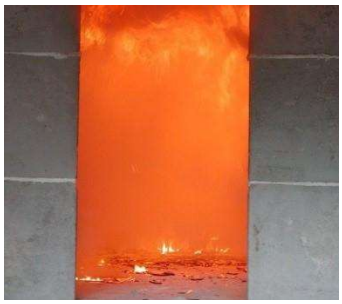

FIRE ASSESSMENT REPORT

FAR 4849 ISSUE 6

ASSESSMENT OF THE FIRE RESISTANCE OF FYREPEX SEALANT

CLIENT

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ASSESSMENT OBJECTIVE

To assess the fire resistance, in accordance with AS 1530.4:2014 and with reference to AS 4072-2005, including amendment one, of FyrePEX™ sealant used to protect a variety of services penetrating different fire-resistant elements.

CONCLUSION

It is considered that, with the modifications identified, FyrePEX™ intumescent sealant would achieve the FRL's given in Table 10 to Table 17 in accordance with AS 1530.4:2014, with reference to AS 4072.1-2005, including amendment one.

Other System Configurations:

- It is considered the penetrations as tested in FTLFT1553.01, Specimen 4, consisting of a 16 mm^2 power cable, 25 mm PVC conduit and six CAT6 cables with a 50 mm Corex collar, FyreSTRAP and filled to full depth with FyrePEX HP sealant would be expected to maintain the FRL of the ceiling for 120/120/120 +RISF 60 if tested in accordance with AS 1530.4:2014.
- VRF cable may be used in place of TPS 2.5 mm^2 cable in the above FyreSHEATH, FyreSTRAP or FyrePEX HP systems and be expected to achieve the same fire performance.
- FyrePEX systems may be positioned nominally 40 mm apart without prejudice to the established fire resistance of the penetrations.

LIMITATION

This report is subject to the accuracy and completeness of the information supplied.

BRANZ reserves the right to amend or withdraw this assessment if information becomes available which indicates the stated fire performance may not be achieved.

This assessment report may only be quoted or reproduced in full.

TERMS AND CONDITIONS

This report is issued in accordance with the Terms and Conditions as detailed and agreed in BRANZ Services Agreement for this work.

The results reported here relate only to the item/s described in this report.

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1	2 May 2018	NA	Initial Issue
2	10 December 2019	10 December 2029	Additional penetrations
3	11 August 2020	11 August 2030	Minor corrections
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5	19 May 2023	19 May 2033	Inclusion of additional services and elements (BRANZ ref: 16124)
6	24 November 2023	24 November 2033	Include masonry wall construction

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1. INTRODUCTION

This report gives BRANZ's assessment of the fire resistance, in accordance with AS 1530.4:2014 and with reference to AS 4072.1-2005, of Trafalgar Group Pty Ltd FyrePEX™ intumescent sealant when used to protect a variety of services penetrating different fire-resistant elements.

2. BACKGROUND

2.1 BRANZ Fire Test Report FP 6009

In the fire resistance test described in BRANZ Fire Test Report FP 6009, the test specimens consisted of a 64 mm steel stud wall, 1,000 mm wide x 2,200 mm high, with two layers of 13 mm fire rated plasterboard on each side and included;

- a 20 mm Pex-B pipe (designated 4.2) passed through a 60 mm diameter hole cut through the linings, with the annular gap between the pipe and plasterboard filled, to the full depth of the plasterboard, with FyrePEX™ sealant; and
- a 20 mm Pex-B pipe (designated 4.3) passed through a 45 mm diameter hole cut through the linings, with a 25 mm deep x 65 mm diameter metal FyreSHEATH screwed to the surface on each side of the element, filled to the full depth of the FyreSHEATH with FyrePEX™ sealant; and
- a 20 mm Pex-Al-Pex pipe (designated 5) passed through a 60 mm diameter hole cut through the linings, with the annular gap between the pipe and plasterboard filled, to the full depth of the plasterboard, with FyrePEX™ sealant; and
- a 25 mm Pex-B pipe (designated 6) passed through a 75 mm diameter hole cut through the linings, with the annular gap between the pipe and plasterboard filled, to the full depth of the plasterboard, with FyrePEX™ sealant.

The specimens were tested for 125 minutes in accordance with AS 1530.4:2014 and achieved the fire resistance as listed in Table 1.

Table 1: Test specimens and results from BRANZ Fire Test Report FP 6009

Specimen	Description	Integrity (minutes)	Insulation (minutes)	FRL Achieved
4.2	20 mm Pex-B Pipe	125	125	-/120/120
4.3	20 mm Pex-B Pipe in a 25 mm deep x 65 mm diameter metal FyreSHEATH	125	125	-/120/120
5	20 mm Pex-Al-Pex Pipe	125	125	-/120/120
6	25 mm Pex-B Pipe	125	125	-/120/120

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2.2 BRANZ Fire Test Report FP 6033

In the fire resistance test described in BRANZ Fire Test Report FP 6033, the test specimens consisted of a 64 mm steel stud wall, 1,000 mm wide x 2,200 mm high, with a single layer of 13 mm fire rated plasterboard on each side and included;

- a 20 mm Pex-B pipe (designated 2) passed through a 30 mm diameter hole cut through the linings, with a 25 mm deep x 65 mm diameter metal FyreSHEATH screwed to the surface on each side of the element, filled to the full depth of the FyreSHEATH with FyrePEX™ sealant; and
- a 20 mm Pex-Al-Pex pipe (designated 3) passed through a 30 mm diameter hole cut through the linings, with a 25 mm deep x 65 mm diameter metal FyreSHEATH screwed to the surface on each side of the element, filled to the full depth of the FyreSHEATH with FyrePEX™ sealant; and
- a 16 mm Pex-B pipe (designated 4) passed through a 25 mm diameter hole cut through the linings, with a 25 mm deep x 50 mm diameter metal FyreSHEATH screwed to the surface on each side of the element, filled to the full depth of the FyreSHEATH with FyrePEX™ sealant; and
- a 16 mm Pex-Al-Pex pipe (designated 5) passed through a 25 mm diameter hole cut through the linings, with a 25 mm deep x 50 mm diameter metal FyreSHEATH screwed to the surface on each side of the element, filled to the full depth of the FyreSHEATH with FyrePEX™ sealant; and
- an air conditioning bundle (designated 6) consisting of a 25 mm thick FR insulated pair-coil (9 mm & 19 mm copper pipes), 2.5 mm^2 2C+E power cable and a Cat 6 data cable, passed through a 60 mm diameter hole cut through the linings, a 60 mm diameter, 60 mm deep FyreCOLLAR (formally FyreCHOKE) collar was screwed to the surface of the plasterboard on each side. The annular gap between the services and the collar was filled to the full depth of the collar with FyreFLEX sealant, a 25 mm thick TWrap blanket was wrapped around the services, covering 300 mm from the collar on each side; and
- an air conditioning bundle (designated 7) consisting of two 25 mm thick FR insulated pair-coil (9 mm & 19 mm copper pipes), a 19 mm thick PE insulated pair-coil (9 mm & 19 mm copper pipes), three 2.5 mm^2 2C+E power cables, three Cat 6 data cables and a 20 mm uPVC conduit, passed through a 111 mm diameter hole cut through the linings, a 115 mm diameter, 60 mm deep FyreCOLLAR (formally FyreCHOKE) collar was screwed to the surface of the plasterboard on each side. The annular gap between the services and the collar was filled to the full depth of the collar with FyreFLEX sealant, a 25 mm thick TWrap blanket was wrapped around the services, covering 300 mm from the collar on each side.

The specimens were tested for 92 minutes in accordance with AS 1530.4:2014 and achieved the fire resistance as listed in Table 2.

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Table 2: Test specimens and results from BRANZ Fire Test Report FP 6033

Specimen	Description	Integrity (minutes)	Insulation (minutes)	FRL Achieved
2	20 mm Pex-B Pipe in a 25 mm deep x 65 mm diameter metal FyreSHEATH	92	56	-/60/30
3	20 mm Pex-Al-Pex Pipe in a 25 mm deep x 65 mm diameter metal FyreSHEATH	92	61	-/60/60
4	16 mm Pex-B Pipe in a 25 mm deep x 50 mm diameter metal FyreSHEATH	92	54	-/60/30
5	16 mm Pex-Al-Pex Pipe in a 25 mm deep x 50 mm diameter metal FyreSHEATH	92	59	-/60/30
6	FR A/C bundle in a 60 mm deep x 60 mm diameter FyreCOLLAR collar with 300 mm of 25 mm thick TWrap blanket each side	92	62	-/60/60
7	2 x FR + 1 x PE A/C bundle in a 60 mm deep x 115 mm diameter FyreCOLLAR collar with 300 mm of 25 mm thick TWrap blanket each side	92	71	-/60/60

2.3 BRANZ Fire Test Report FP 6202-Issue 2

In the fire resistance test described in BRANZ Fire Test Report FP 6202-Issue 2, the test specimens consisted of a 64 mm steel stud wall, 1,000 mm wide x 2,200 mm high, with two layers of 13 mm fire rated plasterboard on each side and included;

- an air conditioning bundle consisting of an FRV insulated pair-coil (3/8” & 3/4" copper pipes), 2.5 mm^2 2C+E power cable and a Cat 6 data cable (designated 3), passed through a 110 mm diameter hole cut through the linings, the annular gap between the services and the plasterboard was filled to the full depth of the plasterboard with FyrePEX™ sealant; and
- an 800 mm wide x 610 mm high x 60 mm thick Maxilite panel was fixed to the exposed side of an opening 600 mm wide x 410 mm high in the element; and
- a 20 mm diameter Pex-B pipe (designated 5) passed through a 25 mm diameter hole cut through the Maxilite panel, with a 25 mm deep x 65 mm diameter metal FyreSHEATH (with a steel band around the perimeter) screwed to the surface on each side of the element, filled to the full depth of the FyreSHEATH with FyrePEX™ sealant; and
- a 20 mm diameter Pex-Al-Pex pipe (designated 8) passed through a 25 mm diameter hole cut through the Maxilite panel, with a 25 mm deep x 65 mm diameter metal FyreSHEATH (with a hinge and clasp) screwed to the surface on each side of the element, filled to the full depth of the FyreSHEATH with FyrePEX™ sealant.

The specimens were tested for 122 minutes in accordance with AS 1530.4:2014 and achieved the fire resistance as listed in Table 3.

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Table 3: Test specimens and results from BRANZ Fire Test Report FP 6202

Specimen	Description	Integrity (minutes)	Insulation (minutes)	FRL Achieved
3	A/C bundle	122	122	-/120/120
5	20 mm Pex-B Pipe in a 25 mm deep x 65 mm diameter metal FyreSHEATH (with a steel band)	122	122	-/120/120
8	20 mm Pex-Al-Pex Pipe in a 25 mm deep x 65 mm diameter metal FyreSHEATH (hinge and clasp)	122	49	-/120/30

2.4 BRANZ Test Report FP 6372

In the fire resistance test described in BRANZ Test Report FP 6372, the test specimens consisted of a 75 mm thick Hebel PowerPanel wall, 1,200 mm wide x 1,200 mm high and included;

- a 25 mm diameter Pex-Al-Pex gas pipe (designated 4) passed through a 67 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled with FyrePEX™ sealant to a depth of 25 mm from each face of the wall and with a 25 mm fillet on each face.

The specimen achieved a fire resistance of 125 minutes Integrity and Insulation.

2.5 Exova Warringtonfire Aus (EWFA) Test Report 51288000.2

In the fire resistance test described in EWFA Test Report 51288000.2, the test specimens consisted of a 75 mm thick Hebel PowerPanel wall, 1,200 mm wide x 1,200 mm high and included;

- a 25 mm diameter Pex-B pipe (designated A) passed through a 65 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 25 mm diameter Pex-B pipe (designated C1) passed through a 65 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 25 mm diameter Pex-A pipe (designated C2) passed through a 65 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- an air conditioning bundle (designated D) consisting of two 12 mm thick FR insulated pair-coils (3/8" & 5/8" copper pipes), two 2.5 mm^2 2C+E power cables, two Cat 6 data cables and a 20 mm diameter uPVC conduit, passed through a 120 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the services and the

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Hebel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and

- an air conditioning bundle (designated G) consisting of a 12 mm thick FR insulated pair-coil (3/8" & 5/8" copper pipes), 2.5 mm^2 2C+E power cable, Cat 6 data cable and a 20 mm diameter uPVC conduit, passed through a 100 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the services and the Hebel PowerPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 20 mm diameter Pex-Al-Pex pipe (designated H) passed through a 60 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 20 mm diameter Pex-B pipe (designated I) passed through a 60 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- an air conditioning bundle (designated J) consisting of an 11 mm thick PE insulated pair-coil (3/8" & 3/4" copper pipes), 2.5 mm^2 2C+E power cable, and a Cat 6 data cable, passed through a 100 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the services and the Hebel PowerPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 16 mm diameter Pex-Al-Pex pipe (designated K) passed through a 40 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 16 mm diameter Pex-B pipe (designated L) passed through a 40 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used.

The specimens were tested for 121 minutes in accordance with AS 1530.4:2014 and achieved the fire resistance as listed in Table 4.

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Table 4: Test specimens and results from EWFA Test Report 51288000.2

Specimen	Description	Integrity (minutes)	Insulation (minutes)	FRL Achieved
A	25 mm Pex-B Pipe	121	11	-/120/-
C1	25 mm Pex-B Pipe	121	10	-/120/-
C2	25 mm Pex-A Pipe	121	121	-/120/120
D	A/C Bundle (2 x 3/8" & 5/8" FR Pair-coils, 2 x 2.5 mm^2 Power cables, 2 x Cat 6 Data cables and 1 x 20 mm conduit)	121	88	-/120/60
G	A/C Bundle (3/8" & 5/8" FR Pair-coil, 2.5 mm^2 Power cable, Cat 6 Data cable and 20 mm conduit)	121	121	-/120/120
H	20 mm Pex-Al-Pex Pipe	121	121	-/120/120
I	20 mm Pex-B Pipe	121	11	-/120/-
J	A/C Bundle (3/8" & 3/4" PE Pair-coil, 2.5 mm^2 Power cable, Cat 6 Data cable)	121	33	-/120/30
K	16 mm Pex-Al-Pex Pipe	121	121	-/120/120
L	16 mm Pex-B Pipe	121	121	-/120/120

2.6 Exova Warringtonfire Aus (EWFA) Test Report 51288100.2

In the fire resistance test described in EWFA Test Report 51288100.2, the test specimens consisted of a 120 mm thick concrete floor slab, 1,760 mm wide x 1,760 mm long and included;

- a 25 mm diameter Pex-B pipe (designated C2) passed through a 65 mm diameter hole cut through the slab, the annular gap between the pipe and the concrete was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 25 mm diameter Pex-A pipe (designated C3) passed through a 65 mm diameter hole cut through the slab, the annular gap between the pipe and the concrete was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- an air conditioning bundle (designated D) consisting of an 11 mm thick PE insulated pair-coil (3/8" & 3/4" copper pipes), 2.5 mm^2 2C+E power cable and a Cat 6 data cable, passed through a 100 mm diameter hole cut through the slab, the annular gap between the services and the concrete was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 25 mm diameter Pex-B pipe (designated F) passed through a 65 mm diameter hole cut through the slab, the annular gap between the pipe and the concrete was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- an air conditioning bundle (designated G) consisting of a 12 mm thick FR insulated pair-coil (3/8" & 3/4" copper pipes), 2.5 mm^2 2C+E power cable, Cat 6 data cable and

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a 20 mm diameter uPVC conduit, passed through a 100 mm diameter hole cut through the slab, the annular gap between the services and the concrete was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and

- a 20 mm diameter Pex-B pipe (designated I) passed through a 60 mm diameter hole cut through the slab, the annular gap between the pipe and the concrete was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- an air conditioning bundle (designated J) consisting of two 12 mm thick FR insulated pair-coils (3/8" & 5/8" copper pipes), two 2.5 mm^2 2C+E power cables, two Cat 6 data cables and a 20 mm diameter uPVC conduit, passed through a 120 mm diameter hole cut through the slab, the annular gap between the services and the concrete was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 16 mm diameter Pex-B pipe (designated K) passed through a 40 mm diameter hole cut through the slab, the annular gap between the pipe and the concrete was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 16 mm diameter Pex-Al-Pex pipe (designated L) passed through a 40 mm diameter hole cut through the slab, the annular gap between the pipe and the concrete was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used.

The specimens were tested for 121 minutes in accordance with AS 1530.4:2014 and achieved the fire resistance as listed in Table 5.

Table 5: Test specimens and results from EWFA Test Report 51288100.2

Specimen	Description	Integrity (minutes)	Insulation (minutes)	FRL Achieved
C2	25 mm Pex-B Pipe	121	10	-/120/-
C3	25 mm Pex-A Pipe	121	14	
D	A/C Bundle (3/8" & 3/4" PE Pair-coil, 2.5 mm^2 Power cable and Cat 6 Data cable)	121	14	-/120/-
F	25 mm Pex-B Pipe	121	84	-/120/60
G	A/C Bundle (3/8" & 3/4" FR Pair-coil, 2.5 mm^2 Power cable, Cat 6 Data cable and 20 mm conduit)	121	121	-/120/120
I	20 mm Pex-B Pipe	121	29	-/120/-
J	A/C Bundle (2 x 3/8" & 5/8" FR Pair-coils, 2 x 2.5 mm^2 Power cables, 2 x Cat 6 Data cables and 1 x 20 mm conduit)	121	121	-/120/120
K	16 mm Pex-B Pipe	121	121	-/120/120
L	16 mm Pex-Al-Pex Pipe	121	121	-/120/120

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2.7 EXOVA Warringtonfire Test Report FRT 180323

In the fire resistance test described in Test Report FRT 180323, the test specimens consisted of a 78 mm thick SpeedPanel wall, 3,000 mm wide x 3,000 mm high and included;

- a 20 mm diameter Pex-A pipe (designated D) passed through a 60 mm diameter hole cut through the SpeedPanel, the annular gap between the pipe and the SpeedPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 20 mm diameter Pex-B pipe (designated E) passed through a 60 mm diameter hole cut through the SpeedPanel, the annular gap between the pipe and the SpeedPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 20 mm diameter Pex-Al-Pex pipe (designated F) passed through a 60 mm diameter hole cut through the SpeedPanel, the annular gap between the pipe and the SpeedPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- an air conditioning bundle (designated K) consisting of a 12 mm thick PE insulated pair-coil (3/8" & 5/8" copper pipes), 2.5 mm^2 2C+E power cable and a Cat 6 data cable, passed through a 100 mm diameter hole cut through the SpeedPanel, the annular gap between the services and the SpeedPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used.

The specimens were tested for 121 minutes in accordance with AS 1530.4:2014 and achieved the fire resistance as listed in Table 6.

Table 6: Test specimens and results from Test Report FRT 180323

Specimen	Description	Integrity (minutes)	Insulation (minutes)	FRL Achieved
D	20 mm Pex-A pipe	121	121	-/120/120
E	20 mm Pex-B pipe	121	121	-/120/120
F	20 mm Pex-Al-Pex pipe	121	60	-/120/60
K	A/C Bundle (3/8" & 5/8" FR Pair-coil, 2.5 mm^2 Power cable, Cat 6 Data cables	121	115	-/120/90

2.8 EXOVA Warringtonfire Test Report FRT 180354.1

In the fire resistance test described in Test Report 180354.1, the test specimens consisted of a 64 mm steel stud wall, 1,200 mm wide x 1,200 mm high x 116 mm thick, with two layers of 13 mm fire rated plasterboard on each side and included;

- a 16 mm diameter Pex-A pipe (designated A) passed through a 60 mm diameter hole cut through the linings, the annular gap between the pipe and the plasterboard was filled to the full depth of the linings with FyrePEX™ sealant.
- a 25 mm PVC conduit with a fibre cable (designated B), passed through a 60 mm diameter hole cut through the plasterboard linings, the annular gap between the

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service and the plasterboard was filled to the full depth of the plasterboard with FyrePEX™ sealant; and

- a 25 mm diameter Pex-A pipe (designated D) passed through a 65 mm diameter hole cut through the linings, the annular gap between the pipe and the plasterboard was filled to the full depth of the plasterboard linings with FyrePEX™ sealant.
- A 32 mm OD x 1.22 mm thick copper pipe insulated with 25 mm thick E-flex FR insulation (designated E) passed through a 110 mm diameter hole cut through the plasterboard linings, the annular gap between the pipe and the plasterboard was filled to the full depth of the linings with FyrePEX™ sealant and finished with a 10 mm x 10 mm fillet each side.
- a 40 mm PVC conduit (designated F), passed through an 80 mm diameter hole cut through the linings, the annular gap between the service and the plasterboard was filled to the full depth of the plasterboard with FyrePEX™ sealant; and
- an air conditioning bundle consisting of a 13 mm PE insulated pair-coil (3/8” & 3/4" copper pipes), a 2.5 mm^2 2C+E power cable and a Cat 6 data cable (designated G), passed through a 110 mm diameter hole cut through the linings, the annular gap between the services and the plasterboard was filled to the full depth of the plasterboard with FyrePEX™ sealant; and
- a cluster of three penetrations, 40 mm apart including;
- an air conditioning bundle consisting of a 19 mm FR insulated pair-coil (3/8” & 3/4" copper pipes), 2.5 mm^2 2C+E power cable and a Cat 6 data cable (designated H1), passed through a 110 mm diameter hole cut through the linings, the annular gap between the services and the plasterboard was filled to the full depth of the plasterboard with FyrePEX™ sealant; and
- an air conditioning bundle consisting of a 19 mm FR insulated pair-coil (3/8” & 3/4" copper pipes), 2.5 mm^2 2C+E power cable and a Cat 6 data cable (designated H2), passed through a 110 mm diameter hole cut through the linings, the annular gap between the services and the plasterboard was filled to the full depth of the plasterboard with FyrePEX™ sealant; and
- an air conditioning bundle consisting of an 19 mm FR insulated pair-coil (1/4” & 1/2" copper pipes), 2.5 mm^2 2C+E power cable and a Cat 6 data cable (designated H3), passed through a 110 mm diameter hole cut through the linings, the annular gap between the services and the plasterboard was filled to the full depth of the plasterboard with FyrePEX™ sealant.

The specimens were tested for 121 minutes in accordance with AS 1530.4:2014 and achieved the fire resistance as listed in Table 7.

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Table 7: Test specimens and results from Test Report FRT 180354.1

Specimen	Description	Integrity (minutes)	Insulation (minutes)	FRL Achieved
A	16 mm diameter Pex-A Pipe	121	121	-/120/120
B	25 mm PVC conduit with 1 x fibre cable	121	121	
D	25 mm diameter Pex-A Pipe	121	121	
E	32 mm OD x 1.22 mm copper pipe with 25 mm FR insulation	121	78	-/120/60
F	40 mm PVC conduit	121	121	-/120/120
G	A/C Bundle (3/8" & 3/4" PE Pair-coil, 2.5 mm^2 Power cable, Cat 6 Data cable)	121	94	-/120/90
H1	A/C Bundle (3/8" & 3/4" FR Pair-coil, 2.5 mm^2 Power cable, Cat 6 Data cable)	121	107	-/120/90
H2	A/C Bundle (3/8" & 3/4" FR Pair-coil, 2.5 mm^2 Power cable, Cat 6 Data cable)	121	112	-/120/90
H3	A/C Bundle (¼" & ½" FR Pair-coil, 2.5 mm^2 Power cable, Cat 6 Data cable)	121	119	-/120/90

2.9 EXOVA Warringtonfire Test Report FRT 180357.2

In the fire resistance test described in Test Report FRT180357.2, the test specimens consisted of a wall 1,200 mm wide x 1,200 mm high constructed of two nominally 600 mm wide x 1,200 mm high x 75 mm thick Hebel PowerPanels and included;

- a 25 mm diameter conduit with a fibre optic cable (designated A) passed through a 65 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled to a depth of 60 from the unexposed side with FyrePEX™ sealant; a PE backing rod was used; and
- a 40 mm diameter conduit (designated B) passed through an 80 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled to a depth of 60 from the unexposed side with FyrePEX™ sealant; a PE backing rod was used; and
- a cluster of three air conditioning bundles through openings 50 mm apart (designated C) including;
- an air conditioning bundle (designated C1) consisting of a 19 mm thick FR insulated pair-coil (3/8" & 3/4" copper pipes), a 2.5 mm^2 2C+E power cable and a Cat 6 data cable, passed through a 110 mm diameter hole cut through the Hebel PowerPanel. The annular gap between the services and the Hebel PowerPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- an air conditioning bundle (designated C2) consisting of a 19 mm thick FR insulated pair-coil (¼" & ½" copper pipes), 2.5 mm^2 2C+E power cable and a Cat 6 data cable, passed through a 110 mm diameter hole cut through the Hebel PowerPanel. The annular gap between the services and the Hebel PowerPanel was filled to a depth of

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60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and

- an air conditioning bundle (designated C3) consisting of a 19 mm thick FR insulated pair-coil (3/8” & 3/4" copper pipes), 2.5 mm^2 2C+E power cable and a Cat 6 data cable, passed through a 110 mm diameter hole cut through the Hebel PowerPanel. The annular gap between the services and the Hebel PowerPanel was filled to a depth of 60 mm from the unexposed side with FyrePEX™ sealant, a PE backing rod was used; and
- a 25 mm diameter Pex-B pipe (designated D) passed through a 65 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled to the full depth of 75 mm with FyrePEX™ sealant; and
- a 20 mm diameter Pex-B pipe (designated E) passed through a 60 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled to the full depth of 75 mm with FyrePEX™ sealant; and
- a panel nominally 450 mm wide x 530 mm high x 60 mm thick of Trafalgar Maxilite board (designated F) installed on the exposed side over an aperture 250 mm wide x 325 mm high and including:
- a 16 mm diameter Pex-AL-Pex pipe (designated F1) passed through a 60 mm diameter hole cut through the board, the annular gap between the pipe and the board was filled to the full depth of the 60 mm thick Maxilite panel; and
- a 16 mm diameter Pex-B pipe (designated F2) passed through a 60 mm diameter hole cut through the board, the annular gap between the pipe and the board was filled to the full depth of the 60 mm thick Maxilite panel; and
- an air conditioning bundle (designated F3) consisting of a 19 mm thick FR insulated pair-coil (3/8” & 3/4" copper pipes), a 2.5 mm^2 2C+E power cable and a Cat 6 data cable, passed through a 110 mm diameter hole cut through the board, the annular gap between the services and the board was filled to the full depth of the 60 mm thick Maxilite panel; and
- a 32 mm OD x 1.22 mm copper pipe insulated with 25 mm of E-flex insulation (designated G) passed through a 120 mm diameter hole cut through the Hebel PowerPanel, the annular gap between the pipe and the Hebel PowerPanel was filled to a depth of 60 from the unexposed side with FyrePEX™ sealant; a PE backing rod was used.

The specimens were tested for 121 minutes in accordance with AS 1530.4:2014 and achieved the fire resistance as listed in Table 8.

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Table 8: Test specimens and results from Test Report FRT 180357.2

Specimen	Description	Integrity (minutes)	Insulation (minutes)	FRL Achieved
A	25 mm PVC conduit with a fibre optic cable	121	121	-/120/120
B	40 mm PVC conduit	121	121	-/120/120
C1	A/C Bundle (3/8" & 3/4" FR Pair-coil, 2.5 mm^2 Power cable, Cat 6 Data cable)	121	95	-/120/90
C2	A/C Bundle (¼" & ½" FR Pair-coil, 2.5 mm^2 Power cable, Cat 6 Data cable)	121	87	-/120/60
C3	A/C Bundle (3/8" & 3/4" FR Pair-coil, 2.5 mm^2 Power cable, Cat 6 Data cable)	121	53	-/120/30
D	25 mm PEX-B pipe	121	121	-/120/120
E	20 mm PEX-B pipe	121	121	-/120/120
F1	16 mm PEX-AL-PEX pipe	121	75/121#	-/120/60
F2	16 mm PEX-B pipe	121	81/95#	-/120/60
F3	A/C Bundle (3/8" & 3/4" FR Pair-coil, 2.5 mm^2 Power cable, Cat 6 Data cable)	121	61/61#	-/120/60
G	32 mm OD x 1.22 mm copper pipe with 25 mm E-flex insulation	121	78	-/120/60

# indicates the Insulation achieved on the Maxilite panel and on the penetration respectively

2.10 EXOVA Warringtonfire Test Report FRT 180358.1

In the fire resistance test described in Test Report 180358.1, the test specimens consisted of a 64 mm steel stud wall, 1,600 mm wide x 1,600 mm high x 118 mm thick, with one layer of 13 mm fire rated plasterboard on each side; and included:

- an air conditioning bundle consisting of a 13 mm PE insulated pair-coil (3/8" & 3/4" copper pipes), a 2.5 mm^2 2C+E power cable and a Cat 6 data cable (designated E), passed through a 110 mm diameter hole cut through the linings, the annular gap between the services and the plasterboard was filled to the full depth of the plasterboard with FyrePEX™ sealant and finished with a 30 mm x 30 mm fillet; and
- a 20 mm diameter Pex-A pipe (designated F) passed through a 61 mm diameter hole cut through the linings, the annular gap between the pipe and the plasterboard was filled to the full depth of the linings and a 30 mm fillet each side with FyrePEX™ sealant.

The specimen F achieved a fire resistance of -/61/59.

2.11 EXOVA Warringtonfire Test Report FRT 180391

In the fire resistance test described in EXOVA Warringtonfire test report FRT 180391, the test specimen consisted of 175 mm thick concrete floor slab through which passed three service penetrations including a 50 mm diameter DN50 Type B copper pipe (Specimen A) passing through a 70 mm diameter hole in the concrete floor slab. A backing rod was inserted into the aperture to a depth of 50 mm below the top surface of the slab and sealant was then applied

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above it in the annular gap between the pipe and the concrete. A 300 mm wide strip of TWrap was then wrapped around the pipe on the unexposed side. The specimen was tested in accordance with AS 1530.4:2014 for 241 minutes and achieved a fire resistance of 241 minutes Integrity without failure and 143 minutes Insulation giving an FRL of -240/120.

2.12 Warringtonfire Test Report FRT 180392

In the fire resistance test described in Test Report FRT 180392 R1.1, the test specimens consisted of a 64 mm steel stud wall, 1,600 mm wide x 1,600 mm high x 116 mm thick, with two layers of 13 mm fire rated plasterboard on each side. Specimen C consisted of eight 16 mm² 3C+E power cables passing through a 110 mm diameter hole cut through the linings. The annular gap between the services and the plasterboard was filled to the full depth of the plasterboard with FyreFLEX sealant and finished with a 30 mm x 30 mm fillet. The cables were then wrapped with 25 mm thick TWrap nominally 300 mm from each face of the wall. The specimen achieved an FRL of -/120/120 in accordance with AS 1530.4:2014.

2.13 EXOVA Warringtonfire Test Report FRT 200160.2

In the fire resistance test described in EXOVA Warrington test report FRT 200160.2, the test specimen consisted of a 60 mm thick Pronto Panel™ wall, 1,600 mm wide x 1,600 mm high and penetrated by the following services;

- Fifteen Firesense fire alarm cables (designated A) passing through a 50 mm diameter hole cut through the Pronto Panel™ wall, the annular gap between the service and the Pronto Panel™ was filled to the full depth of the wall with FyrePEX™ HP sealant, ending with a 25 mm x 25 mm fillet on both sides of the wall; and
- Fifteen CAT6 data cables (designated B) passing through a 50 mm diameter hole cut through the Pronto Panel™ wall, the annular gap between the service and the Pronto Panel™ was filled to the full depth of the wall with FyrePEX™ HP sealant, ending with a 25 mm x 25 mm fillet on both sides of the wall; and
- Fifteen 2.5 mm^2 2C + E TPS cables (designated C) passing through a 50 mm diameter hole cut through the Pronto Panel™ wall, the annular gap between the service and the Pronto Panel™ was filled to the full depth of the wall with FyrePEX™ HP sealant, ending with a 25 mm x 25 mm fillet on both sides of the wall; and
- Eight 16 mm^2 3C + E TPS cables (designated D) passing through a 70 mm diameter hole cut through the Pronto Panel™ wall, the annular gap between the service and the Pronto Panel™ was filled to the full depth of the wall with FyrePEX™ HP sealant, ending with a 25 mm x 25 mm fillet on both sides of the wall; and
- A 25 mm uPVC conduit (designated F) passing through a 40 mm diameter hole cut through the Pronto Panel™ wall, the annular gap between the service and the Pronto Panel™ was filled to the full depth of the wall with FyrePEX™ HP sealant, ending with a 25 mm x 25 mm fillet on both sides of the wall; and
- An air conditioning pair coil with 9 mm and 19 mm diameter copper pipes with 13 mm thick FR insulation and two 2.5 mm^2 2C + E TPS power cables (designated G) passing through a 70 mm diameter hole cut through the Pronto Panel™ wall, the annular gap between the service and the Pronto Panel™ was filled to the full depth of the wall with FyrePEX™ HP sealant, ending with a 25 mm x 25 mm fillet on both sides of the wall; and

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- A 20 mm Pex-Al-Pex pipe (designated H) passing through a 50 mm diameter hole cut through the Pronto Panel™ wall, the annular gap between the service and the Pronto Panel™ was filled to the full depth of the wall with FyrePEX™ HP sealant, ending with a 25 mm x 25 mm fillet on both sides of the wall; and
- A 20 mm Pex-A pipe (designated I) passing through a 50 mm diameter hole cut through the Pronto Panel™ wall, the annular gap between the service and the Pronto Panel™ wall was filled to the full depth of the wall with FyrePEX™ HP sealant, ending with a 25 mm x 25 mm fillet on both sides of the wall; and
- A 25 mm uPVC conduit (designated J) passing through a 40 mm diameter hole cut through the Pronto Panel™ wall, the annular gap between the service and the Pronto Panel™ was filled to the full depth of the wall with FyrePEX™ HP sealant, ending with a 25 mm x 25 mm fillet on both sides of the wall. The service was offset to rest on the bottom edge of the aperture in the wall.

The specimens were tested for 121 minutes in accordance with AS 1530.4:2014 and achieved the fire resistance as listed in Table 9.

Table 9: Test specimens and results from Test Report FRT 200160.2

Specimen	Description	Integrity (minutes)	Insulation (minutes)	FRL Achieved
A	15 x Firesense cables	121	98	-/120/90
B	15 x CAT6 cables	121	95	-/120/90
C	15 x 2.5 mm^2 2C + E cables	121	59	-/120/30
D	8 x 16 mm^2 3C + E cables	121	59	-/120/30
F	25 mm uPVC conduit	121	95	-/120/90
G	Single AC pair coils and cables	121	73	-/120/60
H	20 mm PEX-AL-PEX pipe	121	56	-/120/30
I	20 mm PEX-A pipe	121	101	-/120/90
J	25 mm uPVC conduit	121	91	-/120/90

2.14 EXOVA Warringtonfire Test Report FRT 210260

In the fire resistance test described in EXOVA Warringtonfire test report FRT 210260, the test specimen consisted of a 150 mm thick concrete floor slab, 1,900 mm x 1,900 mm and penetrated by the following services;

- Three 240 mm² single core Al cables (each 31.2 mm OD), one 240 mm² single core Al cable (25.2 mm OD) and one 120 mm² single core Al cable (21 mm OD), specimen F. The penetration achieved an FRL of -/180/120.
- Four 16 mm² 4C+E Al cables (each 26.3 mm OD), one 16 mm² single core Al cable (9.4 mm OD), specimen G. The penetration achieved an FRL of -/180/180.
- One 240 mm² single core Al cable (25 mm OD), specimen H. The penetration achieved an FRL of -/180/180.

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Each of the above services were installed passing through a 100 mm diameter hole which were protected with FyrePEX HP sealant applied from the unexposed face to a depth of 60 mm and finished with a 30 mm x 30 mm cone above the surface of the slab. The cables were wrapped with 25 mm thick TWRAP 300 mm above the surface of the slab.

2.15 CSIRO Test Report FSV 0979

In the fire resistance test described in CSIRO Test Report FSV 0979, a 75 mm thick Hebel autoclaved aerated concrete (AAC) panel wall achieved an FRL of -/90/90.

2.16 CSIRO Test Report FSV 2163

In the fire resistance test described in Test Report FSV 2163 and tested in accordance with AS 1530.4:2014 the test specimen consisted of a 64 mm steel stud wall with two layers of 13 mm fire rated plasterboard on each side and included:

- Three copper pipes nominally 9 mm OD, 19 mm OD and 22 mm OD each individually lagged with 19 mm FR insulation, a TPS 2.5 mm² 2C+E cable and a CAT6 data cable (specimen 9) passing through a 110 mm OD hole protected on both faces with FyrePEX HP Sealant to the full 26 mm depth of the plasterboard. The penetration achieved an FRL of -/120/30.
- A 25 mm OD PVC conduit, a TPS 2.5 mm² 2C+E cable and a 16 mm² 3C+E power cable (specimen 14) penetrating the wall through 30 mm, 20 mm and 25 mm diameter holes in the plasterboard. Outside the face of the wall a FyreSTRAP (FyreSNAKE) system was installed to the underside of a concrete lintel above the penetrations to each face of the wall. The resulting 160 mm x 40 mm hole was filled on both faces with FyrePEX HP sealant to a depth of 50 mm. The penetration achieved an FRL of -/120/120.

2.17 CSIRO Test Report FSP 1709

In the fire resistance test described in CSIRO Test Report FSP 1709, the test specimen consisted of 150 mm thick concrete floor slabs through which passed six service penetrations including:

- a 50 mm OD x 4 mm thick uPVC conduit (designated Specimen 2) containing two 19 mm OD 4-core power cables passing through a 77 mm diameter core hole and sealed with fire collars and sealant to the underside of the floor; and
- a 40 mm OD x 3.3 mm thick uPVC conduit (designated Specimen 3) containing two TPS power cables and five 5 mm OD CAT5 cables passing through a 51 mm diameter core hole and sealed with fire collars and sealant to the underside of the floor; and
- a 25 mm OD x 2.6 mm thick uPVC conduit (designated Specimen 4) containing one TPS power cable and three 5 mm OD CAT5 cables passing through a 34 mm diameter core hole and sealed with fire collars and sealant to the underside of the floor.

All three specimens achieved a fire resistance, in accordance with AS 1530.4-2005, of 121 minutes Integrity and Insulation without failure.

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2.18 CSIRO Test Report FSP 1729A

In the fire resistance test described in Test Report FSP 1729A the test specimen consisted of a 64 mm steel stud wall with one layer of 16 mm fire rated plasterboard on each side and included:

- a 20 mm OD uPVC conduit (designated Specimen 1) containing three 6 mm OD 4-core fibre optic cables passing through a 30 mm diameter hole in both linings and sealed with fire collars and sealant to both sides of the wall; and

The specimen achieved a fire resistance, in accordance with AS 1530.4-2005, of 121 minutes Integrity without failure and 97 minutes Insulation. The insulation failure occurred on the wall and there was no failure of insulation on the conduit for the 121 minutes duration of the test.

2.19 CSIRO Test Report FSP 1801

In the fire resistance test described in Test Report FSP 1801 the test specimen consisted of a 64 mm steel stud wall with one layer of 16 mm fire rated plasterboard on each side and included:

- a 40 mm OD PVC conduit (designated Specimen 2B) containing one 3C+E power cable and one TPS power cable passing through a 45 mm diameter hole in both linings and sealed with fire collars and sealant to both sides of the wall; and
- a 16 mm OD PVC conduit (designated Specimen 2C) containing one 6 mm OD 12 core fibre optic cable passing through a 20 mm diameter hole in both linings and sealed with fire collars and sealant to both sides of the wall; and
- a 50 mm OD PVC conduit (designated Specimen 4) containing one 19 mm OD power cable and one TPS power cable passing through a 60 mm diameter hole in both linings and sealed with fire collars and sealant to both sides of the wall.

The specimens achieved a fire resistance, in accordance with AS 1530.4-2005, of 102 minutes Integrity without failure and 81 minutes and 84 minutes Insulation respectively. The insulation failure occurred on the wall and there was no failure of insulation on the conduits for at least 90 minutes.

2.20 CSIRO Test Report FSP 2117

In the fire resistance test described in CSIRO test report FSP 2117, the test specimen consisted of a 75 mm thick Walsc autoclaved aerated concrete (AAC) panel wall, 1,200 mm wide x 1,200 mm high with established fire resistance level (FRL) of -/90/90, which included five service penetrations as follows:

- A group of three 50 mm diameter holes positioned 75 mm apart (25 mm between holes) through the 75 mm thick AAC panel wall containing respectively, a 20 mm Pex-AL-Pex pipe, a 20 mm Pex-B pipe and a 20 mm Pex-A pipe (specimen 2) each positioned 5 to 10 mm off centre. The annular gap between the service and the AAC wall was filled to the full depth of the wall with FyrePEX™ HP sealant, ending with a 25 mm x 25 mm fillet on both sides of the wall; and
- A 20 mm Pex-Al-Pex pipe (specimen 3) passing through a 33 mm diameter hole cut through the 75 mm thick AAC panel wall and positioned 5 mm to 10 mm off centre. A 25 mm deep x 50 mm outside diameter FyrePEX™ two-piece metal FyreSHEATH was

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retrofitted around the pipe on each side of the wall and fixed with four M6 masonry anchors through the FyreSHEATH metal flange. A 12 mm wide stainless steel cable tie was fixed around the outside perimeter of each FyreSHEATH. FyrePEX™ HP sealant was then filled into the metal FyreSHEATH from each side of the wall; and

- A 20 mm Pex-B pipe (specimen 4) passing through a 33 mm diameter hole cut through the 75 mm thick AAC panel wall and positioned 5 mm to 10 mm off centre. A 25 mm deep x 50 mm outside diameter FyrePEX™ two-piece metal FyreSHEATH was retrofitted around the pipe on each side of the wall and fixed with four M6 masonry anchors through the FyreSHEATH's metal flange. A 12 mm wide stainless steel cable tie was fixed around the outside perimeter of each FyreSHEATH. FyrePEX™ HP sealant was then filled into the metal FyreSHEATH from each side of the wall; and
- A 20 mm Pex-A pipe (specimen 5) passing through a 33 mm diameter hole cut through the 75 mm thick AAC panel wall and positioned 5 mm to 10 mm off centre. A 25 mm deep x 50 mm outside diameter FyrePEX™ two-piece metal FyreSHEATH was retrofitted around the pipe on each side of the wall and fixed with four M6 masonry anchors through the FyreSHEATH metal flange. A 12 mm wide stainless steel cable tie was fixed around the outside perimeter of each FyreSHEATH. FyrePEX™ HP sealant was then filled into the metal FyreSHEATH from each side of the wall; and
- A 32 mm diameter copper pipe with a 20 mm thick FR (Armaflex) foam lagging (specimen 6) passing through a 112 mm diameter hole cut through the 75 mm thick AAC panel wall and positioned 5 mm to 10 mm off centre. The annular gap between the service and the wall was filled to the full depth of the wall with FyrePEX™ HP sealant, finished with a 50 mm x 50 mm fillet on both sides of the wall.

The specimens achieved a fire resistance, in accordance with AS 1530.4:2014, of 241 minutes Integrity and Insulation without failure. As the wall has an established FRL of only -/90/90 the penetrations will also have an FRL of -/90/90.

2.21 CSIRO Test Report FSP 2146

In the fire resistance test described in CSIRO test report FSP 2146, the test specimen consisted of a 150 mm thick concrete slab, 1,150 mm x 1,150 mm, which included a 400 mm x 400 mm double layer of 30 mm thick Fyreboard Maxilite board (total thickness 60 mm) mechanically fixed over a 202 mm diameter opening in the concrete slab. One penetrating service was a 25 mm uPVC conduit passing through a 65 mm diameter hole through the Maxilite panel. The annular gap between the service and the Maxilite board was filled to the full depth of the panel with FyrePEX™ HP sealant, ending flush with the surface of the Maxilite panel each face.

The specimen achieved a fire resistance, in accordance with AS 1530.4:2014, of 241 minutes Integrity and Insulation without failure.

2.22 CSIRO Test Report FSP 2249

In the fire resistance test described in CSIRO test report FSP 2249, the test specimen consisted of a 75 mm thick Walsc autoclaved aerated concrete (AAC) panel wall, 1,000 mm wide x 800 mm high with established fire resistance level (FRL) of -/120/120, which included service penetrations as follows:

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- A 16 mm² 4C+E Al cable passing through a 50 mm diameter opening (specimen 1) protected with FyrePEX HP sealant installed full depth of the wall and finished with a 30 mm x 30 mm cone on each side of the wall.
- Four 630 mm² single Al core cables (45 mm OD each) and a 120 mm² single copper core (16 mm OD) earth cable passing through a 120 mm diameter opening (specimen 2) in the AAC plus a 60 mm thick Maxilite panel. FyrePEX HP sealant was installed full depth of the wall and Maxilite panel. Each side of the penetration was finished with a 40 mm x 40 mm cone.

The specimens achieved an FRL of -/120/120, in accordance with AS 1530.4:2014.

2.23 Resolute Testing Laboratories Test Report RTL FT1553.01

In the fire resistance test described in Resolute Testing Laboratories test report RTL FT1553.01, the test specimen consisted of a floor/ceiling system with an overall cavity depth of 550 mm. The ceiling was lined with three layers of 16 mm fire rated plasterboard secured to a suspended ceiling. The ceiling was secured to timber joists with a timber flooring. The floor/ceiling was overall 1,600 mm x 1,600 mm built in accordance with the CSR ceiling system CSR 6223 with an established FRL of -/120/120 +RISF 60.

The floor/ceiling included a service penetration consisting of a 25 mm PVC conduit (empty), one 19 mm OD 3C+E power cable and six CAT6 data cables. The services are run through small holes through the plasterboard and an adjacent wall of the specimen. A 100 mm wide x two layers of 20 mm thick Corex board were installed as collar and secured to the underside of the ceiling lining providing an opening 160 mm x 60 mm. A FyreSTRAP is secured to the adjacent wall and underside of the Corex collar. The plasterboard, Corex collar and FyreSTRAP are filled to full depth with FyrePEX HP sealant. Where the penetrations pass through the timber floor the hole is filled with FyreFLEX sealant finished with a 30 mm x 30 mm cone.

The penetration achieved an FRL of -/120/120 +RISF 58, in accordance with AS 1530.4:2014

3. DISCUSSION

3.1 Pex Variants

Pex pipe comes in a variety of types and although they are all cross-linked polyethylene, the manufacturing methods used impart different mechanical properties to the end products. The classification of Pex pipes is an indication of the manufacturing process and not the quality of the pipe. All classifications of Pex pipe are still subject to the same test standards and SDR dimensional requirements.

3.1.1 Pex-A

Pex-A pipe is manufactured using peroxide in the Engel process. A small percentage of peroxide is added to the polyethylene before extrusion. The peroxide decomposes, removing hydrogen atoms from the polyethylene, leading to radicals. These then combine, resulting in cross-linking of the polyethylene chains. This process achieves approximately 75% cross-linking with a 6 x outside diameter (OD) minimum bend radius.

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3.1.2 Pex-B

Pex-B pipe is manufactured in the presence of silanes. Irradiation or a small amount of peroxide is used to initiate the reaction, which is then continued in a water bath by hydrolysis, creating Si-OH groups which condense forming Si-O-Si bridges, cross-linking the polyethylene chains. This process achieves approximately 65% cross-linking with an 8 x OD minimum bend radius. This is the most common form of Pex piping.

3.1.3 Pex-C

Pex-C pipe is manufactured using a radiation source. Downstream of the extrusion process, the pipe is irradiated, splitting off hydrogen atoms, allowing cross-linking to occur. The degree of cross-linking is dependent upon the depth of penetration of the irradiating source and can result in interior areas being excluded from the cross-linking process. This process achieves approximately 60% cross-linking with an 8 x OD minimum bend radius.

3.1.4 Pex-D

Pex-D pipe is manufactured with azo compounds using the Lubonyl process in a hot salt bath. This process achieves approximately 60% cross-linking.

3.1.5 Application of Pex pipe test results

Based on the differing mechanical properties and the results of testing to-date, it is not possible to read results across from one classification of pipe to another.

3.2 PEX-A pipes

3.2.1 Steel stud wall with a single layer of 13 mm plasterboard each side

In test FRT 180358.1, specimen F consisted of a 20 mm Pex-A pipe, tested with a 60 mm diameter hole, filled to the full depth of the linings with FyrePEX™ sealant. The specimen achieved an FRL of -/61/59. The insulation failure occurred on the wall lining adjacent to the penetration, but the penetration did not fail insulation for the duration of the test. Based on the temperatures on the wall it is considered that the insulation failure on the wall was due to the premature failure of an adjacent penetration and without that it is expected that Specimen E would have achieved at least an FRL of -/60/60.

Based on this test it is expected that a smaller 16 mm PEX-A pipe penetration sealed in the same manner would also achieve an FRL of at least -/60/60.

3.2.2 Steel stud wall with two layers of 13 mm plasterboard each side

In test FRT 180354.1, specimens A and D consisted of 16 mm and 25 mm Pex-A pipes, tested with a 60 mm and 65 mm diameter holes respectively filled to the full depth of the plasterboard with FyrePEX™ sealant. The specimens achieved an FRL of -/120/120. It is considered that the intermediate 20 mm diameter size of pipe would also achieve an FRL of -/120/120 with the same hole size and seal depth.

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3.2.3 75 mm Hebel PowerPanel wall

In EWFA test 51288000.2, specimen C2 consisted of a 25 mm Pex-A pipe, tested with a 65 mm diameter hole, filled to 60 mm depth from the unexposed side, with FyrePEX™ sealant. The specimen achieved an FRL of -/120/120.

Although the EWFA test 51288000.2 achieved an FRL of -/120/120, the only published data for the wall system is -/90/90 and as a result the FRL of the penetration must be limited to the FRL of the wall system. It is considered that 16 mm and 20 mm diameter PEX-A pipes would also achieve an FRL of at least -/90/90. In a Hebel PowerPanel wall.

Filling from the unexposed side represents the worst case in terms of exposure of the intumescent to the furnace heat. It is therefore considered that a 25 mm Pex-A pipe, installed in a 60 mm diameter hole, filled to 60 mm depth, from either the exposed or unexposed side, with FyrePEX™ sealant would achieve an FRL of -/90/90.

3.2.4 78 mm SpeedPanel wall

In test FRT 180323, specimen D consisted of a 20 mm Pex-A pipe, tested with a 60 mm diameter hole, filled to 60 mm depth, from the unexposed side, with FyrePEX™ sealant. The specimen achieved an FRL of -/120/120.

It is considered that the smaller 16 mm diameter size of pipe would also achieve an FRL of -/120/120 with the same hole size and seal depth.

3.3 Pex-B pipes

3.3.1 Steel stud wall with a single layer of 13 mm plasterboard each side

In BRANZ test FP 6033 the element was a 64 mm steel stud wall with a single layer of 13 mm thick fire-rated plasterboard on each side. The system has a recognised FRL of -/60/60. In this test a number of the specimens failed insulation early on the element, not the service.

The metal FyreSHEATHs used comprised two independent identical halves, each with two screw fixings. On inspection of the exposed side of the specimens at the conclusion of the test, it was determined that the metal FyreSHEATHs containing the FyrePEX™ sealant had been forced open as the intumescent expanded, see Photo 1.

In BRANZ test FP 6202, there were two different installations of the metal FyreSHEATHs. One had an additional stainless-steel cable tie installed around the circumference of the FyreSHEATH (specimen 5), the other had the two halves of the FyreSHEATH hinged together and a clasp (specimen 8). On inspection of the FyreSHEATHs at the conclusion of the test, it was determined that the FyreSHEATHs had not opened up under the pressure from the expanding intumescent sealant, see Photo 2.

It is considered that the cause of the early failure of the specimens in FP 6033 can be attributed to the FyreSHEATHs being forced open, allowing the intumescent sealant to fall away. Once the intumescent sealant had fallen away, furnace gases were able to penetrate into the wall cavity, resulting in the premature failure of the element.

It is therefore considered that a 16 mm or 20 mm Pex-B pipe installed in a 64 mm steel stud wall, with a single layer of 13 mm thick fire rated plasterboard on each side, with a 25 mm

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diameter opening and a 25 mm deep x 50 mm diameter metal FyreSHEATH (where the two halves of the FyreSHEATH are held together with a steel fixing to prevent radial expansion), filled to full depth with FyrePEX™ sealant, would achieve an FRL of -/60/60.

3.3.2 Steel stud wall with a two layers of 13 mm plasterboard each side

In Section 3.3.1, it is considered that a 16 mm Pex-B pipe in a steel stud wall with a single layer of 13 mm plasterboard on each side would achieve an FRL of -/60/60. The temperature rise on the service at the end of the 92 minute test was less than 100 K.

In BRANZ test FP 6009, specimens 4.2 and 4.3 consisted of 20 mm Pex-B pipes. Specimen 4.2 had a 60 mm diameter hole cut through the linings filled to the full depth of the 2 layers of 13 mm plasterboard with FyrePEX™ sealant. Specimen 4.3 had a 45 mm diameter hole cut through the linings and a 25 mm deep x 65 mm diameter FyreSHEATH filled to full depth with FyrePEX™ sealant. Both specimens achieved an FRL of -/120/120.

In BRANZ test FP 6009, specimen 6 consisted of 25 mm Pex-B pipe. Specimen 6 had a 75 mm diameter hole cut through the linings filled to the full depth of the 2 layers of 13 mm plasterboard with FyrePEX™ sealant. The specimen achieved an FRL of -/120/120.

In EWFA test 51288000, specimen L consisted of a 16 mm Pex-B pipe, tested with a 40 mm diameter hole in a Hebel PowerPanel wall, filled to 60 mm depth, from the unexposed side, with FyrePEX™ sealant. The specimen achieved an FRL of -/120/120.

It is considered that there is sufficient margin that a 16 mm Pex-B pipe, installed in a 64 mm steel stud wall with two layers of 13 mm thick plasterboard on each side with a 25 mm diameter opening and a 25 mm deep x 50 mm diameter metal FyreSHEATH (where the two halves of the FyreSHEATH are held together with a steel fixing to prevent radial expansion), filled to full depth with FyrePEX™ sealant, would achieve an FRL of -/120/120.

It is also considered that a 16 mm Pex-B pipe installed through a 60 mm diameter opening, filled to the full depth of the plasterboard on each side would achieve an FRL of -/120/120.

3.3.3 75 mm Hebel PowerPanel wall

In EWFA test 51288000.2, specimen L consisted of a 16 mm Pex-B pipe, tested with a 40 mm diameter hole, filled to 60 mm depth, from the unexposed side, with FyrePEX™ sealant. The specimen achieved an FRL of -/120/120.

In EWFA test 180357.2, specimens D and E consisted of a 25 mm and 20 mm Pex-B pipe, tested with a 65 mm and 60 mm diameter hole respectively, filled to the full depth of the wall with FyrePEX™ sealant. The specimens achieved an FRL of -/120/120.

Although the EWFA tests 51288000.2 and 180357.2 achieved an FRL of -/120/120, the only published data for the wall system is -/90/90 and as a result, the FRL of the penetration must be limited to the FRL of the wall system.

Filling from the unexposed side represents the worst case in terms of exposure of the intumescent to the furnace heat. It is therefore considered that a 16 mm Pex-B pipe, installed in a 40 mm diameter hole, filled to 60 mm depth, from either the exposed or unexposed side, with FyrePEX™ sealant would achieve an FRL of -/90/90.

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3.3.4 120 mm Concrete floor/ceiling slab

In EWFA test 51288100.2, specimen K consisted of a 16 mm Pex-B pipe, tested with a 40 mm diameter hole, filled to 60 mm depth from the unexposed side, with FyrePEX™ sealant. The specimen achieved an FRL of -/120/120.

Filling from the unexposed side represents the worst case in terms of exposure of the intumescent to the furnace heat. It is therefore considered that a 16 mm Pex-B pipe, installed in a 40 mm diameter hole, filled to 60 mm depth from either the exposed or unexposed side, with FyrePEX™ sealant would achieve an FRL of -/120/120.

3.3.5 78 mm thick SpeedPanel wall

In EXOVA Warrington test FRT180323, specimen E consisted of a 20 mm Pex-B pipe, tested with a 60 mm diameter hole, filled to 60 mm depth from the unexposed side, with FyrePEX™ sealant. The specimen achieved an FRL of -/120/120. It is considered that a smaller pipe, as demonstrated in EWFA test 51288100.2, Specimen K, will also achieve the same fire resistance provided that the same annular gaps are maintained around the pipe.

Filling from the unexposed side represents the worst case in terms of exposure of the intumescent to the furnace heat. It is therefore considered that 16 mm and 20 mm Pex-B pipes, installed in 40 mm and 60 mm diameter holes, filled to 60 mm depth, from either the exposed or unexposed side, with FyrePEX™ sealant would achieve an FRL of -/120/120.

3.4 Pex-Al-Pex pipes

3.4.1 Steel stud wall with a single layer of 13 mm plasterboard each side

In BRANZ test FP 6033, specimen 5 consisted of a 16 mm Pex-Al-Pex pipe, tested with a 25 mm diameter hole cut through the linings and a 25 mm deep x 50 mm diameter FyreSHEATH, filled to full depth with FyrePEX™ sealant. The specimen failed insulation on the element after 59 minutes. With the modifications discussed in Section 3.3.1, it is considered that if installed in a 25 mm diameter opening and a 25 mm deep x 50 mm diameter metal FyreSHEATH (where the two halves of the FyreSHEATH are held together with a steel fixing to prevent radial expansion), filled to full depth with FyrePEX™ sealant, would achieve an FRL of -/60/60.

With the modifications discussed in Section 3.3.1, it is considered that if installed in a 30 mm diameter opening and a 25 mm deep x 65 mm diameter metal FyreSHEATH (where the two halves of the FyreSHEATH are held together with a steel fixing to prevent radial expansion), filled to full depth with FyrePEX™ sealant, would achieve an FRL of -/60/60.

In BRANZ test FP 6033, specimen 3 consisted of a 20 mm Pex-Al-Pex pipe, tested with a 30 mm diameter hole cut through the linings and a 25 mm deep x 65 mm diameter FyreSHEATH, filled to full depth with FyrePEX™ sealant. The specimen achieved an FRL of -/60/60.

3.4.2 Steel stud wall with two layers of 13 mm plasterboard each side

As discussed in Section 3.4.1, the 16 mm Pex-Al-Pex pipe in BRANZ test FP 6033 failed on the element. The temperature of the service did not exceed 130 K for the duration of the 92 minute test.

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In BRANZ test FP 6009, specimen 5 consisted of a 20 mm Pex-Al-Pex pipe, tested in a 60 mm diameter opening, the annular gap between the pipe and opening was filled to the full depth of the plasterboard with FyrePEX™ sealant. The specimen achieved an FRL of -/120/120.

In EWFA test 51288000.2, specimen K consisted of a 16 mm Pex-Al-Pex pipe, tested with a 40 mm diameter hole in a concrete floor slab, filled to 60 mm depth from the unexposed side with FyrePEX™ sealant. The specimen achieved an FRL of -/120/120.

It is considered that a 16 mm Pex-Al-Pex pipe installed through a 25 mm diameter opening and a 25 mm deep x 50 mm diameter metal FyreSHEATH (where the two halves of the FyreSHEATH are held together with a steel fixing to prevent radial expansion), filled to full depth with FyrePEX™ sealant, would achieve an FRL of -/120/120.

It is also considered that a 16 mm Pex-Al-Pex pipe installed through a 60 mm diameter opening, filled to the full depth of the plasterboard on each side would achieve an FRL of -/120/120.

In BRANZ test FP 6372, specimen 4 consisted of a 25 mm Pex-Al-Pex pipe, tested with a 67 mm diameter hole in a Hebel PowerPanel wall, filled with FyrePEX™ sealant to 25 mm depth from each side and with a 25 mm fillet to each side of the wall. It is considered that this result will also apply to the plasterboard wall as the seal depth of 25 mm from each face of the wall will be retained.

3.4.3 75 mm Hebel PowerPanel and Walsc Panel™ wall

In EWFA test 51288000.2, specimen K consisted of a 16 mm Pex-Al-Pex pipe, tested with a 40 mm diameter hole, filled to 60 mm depth, from the unexposed side, with FyrePEX™ sealant. The specimen achieved an FRL of -/120/120.

In EWFA test 51288000.2, specimen H consisted of a 20 mm Pex-Al-Pex pipe, tested with a 60 mm diameter hole, filled to 60 mm depth, from the unexposed side, with FyrePEX™ sealant. The specimen achieved an FRL of -/120/120.

In BRANZ test FP 6372, specimen 4 consisted of a 25 mm Pex-Al-Pex pipe, tested with a 67 mm diameter hole, filled with FyrePEX™ sealant to 25 mm depth from each side and with a 25 mm fillet to each side of the wall. The specimen achieved an FRL of -/120/120 but will be limited to the 90 minute rating of the wall.

Although the EWFA test 51288000.2 achieves an FRL of -/120/120, the only published data for the wall system is -/90/90 and as a result the FRL of the penetration must be limited to the FRL of the wall system.

Filling from the unexposed side represents the worst case in terms of exposure of the intumescent to the furnace heat. It is therefore considered that the 16 mmm, 20 mm and 25 mm Pex-Al-Pex pipes, installed in 40 mm, 60 mm and 67 mm diameter holes, filled to 60 mm depth from either the exposed or unexposed side, with FyrePEX™ sealant would achieve an FRL of -/90/90.

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3.4.4 78 mm thick SpeedPanel walls

In EXOVA test FRT180323, specimen F consisted of a 20 mm Pex-Al-Pex pipe, tested with a 60 mm diameter hole, filled with FyrePEX™ sealant to a 60 mm depth from the unexposed side of the wall. The specimen achieved an FRL of -/120/60. The insulation failure at 60 minutes was due to a spike in the temperature measured on the pipe and following this the temperatures reduced to a low value for the remainder of the test. It is considered that this was due to a delay in sealing the pipe due to the intumescent seal being nominally 16 mm back from the exposed face of the wall. It is expected that if the seal was the full depth of the wall the pipe would be closed earlier and hence is expected to achieve at least 120 minutes Insulation as was the case for Specimen 5 in test FP 6009 which was the equivalent penetration but sealed flush with the exposed face of the plasterboard wall. Hence the 20 mm Pex-Al-Pex pipe is expected to achieve an FRL of at least -/120/120.

It is considered that the smaller 16 mm diameter size of pipe would also achieve an FRL of -/120/120 with the same hole size and seal depth.

3.4.5 60 mm thick Pronto Panel™ walls

In Warringtonfire fire resistance test FRT200160 the 20 mm Pex-Al-Pex pipe failed insulation after 56 minutes whereas the same penetration service tested in a 75 mm thick AAC wall, in fire resistance test FSP 2117, when fitted with a retrofit collar filled with the FyrePEX™ sealant achieved Insulation of 120 minutes. It is therefore considered that the Pex-Al-Pex pipe fitted with the FyrePEX™ collar and sealant system would conservatively achieve an Insulation of at least 60 minutes as included in Table 17.

3.4.6 120 mm Concrete floor/ceiling slab

In EWFA test 51288100.2, specimen L consisted of a 16 mm Pex-Al-Pex pipe, tested with a 40 mm diameter hole, filled to 60 mm depth, from the unexposed side with FyrePEX™ sealant. The specimen achieved an FRL of -/120/120.

Filling from the unexposed side represents the worst case in terms of exposure of the intumescent to the furnace heat. It is therefore considered that a 16 mm Pex-Al-Pex pipe, installed in a 40 mm diameter hole, filled to 60 mm depth from either the exposed or unexposed side with FyrePEX™ sealant would achieve an FRL of -/120/120.

3.5 Single FR A/C bundle installations

3.5.1 Steel stud wall with two layers of 13 mm plasterboard each side

In FP 6202, specimen 3 consisted of a single FR insulated A/C bundle, installed in a 110 mm opening, filled to the full depth of the plasterboard on each side with FyrePEX™ sealant and achieved an FRL of -/120/120.

In FSV 2163, specimen 9 consisted of three FR insulated copper pipes (9 mm, 19 mm and 22 mm OD) with a TPS and CAT6 cable bundle installed in a 110 mm diameter opening filled to the full depth of the plasterboard on each side with FyrePEX™ sealant and achieved an FRL of -/120/30. The penetration failed the insulation criteria on the FR insulation of the larger 22 mm diameter copper pipe. As discussed in Clause 3.7.2 below it is considered that if 300 mm wide x 25 mm thick TWrap is applied to the bundle on each side of the wall the

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Insulation performance of the penetration would be expected to increase to 120 minutes if tested in accordance with AS 1530.4:2014.

3.5.2 75 mm Hebel PowerPanel and Walsc Panel™ wall

In EWFA test 51288000.2, specimen G consisted of a single FR insulated A/C bundle installed in a 100 mm diameter opening, filled to 60 mm depth from the unexposed side, with FyrePEX™ sealant and achieved an FRL of -/120/120.

Although the EWFA test 51288000.2 achieves an FRL of -/120/120, the only published data for the wall system is -/90/90 and as a result, the FRL of the penetration must be limited to the FRL of the wall system.

Filling from the unexposed side represents the worst case in terms of exposure of the intumescent to the furnace heat. It is therefore considered that a single FR insulated A/C bundle, installed in a 100 mm diameter hole, filled to 60 mm depth, from either the exposed or unexposed side with FyrePEX™ sealant would achieve an FRL of -/90/90.

3.5.3 78 mm thick SpeedPanel wall

In EWFA test FRT 180323 specimen K consisted of a single PE insulated A/C bundle, installed in a 100 mm diameter hole, filled to 60 mm depth from the unexposed side, with FyrePEX™ sealant and achieved an FRL of -/120/115. The insulation failure at 115 minutes was on the unexposed face of the wall and was considered to be due to the intumescent seal being nominally 16 mm back from the exposed face of the wall. It is expected that if the seal was the full depth of the wall the A/C bundle would be closed earlier and hence is expected to achieve at least 120 minutes Insulation as was the case for Specimen 3 in test FP 6202 which was the equivalent penetration but sealed flush with the exposed face of the plasterboard wall. Hence the single A/C bundle is expected to achieve an FRL of at least -/120/120.

3.5.4 120 mm Concrete floor/ceiling slab

In EWFA test 51288100, specimen G consisted of a single FR insulated A/C bundle, installed in a 100 mm diameter hole, filled to 60 mm depth from the unexposed side, with FyrePEX™ sealant and achieved an FRL of -/120/120.

Filling from the unexposed side represents the worst case in terms of exposure of the intumescent to the furnace heat. It is therefore considered that a single FR insulated A/C bundle, installed in a 100 mm diameter hole, filled to 60 mm depth, from either the exposed or unexposed side, with FyrePEX™ sealant would achieve an FRL of -/120/120.

3.5.5 Variation of hole size

In EXOVA Warrington test FRT 200160, specimen G consisted of a single FR insulated A/C bundle with two power cables, installed in a 70 mm diameter hole, filled to the full 60 mm depth, with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet and achieved an FRL of -/120/60. This is compared with the 100 mm diameter opening successfully tested in the other tests described above. It is therefore considered that these A/C bundles and cables may be installed through holes 60 to 100 mm in diameter in panel walls.

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3.6 Double or Triple FR A/C bundle installations

3.6.1 75 mm Hebel PowerPanel and Walsc Panel™ wall

In EWFA test 51288000.2, specimen D consisted of two A/C bundles, installed through a 120 mm diameter opening, filled to 60 mm depth from the unexposed side with FyrePEX™ sealant. The specimen failed insulation after 88 minutes as a result of a roving thermocouple check on the power cables.

The client has proposed a modification to the installation, requiring the power and data cables be tucked between FR insulated pipes for a minimum of 300 mm each side of the penetration.

Although the EWFA test 51288000 achieved an FRL of -/120/120, the only published data for the wall system is -/90/90 and as a result, the FRL of the penetration must be limited to the FRL of the wall system.

Filling from the unexposed side represents the worst case in terms of exposure of the intumescent to the furnace heat. It is therefore considered that two A/C bundles, installed through a 120 mm diameter opening, with the cables tucked between the insulated pipe for a distance of 300 mm each side of the penetration and filled to 60 mm depth from either the exposed or unexposed side, with FyrePEX™ sealant would achieve an FRL of -/90/90.

Trafalgar have tested FR A/C bundles in nominally 100 mm and 120 mm diameter holes in EWFA test 51288000. Based on the tested results it is considered for double FR A/C bundles the hole can be reduced to 100 mm without prejudice to the established fire resistance of the penetration and be expected to achieve an FRL of at least -/90/90.

3.6.2 120 mm Concrete floor/ceiling slab

In EWFA test 51288100.2, specimen J consisted of a double FR insulated A/C bundle, installed in a 120 mm diameter hole, filled to 60 mm depth from the unexposed side and achieved an FRL of -/120/120.

Filling from the unexposed side represents the worst case in terms of exposure of the intumescent to the furnace heat. It is therefore considered that two A/C bundles, installed through a 120 mm diameter opening, filled to 60 mm depth from either the exposed or unexposed side, with FyrePEX™ sealant would achieve an FRL of -/120/120.

Further to Section 3.6.1 it is considered the penetration hole diameter may be 100 mm to 120 mm diameter without prejudice to the fire resistance of the penetration system.

3.6.3 Triple FR A/C bundle installations

It is proposed to include for clusters of three openings at least 50 mm apart each containing an FR insulated A/C bundle as penetrations though the above discussed walls. In test FRT 180354, a cluster of three holes 40 mm apart each contained a pair coil with 19 mm FR insulation, with two 2c+E 12 mm diameter power cables, and two CAT6 data cables, achieved an FRL of -/120/90 in a two hour plasterboard wall. It is considered that the same configuration would achieve the same result in a concrete wall or a concrete floor slab. As discussed in Clause 3.7.2 below it is considered that if 300 mm wide x 25 mm thick TWrap is applied to the bundles the Insulation will be increased to the rating of the walls or floor.

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3.7 Single PE A/C bundle installations

3.7.1 Steel stud wall with one layer of 13 mm plasterboard each side

In test FRT 180358.1, specimen E consisted of a single PE insulated A/C bundle which failed insulation on the wall after 55 minutes but did not fail on the pipes. It is considered that this was a result of excessive heating of the wall cavity from other penetrations. Based on the results from other penetrations through steel framed walls it is expected that a single PE insulated A/C bundle penetrating a 60 minute steel framed plasterboard lined wall would achieve an FRL of at least -/60/60.

From the tests described in Section 2 it is apparent that PE insulated A/C bundles perform worse than FR insulated A/C bundles. It is therefore considered that an FR insulated A/C bundle will also achieve an FRL of at least -/60/60.

3.7.2 Steel stud wall with two layers of 13 mm plasterboard each side

In FRT 180354.1, specimen G consisted of a single PE insulated A/C bundle, installed in a 110 mm opening, filled to the full depth of the plasterboard on each side with FyrePEX™ sealant and achieved an FRL of -/120/90.

Based on the evidence from FP 6033, it is considered that applying 300 mm of 25 mm thick TWrap blanket to each side of a PE insulated A/C bundle, from the face of the wall would provide sufficient insulation to achieve an FRL of -/120/120.

3.7.3 75 mm Hebel PowerPanel and Walsc Panel™ wall

In EWFA test 51288000.2, specimen J consisted of a single PE insulated A/C bundle which failed insulation after 33 minutes as a result of a roving thermocouple check of the pair-coil pipes. It was noted that the insulation had begun to melt away after 16 minutes.

Although the EWFA test 51288000.2 achieved an FRL of -/120/120, the only published data for the wall system is -/90/90 and as a result, the FRL of the penetration must be limited to the FRL of the wall system.

In BRANZ test FP 6033, specimen 6 consisted of an FR insulated A/C bundle in a FyreCOLLAR collar and 300 mm of 25 mm thick TWrap blanket beyond the collar on each side (secured with 100 mm wide foil tape around each end), through a -/60/60 plasterboard wall system. The specimen failed insulation first on the element after 62 minutes, then on the collar after 72 minutes. The TWrap and services remained well below the 180 K temperature rise criterion for the duration of the 92 minute test.

In BRANZ test FP 6033, specimen 7 consisted of two FR insulated A/C bundles and one PE insulated A/C bundle in a FyreCOLLAR collar and 300 mm of 25 mm thick TWrap blanket beyond the collar on each side, through a -/60/60 plasterboard wall system. The specimen failed insulation first on the element after 71 minutes, then on the collar after 89 minutes. The TWrap and services remained well below the 180 K temperature rise criterion for the duration of the 92 minute test.

The client has proposed fitting an additional 300 mm of 25 mm thick TWrap blanket to each side of an installation containing a PE insulated A/C bundle.

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Based on the evidence from FP 6033, it is considered that applying 300 mm of 25 mm thick TWrap blanket to each side of a PE insulated A/C bundle, from the face of the wall (covering the collar) would provide sufficient insulation to achieve an FRL of -/90/90.

3.7.4 120 mm Concrete floor/ceiling slab

In EWFA test 51288100.2, specimen D consisted of a single PE insulated A/C bundle which failed insulation after 14 minutes on the pair-coil pipes. It was noted that the insulation had begun to melt away after 18 minutes.

In fire resistance test FRT 180391, as described in Clause 2.11 above, a 50 mm copper pipe with a 300 mm x 25 mm TWrap blanket to the unexposed side achieved an FRL of -/240/120. Based on this evidence, because a 50 mm diameter copper pipe would have a greater thermal conduction than the pipes contained in an A/C bundle, it is considered that applying 300 mm of 25 mm thick TWrap blanket to the upper side of a PE insulated A/C bundle would provide sufficient insulation to achieve an FRL of -/120/120.

3.8 PVC Conduit

In test FRT 180354.1, Specimen B consisted of a 25 mm PVC conduit containing a fibre optic cable passing through a 60 mm diameter hole and Specimen F consisted of a 40 mm diameter PVC conduit passing through an 80 mm diameter hole in a steel framed wall lined both sides with two layers of 13 mm thick fire rated plasterboard. Both specimens were sealed to the full depth of the plasterboard on each side with FyrePEX™ intumescent sealant and both achieved an FRL of -/120/120.

In test FRT 180357, Specimen A consisted of a 25 mm PVC conduit containing a fibre optic cable passing through a 65 mm diameter hole and Specimen B consisted of a 40 mm diameter PVC conduit passing through an 80 mm diameter hole in a 75 mm thick Hebel PowerPanel wall. Both specimens were sealed to a depth of 60 mm from the unexposed side with FyrePEX™ intumescent sealant and both achieved an FRL of -/120/120. Although the test achieved an FRL of -/120/120, the only published data for the wall system is -/90/90 and as a result the FRL of the penetration must be limited to the FRL of the wall system.

Based on these tests it is also considered that the conduits up to 40 mm diameter, with or without a single fibre optic cable, would also achieve an FRL of at least -/120/120 in a 78 mm thick SpeedPanel wall.

Filling from the unexposed side represents the worst case in terms of exposure of the intumescent to the furnace heat. It is therefore considered that the conduits, installed through a Hebel PowerPanel or a SpeedPanel wall, filled to 60 mm depth from either the exposed or unexposed side, with FyrePEX™ sealant would achieve an FRL of -/90/90 or -/120/120 respectively.

In CSIRO fire resistance tests FSP 1709, FSP 1729A and FSP 1801, while the PVC pipes were sealed with collars rather than a sealant alone, these tests demonstrated that the PVC pipe penetrations, when sealed by the collars, achieved up to 120 minutes Integrity and Insulation on the pipes despite carrying power cables up to 20 mm OD, up to five 5 mm OD CAT5 data cables and 6 mm OD fibre optic cables. It is therefore considered that the PVC

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conduits, as discussed above can contain any or combinations of these cables without prejudice to their established FRL.

In Warringtonfire test FRT200160.2 the 25 mm conduit penetration of Specimen J had the service sitting on the bottom edge of the hole in the panel wall without reducing the fire resistance of the wall. It is therefore considered that offsetting the conduit from the centre of the penetration will not prejudice the fire resistance of the penetration system. Also, this penetration service achieved 120 minutes Integrity and 90 minutes Insulation in a 60 mm thick panel wall. It is therefore considered that the same seal system would be applicable to the 75 mm thick Hebel and Walsc AAC panel walls.

3.9 Single insulated pipes

In test FRT 180354, Specimen E consisted of a 32 mm copper pipe insulated with 25 mm thick FR insulation passing through a 110 mm diameter hole in a steel framed wall lined both sides with two layers of 13 mm thick fire rated plasterboard. The specimen was sealed to the full depth of the plasterboard on each side with FyrePEX™ intumescent sealant and achieved an FRL of -/120/60.

In test FRT 180357, Specimen G consisted of a 32 mm copper pipe insulated with 25 mm thick FR insulation passing through a 120 mm diameter hole in a 75 mm thick Hebel PowerPanel wall. The specimen was sealed to a depth of 60 mm from the unexposed side of the wall depth with FyrePEX™ intumescent sealant and achieved an FRL of -/120/60. Although the test achieved an FRL of -/120/60, the only published data for the wall system is -/90/90 and as a result, the FRL of the penetration must be limited to the FRL of the wall system, i.e. -/90/60.

Based on these tests it is also considered that the insulated pipes would also achieve an FRL of at least -/120/60 in a 78 mm thick SpeedPanel wall.

Filling from the unexposed side represents the worst case in terms of exposure of the intumescent to the furnace heat. It is therefore considered that the pipes, installed through a Hebel PowerPanel or a SpeedPanel wall, filled to 60 mm depth from either the exposed or unexposed side, with FyrePEX™ sealant would achieve an FRL of -/90/60 or -/120/60 respectively. Also, as copper pipes have a higher thermal conduction than ferrous pipes it is considered that this FRL can also apply to ferrous pipes 32 mm diameter or less.

In test CSIRO fire resistance test FSP 2117, Specimen 6 consisted of a 32 mm copper pipe insulated with 20 mm thick FR insulation passing through a 112 mm diameter hole in a 75 mm thick AAC Walsc panel wall. The specimen was sealed to the full depth with FyrePEX™ intumescent sealant finishing with a 50 mm x 50 mm fillet on both sides of the wall and achieved an FRL of -/120/120. Although the test achieved an FRL of -/120/120, the only published data for the wall system is -/90/90 and as a result, the FRL of the penetration must be limited to the FRL of the wall system, i.e. -/90/90.

In fire resistance test FRT 180391 as described in Clause 2.11 above the 50 mm copper pipe with a 300 mm x 25 mm TWrap blanket to the unexposed side only achieved an FRL of -/240/120. Based on this evidence, because a 50 mm diameter copper pipe would have a greater thermal conduction than the 32 mm diameter pipes, it is considered that applying

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300 mm of 25 mm thick TWrap blanket to the 32 mm diameter or less copper or ferrous pipes would provide sufficient insulation to achieve an FRL of -/90/90 and -/120/120 respectively.

It is proposed to include for bundles of three FR insulated copper pipes as penetrations though the above discussed walls. Based in tests FRT 180354 and FRT 51288100 where bundles of two pair coils with 19 mm FR insulation, with two 2c+E 12 mm diameter power cables and two CAT6 data cables achieved an FRL of -/120/90 in a two hour plasterboard wall and -/120/60 in a Hebel wall it is expected that up to three FR insulated copper pipes would have similar conduction and hence would achieve the same FRLs.

3.10 Cable services

In fire resistance test FRT 200160.2, as described in Clause 2.13 above, a range of Firesense cables, CAT6 data cables and power cables were tested in a Pronto Panel™ wall. All achieved an Integrity of at least 120 minutes. The 2.5 mm^2 power cables of Specimen C and the 16 mm^2 power cables of Specimen D both failed insulation on the cables after 59 minutes as determined by thermocouples placed at 25 mm from the 25 mm fillet seal on the cables. It is considered that if the fillet was increased to 50 mm x 50 mm on each side of the penetration the thermocouples on the cables would be shifted 25 mm further away from the exposed side, an increase in conduction path of approximately 37%, and it would be expected that the cables would achieve Insulation of at least 60 minutes. These results are shown in Table 17.

In fire resistance test FRT 180392 eight 16 mm² cables were tested in a steel framed plasterboard wall with the cables insulated with 300 mm of TWrap on each face. The penetration achieved an FRL of -/120/120. Although the sealant is different to that described above for the Firesense cables the system details are sufficiently similar with the addition of 300 mm TWap to expect a similar performance would be expected. Based on the performance of larger conductor cables with 300 mm of TWrap it is considered that if the penetration as tested with the Firesense cables had 300 mm of TWrap it would be expected to maintain the Insulation criteria for at least 120 minutes.

3.11 Aluminium Cable Services

3.11.1 75 mm Hebel PowerPanel and Walsc Panel™ wall

In fire resistance test FSP 2249 a range of aluminium cables were tested in a nominal 75 mm thick AAC wall panel. Specimen 1 consisted of a single 16 mm² 4C+E Al power cable with a 25 mm OD installed through a 50 mm diameter hole. The hole was filled to full depth with FyrePEX sealant and finished on each side with a nominal 30 mm x 30 mm cone. Specimen 2 consisted of four 630 mm² Al core power cables with a 120 mm² copper core earth cable installed through a 120 mm diameter hole. A 60 mm thick Maxilite panel was laminated to the unexposed face. The hole was filled to the full depth of the combined wall thickness with FyrePEX sealant and the cables finished on each side with a nominal 40 mm x 40 mm cone. The cables were then wrapped with nominally 25 mm thick TWrap for a distance of 450 mm from the face of the wall on each side.

Based on the above testing it is considered single or multiple Al cables up to 16 mm² and no larger than 25 mm OD overall would be expected to achieve at least an FRL of -/120/120 if tested in accordance with AS 1530.4:2014.

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Where the penetration includes the 60 mm thick Maxilite panel it is considered single core Al cables up to 630 mm², installed as tested, from a single cable up to a maximum of five cables would be expected to achieve an FRL of at least -/120/120 if tested in accordance with AS 1530.4:2014. This may be combined with an optional 120 mm² copper earth cable.

3.11.2 Concrete and Masonry Walls

3.11.2.1 Concrete Wall Minimum 120 mm thick (FRL 120/120/120)

It is considered single or multiple Al cables up to 16 mm² and no larger than 25 mm OD overall would be expected to achieve at least an FRL of -/120/120 if tested in accordance with AS 1530.4:2014 when installed in a fire rated concrete wall with a minimum thickness of 120 mm.

3.11.2.2 Concrete Wall Minimum 135 mm thick (FRL 120/120/120)

Where the concrete wall is 135 mm or thicker it is considered single core Al cables up to 630 mm², installed as tested in FSP 2249 but without the Maxilite panel, from a single cable up to a maximum of five cables would be expected to achieve an FRL of at least -/120/120 if tested in accordance with AS 1530.4:2014. This may be combined with an optional 120 mm² copper earth cable.

3.11.2.3 Concrete Wall Minimum 150 mm thick (FRL 180/180/180)

In fire resistance test FRT 210260 Al cables were tested in a 150 mm thick floor slab with Twrap to the top face only. Based on the test results from FSP 2249 and FRT 210260 it is considered the cables as tested in FRT 210260 in a 150 mm thick concrete wall and Twrap nominally 300 mm from each face would be expected to achieve the same fire resistance performance in a wall.

Based on the tested penetrations it is considered single core Al cables up to 240 mm² installed as tested from a single cable up to a maximum of five cables would be expected to achieve an FRL of at least -/180/120 in a concrete wall 150 mm or thicker if tested in accordance with AS 1530.4:2014.

Based on the tested penetrations it is considered single core Al cables would be expected to achieve an FRL of at least -/180/180 in a concrete wall 150 mm or thicker if tested in accordance with AS 1530.4:2014. In the following configurations:

- Up to five 16 mm² single core or 4C+E
- One single core cable with a cross section up to 240 mm².

3.11.2.4 Masonry Wall Minimum 110 mm thick (FRL 90/90/90)

It is considered single or multiple Al cables up to 16 mm² and no larger than 25 mm OD overall would be expected to achieve at least an FRL of -/90/90 if tested in accordance with AS 1530.4:2014 when installed in a fire rated masonry wall with a minimum thickness of 110 mm.

3.11.2.5 Masonry Wall Minimum 135 mm thick (FRL 120/120/120)

Where the overall masonry wall is 135 mm or thicker it is considered single or multiple core Al cables up to 630 mm², installed as tested in FSP 2249 but without the Maxilite panel, from a single cable up to a maximum of five cables would be expected to achieve an FRL of at least

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-/120/120 if tested in accordance with AS 1530.4:2014. This may be combined with an optional 120 mm² copper earth cable.

3.11.3 Concrete Floor Slab

In fire resistance test FRT 210260, as described in Clause 2.14 above, a range of aluminium cables were tested in a nominal 150 mm thick concrete floor slab. They all achieved an Integrity of at least 180 minutes. The multiple 16 mm² (specimen G) and single 240 mm² (specimen H) cables achieved an Insulation of at least 180 minutes and the multiple 240 mm² + 120 mm² (specimen F) aluminium cables failed the Insulation criteria after 171 minutes.

Based on the tested penetrations it is considered single core Al cables up to 240 mm² installed as tested from a single cable up to a maximum of five cables would be expected to achieve an FRL of at least -/180/120 in a concrete floor slab 150 mm or thicker if tested in accordance with AS 1530.4:2014.

Based on the tested penetrations it is considered single core Al cables would be expected to achieve an FRL of at least -/180/180 in a concrete floor slab 150 mm or thicker if tested in accordance with AS 1530.4:2014. In the following configurations:

- Up to five 16 mm² single core or 4C+E
- One single core cable with a cross section up to 240 mm².

The penetrations are to be installed as tested in FRT 210260 with an annular gap of up to 20 mm.

3.12 Penetrations in a Maxilite panel

In test FRT 180357, Specimen F consisted of a 60 mm thick Maxilite panel through which passed three penetrations. F1 was a 16 mm diameter PEX-Al-PEX pipe, F2 was a 16 mm diameter PEX-B pipe and F3 was an FR insulated A/C Bundle containing a 3/8" & 3/4" PE Pair-coil, a 2.5 mm^2 Power cables and a Cat 6 Data cable. All penetrations were sealed to the full depth of the panel with FyrePEX™ intumescent sealant and all achieved an Integrity of 121 minutes. The specimens failed Insulation after 75, 81 and 61 minutes respectively and hence all achieved an FRL of -/120/60. The insulation failures occurred on the Maxilite panel adjacent to the penetrations, but failure of insulation did not occur for the 120 minutes duration on Specimen F1 and failure occurred on F2 after 95 minutes and on F3 after 61 minutes. If it is required to have a higher insulation for the F1 and F2 specimens, then it would be necessary to double the thickness of the Maxilite panel to 120 mm. This is expected to increase the Insulation on the Maxilite panel to 120 minutes but will not significantly increase the Insulation on the penetrations. Hence, it is expected that the penetrations will achieve an FRL of at least the following;

F1	Pex-Al-Pex pipe	-/120/60 with 60 mm thick panel
		-/120/120 with 120 mm thick panel
F2	Pex-B pipe	-/120/60 with 60 mm thick panel
		-/120/90 with 120 mm thick panel
F3	A/C Bundle	-/120/60 with 60 mm or 120 mm thick panel

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3.13 Penetrations in a Pronto Panel wall System

In FRT200160 a number of cable and pipe penetrations were tested in a nominal 60 mm thick solid Pronto Panel wall system with an established FRL of -/60/60. The penetrations maintained the Integrity criteria for 120 minutes and Insulation between 60 and 90 minutes. See Table 17 for a summary.

It is considered if the penetrations as tested in FRT200160 were installed into thicker solid fire rated wall elements the penetrations would be expected to achieve a similar fire resistance. It is considered the penetrations may be installed in 75 mm Hebel PowerPanel and Walsc Panel walls (Table 14), 78 mm SPEEDPANEL walls (Table 16), 120 mm concrete/masonry walls and Maxilite board systems (Table 11).

3.14 Installation Framed Plasterboard Walls

3.14.1 90 minute Plasterboard Lined Walls

Where it is required to install the penetrations in a 90 minute steel stud wall with two layers of 13 mm or a single layer of 16 mm fire rated plasterboard each face it is proposed to add another layer of plasterboard for 100 mm around the penetration on each face of the wall to allow the FyrePEX™ sealant to be installed to at least 26 mm deep, the same depth as the two hour plasterboard systems. The additional plasterboard to be fixed to the wall lining with four 8g x 45 mm long plaster screws, one in each corner, and the perimeter sealed with FyreFLEX sealant as shown in Figure 8.

Where the 90 minute plasterboard wall consists of nominally 26 mm of plasterboard each side of a framed cavity the additional layer of plasterboard around the penetration is not required. For example a Shaftwall consisting of two layers of 13 mm fire rated plasterboard to one face and 25 mm shaft liner to the other is acceptable.

3.14.2 120 minute plasterboard Shaft Walls

Where a 120 minute plasterboard shaft wall consists of at least the same overall thickness of plasterboard and wall depth as the tested plasterboard walls it is expected the penetrations would achieve a similar fire resistance. For example a 120 minute shaft wall consisting of two layers of 16 mm fire rated plasterboard on one face and 25 mm Shaftliner on the other is considered acceptable.

3.15 FyreSTRAP Penetration System

3.15.1 FyreSTRAP General Details

The Trafalgar FyreSTRAP penetration system consists of a steel strap resembling linked octagons nominally 40 mm wide x up to 8 octagons long. See Figure 9 for details. The steel FyreSTRAP is folded into a top hat profile to create a void nominally 40 mm high and in 40 mm wide increments up to a maximum 160 mm (4 octagons) wide. The outer octagons of the top hat are secured to the underside of a concrete soffit/slab above on each side of the wall. The void created by the FyreSTRAP is filled with FyrePEX sealant to the full depth + 10 mm (50 mm depth).

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3.15.2 Fire Rated Plasterboard Walls

In fire resistance test FSV 2163 a Trafalgar FyreSTRAP penetration system, Specimen 14, was tested mounted to the underside of a concrete soffit with the services penetrating a steel stud plasterboard wall lined with two layers of 13 mm fire rated plasterboard. The services tested included a nominal 25 mm PVC conduit, 2.5 mm^2 TPS power cable and 16 mm^2 3C+E power cable each installed in separate holes which was nominally 5 mm larger than the service. The FyreSTRAP was filled with FyrePEX sealant. The FyreSTRAP penetration maintained the Integrity and Insulation criteria for the 121 minute duration of the test.

The FyreSTRAP system is similar in concept to the FyreSHEATH in that they are both filled with FyrePEX sealant and has been extensively tested with different services. FyrePEX sealant has also been tested with a variety of services in plasterboard walls. The depth of the FyrePEX sealant required with the FyreSTRAP is either more or similar to that for the FyreSHEATH or FyrePEX only penetrations.

The FyreSTRAP penetration tested in FSV 2163 in a steel framed plasterboard wall maintained the FRL of the wall system for 120 minutes. It is considered other services up to the size tested, as discussed in this report, which also maintain the FRL of the wall would be expected to also achieve at least an FRL of -/120/120 if installed in a FyreSTRAP system but otherwise as tested in FSV 2163. The services considered suitable are as follows:

- Power cables – TPS up to 2.5mm^2, 2C+E and 3C+E up to 16 mm^2
- Comms cables – CAT6 and RG6
- Pipes/Conduits – up to 25 mm PVC (with or without cables), up to 20 mm PEX or PEX-AL-PEX.

Based on the performance of the FyrePEX systems as discussed above it is also considered the FyreSTRAP system can be installed in fire rated plasterboard lined walls and maintain the FRL of the wall from 60 minutes up to 120 minutes.

3.15.3 Other Fire Rated Walls

In reviewing the services discussed in Section 3.15.2 above and FyrePEX penetration systems it is considered they would also maintain the FRL's of the following walls as given in the tables listed:

- 75 mm Hebel PowerPanel and Walsec Panel wall systems (Table 14)
- 78 mm SPEEDPANEL wall system (Table 16)
- 60 mm Pronto Panel wall system (Table 17)

3.16 Installation in a Floor/Ceiling System

In FTL FT1553.01, Specimen 4 consisted of a 16 mm^2 3C+E copper power cable, a 25 mm PVC conduit and six CAT6 cables installed in a 120 minute fire rated floor/ceiling system. The penetration was positioned next to an adjacent plasterboard wall. Each penetration was installed in a slightly oversize hole in the plasterboard ceiling lining. To the underside of the plasterboard a 40 mm thick Corex collar was installed followed by a FyreSTRAP which was secured to the wall. The cavity created by the Corex collar and FyreSTRAP, nominally 160 mm x 40 mm was filled with FyrePEX HP sealant extending approximately 10 mm below the

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FyreSTRAP. The penetration achieved an FRL of -/120/120 and failed the RISF criteria after 58 minutes.

It is proposed to increase the thickness of the Corex collar to 50 mm thick. It is considered the increase in thickness would be sufficient for the penetration as otherwise tested to achieve an RISF of at least 60 minutes if tested in accordance with AS 1530.4:2014.

It is considered any combination of the tested services, up to the overall size tested, would not prejudice the fire resistance of the penetration system before at least 120 minutes. Each service shall be installed in separate holes through the plasterboard.

3.17 Installation

Figure 1 to Figure 8 demonstrate the method of installing the penetrating services in the walls or floors as discussed above.

The results of the specimens tested in CSIRO fire resistance test FSP 2117 demonstrated that the Pex pipes may be offset by up to 10 mm from the centre of the penetration without prejudicing the fire resistance of the penetrating service. It is considered that this variation can be applied to all the wall types.

Similarly, the results of Specimen 2 tested in CSIRO fire resistance test FSP 2117 demonstrated that the Pex pipes may be installed in a 50 mm diameter opening without prejudicing the fire resistance of the penetrating service. This is compared with the 60 mm diameter opening successfully tested in EXOVA Warringtonfire fire resistance test FRT 180357. It is therefore considered that these pipes may be installed through holes 50 to 60 mm in diameter in panel walls.

The results of Specimens 3, 4 and 5 tested in CSIRO fire resistance test FSP 2117 demonstrated that the Pex pipes can be sealed with the smaller 50 mm outside diameter FyreSHEATHs without prejudicing the fire resistance of the penetrating service. This is compared with the 65 mm diameter FyreSHEATHs successfully tested in BRANZ fire resistance tests FR 6033, FR 6202 and FP 6009. It is considered that either the 50 mm outside diameter or the 65 mm outside diameter FyreSHEATHs may be used in all the wall types.

3.18 Concrete walls

In accordance with Clause 10.12.1 (c) of AS 1530.4:2014 results obtained from framed wall systems may be applied to the performance of a system in concrete, masonry or solid gypsum blocks of greater or equal thickness to that of the tested prototype.

3.19 Penetration Separation Distance

In accordance with Clause 4.9.3 of AS 4072.1-2005 (including amendment No. 1) *the minimum distance between penetrations in a modular system shall be not less than 40 mm unless otherwise tested*. In addition to this in FP 6009 three separate pipe penetrations (Specimen No. 4) were tested in close proximity. Two of the holes for the penetrations were nominally 40 mm apart without any indication that the proximity of the holes influenced the performance of each penetration. It is therefore considered the FyrePEX penetrations may be placed nominally 40 mm apart without prejudice to their established fire resistance performance.

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3.20 VRF Cable

A VRF instrumentation cable consists of PVC insulated copper conductors in pairs with the conductor cross section ranging from nominally 0.5 mm^2 to 1.5 mm^2. While currently the cable has not been tested it is considered to fall somewhere between a communications cable (CAT6 etc) and a TPS power cable in terms of materials of construction and conductor size. Based on the information supplied the conductor consists of 7 strands ranging from 0.3 mm to 0.5 mm which is slightly larger than a CAT6 conductor of 0.22 mm and smaller than the seven strand 0.67 mm diameter TPS 2.5 mm^2 power cable. Based on this it is considered a VRF cable would be expected to perform at least as well as a TPS 2.5 mm^2 power cable. The specific VRF cable size and bundle size is limited to what is permitted for TPS 2.5 mm^2 power cables.

4. CONCLUSION

It is considered that, with the modifications identified, FyrePEX™ intumescent sealant would achieve the FRL's given in Table 10 to Table 17 in accordance with AS 1530.4:2014, and with reference to AS 4072.1-2005, including amendment one.

Table 10: 60 minute plasterboard wall system FRL's

Service^	64 mm Steel Stud, single layer of 13 mm plasterboard each side	
	Installation details	FRL
16 mm pipes Pex-A, Pex-B Pex-Al-Pex	25 mm opening, 25 x 50 FyreSHEATH (where the two halves of the FyreSHEATH are held together with a steel fixing to prevent radial expansion), filled to full depth with FyrePEX™ sealant.	-/60/60
20 mm pipes Pex-A, Pex-B Pex-Al-Pex	25 mm opening, 25 x 50 or 65 FyreSHEATH (where the two halves of the FyreSHEATH are held together with a steel fixing to prevent radial expansion), filled to full depth with FyrePEX™ sealant.	-/60/60
Single FR & PE A/C*	110 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant and finished with a 30 mm x 30 mm fillet.	-/60/60
FyreSTRAP services**	5 mm oversize hole for each service FyreSTRAP secured to underside of concrete sofit/concrete slab. FyreSTRAP 40 mm high x up to 160 mm wide filled with 50 mm deep FyrePEX HP sealant on each face of the wall.	-/60/60

* A/C Bundles can consist of copper pipes up to 20 mm diameter, plus up to 20 mm insulation thickness, with or without: Power cables up to 12 mm OD, data cables up to 6 mm OD and flexible or rigid drains up to 20 mm.

** FyreSTRAP services may consist of a combination of the following cables; up to TPS 2.5mm^2 power cable, 16 mm^2 2C+E or 3C+E power cables, Cat6, RG6, up to 25 mm PVC conduit (with or without cables), 20 mm PEX or 20 mm PEX-AL-PEX.

^ Pipes may be up to 10 mm offset from centre without prejudicing the fire resistance.

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Table 11: Maxilite panel construction as approved by others

Service^	Installation details		
	Maxilite panel thickness	60 mm	120 mm
16 mm pipes Pex-B	50 - 60 mm opening, filled to full depth of panel with FyrePEX™ sealant.	-/120/60	-/120/90
16 mm pipes Pex-Al-Pex	50 - 60 mm opening, filled to full depth of panel with FyrePEX™ sealant.	-/120/60	-/120/120
20 mm Pex-Al-Pex pipe	33 mm diameter opening, fitted with a 25 mm deep by 50 mm or 65 mm diameter FyrePEX™ FyreSHEATH fixed to each side of the wall filled with FyrePEX™ sealant.	-/120/60	-/120/60
20 mm Pex-A pipe	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/120/90	-/120/90
Up to 25 mm uPVC conduit*	50 - 60 mm opening, filled to full depth of panel with FyrePEX™ sealant.	-/240/240	-/240/240
	40 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side. #	-/120/90	-/120/90
Single FR A/C**	110 mm opening, filled to full depth of panel with FyrePEX™ sealant and finished with a 30 mm x 30 mm fillet.	-/120/60	-/120/60
	110 mm opening, filled to full depth of panel with FyrePEX™ sealant with 300 mm of 25 mm thick TWrap blanket applied each side of the opening.	-/120/120	-/120/120
Single FR A/C**	70 mm to 100 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/120/60	-/120/60
Up to 15x Firesense 1.5 mm^2 TPS cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/120/90	-/120/90
	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side and 300 mm of 25 mm thick TWrap blanket applied each side.	-/120/120	-/120/120
Up to 15x CAT6 data cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/120/90	-/120/90
Up to 15x 2.5 mm^2 TPS cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side.	-/120/60	-/120/60
Up to 8x 16 mm^2 3C + E TPS power cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side.	-/120/60	-/120/60
FyreSTRAP services***	5 mm oversize hole for each service FyreSTRAP secured to underside of concrete soffit/concrete slab. FyreSTRAP 40 mm high x up to 160 mm wide filled with 50 mm deep FyrePEX HP sealant on each face of the wall.	-/120/60	-/120/60

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* Conduit may be empty or include a combination of the following cables; up to TPS 2.5mm^2 power cable, Cat6, RG6 or fibre cables

** A/C Bundles can consist of copper pipes up to 20 mm diameter, plus up to 20 mm insulation thickness, with or without: Power cables up to 12 mm OD, data cables up to 6 mm OD and flexible or rigid drains up to 20 mm.

*** FyreSTRAP services may consist of a combination of the following cables; up to TPS 2.5mm^2 power cable, 16 mm^2 2C+E or 3C+E power cables, Cat6, RG6, up to 25 mm PVC conduit (with or without cables), 20 mm PEX or 20 mm PEX-AL-PEX.

^ Pipes may be up to 10 mm offset from centre without prejudicing the fire resistance.

The conduit may be offset to touch the side of the aperture without prejudicing the fire resistance of the penetration.

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Table 12: 90 minute plasterboard wall system with additional plasterboard around each penetration as shown in Figure 8

Service^	64 mm Steel Stud, two layers of 13 mm plasterboard each side	
	Installation details	FRL
PVC conduit** up to 40 mm	20 mm annular gap around the services, filled with FyrePEX™ sealant to the full depth of plasterboard on both side of the wall.	-/90/90
16 mm pipes Pex-A, Pex-B Pex-Al-Pex	25 mm opening, 25 x 50 FyreSHEATH (where the two halves of the FyreSHEATH are held together with a steel fixing to prevent radial expansion), filled to full depth with FyrePEX™ sealant.	-/90/90
	60 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant	-/90/90
20 mm pipes Pex-A, Pex-B Pex-Al-Pex	30 mm opening, 25 x 50 or 65 FyreSHEATH (where the two halves of the FyreSHEATH are held together with a steel fixing to prevent radial expansion), filled to full depth with FyrePEX™ sealant.	-/90/90
	60 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant	-/90/90
25 mm pipes Pex-A, Pex-B	65 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant.	-/90/90
25 mm pipes Pex-Al-Pex	65 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet.	-/90/90
Single FR A/C*	110 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant.	-/90/90
Single PE A/C*	110 mm opening filled to full depth of plasterboard on each side with FyrePEX™ sealant.	-/90/90
	110 mm opening filled to full depth of plasterboard on each side with FyrePEX™ sealant with 300 mm of 25 mm thick TWrap blanket applied each side of the opening.	-/90/90
Cluster of up to three FR insulated A/C bundles*	Three 110 mm openings spaced minimum 50 mm apart, each with a single A/C bundle and filled to full depth of plasterboard on each side with FyrePEX™ sealant.	-/90/90
	Three 110 mm openings spaced minimum 50 mm apart, each with a single A/C bundle and filled to full depth of plasterboard on each side with FyrePEX™ sealant, with additional 300 mm wide x 25 mm thick TWrap applied each side of the opening enclosing the bundles.	-/90/90
Copper or ferrous pipe up to 32 mm with 25 mm FR insulation	110 mm opening filled to full depth of plasterboard on each side with FyrePEX™ sealant.	-/90/60
Copper or ferrous pipe up to 32 mm with 25 mm FR insulation	110 mm opening filled to full depth of plasterboard on each side with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side of the wall.	-/90/90
FyreSTRAP services***	5 mm oversize hole for each service FyreSTRAP secured to underside of concrete soffit/concrete slab. FyreSTRAP 40 mm high x up to 160 mm wide filled with 50 mm deep FyrePEX HP sealant on each face of the wall.	-/90/90

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* A/C Bundles can consist of copper pipes up to 20 mm diameter, plus up to 20 mm insulation thickness, with or without: Power cables up to 12 mm OD, data cables up to 6 mm OD and flexible or rigid drains up to 20 mm.

** Conduit may be empty or contain combinations of power cables up to 20 mm OD, 6 mm OD fibre optic cables or 5 mm OD CAT5 or CAT6 data cables. The conduit may be offset to touch the side of the aperture without prejudicing the fire resistance of the penetration.

*** FyreSTRAP services may consist of a combination of the following cables; up to TPS 2.5mm^2 power cable, 16 mm^2 2C+E or 3C+E power cables, Cat6, RG6, up to 25 mm PVC conduit (with or without cables), 20 mm PEX or 20 mm PEX-AL-PEX.

^ Pipes may be up to 10 mm offset from centre without prejudicing the fire resistance.

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Table 13: 120 minute plasterboard wall system FRL's

Service^	64 mm Steel Stud, two layers of 13 mm plasterboard each side	
	Installation details	FRL
PVC conduit** up to 40 mm	20 mm annular gap around the services, filled with FyrePEX™ sealant to the full depth of plasterboard on both side of the wall.	-/120/120
16 mm pipes Pex-A, Pex-B Pex-Al-Pex	25 mm opening, 25 x 50 FyreSHEATH (where the two halves of the FyreSHEATH are held together with a steel fixing to prevent radial expansion), filled to full depth with FyrePEX™ sealant.	-/120/120
	60 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant	-/120/120
20 mm pipes Pex-A, Pex-B Pex-Al-Pex	30 mm opening, 25 x 50 or 65 FyreSHEATH (where the two halves of the FyreSHEATH are held together with a steel fixing to prevent radial expansion), filled to full depth with FyrePEX™ sealant.	-/120/120
	60 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant	-/120/120
25 mm pipes Pex-A, Pex-B	65 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant	-/120/120
25 mm pipes Pex-Al-Pex	65 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet	-/120/120
Single FR A/C*	110 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant.	-/120/120
FR A/C*** bundle with/out TWrap	110 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant.	-/120/30
	110 mm opening, filled to full depth of plasterboard on each side with FyrePEX™ sealant additional 300 mm wide x 25 mm thick TWrap applied each side of the opening enclosing the bundles.	-/120/120
Single PE A/C*	110 mm opening filled to full depth of plasterboard on each side with FyrePEX™ sealant and finished with a 30 mm x 30 mm fillet.	-/120/90
	110 mm opening filled to full depth of plasterboard on each side with FyrePEX™ sealant with 300 mm of 25 mm thick TWrap blanket applied each side of the opening.	-/120/120
Cluster of up to three FR insulated A/C bundles*	Three 110 mm openings spaced minimum 50 mm apart, each with a single A/C bundle and filled to full depth of plasterboard on each side with FyrePEX™ sealant.	-/120/90
	Three 110 mm openings spaced minimum 50 mm apart, each with a single A/C bundle and filled to full depth of plasterboard on each side with FyrePEX™ sealant with additional 300 mm wide x 25 mm thick TWrap applied each side of the opening enclosing the bundles.	-/120/120
Copper or ferrous pipe up to 32 mm with 25 mm FR insulation	110 mm opening filled to full depth of plasterboard on each side with FyrePEX™ sealant and finished with a 10 mm x 10 mm fillet.	-/120/60
Copper or ferrous pipe up to 32 mm with 25 mm FR insulation	110 mm opening filled to full depth of plasterboard on each side with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side of the wall.	-/120/120
FyreSTRAP services****	5 mm oversize hole for each service FyreSTRAP secured to underside of concrete soffit/concrete slab. FyreSTRAP 40 mm high x up to 160 mm wide filled with 50 mm deep FyrePEX HP sealant on each face of the wall.	-/120/120

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* A/C Bundles can consist of copper pipes up to 20 mm diameter, plus up to 20 mm insulation thickness, with or without: Power cables up to 12 mm OD, data cables up to 6 mm OD and flexible or rigid drains up to 20 mm.

** Conduit may be empty or contain combinations of power cables up to 20 mm OD, 6 mm OD fibre optic cables or 5 mm OD CAT5 or CAT6 data cables. The conduit may be offset to touch the side of the aperture without prejudicing the fire resistance of the penetration.

*** Up to three copper pipes up to 22 mm diameter, plus 19 mm OD FR insulation, with or without 2.5mm^2 TPS power cable, CAT6 cable.

**** FyreSTRAP services may consist of a combination of the following cables; up to TPS 2.5mm^2 power cable, 16 mm^2 2C+E or 3C+E power cables, Cat6, RG6, up to 25 mm PVC conduit (with or without cables), 20 mm PEX or 20 mm PEX-AL-PEX.

^ Pipes may be up to 10 mm offset from centre without prejudicing the fire resistance.

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Table 14: 75 mm Hebel PowerPanel and Walsc Panel™ wall system FRL's

Service	75 mm Hebel PowerPanel & 75 mm Walsc Panel™ Wall	
	Installation details	FRL
PVC conduit** up to 40 mm dia.	20 mm annular gaps around the service filled to a depth of at least 60 mm from either side with FyrePEX™ sealant.	-/90/90
PVC conduit** up to 25 mm dia.	40 mm opening filed to full depth with FyrePEX sealant finished with a 25 mm x 25 mm fillet each side	-/90/90
16 mm pipes Pex-A, Pex-B Pex-Al-Pex	40 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant.	-/90/90
20 mm pipes Pex-A, Pex-B Pex-Al-Pex	50 - 60 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant.	-/90/90
20 mm pipes Pex-A, Pex-B Pex-Al-Pex	50 mm to 60 mm diameter opening, filled to the full depth with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/90/90
20 mm pipes Pex-A, Pex-B Pex-Al-Pex	33 mm diameter opening, fitted with a 25 mm deep by 50 mm or 60 mm diameter FyrePEX™ FyreSHEATH fixed to each side of the wall filled with FyrePEX™ sealant.	-/90/90
20 mm pipe Pex-A	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/90/90
25 mm pipes Pex-A, Pex-B	65 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant.	-/90/90
25 mm pipes Pex-Al-Pex	67 mm opening, filled to a depth of 25 mm from each side with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet.	-/90/90
Single FR A/C*	70 mm to 100 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant.	-/90/90
Double FR A/C*	100 to 120 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant, cables to be tucked between insulation for a minimum of 300 mm each side of the penetration.	-/90/90
Cluster of up to three FR A/C bundles	Three 110 mm openings spaced minimum 50 mm apart, each with a single A/C bundle and filled to full depth of wall on each side with FyrePEX™ sealant.	-/90/60
Cluster of up to three FR A/C bundles	Three 110 mm openings spaced minimum 50 mm apart, each with a single A/C bundle and filled to full depth of wall on each side with FyrePEX™ sealant, with the addition of 300 mm wide x 25 mm thick TWrap applied each side of the opening enclosing the bundles.	-/90/90
Single PE A/C*	70 mm to 100 mm opening filled to a depth of 60 mm from either side with FyrePEX™ sealant with 300 mm of 25 mm thick TWrap applied each side of the opening.	-/90/90
	120 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant.	-/90/60
Copper or ferrous pipe up to 32 mm with 25 mm FR insulation	110 mm opening filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 10 mm x 10 mm fillet.	-/90/60

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Table 14 Continued

Service^	75 mm Hebel PowerPanel & 75 mm Walsc Panel™ Wall	
	Installation details	FRL
Copper or ferrous pipe up to 32 mm with 20 mm FR insulation	110 mm opening filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side.	-/90/90
Al cable Up to 16 mm^2 up to 25 mm OD	50 mm opening filled to full depth of the panel wall with FyrePEX sealant finished with a 30 mm x 30 mm filled each side.	-/90/90
Al cables Up to 5x 630 mm^2 power + 120 mm^2 copper	120 mm opening with laminated 60 mm thick Maxilite panel filled to full depth (135 mm) with FyrePEX sealant.	-/90/90
Up to 15x Firesense 1.5 mm^2 TPS cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/90/90
Up to 15x CAT6 data cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/90/90
Up to 15x 2.5 mm^2 TPS cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side.	-/90/60
	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side with 300 mm of 25 mm thick TWrap applied each side of the wall.	-/90/90
Up to 8x 16 mm^2 3C + E TPS power cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side.	-/90/60
FyreSTRAP services***	5 mm oversize hole for each service FyreSTRAP secured to underside of concrete soffit/concrete slab. FyreSTRAP 40 mm high x up to 160 mm wide filled with 50 mm deep FyrePEX HP sealant on each face of the wall.	-/90/90

* A/C Bundles can consist of copper pipes up to 20 mm diameter, plus up to 20 mm insulation thickness, with or without: Power cables up to 12 mm OD, data cables up to 6 mm OD and flexible or rigid drains up to 20 mm.

** Conduit may be run empty or contain combinations of power cables up to 20 mm OD, 6 mm OD fibre optic cables or 5 mm OD CAT5 or CAT6 data cables The conduit may be offset to touch the side of the aperture without prejudicing the fire resistance of the penetration.

*** FyreSTRAP services may consist of a combination of the following cables; up to TPS 2.5mm^2 power cable, 16 mm^2 2C+E or 3C+E power cables, Cat6, RG6, up to 25 mm PVC conduit (with or without cables), 20 mm PEX or 20 mm PEX-AL-PEX.

^ Pipes may be up to 10 mm offset from centre without prejudicing the fire resistance.

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Table 15: 120 mm concrete floor/ceiling system FRL's

Service^	120 mm thick concrete slab	
	Installation details	FRL
16 mm pipes Pex-B Pex-Al-Pex	40 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant.	-/120/120
Single FR A/C*	70 mm to 100 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant.	-/120/120
Up to 25 mm conduit# with fibre cable	65 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant.	-/120/120
Double or triple FR A/C*	100 to 120 mm opening for double, 120 mm opening for triple, filled to 60 mm from either side with FyrePEX™ sealant.	-/120/120
Single PE A/C*	70 mm to 100 mm opening filled to a depth of 60 mm from either side with FyrePEX™ sealant with 300 mm of 25 mm thick TWrap blanket to be applied to the unexposed side of the opening.	-/120/120
Cluster of up to three FR A/C bundles	Three 110 mm openings spaced minimum 50 mm apart, each with a single A/C bundle and filled to full depth of floor/ceiling on each side with FyrePEX™ sealant.	-/120/90
	Three 110 mm openings spaced minimum 50 mm apart, each with a single A/C bundle and filled to full depth of floor/ceiling on each side with FyrePEX™ sealant with the addition of 300 mm wide x 25 mm thick TWrap applied each side of the opening enclosing the bundles.	-/120/120
150 mm thick concrete slab		
Al cable Up to 5x 240 mm^2	100 mm opening filled from the top face with 60 mm depth FyrePEX sealant finished with a 30 mm x 30 mm fillet with the addition of 300 mm wide x 25 mm thick TWrap applied to the top face enclosing the bundles.	-/180/120
Al cable Up to 5x 16 mm^2 or 1x 240 mm^2		-/180/180

* A/C Bundles can consist of copper pipes up to 20 mm diameter, plus up to 20 mm insulation thickness, with or without: Power cables up to 12 mm OD, data cables up to 6 mm OD and flexible or rigid drains up to 20 mm.

^ Pipes may be up to 10 mm offset from centre without prejudicing the fire resistance.

The conduit may be offset to touch the side of the aperture without prejudicing the fire resistance of the penetration

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Table 16: 78 mm SPEEDPANEL wall system FRL's

Service^	78 mm SPEEDPANEL wall system	
	Installation details	FRL
PVC conduit** up to 40 mm dia.	20 mm annular gaps around the service filled to a depth of 60 mm from either side with FyrePEX™ sealant.	-/120/120
25 mm PVC conduit# with fibre cable	40 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/120/90
16 mm pipes Pex-A, Pex-B	40 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant.	-/120/120
16 mm pipes Pex-Al-Pex	40 mm opening, filled to the full 78 mm depth of the wall with FyrePEX™ sealant and finished with a 10 mm x 10 mm fillet.	-/120/120
20 mm pipes Pex-A, Pex-B	50 - 60 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant and finished with a 10 mm x 10 mm fillet.	-/120/120
20 mm Pex-A pipe	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/120/90
20 mm pipes Pex-Al-Pex	50 - 60 mm opening, filled to the full 78 mm depth of the wall with FyrePEX™ sealant and finished with a 10 mm x 10 mm fillet.	-/120/120
	33 mm diameter opening, fitted with a 25 mm deep by 50 mm or 65 mm diameter FyrePEX™ FyreSHEATH fixed to each side of the wall filled with FyrePEX™ sealant.	-/120/60
Single FR A/C*	100 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant.	-/120/90
	70 mm to 100 mm opening, filled to a depth of 60 mm from either side with FyrePEX™ sealant with additional 300 mm wide x 25 mm thick TWrap applied each side of opening.	-/120/120
Cluster of up to three FR A/C bundles	Three 110 mm openings spaced minimum 50 mm apart, each with a single A/C bundle and filled to full depth of wall on each side with FyrePEX™ sealant. finished with a 30 mm x 30 mm fillet. Maximum of three penetrations per cluster.	-/120/90
Cluster of up to three FR A/C bundles	Three 110 mm openings spaced minimum 50 mm apart, each with a single A/C bundle and filled to full depth of wall on each side with FyrePEX™ sealant with additional 300 mm wide x 25 mm thick TWrap applied each side of the opening enclosing the bundles.	-/120/120
Single PE A/C*	100 mm opening, filled to 60 mm from either side with FyrePEX™ sealant.	-/120/60
	70 mm to 100 mm opening, filled to 60 mm from either side with FyrePEX™ sealant with additional 300 mm wide x 25 mm thick TWrap applied each side of the opening.	-/120/120
Copper or ferrous pipe up to 32 mm with 25 mm FR insulation	110 mm opening filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 10 mm x 10 mm fillet.	-/120/60
Copper or ferrous pipe up to 32 mm with 25 mm FR insulation	110 mm opening filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side of the wall.	-/120/120

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Table 16 Continued

Service^	78 mm SPEEDPANEL wall system	
	Installation details	FRL
Up to 15x Firesense 1.5 mm^2 TPS cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/120/90
Up to 15x CAT6 data cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/120/90
Up to 15x 2.5 mm^2 TPS cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side.	-/120/60
Up to 8x 16 mm^2 3C + E TPS power cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side.	-/120/60
FyreSTRAP services***	5 mm oversize hole for each service FyreSTRAP secured to underside of concrete soffit/concrete slab. FyreSTRAP 40 mm high x up to 160 mm wide filled with 50 mm deep FyrePEX HP sealant on each face of the wall.	-/120/120

* A/C Bundles can consist of copper pipes up to 20 mm diameter, plus up to 20 mm insulation thickness, with or without: Power cables up to 12 mm OD, data cables up to 6 mm OD and flexible or rigid drains up to 20 mm.

** Conduit may be run empty or contain combinations of power cables up to 20 mm OD, 6 mm OD fibre optic cables or 5 mm OD CAT5 or CAT6 data cables. The conduit may be offset to touch the side of the aperture without prejudicing the fire resistance of the penetration.

*** FyreSTRAP services may consist of a combination of the following cables; up to TPS 2.5mm^2 power cable, 16 mm^2 2C+E or 3C+E power cables, Cat6, RG6, up to 25 mm PVC conduit (with or without cables), 20 mm PEX or 20 mm PEX-AL-PEX.

^ Pipes may be up to 10 mm offset from centre without prejudicing the fire resistance.

The conduit may be offset to touch the side of the aperture without prejudicing the fire resistance of the penetration

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Table 17: 60 mm thick Pronto Panel™ wall system FRL's

Service^	60 mm Pronto Panel™ wall	
	Installation details	FRL
Up to 15x Firesense 1.5 mm^2 TPS cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/60/60
Up to 15x CAT6 data cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/60/60
Up to 15x 2.5 mm^2 TPS cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side.	-/60/60
Up to 8x 16 mm^2 3C + E TPS power cables	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 50 mm x 50 mm fillet each side.	-/60/60
25 mm PVC conduit with fibre cable	40 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side. #	-/60/60
Single FR A/C pair coil with 2x power cables	70 mm to 100 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/60/60
20 mm Pex-Al-Pex pipe	33 mm diameter opening, fitted with a 25 mm deep by 50 mm or 65 mm diameter FyrePEX™ FyreSHEATH fixed to each side of the wall filled with FyrePEX™ sealant.	-/60/60
20 mm Pex-A pipe	50 mm diameter opening, filled to the full depth of the panel wall with FyrePEX™ sealant finished with a 25 mm x 25 mm fillet each side.	-/60/60
FyreSTRAP services*	5 mm oversize hole for each service FyreSTRAP secured to underside of concrete soffit/concrete slab. FyreSTRAP 40 mm high x up to 160 mm wide filled with 50 mm deep FyrePEX HP sealant on each face of the wall.	-/60/60

* FyreSTRAP services may consist of a combination of the following cables; up to TPS 2.5mm^2 power cable, 16 mm^2 2C+E or 3C+E power cables, Cat6, RG6, up to 25 mm PVC conduit (with or without cables), 20 mm PEX or 20 mm PEX-AL-PEX.

The conduit may be offset to touch the side of the aperture without prejudicing the fire resistance of the penetration.

^ Pipes may be up to 10 mm offset from centre without prejudicing the fire resistance.

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Other System Configurations:

- It is considered the penetrations as tested in FTL FT1553.01, Specimen 4, consisting of a 16 mm^2 power cable, 25 mm PVC conduit and six CAT6 cables with a 50 mm Corex collar, FyreSTRAP and filled to full depth with FyrePEX HP sealant would be expected to maintain the FRL of the ceiling for 120/120/120 +RISF 60 if tested in accordance with AS 1530.4:2014.
- VRF cable may be used in place of TPS 2.5 mm^2 cable in the above FyreSHEATH, FyreSTRAP or FyrePEX HP systems and be expected to achieve the same fire performance.
- FyrePEX systems may be positioned nominally 40 mm apart without prejudice to the established fire resistance of the penetrations.

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PHOTOS

Photo 1: FP 6033 Specimen 4, FyreSHEATH forced open during test

Photo 2: FP 6202 Specimen 8, hinge and clasp FyreSHEATH intact following the test

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FIGURES

Figure 1: Installation in a single layer plasterboard wall

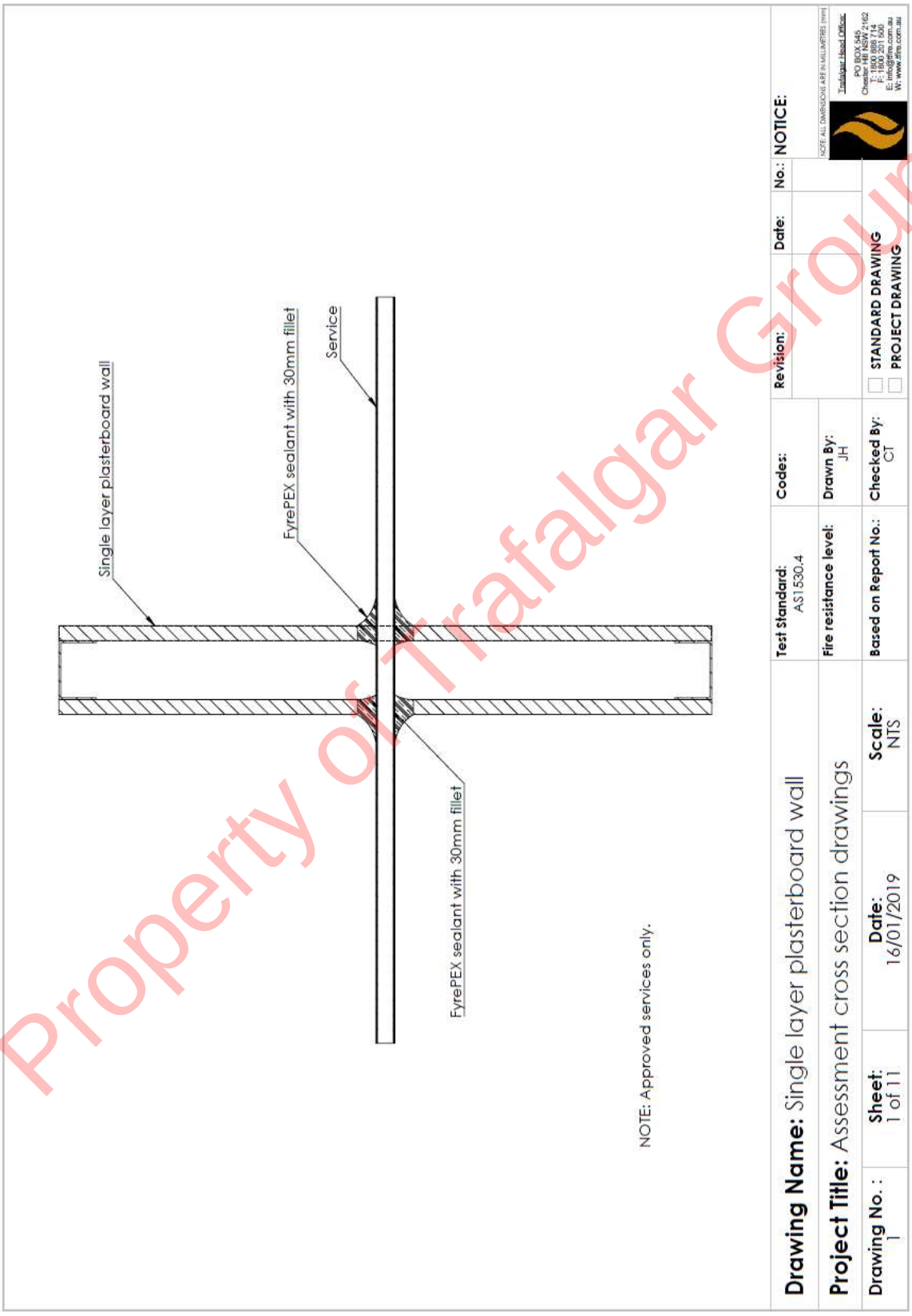

Figure 2: Installation in a double layer plasterboard wall

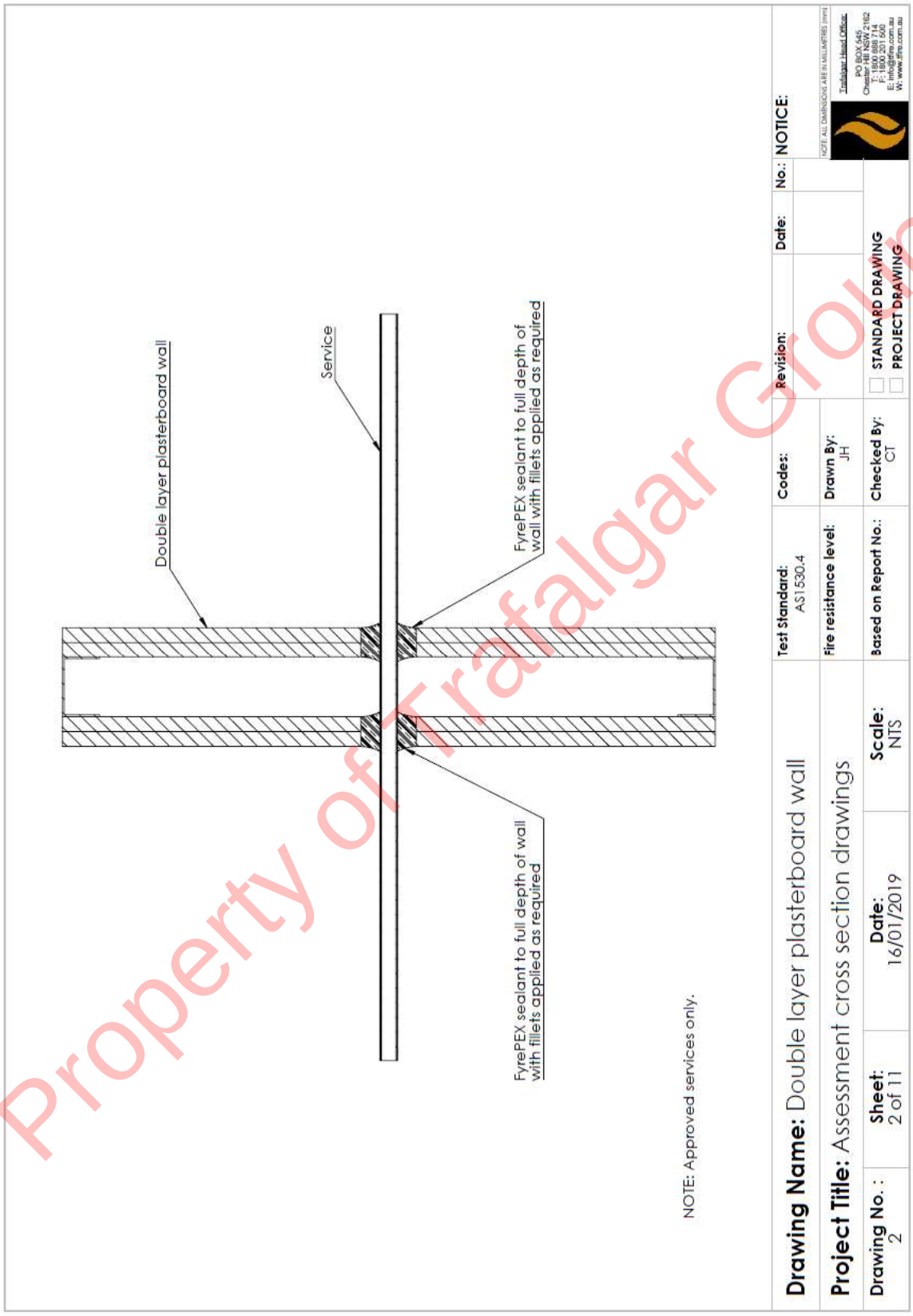

Figure 3: Installation in an ACC wall

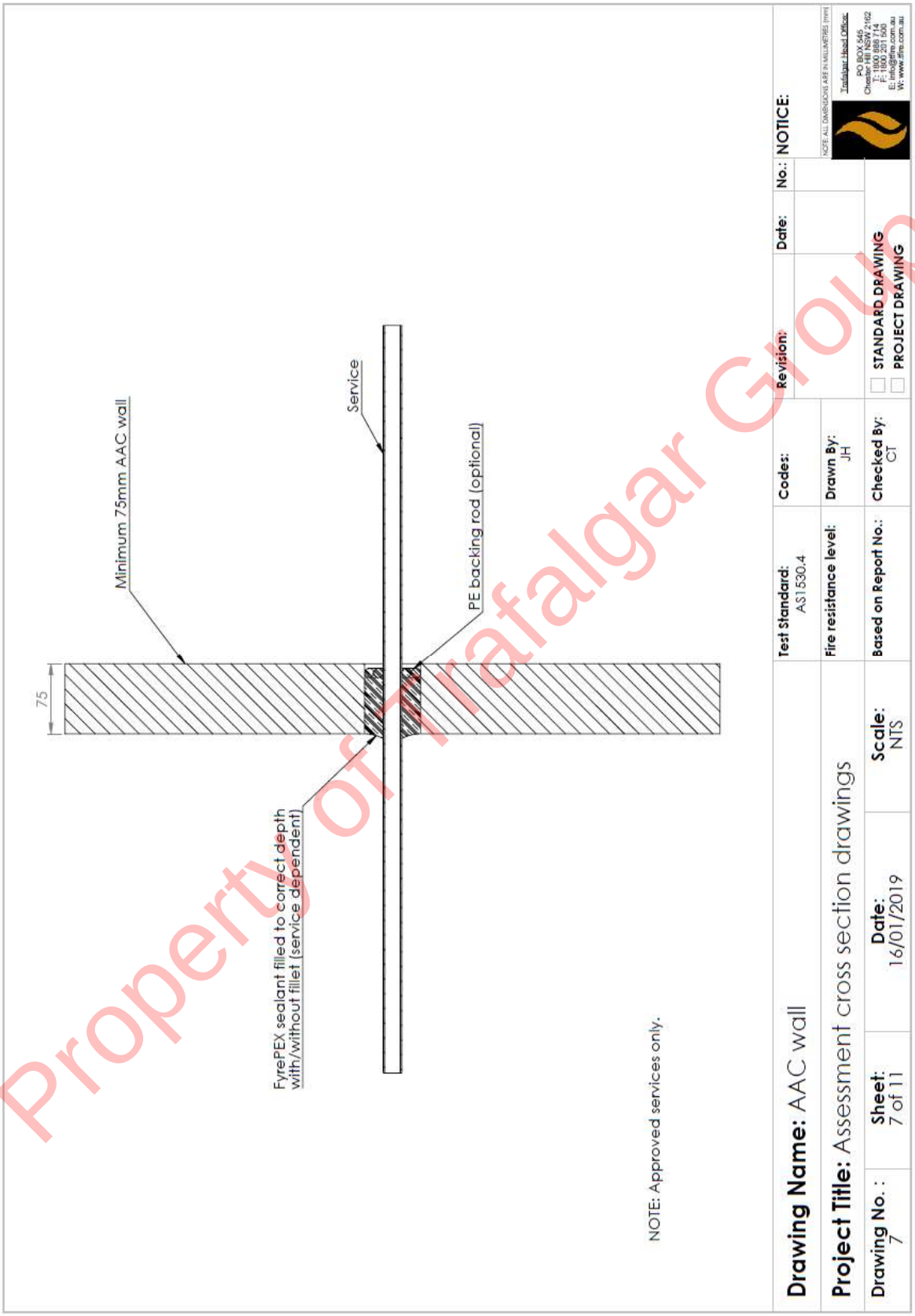

Figure 4: Installation in a SpeedPanel wall

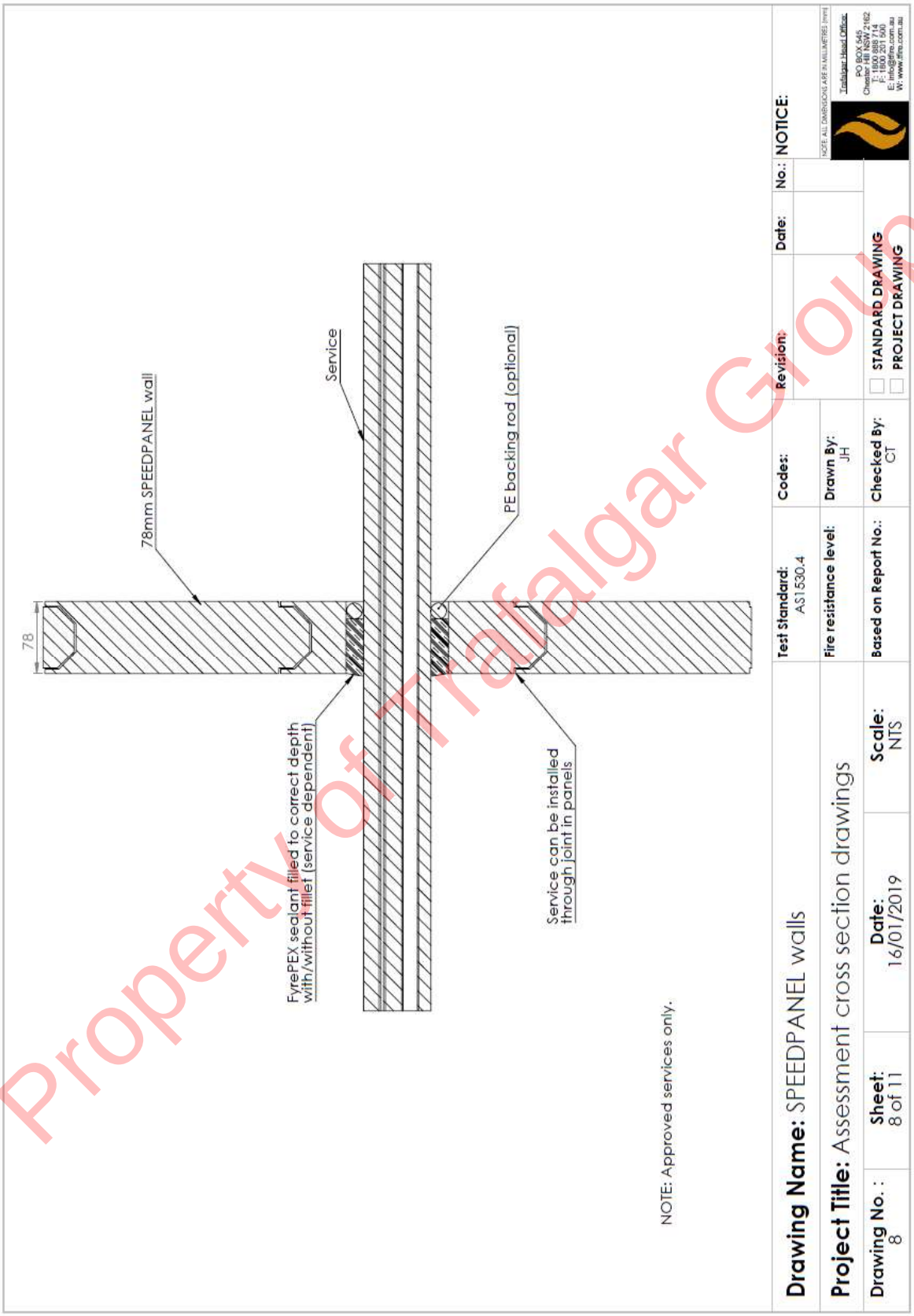

Figure 5: Installation in a concrete floor

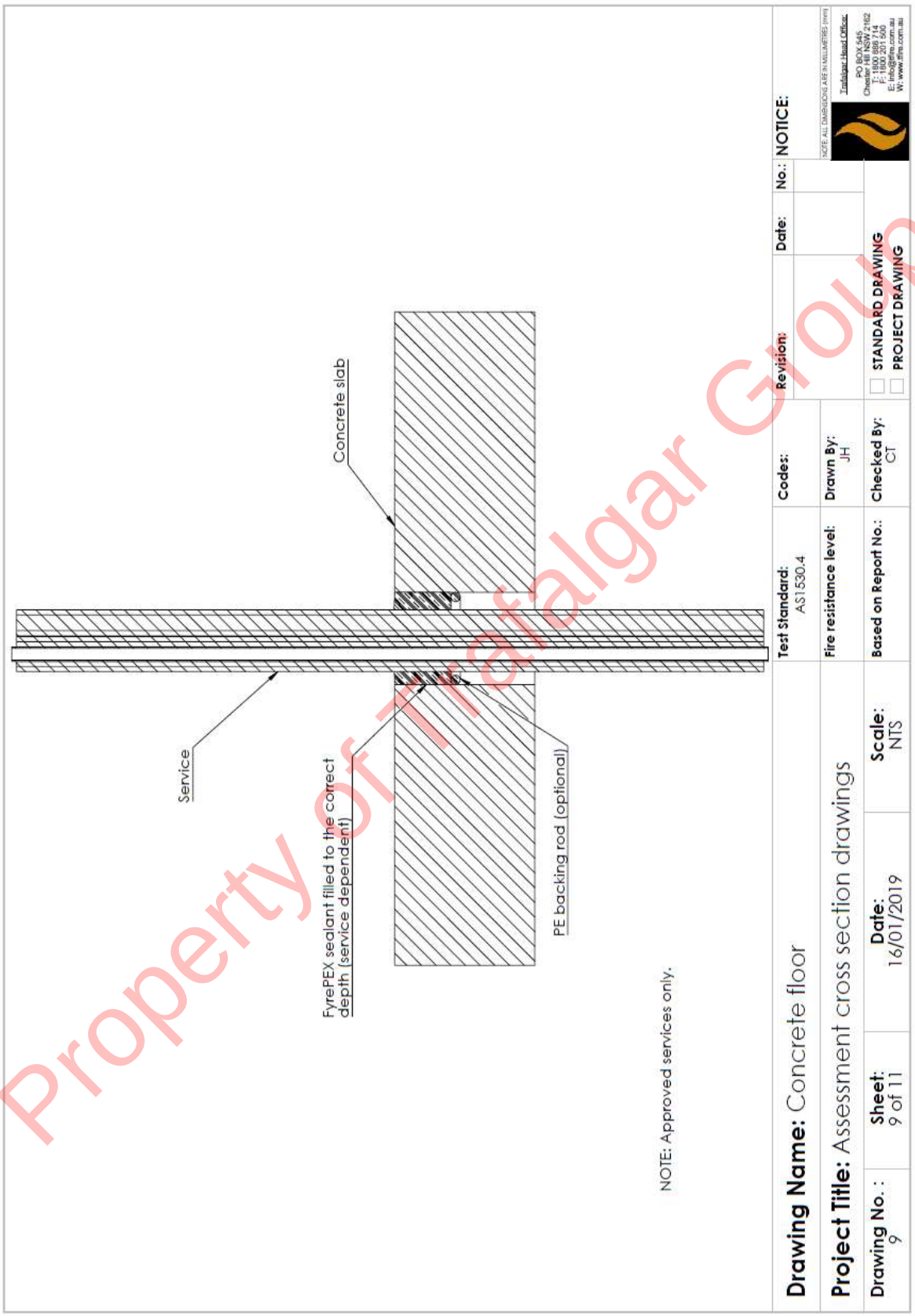

Figure 6: Installation in a concrete floor with TWrap

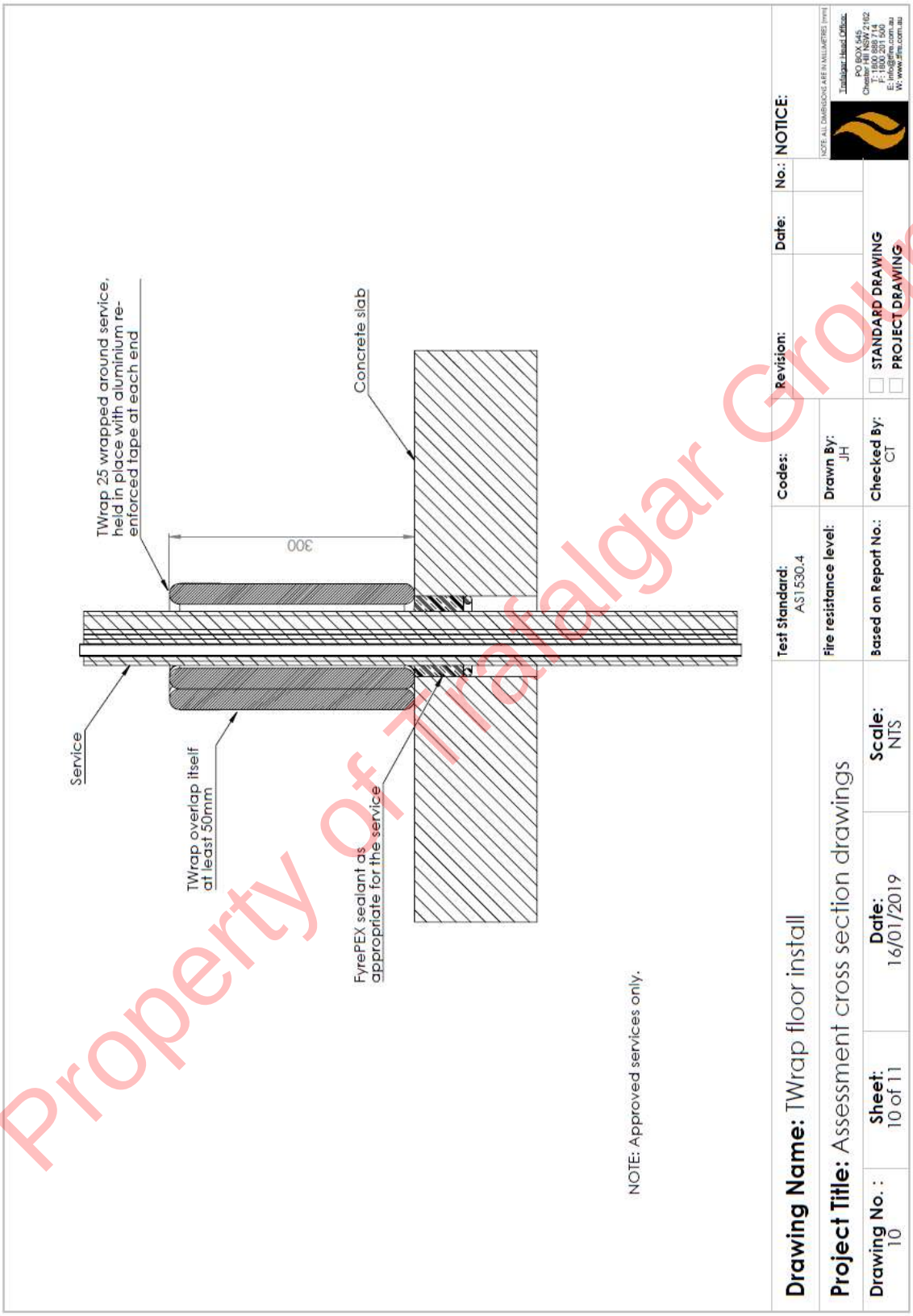

Figure 7: Installation in a wall with TWrap

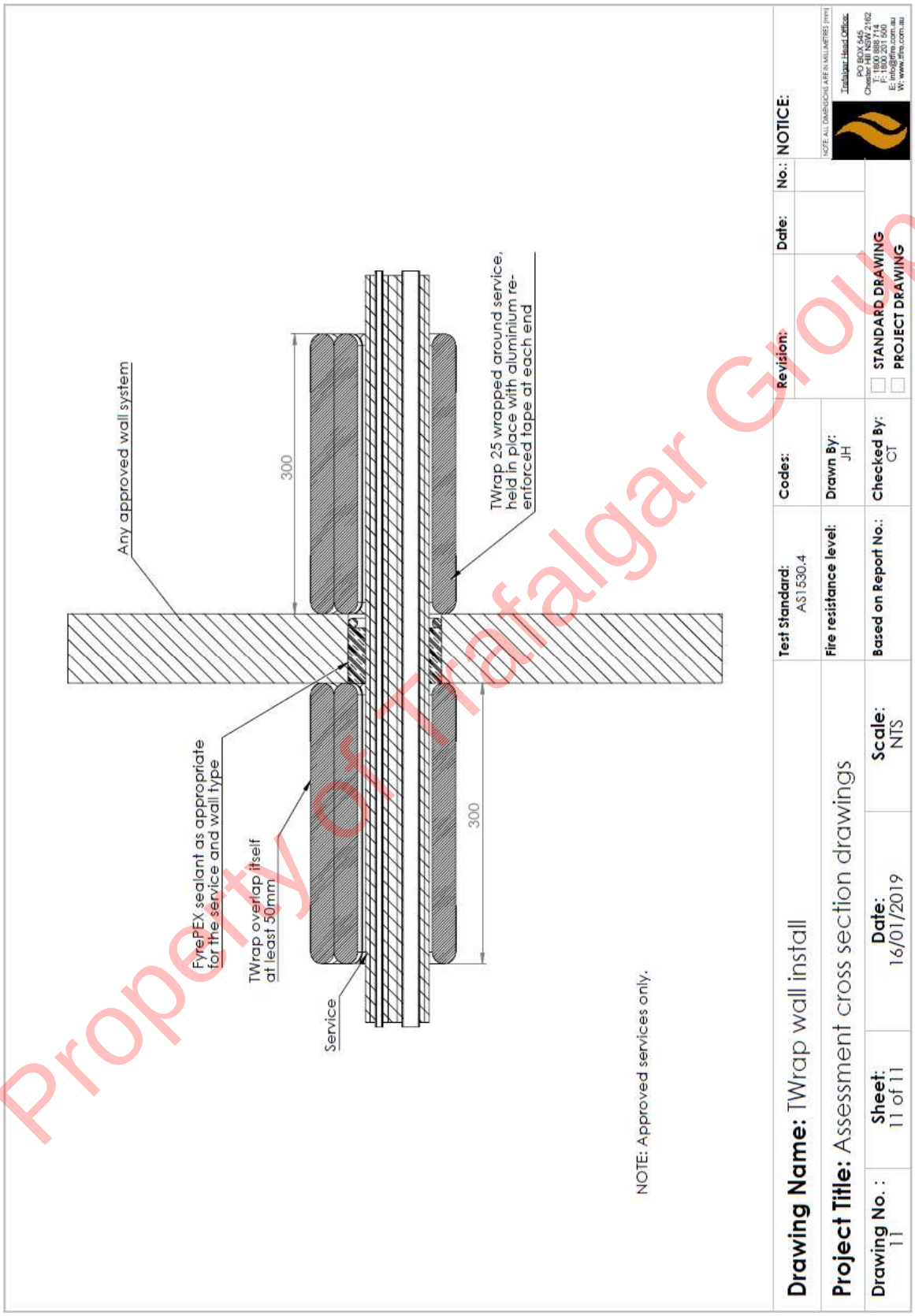

Figure 8: Installation in a thickened single layer plasterboard wall

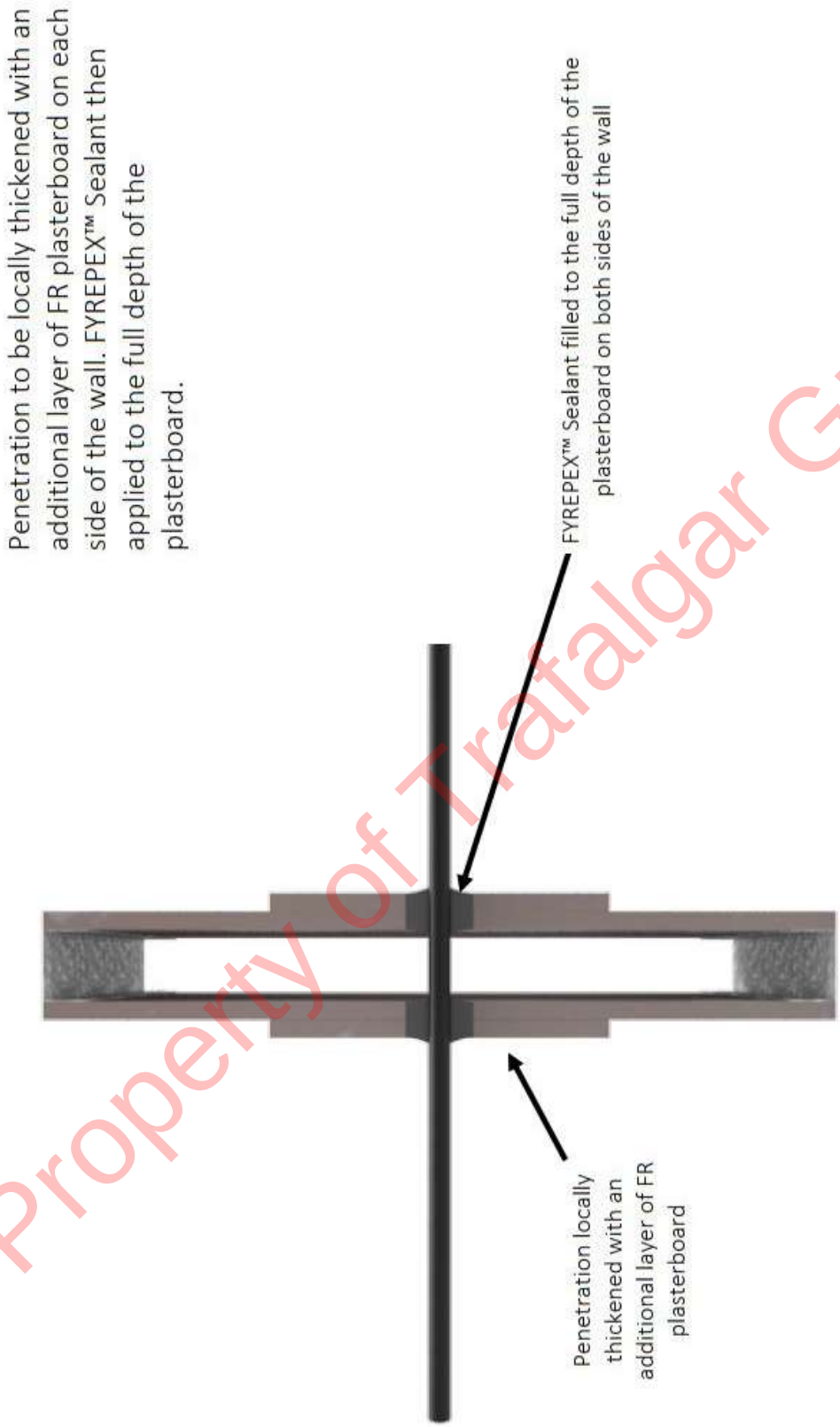

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Figure 9: FyreSTRAP System