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Fire assessment report

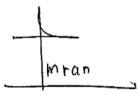
Assessment of service penetrations protected with Boss PenoPatch in walls

Client: BOSS Fire & Safety

Product: Boss PenoPatch Job number: FAS190100 Revision: R1.0

Issue date: 11 October 2019 Expiry date: 31 October 2024

Amendment schedule

Version	Date	Information relating to report			
R1.0	Issue: 11/10/2019	Reason for issue	Report issued to BOSS Fire & Safety for review and comment.		
		Initial Issue	Prepared by	Reviewed by	Approved by
	Expiry: 31/10/2024	Name	Imran Ahamed	Mahmoud Akl	Kjetil Pedersen
		Signature			
	Issue:	Reason for issue			
			Prepared by	Reviewed by	Approved by
	Expiry:	Name			
		Signature			
	Issue:	Reason for issue			
			Prepared by	Reviewed by	Approved by
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General conditions of use

Executive summary

This report documents the findings of the assessment undertaken to determine the likely fire resistance level (FRL) of various penetrations protected with Boss PenoPatch if tested in accordance with AS 1530.4: 2014.

The analysis conducted in Sections 5 and 6 of this report found that the proposed variations are likely to achieve the FRLs shown in Table 1 if tested in accordance with AS 1530.4:2014 and assessed in accordance with AS 4072.1:2015.

Table 1 Variations and assessment outcome

Service	Protection System	Wall Type*	Referenced figure	FRL
Blank Seal	60mm Ø Boss PenoPatch in 20mm Ø aperture	Min. 118mm thick plasterboard wall with at least one 13mm plasterboard on both sides. The cavity will be filled with the tested insulation material or with an equivalent fiberglass cavity insulation material (friction fitted). Wall type can optionally be concrete, masonry, Autoclaved Aerated Concrete (AAC), Hebel, metal clad AAC, Speedpanel or Korok provided that a minimum thickness of 118mm is maintained around the aperture#.	Figure 1 and Figure 6	-/60/60
Up to 16mm Ø Pe-Xa Pipe			Figure 2 and Figure 7	-/60/60
Bundle of CAT6 Data cables (Up to 5 cables)			Figure 3 and Figure 8	-/60/30
Bundle of CAT6 Data cables (Up to 3 cables)			Figure 4 and Figure 9	-/60/60
Bundle of TPS Power Cables (Up to 3 cables)	60mm Ø Boss PenoPatch in 25mm Ø aperture		Figure 3 and Figure 8	-/60/60
Blank Seal	60mm Ø Boss PenoPatch in 25 x 25mm aperture	Min. 100mm thick plasterboard wall with at least two 13mm or a combination of 13mm and 16mm plasterboards on both sides. The cavity will be filled with mineral wool insulation (friction fitted). Wall type can optionally be concrete, masonry, AAC, Hebel, metal clad AAC, Speedpanel or Korok provided that a minimum thickness of 100mm is maintained around the aperture#.	Figure 1 and Figure 6	-/120/60
Single PVC / PVC Sheathed 5mm x 1.5mm² Cable			Figure 3 and Figure 8	-/60/30
			Figure 5 and Figure 10	-/60/60
Single EPR / PO Sheathed 5mm x 1.5mm² Cable			Figure 3 and Figure 8	-/60/30
			Figure 5 and Figure 10	-/60/60
Single XLPE /EVA Sheathed 5mm x 1.5mm² Cable			Figure 3 and Figure 8	-/120/60
Single PVC / PVC Sheathed 1mm x 95mm² Cable			Figure 3 and Figure 8	-/120/30
			Figure 5 and Figure 10	-/120/60
Steel or Copper Pipe up to 16mm Dia.			Figure 2	-/120/-
PVC Conduit up to 16mm Dia.			Figure 2 and Figure 7	-/60/60
Single PVC / PVC Sheathed 1mm x 185mm² Cable			Figure 3 and Figure 8	-/120/30
			Figure 5 and Figure 10	-/120/60

Bundle of 3 PVC / PVC Sheathed 5mm x 1.5mm² Cables	100mm Ø Boss PenoPatch in 50 x 50mm aperture		Figure 3 and Figure 8	-/60/60
Bundle of 3 EPR / PO Sheathed 5mm x 1.5mm² Cables			Figure 3 and Figure 8	-/60/30
			Figure 5 and Figure 10	-/60/60
Bundle of 3 XLPE /EVA Sheathed 5mm x 1.5mm² Cables			Figure 3 and Figure 8	-/60/60
Single PVC / PVC Sheathed 1mm x 95mm² Cable			Figure 3 and Figure 8	-/60/30
Blank Seal			Figure 1 and Figure 6	-/60/60
Steel or Copper Pipe up to 16mm Dia.			Figure 2	-/60/-
PVC Conduit up to 16mm Dia.			Figure 2 and Figure 7	-/60/30
Single PVC / PVC Sheathed 1mm x 185mm² Cable			Figure 3 and Figure 8	-/30/30

* In masonry and concrete walls, the PenoPatch shall be fixed to the walls using at least 2 masonry nails (minimum 12mm long) fixed through the PenoPatch outer edges. In other wall types such as AAC, Hebel, metal clad AAC, Speedpanel and Korok walls, the PenoPatch shall be fixed to the walls using at least 2 metal pins/screws (minimum 12mm long) fixed through the PenoPatch on the outer edges.

The overall FRL will be governed by the established FRL of the wall

Minimum thickness stipulated in the table shall be maintained around the aperture. Build-ups using fire rated plasterboards or 50mm thick Boss Batt may be used in order to obtain the minimum thickness around the aperture. The build-up may be installed on one side of the wall or both side of wall as appropriate and the build-up should extend at least 100mm from the edge of the penetration in all directions.

In addition, a fire rated sealant shall be applied for at least 20mm deep around the plasterboard build-up part.

The variations and outcome of this assessment are subject to the limitations and requirements described in Sections 2, 4 and 7 of this report. The results of this report are valid until 31 October 2024.

Contents

1. Introduction

This report documents the findings of the assessments undertaken to determine the likely fire resistance level (FRL) of various penetrations protected with BOSS PenoPatch if tested in accordance with AS 1530.4:2014[1] and assessed in accordance with AS 4072.1:2015[2]. This assessment was carried out at the request of BOSS Fire & Safety. The sponsor details are included in Table 2.

Furthermore, it has been confirmed that Boss Fire & Safety has obtained the approval from other test sponsors to use their report in this assessment.

Table 2 Sponsor details

Client	Address
BOSS Fire and Safety	Unit 8, 15-23 Kumulla Rd Caringbah NSW 2229

2. Framework for the assessment

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

No specific framework, methodology, standard or guidance documents exists in Australia for doing these assessments. Therefore, we have followed the Guide to Undertaking Assessments In Lieu of Fire Tests prepared by the Passive Fire Protection Federation (PFPF) in the UK[3].

This guide provides a framework to undertake assessments in the absence of specific fire test results. *'Some areas where assessments may be offered are:*

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

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

3. Description of the specimen and variations

3.1 System description

The assessment report references the fire test report EWFA 49527300.3 and 393094, which comprise of various penetrations protected with Boss PenoPatch in 118mm and 100mm thick fire rated plasterboard wall systems, respectively. The referenced tests EWFA 49527300.3 and 393094 were conducted in accordance with AS 1530.4:2014 and BS EN 1366-3:2009[4], respectively.

[1] Standards Australia (2014) Methods for fire tests on building materials, components and structures Part 4: Fire resistance tests for elements of construction, AS 1530.4:2014.

[2] Standards Australia (2005) Components for the protection of openings in fire-resistant separating elements Part 1: Service penetrations and control joints, AS 4072.1:2005.

[3] Guide to Undertaking Assessments In Lieu of Fire Test - The Passive Fire Protection Federation (PFPF), June 2000, UK.

[4] British Standards Institute (1999) Fire resistance tests for service installations, Penetration seals, BS EN 1363.3:2009.

3.2 Referenced test data

The assessment of the variation to the tested system and the determination of the likely performance is based on the results of the fire tests documented in the reports summarised in Table 3. Further details of the tested system are described in Appendix A.

Table 3 Referenced test data

Report number	Test sponsor	Test date	Testing authority
EWFA 49527300.3	Boss Fire	12 July 2018	Exova Warringtonfire (Australia)
393094	FSi Limited	19 April 2018	Exova Warringtonfire (UK)

3.3 Purpose of the test

Sections 2 of AS 1530.4:2014 specify the general requirements for conducting fire resistance tests. Section 10 of AS 1530.4:2014 give guidelines for determining the fire resistance of elements of construction penetrated by services. As per Section 10.3 of AS 1530.4:2014, the purpose of the test covering service penetrations is to assess-

(a) The effect of the penetration on the integrity and insulation of the element

(b) Insulation or integrity failure of the penetrating service

3.4 Variations to tested systems

Identical penetration systems have not been subject to a standard fire test. We have therefore assessed the different systems using baseline test information for similar systems. The variations to the tested systems, together with the referenced baseline standard fire tests, are described in Table 4.

Table 4 Variation to tested systems

Assessment no	Reference test	Description	Variations
1	393094	The referenced tests were conducted in accordance with BS EN 1366-3:2009 and EN 1363-1:1999[5].	Assessment of the likely fire resistance performance of penetrations if tested in accordance with AS 1530.4:2014.
2	EWFA 49527300.3 and 393094	The reference tests were conducted in fire rated plasterboard wall systems. Tests included various penetrations protected using Boss PenoPatch on both exposed and unexposed sides.	Assessment of the likely fire resistance performance with following variations: a) The wall type can optionally be concrete, masonry, Autoclaved Aerated Concrete (AAC), Hebel, metal clad AAC, Speedpanel or Korok wall systems. b) The option of having CAT6 bundle consisting of up to 3 CAT6 cables c) The option of having a blank seal protecting a 20mm diameter aperture a) Use of a 50mm wide PenoPatch putty layer wrapped around the cable penetrations as shown in Figure 5 for increased insulation performance b) Service penetrations penetrating the wall without exiting to the other side (refer to Figure 6 - Figure 10)

[5] British Standards Institute (1999) Fire resistance tests, General requirements, BS EN 1363.1:1999.

3.5 Schedule of components

Table 5 outlines the schedule of components for the assessed systems.

Table 5 Schedule of components of assessed systems

Item	Description
Separating element	The separating wall element can be plasterboard wall, concrete, masonry, Autoclaved Aerated Concrete (AAC), Hebel, metal clad AAC, Speedpanel or Korok wall systems as shown in Table 9. For wall elements with thickness less than the tested system, the minimum thickness stipulated in the Table 9 should be maintained around the aperture using plasterboard or Boss Batt build-up. The build-up piece should extend at least 100mm from the edge of the penetration in all directions and a fire rated sealant should be applied for at least 20mm deep around the build-up piece. For masonry and concrete walls at least 2 masonry nails (minimum 12mm long) should be fixed through the PenoPatch on the outer edges. For AAC, Hebel, metal clad AAC, Speedpanel and Korok walls at least 2 metal pins/screws (minimum 12mm long) should be fixed through the PenoPatch on the outer edges.
Penetration	As specified in Table 9
Fire protection system	60mm Ø and 100mm Ø Boss PenoPatch. At least 50mm wide Boss PenoPatch putty layer shall be used for increased insulation performance (refer to Figure 4, Figure 5, Figure 9 and Figure 10 for corresponding configurations).
Apart from the variations addressed in this report, all other elements should be similar to the tested systems.	

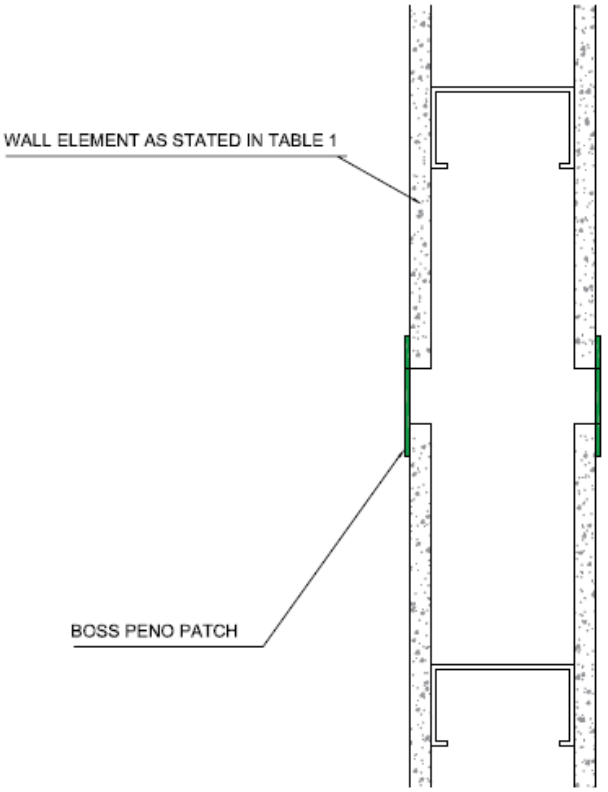

Figure 1 Blank seal

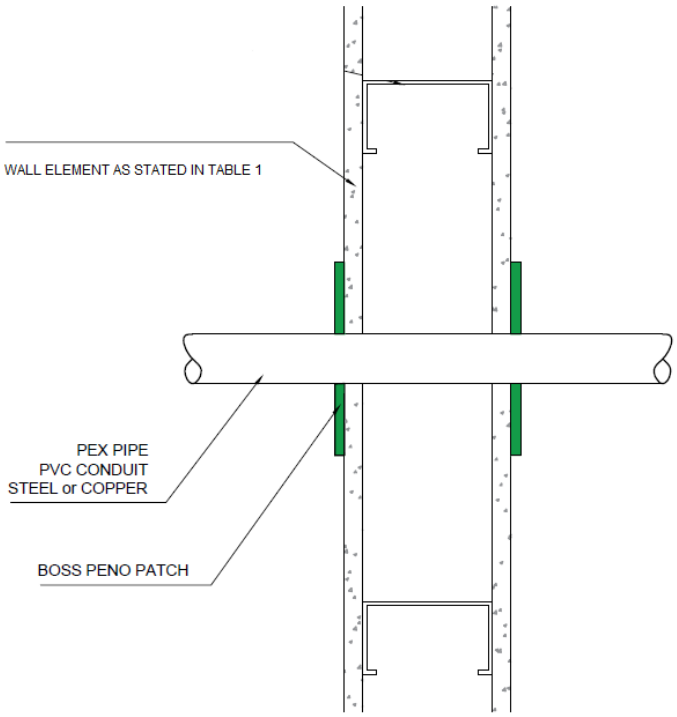

Figure 2 Pe-Xa pipe, PVC, steel or copper conduit penetrations

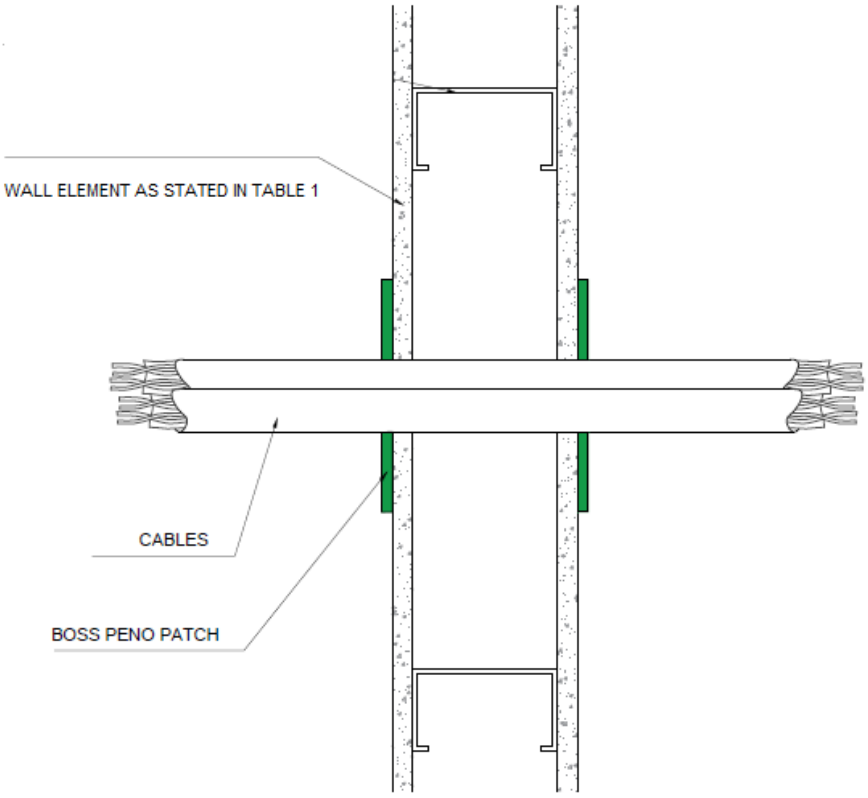

Figure 3 Cable penetrations

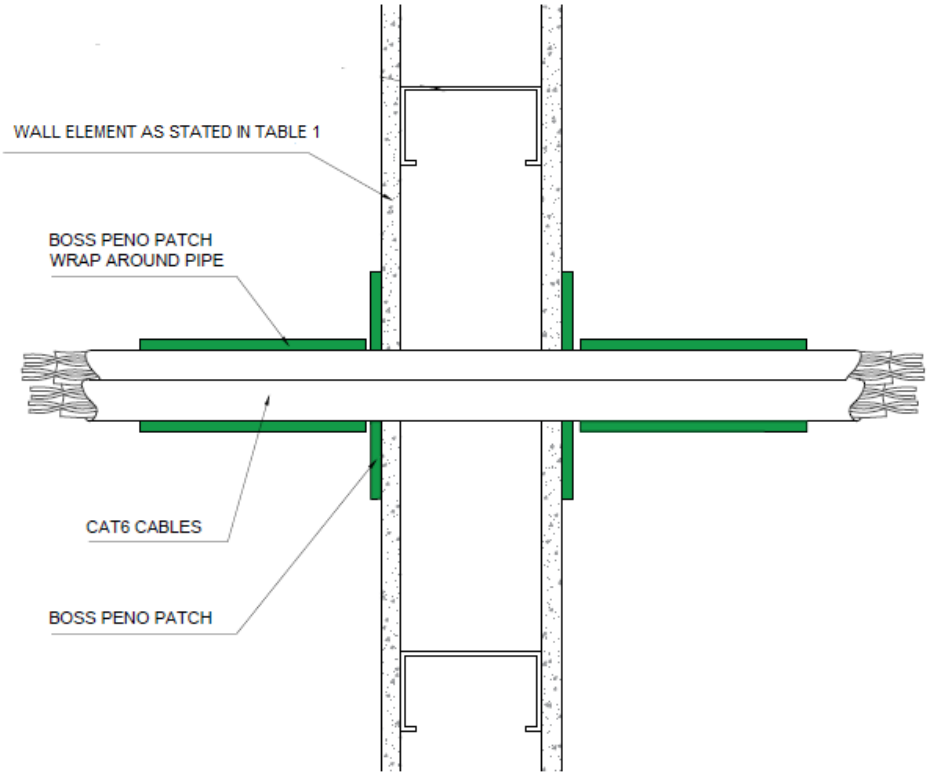

Figure 4 CAT6 cable bundle (up to 3 cables) penetration

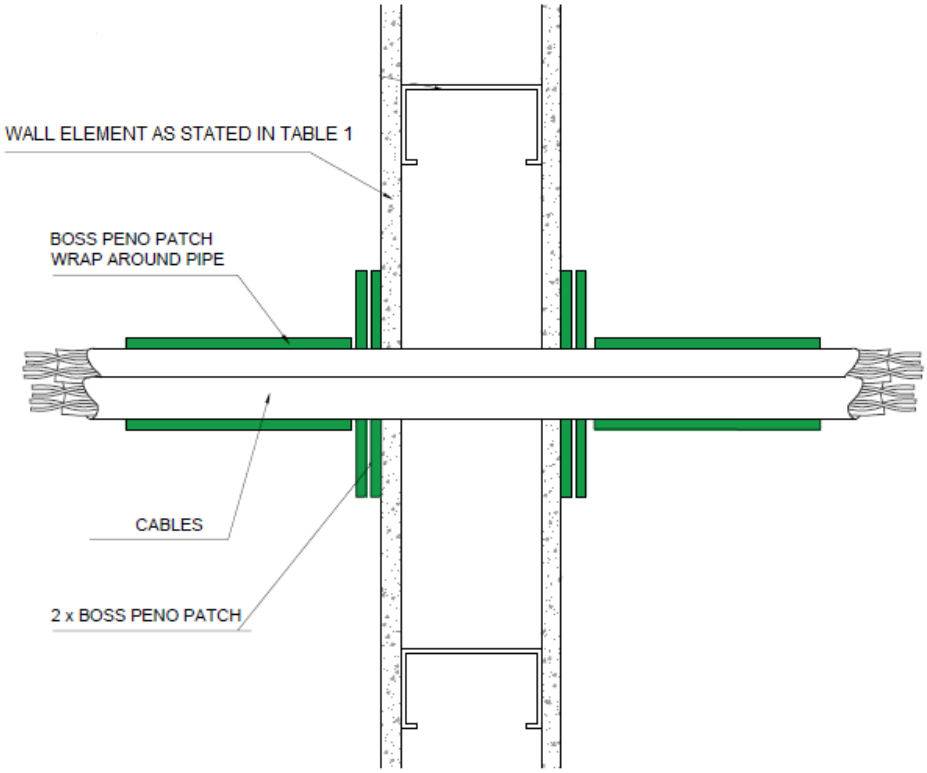

Figure 5 Cable penetrations with additional protection

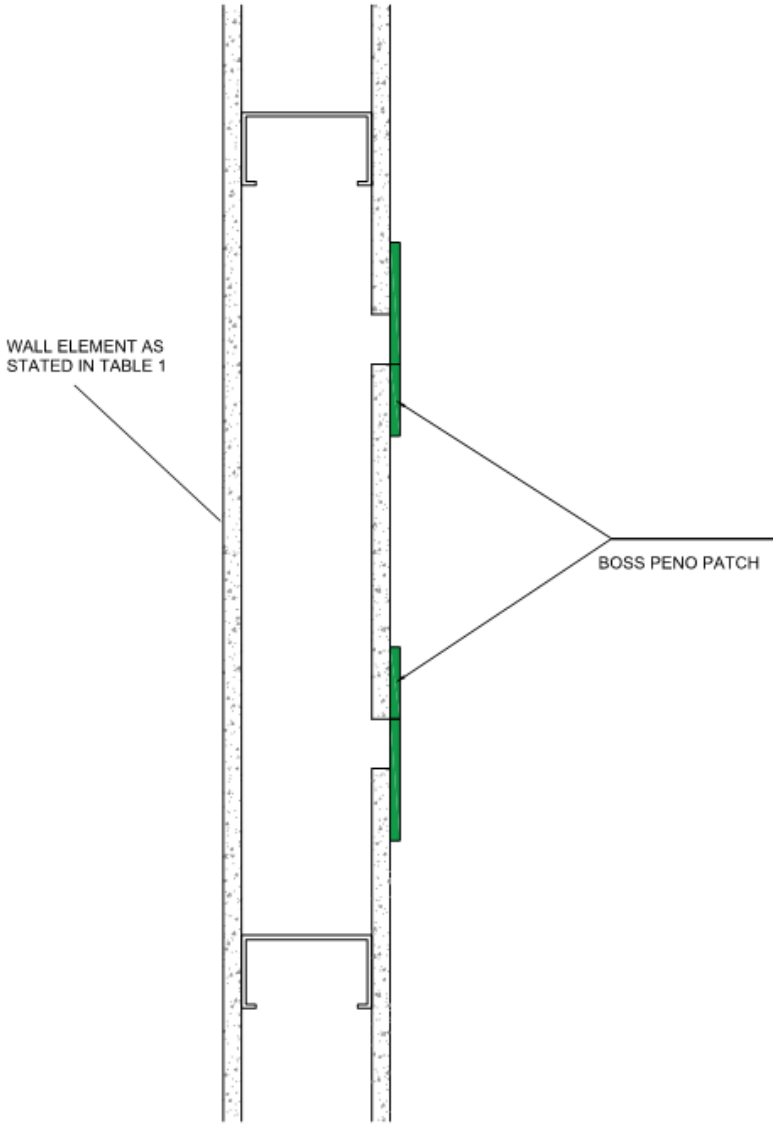

Figure 6 Blank seal on the same side of the wall

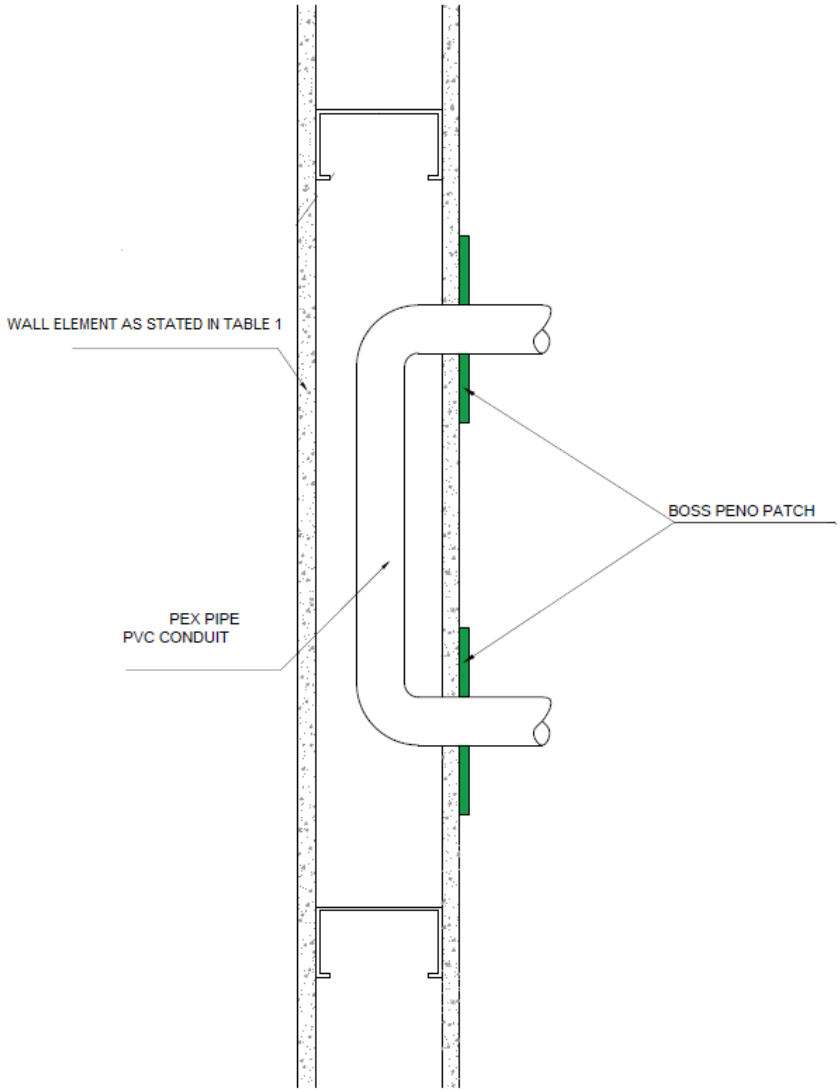

Figure 7 Pe-Xa pipe or PVC conduit penetrating the wall without exiting to the other side

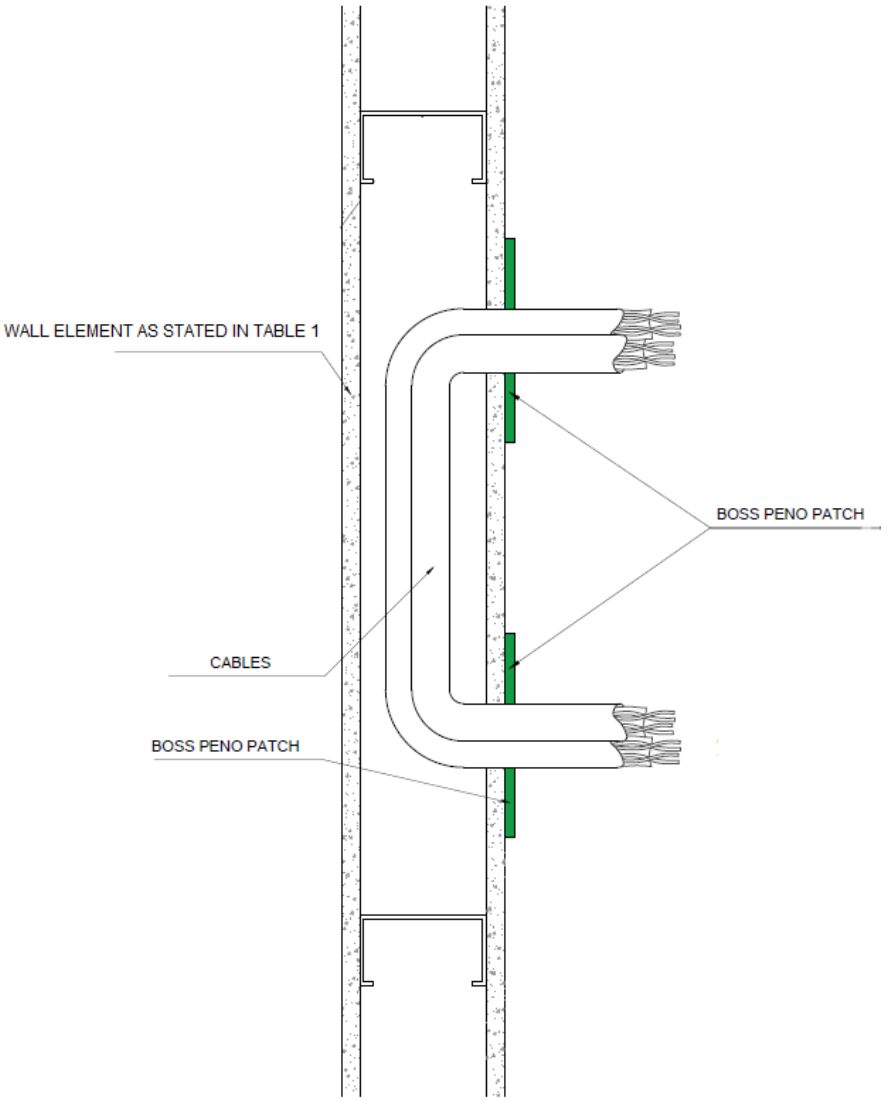

Figure 8 Cable penetrations penetrating the wall without exiting to the other side

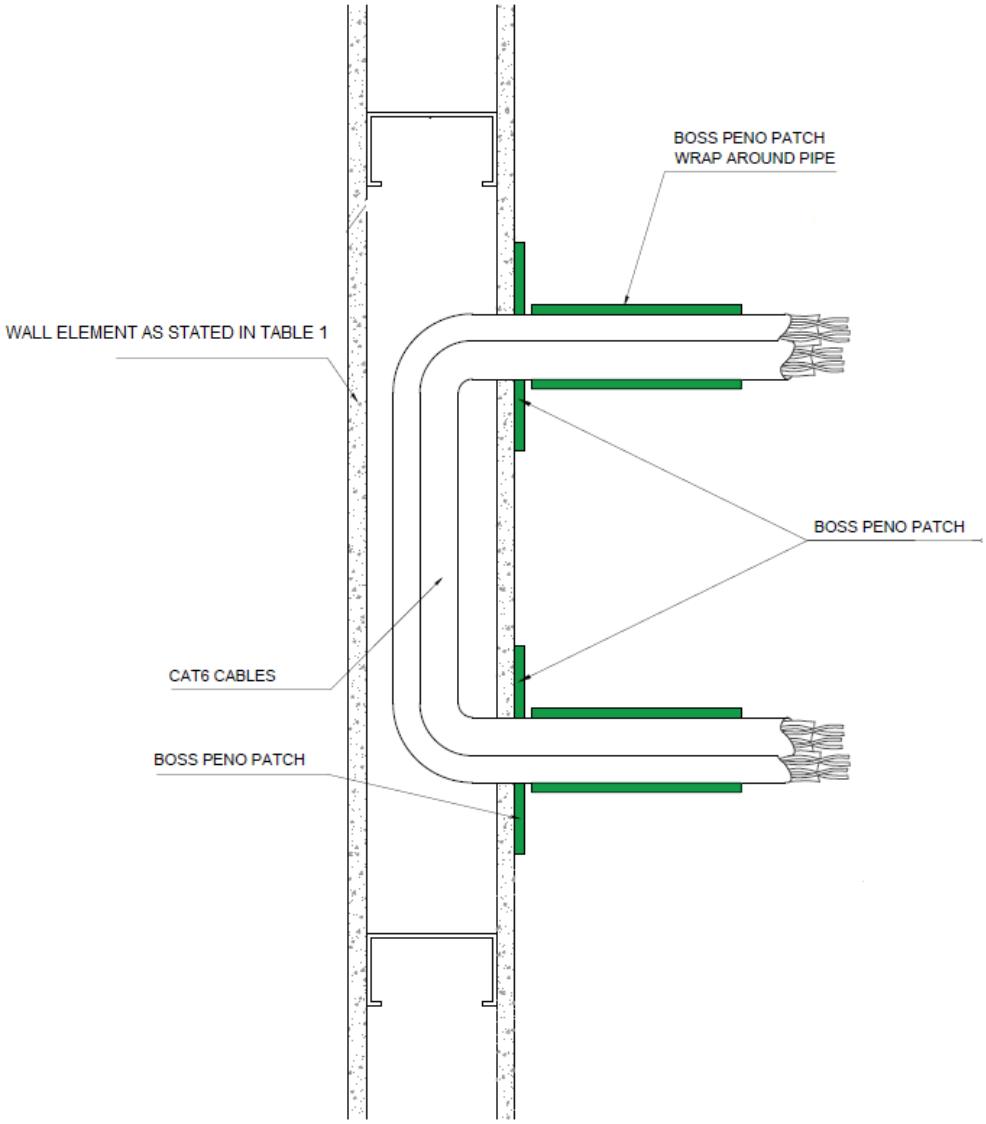

Figure 9 **CAT6 cable bundle (up to 3 cables) penetrating the wall without exiting to the other side**

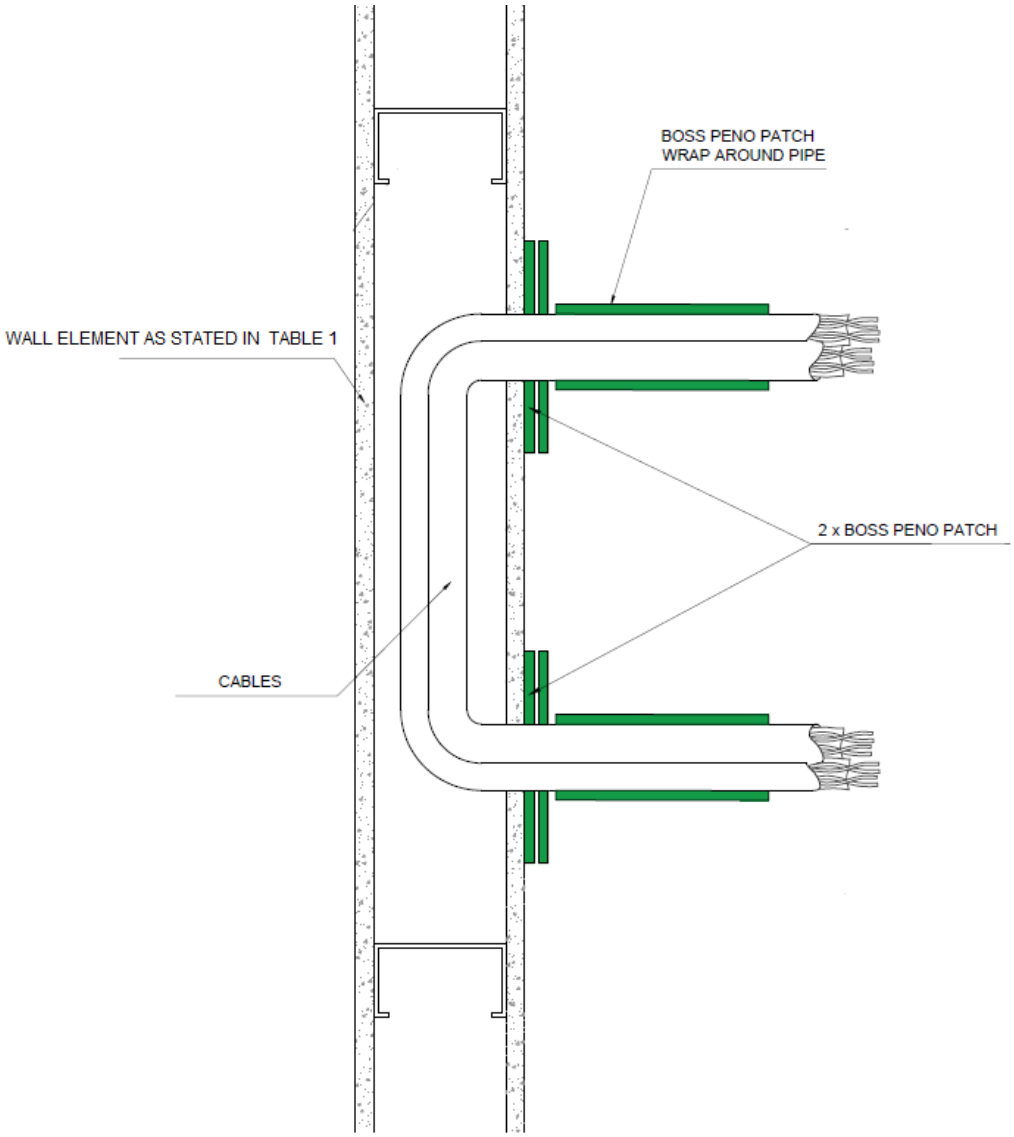

Figure 10 Cable penetrations with additional protection penetrating the wall without exiting to the other side

3.6 Declaration

The guide to undertaking assessments in lieu of fire tests prepared by the PFPF in the UK requires a declaration from the client. By accepting our fee proposals dated 27 August 2019 and 29 August 2019, BOSS Fire & Safety confirmed that:

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

4. Scope, objective and assumptions

4.1 Scope and objective

- The scope of this report is limited to an assessment of the variations to the tested systems described in Section 3.4.
- This report details the methods of construction, test conditions and assessed results that would have been expected if the specific elements of construction described here had been tested in accordance with AS 1530.4:2014.
- The results of this assessment are applicable to penetrations exposed to fire from both sides, but not simultaneously.
- This report is only valid for the assessed system/s. Any changes with respect to size, construction details, loads, stresses, edge or end conditions, other than those identified in this report, may invalidate the findings of this assessment. If there are changes to the system, a reassessment will be needed to verify consistency with the assessment in this report.
- The data, methodologies, calculations and conclusions documented in this report specifically relate to the assessed systems and must not be used for any other purpose.
- This report has been prepared based on information provided by others. Warringtonfire has not verified the accuracy and/or completeness of that information and will not be responsible for any errors or omissions that may be incorporated into this report as a result.

5. Assessment 1 – Assessment of likely fire performance with respect to AS 1530.4:2014

5.1 Description of variation

Assessment 1 refers to fire test report 393094 which consisted of various penetrations protected with Boss PenoPatch penetrating a 100mm thick plasterboard wall system. The test was conducted in accordance with BS EN 1366-3:2009 and EN 1363-1:1999, and it has been proposed to assess the likely fire resistance performance of these penetrations if tested in accordance with AS 1530.4:2014.

5.2 Methodology

The approach and method of assessment used for this assessment is summarised in Table 6.

Table 6 Method of assessment

Assessment method	
Level of complexity	Intermediate assessment
Type of assessment	Comparative

5.3 Assessment

Referenced fire test report 393094 was conducted in accordance with BS EN 1366-3:2009 and EN 1363-1:1999. These standards slightly differ from AS 1530.4:2014 and the effect of these differences has on the fire resistance performance of tested penetrations are discussed below.

5.3.1 Furnace temperature measurement

- The furnace thermocouples specified in AS 1530.4:2014 are type K, mineral insulated metal sheathed (MIMS) with a stainless-steel sheath having a wire of diameter of less than 1.0mm and an overall diameter of 3mm. The measuring junction protrudes at least 25mm from the supporting heat resistant tube.
- The furnace thermocouple specified in EN 1363.1:1999 is made from folded steel plate that faces the furnace chamber. A thermocouple is fixed to the side of the plate facing the specimen with the thermocouple hot junction protected by a pad of insulating material. The plate part is to be constructed from 150 ±1 mm long by 100 ±1 mm wide by 0.7 ±0.1 mm thick nickel alloy sheet strips.
- The measuring junction is to consist of nickel chromium/nickel aluminium (Type K) wire as defined in IEC 60584-1, contained within mineral insulation in a heat-resisting steel alloy sheath of nominal diameter 1 mm, the hot junctions being electrically insulated from the sheath.
- The thermocouple hot junction is to be fixed to the geometric centre of the plate, by a small steel strip made from the same material as the plate. The steel strip can be welded to the plate or may be screwed to it to facilitate replacement of the thermocouple. The strip should be approximately 18 mm by 6 mm if it is spot-welded to the plate, and nominally 25 mm by 6 mm if it is to be screwed to the plate. The screw is to be 2 mm in diameter.
- The assembly of plate and thermocouple should be fitted with a pad of inorganic insulation material 97 ±1 mm by 97 ±1 mm by 10 ±1 mm thick with a density of 280 ±30 kg/m³.
- The relative location of the furnace thermocouples for the exposed face of the specimen, for AS 1530.4:2014 and EN 1363.1:1999, is 100mm +10mm and 100mm +50mm respectively.
- The furnace control thermocouples required by EN 1363.1:1999 are less responsive than those specified by AS 1530.4:2014. This variation in sensitivity can produce a potentially more onerous heating condition for specimens tested to EN 1363.1:1999, particularly when the furnace temperature is changing quickly in the early stages of the test.

5.3.2 Furnace temperature regime

- The furnace temperature regime for fire resistance tests conducted in accordance with AS 1530.4:2014 follows the same trend as EN 1363-1:1999.
- The parameters outlining the accuracy of control of the furnace temperature in AS 1530.4:2014 and EN 1363-1:1999 are not appreciably different.

5.3.3 Furnace pressure regime

- It is a requirement of AS 1530.4:2014 that for vertical elements with more than 1m height, a furnace pressure of 20 ± 3 Pa shall be established at the top of the separating element and all the penetration services shall have a pressure greater than 10 Pa.
- Similarly, as per BS EN 1366-3:2009, a minimum pressure of 20 Pa shall be maintained at the top of the uppermost penetration seal. In addition, all the other services shall only be placed in the zone where the positive pressure exceeds 10 Pa.
- Therefore, the pressure conditions stipulated in both standards for horizontal penetrations in vertical separation is almost similar. Moreover, the parameters outlining the accuracy of control of the furnace pressure in AS 1530.4:2014 and EN 1363-1:1999 are also not appreciably different.

5.3.4 Integrity performance criteria

- Specimens shall be deemed to have failed the integrity criterion in accordance with AS 1530.4:2014 when any of the following occur:
    - sustained flaming for 10 seconds, however, flaming from the end of a pipe on the unexposed side is not considered integrity failure.
    - a gap forms that allows the passage of hot gases to the unexposed face and ignite the cotton pad when applied for up to 30 seconds.
    - a gap forms that allows the penetration of a 25mm gap gauge anywhere on the specimen.
    - a gap forms that allows a 6mm × 150mm gap gauge to penetrate the specimen anywhere on the specimen
- Except for minor technical variations, the integrity criteria in EN 1363-1:1999 are generally applied in a comparable manner.

5.3.5 Specimen temperature measurement and insulation performance criteria

- For the penetration construction considered, AS 1530.4:2014 specifies the following locations for thermocouples to be placed:
    - At not less than two points located approximately 25mm from the edge of the hole made for the passage of the service.
    - On the surface of the penetrating service, at least two thermocouples located approximately 25mm from the plane of the general surface of the penetrated element.
    - At least two positions 25 mm from the interface of the separating element and the main penetration seal.
- For penetration sealing systems, EN 1366-3:2009 specifies thermocouples are fixed in the following locations:
    - On the surface of the service protruding from the unexposed face 25mm from the point where the service emerges from the penetration seal and any applied insulation or coting

- On the surface of the penetration seal at 25mm from each type of penetration service
- On the surface of the supporting construction 25mm away from the penetration seal.

- Based on the above, it is understood that the thermocouple locations in EN 1366-3:2009 standard is slightly more onerous than the AS 1530.4:2014 and their effect is a on case by case basis.
- A review of BS EN 1366-3:2009 thermocouple requirements show that while the unexposed surface thermocouple locations specified are in agreement with those specified in AS 1530.4:2014, the former is more onerous in certain aspects.

Apart from the slight variation in the thermocouple locations, the general insulation criteria of AS 1530.4:2014 and BS EN 1366-3:2009 are not appreciably different.

5.3.6 Application of test data to AS 1530.4:2014

- The variations in furnace pressure, furnace thermocouples and the responses of the different thermocouple types to the furnace conditions are not expected to have significant effect on the outcome of the referenced fire resistance test.
- It is noted that thermocouple location requirement in the BS EN 1366-3:2009 standard is more onerous than the AS 1530.4:2014. As a result, if the test specimens were to be tested in accordance with AS 1530.4:2014, it will likely achieve similar or better insulation performance.

5.4 Conclusion

Based on the above discussion, it is considered that the penetrations tested in the test report 393094 will likely achieve a similar integrity and insulation performances, if tested in accordance with AS 1530.4: 2014.

6. Assessment 2 – Performance of Boss PenoPatch with various variations

6.1 Description of variation

The proposed construction shall be similar to the tested specimen in test reports EWFA 49527300.3 and 393094 subject to the following variations:

a) The wall type can optionally be concrete, masonry, AAC, Hebel, metal clad AAC, Speedpanel or Korok wall systems.
b) The option of having CAT6 bundle consists of up to 3 CAT6 cables
c) The option of having a blank seal protecting 20mm diameter aperture
d) Use of a 50mm wide PenoPatch layer wrapped around the cable penetrations for increased insulation performance (refer to Figure 4, Figure 5, Figure 9 and Figure 10)
e) Service penetrations penetrating the wall without exiting to the unexposed side (refer to Figure 6 - Figure 10).

6.2 Methodology

The approach and method of assessment used for this assessment is summarised in Table 6.

Table 7 Method of assessment

Assessment method	
Level of complexity	Intermediate assessment
Type of assessment	Comparative

6.3 Assessment

6.3.1 Optional installation in various wall systems

It is proposed that the wall type can optionally be varied to concrete, masonry, AAC, Hebel, metal clad AAC, Speedpanel or Korok wall systems instead of the tested plasterboard wall systems.
AS 1530.4:2014 allows the application of test results obtained in the plasterboard lined wall systems to be applied to masonry or concrete walls of same or greater thickness.

Generally, rest of the other wall systems have lower total thicknesses compared to the tested plasterboard wall systems. Therefore, the insulation performance is expected to be compromised if these walls were to be penetrated with similar penetrations as tested. In order to reduce the risk of insulation failure, it is proposed to construct build-ups using 13mm or 16mm fire rated plasterboards around the penetration to achieve the minimum thickness stipulated in Table 9. Further, the build-up pieces are required to extend at least 100mm for all directions from the penetration.

For metal clad AAC, Speedpanel and Korok walls, which are of irregular thickness, a fire rated sealant is required to be applied for at least 20mm depth around the plasterboard build-up part. This will restrain hot gases escaping to the unexposed side because of the profile shape of such wall systems.

Based on the discussion presented above, the wall type can be optionally varied without detrimentally affecting the integrity and insulation performance of the penetrations provided that the overall FRL will be governed by the established FRL of the wall.

6.3.2 CAT6 bundle consist of up to 3 cables

With reference to test report EWFA 49527300.3, Specimen 10 consisted of five CAT6 (Ø 5.8mm) cables protected with Boss PenoPatch on the exposed and the unexposed sides. Upon testing the CAT6 cable bundle, it was found to maintain integrity for the whole duration of the test without any signs of flaming or gaps forming at the unexposed side. However, it demonstrated insulation failure after 31 minutes as the thermocouple placed on the cable bundle 25mm away from the separating element showed a temperature rise greater than 180˚C.

Therefore, in order to increase the insulation performance, it is proposed to reduce the number of CAT6 cables in the bundle to three cables. Confidence is gained by the results of Specimen 11 of EWFA 49527300.3 test report, where a bundle of three TPS cable penetration achieved integrity and insulation performance greater than 60 minutes. It is understood that the amount of metal conductor area of three TPS cable bundle is higher than that of three CAT6 cables. As a result, amount of heat transfer to the unexposed side via conduction is expected to be low if there were to be a bundle of three CAT6 cables. Therefore, a CAT6 cable bundle of three CAT6 cables protected with Boss PenoPatch will likely perform similar or better to that of bundle of three TPS cable penetration (Specimen 11 in EWFA 49527300.3) if exposed to fire.

Nevertheless, a conservative approach has been taken where it is proposed to wrap both exposed and unexposed sides of the proposed cable penetration with at least 50mm wide PenoPatch layer as an additional protection (refer to Figure 4). This additional protection is expected to reduce the unexposed side thermocouple readings, which are to be placed on the cable penetration at 25mm away from the additional PenoPatch wrap and on the PenoPatch wrap at 25mm away from the separating element and likely keep the temperature readings below the insulation failure limit for at least more than 60 minutes.

Based on the above discussion it is expected that CAT6 cable bundle comprised of up to three cables with proposed Boss PenoPatch protection will likely achieve an integrity and insulation performances of 60 minutes if tested in accordance with AS 1530.4:2014.

6.3.3 The option of having a blank seal protecting 20mm diameter aperture

With reference to the test report EWFA 49527300.3, test Specimen 9 which comprised of 16mm Pe-Xa pipe penetration was protected using Boss PenoPatch on the exposed and unexposed sides. Upon testing, the penetration was found to maintain both integrity and insulation performances for the whole duration of the test without any signs of failure.

Time-temperature curve of thermocouples placed on the pipe showed that there was a significant spike in the temperature during the first 12 minutes, where it showed a maximum temperature rise of around 170˚C. This is expected during the melting phase of the pipe as more hot gases are expected to pass through to the unexposed side until the Boss PenoPatch is fully activated. The same thermocouples showed a drop in the temperature within the next few minutes, where the recorded temperature rise after 20 minutes was around 120˚C. This is a clear indication that the Boss PenoPatch at the exposed side has fully activated and blocked any further hot gases from passing through to the unexposed side.

Provided that a 16mm pipe penetration protected using Boss PenoPatch has achieved an FRL of -/60/60 and the observation that Boss PenoPatch activates within a shorter time frame (within around 12 minutes), it is expected that a blank seal protected using Boss PenoPatch without any penetration will achieve an FRL of at least -/60/60 if tested in accordance with AS 1530.4:2014.

6.3.4 Use of a 50mm wide PenoPatch layer wrapped around cable penetrations

Cable A1 and A2

With reference to the test report 393094, all cable penetrations shown in Table 8 were protected using Boss PenoPatch on the exposed and unexposed sides. Upon testing these cable penetrations, the services were found to maintain integrity for at least 60 minutes without any signs of flaming or gaps forming at the unexposed side.

However, Cables A1 and A2 failed insulation criteria after 45 and 42 minutes, respectively, where thermocouple placed on the Boss PenoPatch 25mm away from the penetration exceeded 180˚C. However, when compared to AS 1530.4:2014, it is unlikely that a thermocouple will be placed on the Boss PenoPatch surface due to the limited distance between the penetration and the Boss PenoPatch edge. Therefore, the insulation criterion is expected to be governed by the thermocouple placed on the cable penetration 25mm away from the separating element if tested in accordance with AS 1530.4:2014. Nevertheless, a conservative approach was followed where additional mode of insulation will be included.

As shown in Table 8, temperature rise on the A1 and A2 cable penetrations 25mm away from the wall at 60 minutes were found to be 145˚C and 181˚C, respectively. As the temperature rise has marginally exceeded the limit for A2 cable, it is proposed to wrap both cable penetrations along the length for at least 50mm using Boss PenoPatch putty (refer to Figure 5). This additional protection is expected to reduce the unexposed side thermocouple readings, which are to be placed on the cable penetration at 25mm away from the additional PenoPatch wrap and on the PenoPatch wrap at 25mm away from the separating element, significantly.

Table 8 Cable penetrations considered to include additional 50mm wide PenoPatch putty

Designation	Cable type	Insulation failure (minutes)	Maximum temperature rise on the cable 25mm away from the wall at 60 minutes (˚C)
A1	Single PVC / PVC Sheathed 5mm x 1.5mm² Cable	45	146
A2	Single EPR / PO Sheathed 5mm x 1.5mm² Cable	42	181
B	Single PVC / PVC Sheathed 1mm x 95mm² Cable	55	188
E	Single PVC / PVC Sheathed 1mm x 185mm² Cable	40	119

To obtain further confidence on the insulation performance of both cable A1 and A2 penetrations, it is proposed to use two 60 mm diameter Boss PenoPatch layers to protect the penetrations instead of the tested single Boss PenoPatch layer on both exposed and unexposed sides (refer to Figure 5). This would leave the total thickness of the Boss PenoPatch protection at the aperture to be 8mm instead of the tested 4mm. As a result, temperature measurements of the unexposed side PenoPatch surface is expected to be reduced significantly than tested. Therefore, it is reasonable to expect that A1 and A2 cable penetrations with proposed additional protections would likely achieve an insulation performance of 60 minutes if tested in accordance with AS 1530.4:2014.

Based on the same discussion, it is expected that a A2 cable bundle in a 50mm x 50mm aperture with above mentioned additional protection will also achieve an FRL of -/60/60 if tested in accordance with AS 1530.4:2014.

Cable B

Cable B failed insulation criteria after 55 minutes, where thermocouple placed on the cable 25mm away from the penetration exceeded 180˚C. The maximum temperature rise after 60 minutes was found to be 188˚C. As the temperature rise has marginally exceeded the limit for cable B at 60 minutes, it is proposed to wrap the cable penetration along the length for at least 50mm using Boss PenoPatch putty. This additional protection is expected to reduce the unexposed side thermocouple readings, which are to be placed on the cable penetration at 25mm away from the additional PenoPatch wrap and on the PenoPatch wrap at 25mm away from the separating element, significantly.

To obtain further confidence, it is proposed to use two 60 mm diameter Boss PenoPatch layers to protect the penetrations as of cable A1 and A2 described above (refer to Figure 5). This would leave the total thickness of the Boss PenoPatch protection at the aperture to be 8mm instead of the tested 4mm. As a result, temperature measurements of the unexposed side PenoPatch surface is expected to be reduced significantly than tested. Therefore, it is reasonable to expect that the cable B penetration with proposed additional protections would at least achieve an insulation performance of 60 minutes if tested in accordance with AS 1530.4:2014.

Cable E

The test report 393094 has deemed insulation failure in cable E because the thermocouple attached to the Boss PenoPatch 25mm away from the cable penetration malfunctioned at 40 minutes. However, by inspecting the temperature readings up to 40 minutes, it was found that the thermocouple placed on the cable 25mm away from the separating element yielded higher temperatures than the malfunctioned thermocouple. Therefore, it is reasonable assume that, even if

the malfunctioned thermocouple were to be active for the total duration of the test, the thermocouple placed on the cable would have govern the insulation criterion on the cable penetration.

Upon testing, the maximum temperature rise recorded on the thermocouple on the cable 25mm away from the separating element was 119˚C after 60 minutes, which is 61 degrees less than insulation failure limit. However, to obtain further confidence, it was proposed to use both additional protection systems discussed above even for this cable penetration system (refer to Figure 5). By adopting such very conservative approach, it was made sure that the cable E penetration protected with Boss PenoPatch would achieve an insulation performance of 60 minutes if tested in accordance with AS 1530.4:2014.

6.3.5 Service penetrations penetrating the wall without exiting to the unexposed side

As shown in Figure 6 to Figure 10, it is proposed to have plastic conduit, telecommunication and electric cable penetrations entering and exiting the wall from the same side without penetrating to the other side. The worst case is expected to be if the cable penetrations were to be in the exposed side.

As discussed above, if the proposed penetrations were to be exposed to fire, both Boss PenoPatches (at top and bottom) are expected to fully activate in the first few minutes and cover the penetration apertures. This would likely block hot gases from passing through to the cavity and consequently to the unexposed side.

Given that there are no apertures in the unexposed side, the temperature rise on the unexposed side is expected to be predominantly governed by heat transfer via convection and radiation. As discussed above, once the apertures are blocked by the PenoPatch, the temperatures of cable penetrations within the cavity are expected to remain at low levels. As a result, unexposed side temperature increase, due to the radiation and convection heat transfer modes, is not expected to be significant and thus, unexposed side temperatures are likely to be significantly less than the tested penetration systems.

However, the approved services shall exclude any metal pipes or metal connections in this penetration configuration as it would increase the radiation heat transfer effects, which would detrimentally affect the insulation performance of the penetration.

Given that above criterion is met, it is the opinion of the testing authority that the proposed penetration configurations are expected to achieve the same FRL obtained through the test.

6.4 Conclusion

Based on the above discussion, it is expected that the proposed service penetrations protected using Boss PenoPatch would achieve the FRLs given in Table 9 if tested in accordance with AS 1530.4:2014.

Table 9 Assessment summary

Service	Protection System	Wall Type*	Referenced figure	FRL
Blank Seal	60mm Ø Boss PenoPatch in 20mm Ø aperture	Min. 118mm thick plasterboard wall with at least one 13mm plasterboard on both sides. The cavity will be filled with the tested insulation material or with an equivalent fiberglass cavity insulation material (friction fitted). Wall type can optionally be concrete, masonry, AAC, Hebel, metal clad AAC, Speedpanel or Korok provided that a minimum thickness of 118mm is maintained around the aperture#.	Figure 1 and Figure 6	-/60/60
Up to 16mm Ø Pe-Xa Pipe			Figure 2 and Figure 7	-/60/60
Bundle of CAT6 Data cables (Up to 5 cables)			Figure 3 and Figure 8	-/60/30
Bundle of CAT6 Data cables (Up to 3 cables)			Figure 4 and Figure 9	-/60/60
Bundle of TPS Power Cables (Up to 3 cables)	60mm Ø Boss PenoPatch in 25mm Ø aperture		Figure 3 and Figure 8	-/60/60
Blank Seal	60mm Ø Boss PenoPatch in 25 x 25mm aperture	Min 100mm thick plasterboard wall with at least two 13mm or a combination of 13mm and 16mm plasterboards on both sides. The cavity will be filled with mineral wool insulation (friction fitted). Wall type can optionally be concrete, masonry, AAC, Hebel, metal clad AAC, Speedpanel or Korok provided that a minimum thickness of 100mm is maintained around the aperture#.	Figure 1 and Figure 6	-/120/60
Single PVC / PVC Sheathed 5mm x 1.5mm² Cable			Figure 3 and Figure 8	-/60/30
			Figure 5 and Figure 10	-/60/60
Single EPR / PO Sheathed 5mm x 1.5mm² Cable			Figure 3 and Figure 8	-/60/30
			Figure 5 and Figure 10	-/60/60
Single XLPE /EVA Sheathed 5mm x 1.5mm² Cable			Figure 3 and Figure 8	-/120/60
Single PVC / PVC Sheathed 1mm x 95mm² Cable			Figure 3 and Figure 8	-/120/30
			Figure 5 and Figure 10	-/120/60
Steel or Copper Pipe up to 16mm Dia.			Figure 2	-/120/-
PVC Conduit up to 16mm Dia.			Figure 2 and Figure 7	-/60/60
Single PVC / PVC Sheathed 1mm x 185mm² Cable			Figure 3 and Figure 8	-/120/30
			Figure 5 and Figure 10	-/120/60

Bundle of 3 PVC / PVC Sheathed 5mm x 1.5mm² Cables	100mm Ø Boss PenoPatch in 50 x 50mm aperture		Figure 3 and Figure 8	-/60/60
Bundle of 3 EPR / PO Sheathed 5mm x 1.5mm² Cables			Figure 3 and Figure 8	-/60/30
			Figure 5 and Figure 10	-/60/60
Bundle of 3 XLPE /EVA Sheathed 5mm x 1.5mm² Cables			Figure 3 and Figure 8	-/60/60
Single PVC / PVC Sheathed 1mm x 95mm² Cable			Figure 3 and Figure 8	-/60/30
Blank Seal			Figure 1 and Figure 6	-/60/60
Steel or Copper Pipe up to 16mm Dia.			Figure 2	-/60/-
PVC Conduit up to 16mm Dia.			Figure 2 and Figure 7	-/60/30
Single PVC / PVC Sheathed 1mm x 185mm² Cable			Figure 3 and Figure 8	-/30/30

* In masonry and concrete walls, the PenoPatch shall be fixed to the walls using at least 2 masonry nails (minimum 12mm long) fixed through the PenoPatch outer edges. In other walls types such as AAC, Hebel, metal clad AAC, Speedpanel and Korok walls, the PenoPatch shall be fixed to the walls using at least 2 metal pins/screws (minimum 12mm long) fixed through the PenoPatch on the outer edges.

The overall FRL will be governed by the established FRL of the wall

Minimum thickness stipulated in the table shall be maintained around the aperture. Build-ups using fire rated plasterboards or 50mm thick Boss Batt may be used in order to obtain the minimum thickness around the aperture. The build-up may be installed on one side of the wall or both side of wall as appropriate and the build-up should extend at least 100mm from the edge of the penetration in all directions.

In addition, a fire rated sealant shall be applied for at least 20mm deep around the plasterboard build-up part.

7. Validity

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

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

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

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

This assessment is provided to the BOSS Fire & Safety for its own purposes and we cannot express an opinion on whether it will be accepted by building certifiers or any other third parties for any purpose.

Appendix A Summary of supporting test data

A.1 Test report – EWFA 49527300.1

Table 10 Information about test report

Item	Information about test report
Report sponsor	Boss Fire
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 12/07/2018.
Test standards	The test was done in accordance with AS 1530.4:2014.
Variation to test standards	None
General description of tested specimen	The test specimen comprised of 92mm thick steel frame system cladded with 13mm USG Boral Firestop plasterboard on both sides. The wall cavity was filled with Fletcher Insulation Pink Partition. The wall system was penetrated with 11 different pipe and cable services. However, Service No. 9, 10 and 11, which were protected by Boss PenoPatch is referenced in this assessment report. Details of these services are given in Table 11.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2014.

Table 11 Description of referenced test specimens

Service No.	Item	Service Installation	Protection
9	16mm Pe-Xa pipe	The pipe was installed at the centre of the core with an annular gap of 2mm. The pipe was protruded 500mm and 2000mm from the exposed and unexposed sides, respectively. The pipe was supported at 500mm and 1500mm away from the unexposed side of the wall system. The pipe was sealed on the exposed side only.	A 60mm Ø Boss PenoPatch was applied on the surface of the wall system around the pipe on both exposed and unexposed sides.
10	Bundle of CAT 6 cables	Five cables which were held together using electrical tape was installed at the centre of the core with an annular gap of 5mm. The bundle of cables was protruded 500mm from the exposed and unexposed sides. The bundle of cables was supported at 400mm away from the unexposed side of the wall system.	A 60mm Ø Boss PenoPatch was applied on the surface of the wall system around the bundle of cables on both exposed and unexposed sides.
11	Bundle of TPS cables	Three cables which were held together using electrical tape was installed at the centre of the core with an annular gap of 5mm. The bundle of cables was protruded 500mm from the exposed and unexposed sides. The bundle of cables was supported at 400mm away from the unexposed side of the wall system.	A 60mm Ø Boss PenoPatch was applied on the surface of the wall system around the bundle of cables on both exposed and unexposed sides.

The test specimen achieved the results shown in Table 12:

Table 12 Results summary

Service No.	Integrity	Insulation	FRL
9	61*	61*	-/60/60
10	61*	31	-/60/30
11	61*	61*	-/60/60
*The test was terminated at 61 minutes			

A.2 Test report – 393094

Table 13 Information about test report

Item	Information about test report
Report sponsor	FSi Limited
Test laboratory	Exova Warringtonfire (UK), Lochend Industrial Estate, Newbridge, Midlothian EH28 8PL United Kingdom.
Test date	The fire resistance test was completed on 19/04/2018.
Test standards	The test was done in accordance with BS EN 1366-3:2009.
Variation to test standards	None
General description of tested specimen	The test specimen comprised of 50mm thick steel frame system cladded with two 12.5mm thick Gypsum 'Type F' plasterboard on both sides. The wall cavity was filled with 50mm thick mineral wool insulation. Service penetrations 1 and 2, which included eight different penetration each, are referenced in this assessment report. Details of these services are given in Table 14.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2014.

Table 14 Description of referenced test specimens

Service No.	Item No	Service Installation
1	1a	25mm × 25mm aperture filled with blank seal of 60mm PenoPatch
	1b	25mm × 25mm aperture with a 'A1' cable penetration filled with 60mm PenoPatch
	1c	25mm × 25mm aperture with a 'A2' cable penetration filled with 60mm PenoPatch
	1d	25mm × 25mm aperture with a 'A3' cable penetration filled with 60mm PenoPatch
	1e	25mm × 25mm aperture with a 'B' cable penetration filled with 60mm PenoPatch
	1f	25mm × 25mm aperture with a steel 'H' conduit (Ø16mm with a thickness of 3.6mm) penetration filled with 60mm PenoPatch
	1g	25mm × 25mm aperture with a PVC 'I' conduit (Ø16mm with a thickness of 1.0mm) penetration filled with 60mm PenoPatch
	1h	25mm × 25mm aperture with a 'E' cable penetration filled with 60mm PenoPatch

2	2a	50mm × 50mm aperture with three ‘A1’ cable penetration filled with 100mm PenoPatch
	2b	50mm × 50mm aperture with three ‘A2’ cable penetration filled with 100mm PenoPatch
	2c	50mm × 50mm aperture with three ‘A3’ cable penetration filled with 100mm PenoPatch
	2d	50mm × 50mm aperture with a ‘B’ cable penetration filled with 100mm PenoPatch
	2e	50mm × 50mm aperture with filled with a blank seal of 100mm PenoPatch
	2f	50mm × 50mm aperture with a steel ‘H’ conduit (Ø16mm with a thickness of 3.6mm) penetration filled with 100mm PenoPatch
	2g	50mm × 50mm aperture with a PVC ‘I’ conduit (Ø16mm with a thickness of 1.0mm) penetration filled with 10mm PenoPatch
	2h	50mm × 50mm aperture with a ‘E’ cable penetration filled with 100mm PenoPatch

The test specimen achieved the results shown in Table 15:

Table 15 Results summary

Service No.	Item No.	Integrity			Insulation
		Cotton pad	Sustained flame	Gap Gauge	
1	1a	132*	132*	132*	75
	1b	76	132*	132*	45
	1c	72	132*	132*	42
	1d	132*	132*	132*	60
	1e	132*	132*	132*	55
	1f	132*	132*	132*	28
	1g	77	132*	132*	68
	1h	132*	132*	132*	40
2	2a	69#	69#	69#	66
	2b	69#	69#	69#	51
	2c	69#	69#	69#	62
	2d	69#	69#	69#	52
	2e	63#	63#	63#	63
	2f	63#	63#	63#	17
	2g	63#	63#	63#	42
	2h	52	52	63#	51

*The test was terminated at 132 minutes
Specimen blanked off to allow the test to continue