.8 Maxilite board as a flat seal in a floor

The proposed Maxilite flat seal shall be evaluated under integrity and insulation criteria relevant to the constructions outlined in accordance with AS 1530.4-2014 Section 10. The proposed construction is shown in Figures 18, 34 and 59.

It is required that

- Floor separating elements supporting the penetration seals shall be supported by a test, assessment or appropriate design to achieve the required FRL when including an opening.
- The Maxilite seal shall comprise a minimum of 40mm thick grey or white Maxilite board.
- Size of opening in the floor to be max. 1.8m long and area less than 1.62m<sup>2</sup>
- No joints allowed in Maxilite board
- No penetrations allowed in the board
- Fire exposure from below only
- Refer to Figures, 18, 34 and 59

### ***Integrity performance of White and Grey Maxilite penetration seal away from joints***

As discussed above in Section B1, the 40mm Grey and White Maxilite Board demonstrated their ability to remain intact for up to 120 minutes away from the joints.

With reference to FSP 1907, the 40mm thick grey Maxilite which was fixed to a concrete opening via angles was able to maintain insulation away from joints for up to 120 minutes.

The proposed detail in Figure 18 comprises a Maxilite board fixed on the topside of a floor opening.

The proposed detail in Figure 18 would result in the perimeter thermal couples being located on top of the floor and a layer of 40mm Maxilite. This would allow the perimeter thermocouples to be even cooler than the Maxilite board that's exposed to fire.

The proposed detail in Figure 59 comprises a Maxilite board fixed from the underside of a floor opening.

With reference to FR 3981 specimen K, a 30mm thick white Maxilite was fixed from the underside of a slab. The board was able to maintain integrity for up to 241 minutes with no signs of failure at the perimeter. The thermocouple at the perimeter of the board to floor opening failed insulation at 90 minutes. The thermocouple away from the perimeter did not fail under 116 minutes. The sealant around the opening on top of the board was observed to be minimal. This demonstrates that the failure at the perimeter of the board is due to the furnace heat entering between the board and heating up the thermocouple at the perimeter of the board.

The proposed Figure 59 moves the sealant from the top of the board to the outside edge of the board as well as the addition of more sealant between the board and the floor. It is expected that this will provide a sufficient seal to board to floor interface such that the thermocouples around the perimeter of the board will be of similar temperature to the thermocouples that are away from the perimeter of the board as tested in FSP 1907.

Based on the above, it is expected that the proposed size for the 40mm thick White and Grey Maxilite board will be able to remain intact and maintain integrity and insulation for up to 120 minutes based on design when tested in accordance with AS 1530.4 -2014.

## B.9 Maxilite access panel

The proposed access panel in the Maxilite ceiling (element 4) part of the Maxilite floor-ceiling or roof-ceiling system shall be evaluated under the integrity and insulation criteria relevant to the constructions outlined in AS 1530.4 – 2014 Section 4 clause 4.3.4 and clause 4.3.6. The FRL is applied through the Maxilite ceiling membrane to the top of the floor or roof system above the Maxilite ceiling membrane. The resistance to incipient spread (RISF) is not normally required for this type of application. The proposed construction is shown in Figures 60a, 60b, 61, 62 and 45b

The proposed access panel in the Maxilite ceiling (element 4) part of the Maxilite ceiling system shall be evaluated under integrity and insulation criteria relevant to the constructions outlined in AS 1530.4 – 2014 Section 4 clause 4.3.7. The FRL is applied through the Maxilite ceiling membrane only. The proposed construction is shown in Figures 60a, 60b, 61 and 62.

It is required that

- Maximum aperture in Maxilite support construction size of 600mmx600mm
- Access panel to be constructed and installed as per Figure 60a and 60b:
- The Access panels must be mounted into 1x 60mm or 2x 30mm white or grey Maxilite boards regardless of application
- Installed at least 300mm away from the edge of any Maxilite sheet and may be installed across a joint centrally, where the maximum cut-out in the Maxilite construction is maximum of 300mm as per Figure 62 and Table 11a. Joint to be cover with a cover strip as per Figure 21b
- Where Access panel is larger than 500mm x 500mm, Maxilite part of the floor/roof ceiling or ceiling system shall be reinforced with Unistrut around the access panel opening as per Figure 60b

The proposed construction comprises Maxilite board installed in a similar manner as for when it is installed as a flat penetration seal discussed in Section B.3, except the support construction is Maxilite boards as a ceiling. It is expected that the difference in thermal behaviour of Maxilite covering to Maxilite ceiling would be minimal.

The main risk factor associated with this construction is the weight of the access panel imposing on the cut part of the Maxilite board as well as the exposure of the metal element to heat resulting in buckling.

It is expected that for Maxilite access panel covering opening less than 500mm x 500mm, the weight of access panel will not detrimentally affect the integrity of the proposed floor/roof-ceiling system or ceiling system discussed in section B1 and B2 above for up to 120 minutes.

The proposed Maxilite access panel covering for opening less than 600mm x 600mm comprise additional support around the ceiling opening, and as such the proposed construction will not detrimentally affect the integrity of the proposed floor/roof-ceiling system or ceiling system discussed in section B1 and B2 above for up to 120 minutes.

By observation, the access panel frame is kept from direct fire attack and thus it is expected to not buckle for at least 120 minutes. Therefore, the Maxilite to access panel junction will not introduce gaps that causes integrity failure.

Based on the above, it is expected that the proposed construction will be able to remain intact and not detrimentally affect the integrity and insulation performance of the construction discussed in section B1 and B2 for up to 120 minutes when tested in accordance with AS 1530.4 -2014.

## B.10 Maxilite board protecting penetrations in a plasterboard ceiling system

The proposed patching of floor-ceiling or roof-ceiling system shall be evaluated under the integrity and insulation criteria relevant to the constructions outlined in AS 1530.4 – 2014 Section 4 clause 4.3.4 and clause 4.3.6. The FRL is applied through the plasterboard ceiling membrane to the top of the floor or roof system above the plasterboard ceiling membrane. The resistance to incipient spread (RISF) is required for this type of application. The proposed construction is shown in Figures 63- 67.

It is required that

- The fire exposure is either
  - from below the plasterboard ceiling to the top of the floor as shown in Figures 63 and 65, or
  - also, from below the plasterboard ceiling to the unexposed side of the fire rated wall (element 3a, 3b, 3c or 3d) as shown in Figure 64
- Floor/roof - ceiling separating elements supporting the penetration seals shall be supported by a test, assessment or appropriate design to achieve the required FRL and RISF when including an opening.
- It is required that the walls (element 3a, 3b, 3c or 3d) shall have the required FRL without the assistance of the plasterboard ceiling and provide the required support to the floor ceiling system (element 2a)
- The Maxilite patch can either be
  - A patching of an oversized holes in plasterboard lining of a floor ceiling system or
  - A local thickening of the ceiling system with a tightly cut hole in the floor/roof ceiling system

The proposed construction is a floor/roof ceiling system that comprises two or more layers of fire rated plasterboard lined ceiling spanning across walls under a fire rated or non-fire rated floor structure as shown in Figure 1. Where service penetrates the fire rated ceiling lining, it is treated locally with Maxilite board of minimum 60mm thickness.

With reference to RTL FT 1522.01 and RTL FT 1553.2, a floor/roof ceiling system was patch on the ceiling lining with 60mm thick White and blue Maxilite board respectively. The opening size in the ceiling lining varied from 600mm x 100mm to 350mm x 500mm and was covered on the fire side with Maxilite board resulting in a 100mm overlap. 10g x 100mm screws were used to fix the Maxilite board at each corner of board and in the mid span of board, to a ceiling furring channel, with the perimeter of Maxilite was sealed with a small fillet of sealant. The Maxilite board did not dislodge from the ceiling lining for up to 60 and 120 minutes respectively.

The proposed construction in Figure 67 comprises the fire rated lining of the floor-ceiling or roof-ceiling system with a small hole for services be locally thickened with a layer of 60mm thickness blue and white Maxilite.

It is required that the existing floor/roof ceiling separating elements be supported by a test, assessment or appropriate design to achieve the required FRL and RISF.

It is expected that the local thickening of the plasterboard lining barrier of the floor or roof ceiling system will improve the insulation performance of the system cavity temperature, and therefore will not detrimentally affect the FRL and RISF of the proposed floor/roof ceiling system.

The proposed construction in Figure 66 comprises a maximum 600mm x 600mm opening in the fire rated lining of the floor-ceiling or roof-ceiling system be covered with a layer of 60mm thickness blue and white Maxilite.

With reference to RTL FT 1522.01 and RTL FT 1553.2, these tests demonstrated the compatibility of Maxilite board covering up an opening in ceiling lining for up to 120 minutes.



Based on the discussion in Section B1 of this report, it is expected that the 60mm Maxilite, with butt joints will be able to maintain integrity for up to 120 minutes and RISF for up to 60 minutes, and therefore will not detrimentally affect the FRL and RISF of the proposed floor/roof ceiling system.

### **Inclusion of service penetrations in the system**

The proposed floor-ceiling or roof-ceiling system where patched with minimum 60mm thick Maxilite board, may include services that penetrate the Maxilite board in the following cases:

- a) Unexposed face of roof/floor ceiling construction (element 2a) and Maxilite patch in the lining of ceiling construction (element 4) as shown in Figure 63.
  - Services shall be protected at the Maxilite patch (element 4) with systems listed in Tables 12 and 13
  - The gap between the roof/floor ceiling system and services shall be sealed on the unexposed side of the roof/floor ceiling system with at least a 15mm fillet of Trafalgar FyreFLEX sealant
- b) Maxilite patch in the lining of ceiling construction (element 4) and Wall (element 3a, 3b, 3c or 3d) as shown in Figure 64
  - Services shall be protected at Maxilite ceiling (element 4) with systems listed in Tables 12 and 13
  - Services shall be protected at the wall (element 3a, 3b, 3c or 3d) systems listed in Section 3.7
  - Length of service from ceiling patch to fire rated wall shall be at least 550mm
- c) Maxilite patch in the lining of ceiling construction (element 4) only as shown in Figure 65.
  - Services shall be protected at the Maxilite patch (element 4) with systems listed in Tables 12, 13 and 14
  - Service shall remain in the same fire compartment

It is required that

- Plasterboard lining of the floor/roof ceiling system (element 2a) nor Maxilite patch shall not support the weight of any service penetrations. All services shall be supported from above independently of the ceiling.
- Services shall be spaced by a minimum of 40mm

#### **Case a)**

The proposed construction is as tested in RTL FT 1522.01 and RTL FT 1553.2, which as shown in Table B9, the system was able to maintain integrity and insulation for 60 and 120 minutes, and RISF for 60 minutes.

Provided that the gap between the services and the roof/floor ceiling system is sealed with the proposed 15mm fillet of sealant, it is expected that the unexposed side of the floor or roof construction will be able to maintain insulation for at least 120 minutes and the roof/floor ceiling system will maintain RISF for 60 minutes.

#### **Case b)**

The proposed construction is similar to case a) except the penetration does not exit the top of the floor/ceiling system but exit through a fire rated wall to the next fire compartment.

It is required the roof/floor ceiling system is bounded by fire resistant wall construction (element 3a, 3b, 3c or 3d) with the performance of the service penetrations through vertical Maxilite boards was discussed in Section B.5.

The proposed length of services within the cavity of the system is the same or greater than that tested in RTL FT 1522.01 and RTL FT 1553.2, and therefore it is expected that the unexposed side of the floor or roof construction and the fire rated wall will be able to maintain insulation for at least 120 minutes and the roof/floor ceiling system will maintain RISF for 60 minutes.



### Case c)

The proposed construction is similar to case a) except the service does not exit the top of the floor/ceiling system, but remains within the cavity of the system, in the same fire compartment. It is expected that this scenario is more conservative than case a) as the top of the floor/ceiling system does not have an opening which may compromise its performance.

Based on the above, it is expected that the proposed construction will be able to maintain insulation for at least 120 minutes the roof/floor ceiling system will maintain RISF for 60 minutes.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes and RISF for 60 minutes when tested in accordance with AS 1530.4 – 2014.

### Service penetrations

The proposed construction shall be for services penetrating the ceiling lining of the floor-ceiling or roof-ceiling system and subject to the following variations:

- Inclusion of services as shown in Tables 12 and 13 and Figures 66 and 67
- Inclusion of services as shown in Table 14 and Figure 8
- The minimum thickness of the Maxilite board shall be 60mm
- The gap between underside of Maxilite and service shall be sealed with full depth Trafalgar FyreFLEX sealant and finished off with a 30mm x 30mm fillet of Trafalgar FyreFLEX sealant
- Twrap around services to overlap itself by 50mm, held in place with aluminium foil tape and tied off with min 4.6mm wide stainless steel cable ties

### ***Inclusion of copper pipes up to DN50***

The proposed construction comprises copper pipes up to DN50 and penetration through ceiling lining either locally thickened or has an oversize hole that's patched with Maxilite as shown in Figures 66 and 67 with protection as per Table 13.

With reference to Table B9, RTL FT 1553.2 Specimen 1E comprise 50mm copper pipe penetrating an oversized hole in a 3 layered floor ceiling system. It was protected on the top side of the Maxilite board with 450mm length of Twrap and sealed on the fire side with 30mm x 30mm of FyreFLEX sealant. The specimen was able to maintain integrity and insulation for 120 minutes and did not detrimentally affect the RISF of the floor ceiling system for at 99 minutes.

The proposed variation would require the pipe be installed in a 2 layered floor ceiling system which can achieve an integrity and insulation performance of 60 minutes and maintain RISF of at least 60 minutes.

When the ceiling is locally thickened by Maxilite, the performance of the ceiling system in the cavity is expected to improve locally.

With 60 minutes margin in integrity and insulation performance and 39 minutes margin in RIFS, it is expected the reduction in the conduction path due to the reduced layer of ceiling lining will not detrimentally affect the integrity and insulation performance for up to 60 minutes and RISF performance for up to 60 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

### ***Inclusion of copper pipes up to NB100***

The proposed construction comprises copper pipes up to NB100 and penetration through ceiling lining either locally thickened or has an oversize hole that's patched with Maxilite as shown in Figures 66 and 67 with protection as per Table 13.

With reference to Table B9, RTL FT 1553.2 Specimen 1D comprise 100mm steel pipe penetrating an oversized hole in a 3 layered floor ceiling system. It was protected on the top side of the Maxilite board with 450mm length of Twrap and sealed on the fire side with 30mm x 30mm of FyreFLEX sealant. The

specimen was able to maintain integrity and insulation for 120 minutes and did not detrimentally affect the RISF of the floor ceiling system for at 94 minutes.

The proposed variation would require the pipe be installed in a 2 layered floor ceiling system which can achieve an integrity and insulation performance of 60 minutes and maintain RISF of at least 60 minutes.

When the ceiling is locally thickened by Maxilite, the performance of the ceiling system in the cavity is expected to improve locally.

With 60 minutes margin in integrity and insulation performance and 34 minutes margin in RIFS, it is expected the reduction in the conduction path due to the reduced layer of ceiling lining will not detrimentally affect the integrity and insulation performance for up to 60 minutes and RISF performance for up to 60 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

#### ***Inclusion of steel pipes up to NB50***

The proposed construction comprises steel pipes up to NB50 and penetration through ceiling lining either locally thickened or has an oversize hole that's patched with Maxilite as shown in Figures 66 and 67 with protection as per Table 13.

With reference to Table B9, RTL FT 1553.2 Specimen 1D comprise 100mm steel pipe penetrating an oversized hole in a 3 layered floor ceiling system. It was protected on the top side of the Maxilite board with 450mm length of Twrap and sealed on the fire side with 30mm x 30mm of FyreFLEX sealant. The specimen was able to maintain integrity and insulation for 120 minutes and did not detrimentally affect the RISF of the floor ceiling system for at 94 minutes.

The proposed variation would require the pipe be installed in a 2 layered floor ceiling system which can achieve an integrity and insulation performance of 60 minutes and maintain RISF of at least 60 minutes.

When the ceiling is locally thickened by Maxilite, the performance of the ceiling system in the cavity is expected to improve locally.

The reduction of pipe size will reduce the temperature of the pipe 25mm away from the Twrap, and so it is expected that the pipe will be less than 250°C at 60 minutes.

With 60 minutes margin in integrity and insulation performance and 34 minutes margin in RIFS, it is expected the reduction in the conduction path due to the reduced layer of ceiling lining will not detrimentally affect the integrity and insulation performance for up to 60 minutes and RISF performance for up to 60 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

#### ***Inclusion of various cables***

The proposed construction comprises up to 20 x CAT6 cable, 10 x 10mm TPS cables, 7 x 19mm OD 3C+E power cables with cable tray penetration through ceiling lining either locally thickened or has an oversize hole that's patched with Maxilite as shown in Figures 66 and 67 with protection as per Table 12.

With reference to Table B9, RTL FT1522.01, Specimen 4(1) comprise 20 x CAT6 cable, 10 x 10mm TPS cables, 7 x 19mm OD 3C+E power cables with cable tray penetrating an oversized hole in a 2 layered floor ceiling system. It was protected on the top side of the white Maxilite board with 300mm length of Twrap and sealed on the fire side with 30mm x 30mm of FyreFLEX sealant. The specimen was able to maintain integrity and insulation for 60 minutes and did not detrimentally affect the RISF of the floor ceiling system for at 60 minutes.

The proposed variation would require the cables be installed in a 2 layered floor ceiling system which can achieve an integrity and insulation performance of 60 minutes and maintain RISF of at least 60 minutes.

With some margin on the temperature measured on the white Maxilite board, it is expected that blue Maxilite board will also be able to be below 250oC for at least 60 minutes when protecting the proposed Services,

When the ceiling is locally thickened by Maxilite, the performance of the ceiling system in the cavity is expected to improve locally.

Based on the above, it is expected the proposed construction will not detrimentally affect the integrity and insulation performance for up to 60 minutes and RISF performance for up to 60 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

**Inclusion of Fyrebox**

The proposed construction comprises Fyreboxes as per Table 14 through ceiling lining locally thickened with Maxilite as shown in Figure 68 with protection as per Table 14.

The proposed variation would require the Fyrebox to be installed in a 2 layered floor ceiling system which can achieve an integrity and insulation performance of 60 minutes and maintain RISF of at least 60 minutes.

With reference to Table B9, TR-F40.01, Specimen B comprise a Fyrebox with services penetrating a penetrating a 3 layered floor ceiling system. It was protected on the top side of the white Maxilite board with 300mm length of Twrap. The specimen did not detrimentally affect the integrity and insulation of the ceiling for 121 minutes, and RISF of the floor ceiling system for 91 minutes.

With 61 minutes margin in integrity and insulation performance and 39 minutes margin in RIFS, it is expected the reduction in the conduction path due to the reduced layer of ceiling lining will not detrimentally affect the integrity and insulation performance for up to 60 minutes and RISF performance for up to 60 minutes when tested in accordance with AS 1530.4 – 2014 and assessment in accordance with AS 4072.1 -2005.

**Table B9: Summary of penetrations through tested floor/roof ceiling systems**

Test Report	Plasterboard Ceiling Specification	Service	Opening in the separating element	Maxilite	Service	Annular gap	Local Fire Stopping*	Sealant	FRL and RISF
RTL FT 1522.01	1 x 13mm & 1 x 16mm plasterboard with a 600mm cavity	4(1)	600 x 200mm	Maxilite 60mm white, installed from below with 100mm overlap. Fixed into furring channels.	20 x CAT6 cable, 10 x 10mm TPS cables, 7 x 19mm OD 3C+E power cables	5-50mm	Top of Maxilite: 300mm Twrap with 2 foil tape, and 50mm overlap	30mm x 30mm Fyreflex sealant fillet and full depth Maxilite board	-/60/60 60min RISF
RTL FT 1553.2	3 x 16mm plasterboard with a 550mm cavity	1D	350 x 500mm	Maxilite 60mm grey, installed from below with 100mm overlap. Fixed into furring channels.	100mm x 4.25mm steel pipe	≤ 5mm	Top of Maxilite: 450mm Twrap with 2 foil tape, and 50mm overlap	30mm x 30mm Fyreflex sealant fillet and full depth Maxilite board	- /120/120 60min RISF
		1E			50mm x 1.3mm copper pipe	≤ 5mm			
		1F			8 x CAT 6 data cable	≤ 5mm	Top of Maxilite: 300mm Twrap with 2 foil tape, and 50mm overlap		

Test Report	Plasterboard Ceiling Specification	Service	Opening in the separating element	Maxilite	Service	Annular gap	Local Fire Stopping*	Sealant	FRL and RISF
TR-F40.01	3 x 16mm plasterboard with a 500mm cavity	B	360mm x 135mm	Maxilite 60mm grey, installed from below with min. 100mm overlap. Fixed into furring channels.	350mm x 125mm  FyreBOX Maxi  With Fyrebox Foam at the top of the box	≤ 5mm	Top of Maxilite: 300mm Twrap with 2 foil tape, and 50mm overlap over the Fyrebox	5mm x 5mm Fyreflex sealant fillet and full depth Maxilite board	- /120/120  90min RISF

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CONTACT US

**t** 1300 363 400  
+61 3 9545 2176  
**e** enquiries@csiro.au  
**w** www.csiro.au

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FOR FURTHER INFORMATION

**Infrastructure Technologies**

Keith Nicholls  
Group Leader, Fire Testing and Assessments  
**t** +61 2 94905450  
**e** keith.nicholls@csiro.au  
**w** <https://research.csiro.au/infratech/fire-safety/fire-testing/>

**Infrastructure Technologies**

Jing Xu  
Fire Testing and Assessments  
**t** +61 2 9490 8041  
**e** jing.xu@csiro.au  
**w** <https://research.csiro.au/infratech/fire-safety/fire-testing/>

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