

Fire resistance of SNAP Multiple Services Retrofit Collar (MS70R) when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 Admt. 1

Assessment Report

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1 Introduction

This report is an assessment of fire resistance of various SNAP Multiple Services Retrofit Collars (MS70R) when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 Admt. 1.

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

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

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

2 Supporting Data

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

Table 1: Reference test data

Report Reference	Test Standard	Outline of Test Specimen
FSP 1990	AS 1530.4 - 2014	A fire resistance testing of an 1160-mm x 1160-mm x 116-mm thick wall penetrated by two (2) pipes protected by retrofit fire collars.
FSP 1902	AS 1530.4 - 2014	A fire resistance testing of nine (9) retrofit Fire Collars protecting a steel framed plasterboard wall system.
FSP 2049	AS 1530.4 - 2014	A fire resistance testing of an 1150-mm x 1150-mm x 120-mm thick concrete slab penetrated by three (3) floor wastes and two (2) stack pipes with multiple services protected by three (3) cast-in and two (2) retrofit fire collars.
FSP 2058	AS 1530.4 - 2014	A fire resistance testing of an 1150-mm x 1150-mm x 75-mm thick Hebel PowerPanel wall penetrated by five (5) services protected by retrofit fire collars
FSP 2118	AS 1530.4 - 2014	A fire resistance testing of an 1150-mm x 1150-mm x 75-mm thick Hebel PowerPanel wall penetrated by six (6) services protected by retrofit Snap Fire Systems fire collars.
FSP 2120	AS 1530.4 - 2014	A fire resistance testing of an 1150-mm x 1150-mm x 90-mm thick plasterboard wall system penetrated by six (6) services protected by retrofit fire collars.
FSP 2126	AS 1530.4 - 2014	A fire resistance testing of an 1150-mm x 1150-mm x 116-mm thick plasterboard wall system penetrated by six (6) services protected by retrofit fire collars.
FSP 2135	AS 1530.4 - 2014	A fire resistance testing of an 1150-mm x 1150-mm x 150-mm thick concrete slab penetrated by 7 services protected with various SNAP fire collars.
FSP 2174	AS 1530.4 - 2014	A fire resistance testing of an 1150-mm x 1150-mm x 150-mm thick concrete slab penetrated by 7 services protected with various SNAP fire collars.
FSP 2188	AS 1530.4 - 2014	A fire resistance testing of a steel framed plasterboard wall system penetrated by 8 services protected with various SNAP fire collars.
FSP 2203	AS 1530.4 - 2014	A fire resistance testing of an 1150-mm x 1150-mm x 150-mm thick concrete slab penetrated by 6 services protected with various SNAP fire collars
FSP 2206	AS 1530.4 - 2014	A fire resistance testing of a steel framed plasterboard wall system penetrated by 9 services protected with various SNAP fire collars.
FSP 2216	AS 1530.4 - 2014	A fire resistance testing of a steel framed plasterboard wall system penetrated by 8 services protected with various SNAP fire collars.

Report Reference	Test Standard	Outline of Test Specimen
FSP 2213	AS 1530.4 - 2014	A fire resistance testing of an 1150-mm x 1150-mm x 150-mm thick concrete slab penetrated by various services protected with various SNAP fire collars.
FSP 2225	AS 1530.4 - 2014	A fire resistance testing of an 1150-mm x 1150-mm x 150-mm thick concrete slab penetrated by various services protected with various SNAP fire collars.
FSP 2231	AS 1530.4 - 2014	A fire resistance testing of an 1150-mm x 1150-mm x 150-mm thick concrete slab penetrated by various services protected with various SNAP fire collars.

The reports FSP 1990, FSP 1902, FSP 2049, FSP 2058, FSP 2118, FSP 2120, FSP 2126, FSP 2206, FSP 2213, FSP 2216, FSP 2188, FSP 2135, FSP 2174 FSP 2203, FSP 2225, FSP 2231 were undertaken by CSIRO North Ryde and sponsored by IG6 Pty Ltd.

3 Proposed Variations

3.1 MS70R collars in walls

The proposed construction shall be MS70R collars tested in Table 2, and subject to the following variations:

- The wall constructions tested shall vary from that tested to one of the following types as listed in Table 3.
- The service tested with MS70R collars in Table 2, may vary in any combination from the minimum to the maximum service sizes and collar fills as listed in Tables 4 and 5.
- Collars are fixed to substrates with the fixing shown in Table 6 below and as shown in Figures 1-5.
- The aperture to aperture spacing in the substrate shall be at least 40mm as shown in Figures 6 and 7.
- Inclusion of Snap Fire Seal FRAS sealant to fill gaps when cable and services are protected by MS70R collar without PVC conduits.
- The collar may include a mix of services from Tables 4 and 5.
- The services are sealed at the wall with sealants as listed in Table 7

Table 2: Referenced test data for penetrations in walls

Report	ID #	Collar Code	Element	Service	Details
FSP 1990	2	MS50R	2x13mm plasterboard sheets on each side of a 64mm steel stud	3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 4C+E round power cable and 20mm Pressure PVC	100% full
FSP 2049	4	MS70R	120mm concrete slab	3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 3C+E round power cable and 20mm Pressure PVC	100% full
FSP 2058	3	MS70R	75mm Hebel PowerPanel	3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 3C+E round power cable and 25mm Pressure PVC	100% full

Report	ID #	Collar Code	Element	Service	Details
FSP 2118	1	MS70R	75mm Hebel PowerPanel	50 PN6 PVC	Conduit Empty
	2	MS70R		50mm Medium Duty Conduit filled with 2x6mm ² 3C+E power cables 2x16mm ² 3C+E power cables	Conduit 100% full
	3	MS70R		20xCat5e	20% full
	4	MS70R		100xCat5	100% full
	5	MS70R		1in copper pipe with 19mm F/R lagging (Thermotec E-flex ST FRV) and 2.5mm ² 3C TPS flat power cable	100% full
	6	MS70R		3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	100% full
FSP 2120	1	MS70R	1x13mm plasterboard sheets on each side of a 64mm steel stud	1in copper pipe with 19mm F/R lagging (Thermotec E-flex ST FRV E-flex) and 2.5mm ² 3C TPS flat power cable	100% full
	2	MS70R		50mm Medium Duty Conduit filled with 2x16mm ² 3C+E power cables 2x6mm ² 3C+E power cables	Conduit 100% full
	3	MS70R		20xCat5	20% full
	4	MS70R		100xCat5	100% full
	5	MS70R		3/8in & 3/4in copper pair coil lagged in 9mm non-F/R lagging, 2.5mm ² 3C+E round power cable and 25mm Pressure PVC	100% full
	6	MS70R		3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	100% full
FSP 2126	1	MS70R	2x13mm plasterboard sheets on each side of a 64mm steel stud	1 inch copper pipe with 19mm F/R lagging (Thermotec E-flex ST FRV) and 2.5mm ² 3C TPS flat power cable	100% full
	2	MS70R		50mm Medium Duty Conduit filled with 2x16mm ² 3C+E power cables 2x6mm ² 3C+E power cables	Conduit 100% full
	3	MS70R		20xCat5	20% full
	4	MS70R		100xCat5	100% full
	5	MS70R		3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 3C+E round power cable and 25mm Pressure PVC	100% full
	6	MS70R		3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	100% full

Report	ID #	Collar Code	Element	Service	Details
FSP 2206	7	MS70R	2x13mm plasterboard sheets on each side of a 64mm steel stud	1inch (25.36mm OD x 1.27mm) copper pipe with 25mm thick foil faced Sekisui foam lagging (Thermobreak tube) through 75mm diameter cut out	100% full
	9	MS70R		32mm (42.2mm OD x 2.57mm) PN12 PVC Pipe with 19mm F/R lagging (Armaflex FRV nitrile rubber) through 70mm diameter cut out	100% full
FSP 2216	2	MS70R	1x13mm plasterboard sheets on each side of a 64mm steel stud	32mm (43.2mm OD x 2.2mm) PN12 PVC Pipe with 19mm F/R lagging (Armaflex FRV nitrile rubber) through 70mm cut out	100% full
FSP 2188	2	MS70R		1in (25mm OD x 1.34mm) copper pipe with 25mm thick foil faced Sekisui foam lagging (Thermobreak tube)	100% full

Table 3: Separating elements

Wall ID	Separating elements	Minimum wall thickness (mm)	Required separating element FRL
1	13mm fire rated plasterboard sheet on each side of a 64mm steel stud	90	-/60/60
2	Minimum 90mm Concrete and Masonry Wall	90	-/60/60
3	16mm fire rated plasterboard sheet on each side of a 64mm steel stud	96	-/90/90
4	10mm FireCrunch board on each side of a 90mm steel stud + Rockwool insulation (as tested)	110	-/90/90
5	2 x 7.5mm Multiboard board on each side of a 90mm steel stud	120	-/90/90
6	Minimum 75mm Hebel PowerPanel 90min wall	75	-/90/90
7	2x13mm fire rated plasterboard sheets on each side of a 64mm steel stud	116	-/120/120
8	Minimum 75mm Hebel PowerPanel 120min wall	75	-/120/120
9	Minimum 78mm SpeedPanel Wall with 13mm plasterboard patch on each side	78	-/120/120
10	Minimum 116mm Concrete and Masonry Wall	116	-/120/120
11	2x16mm fire rated plasterboard sheets on each side of a 64mm steel stud	128	-/180/180

Table 4 – Lagged pipe details

Service	Detail		Sealant (Table 7)
	Pipe size	Lagging	
Copper Pair Coil	Min. ¼ inch & 3/8 inch	9mm PE foam lagging or 9mm Thermotec E-flex ST FRV lagging or 25mm foil faced Sekisui lagging (Thermobreak tube) with vertical joints taped and then two turns of radial tapes at 100mm centres	In the annular gap between the wall aperture and services to a minimum depth of 10mm and finished off flush with the wall prior to the fitting of the collar.
	Max. 3/8 inch & ¾ inch	15mm PE foam lagging or 25mm Thermotec E-flex ST FRV lagging or 25mm foil faced Sekisui lagging (Thermobreak tube) with vertical joints taped and then two turns of radial tapes at 100mm centres	
Lagged Copper & Steel Pipes	Pipe size	Lagging	
	¼ inch	9mm PE foam lagging or 9mm Thermotec E-flex ST FRV lagging or 25mm foil faced Sekisui lagging (Thermobreak tube) with vertical joints taped and then two turns of radial tapes at 100mm centres	Optional
	¾ inch	15mm PE foam lagging or 25mm Thermotec E-flex ST FRV lagging or 25mm foil faced Sekisui lagging (Thermobreak tube) with vertical joints taped and then two turns of radial tapes at 100mm centres and then two turns of radial tapes at 100mm centres	
	1 inch	19 - 25mm Thermotec E-flex ST FRV lagging or 25mm foil faced Sekisui lagging (Thermobreak tube) with vertical joints taped and then two turns of radial tapes at 100mm centres	
PN12 PVC Pipe	Max. 32mm (43.2mm OD x 2.2mm)	19 - 25mm Armaflex FRV nitrile rubber lagging or 25mm foil faced Sekisui lagging (Thermobreak tube) with vertical joints taped and then two turns of radial tapes at 100mm centres	Optional
Mix services	various	various	In the annular gap between the wall aperture and services to a minimum depth of 10mm and finished off flush with the wall prior to the fitting of the collar.

Table 5: Conduit and Cable details

Service	Detail	Sealant (Table 7)
PVC Conduit (Light to Medium Duty) (Conduit Wall Thickness 1.6mm to 2.85mm)	20mm – 50mm PVC conduit (PVC conduit empty to full of data and communication cables as well as power cables as shown below)	Optional
Data and Comms Cables Cat5e, Cat6, Cat 7, RG6	Collar empty to collar 100% full Up to 100 Cat5e, Cat6 and RG6 cables Up to 100 Cat7 cables	Optional
Fibre optic cables (12F NBN Optical Fibre Cables)	Collar empty to collar 100% full	Optional
Power Cables (Up to 16mm ² 3C+E Cables)	Collar empty to collar 100% full	In the annular gap between the wall aperture and services to a minimum depth of 10mm and finished off flush with the wall prior to the fitting of the collar.
Mix services	various	In the annular gap between the wall aperture and services to a minimum depth of 10mm and finished off flush with the wall prior to the fitting of the collar.

Table 6: Collar to wall fixing fixings for each wall type

Element	Fixing (minimum size)
13mm and 16mm Plasterboard lined wall	M4 Expandable Steel Anchors
10mm and greater FIRECRUNCH and Multiboard Board lined Wall	M4 Expandable Steel Anchors
75mm Hebel PowerPanel Wall	14-10 65mm Hex Head Screws
78mm SpeedPanel Wall	14-10 65mm Hex Head Screws
Concrete or Masonry Wall	5mm x 30mm Concrete Screw Bolts

Table 7: Sealant at the wall

Product	Detail
Snap Fire Seal FRAS (Fire Rated Acoustic Sealant)	Install around the perimeter of the service at the wall junctions where shown in Figures 1-10

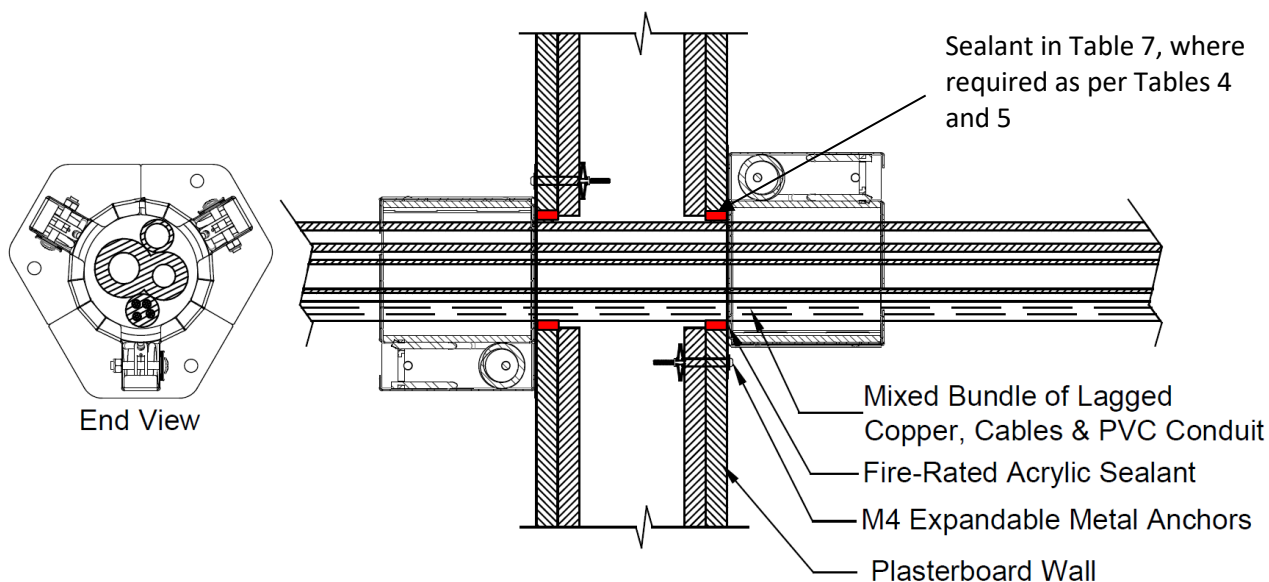


Figure 1: Plasterboard, FIRECRUNCH and Multiboard lined wall with collar

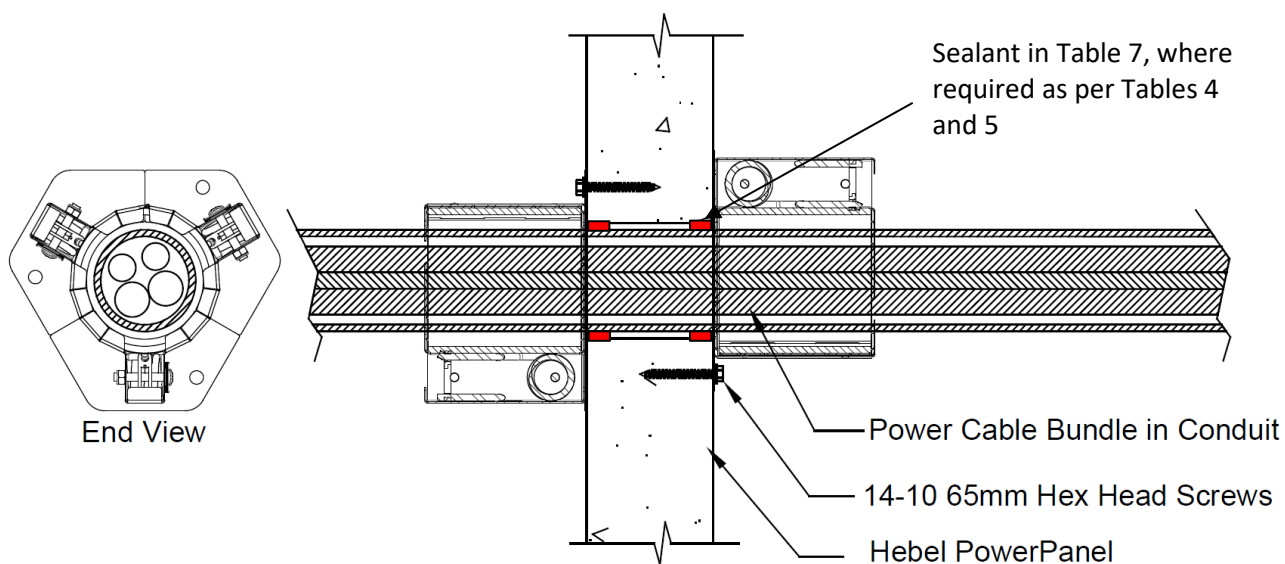


Figure 2: Hebel PowerPanel wall with collar

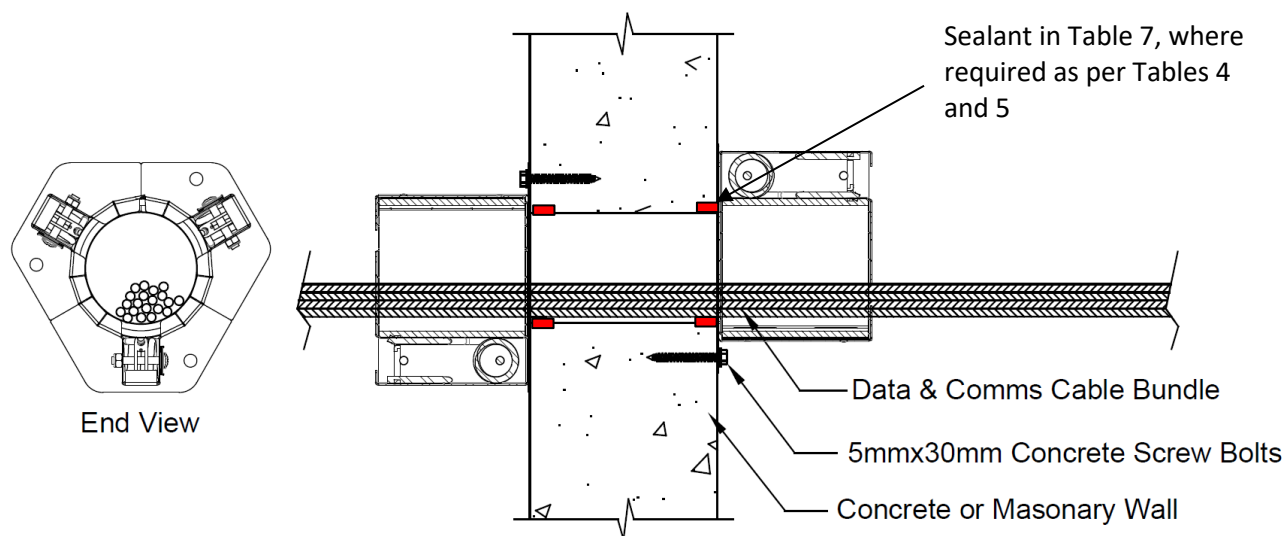


Figure 3: Concrete or Masonry wall with collar

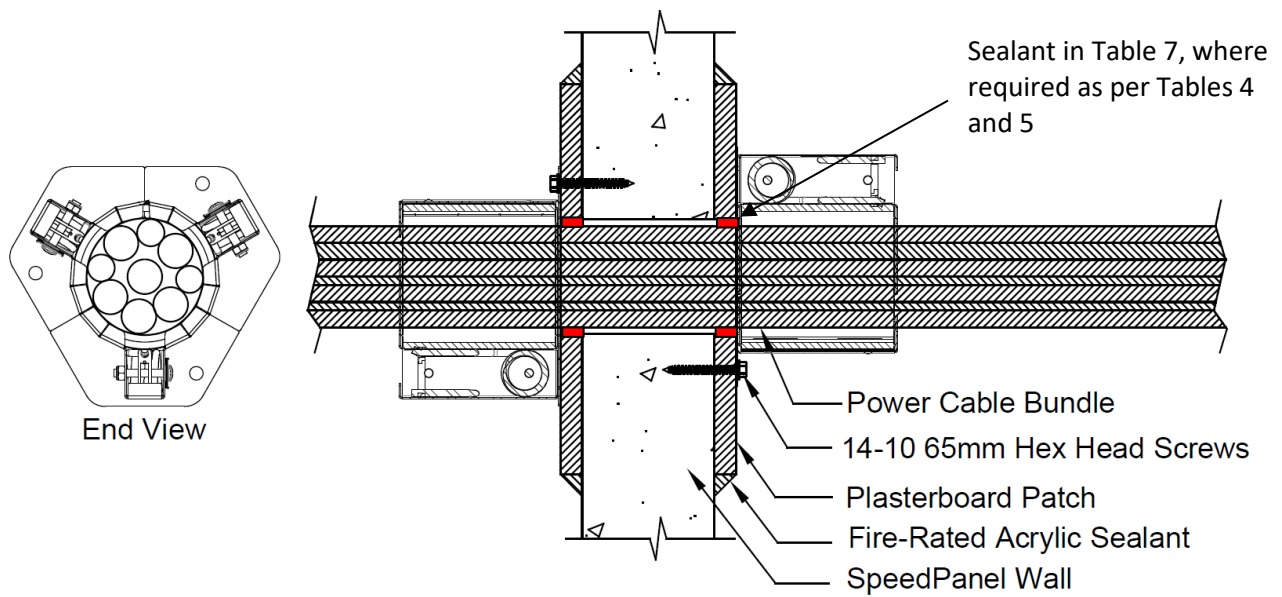


Figure 4: SpeedPanel Wall with collar

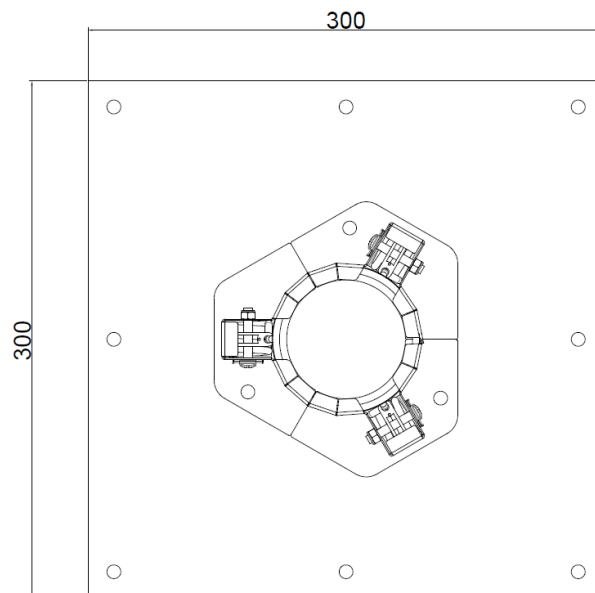


Figure 5: 13mm Fire grade plasterboard patch for SpeedPanel walls

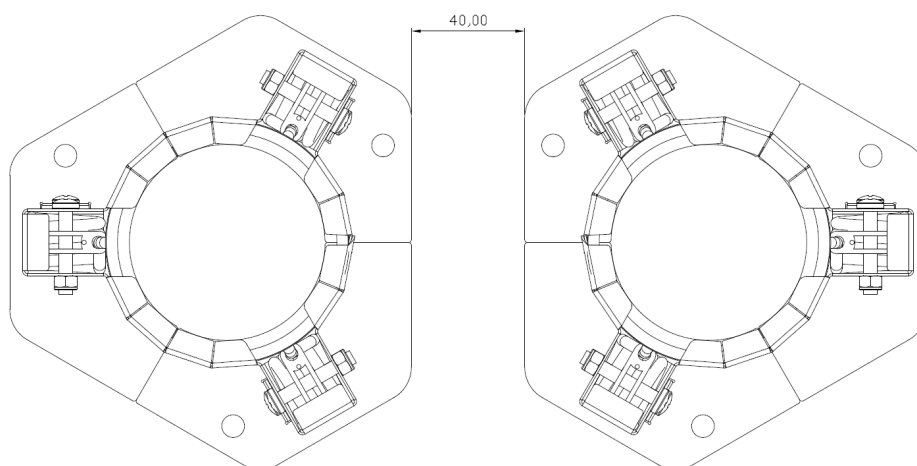


Figure 6: Collars when spaced 40mm apart

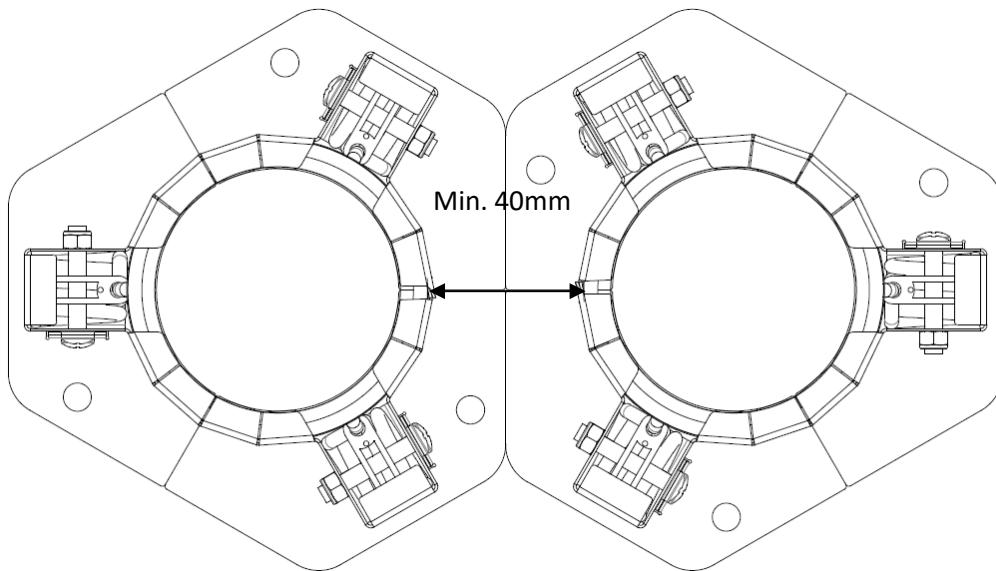


Figure 7: Collars when side by side

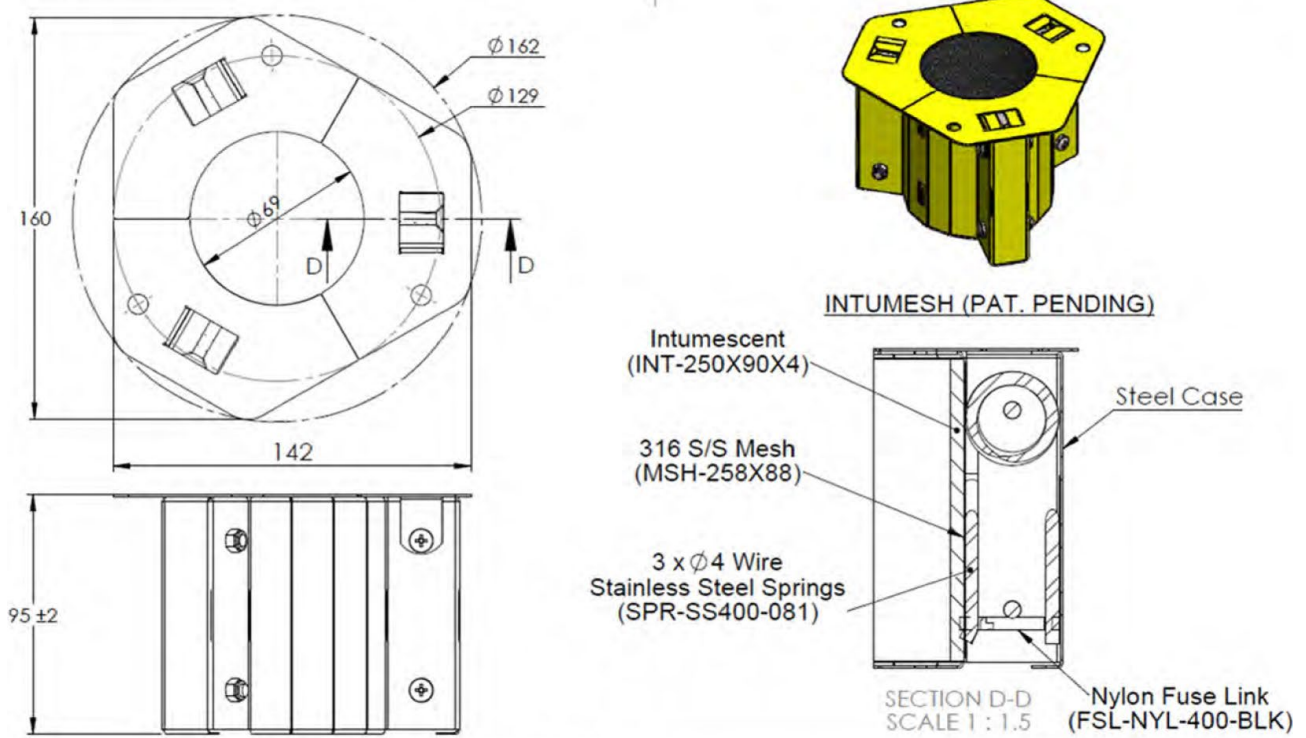


Figure 8: MS70R collar

3.2 MS70R collars in slabs

The proposed construction shall be MS70R collars tested in Table 8, and subject to the following variations:

- The services tested with MS70R collars in Table 8, may vary as listed in Tables 9 - 10
- Collars are fixed to the substrate as shown in Table 11 with the fixing shown in Table 12
- Collars may be positioned 40mm apart when installed on the separating element

Table 8: Referenced test data for penetrations in slabs

Report	Pen. #	Collar Code	Element	Service	Details
FSP 2135	1	MS70R + SNAP H50S blank cast-in collar	150mm Concrete Slab	60mm OD Medium Duty Conduit(continuous) filled with 2x6mm ² 3C+E power cables 2x16mm ² 3C+E power cables	100% full
	2	MS70R		Cat5 (approx. 100)	100% full
	3	MS70R		Cat5e (approx. 20)	20% full in 70mm diameter aperture A bead of sealant which the manufacturer has stated to be the identical to Snap Fire Seal FRAS filled large gap 6mm deep bead of sealant on 22mm diameter PE backing rod
	4	MS70R + SNAP H50S blank cast-in collar		60mm OD PN6 PVC Pipe	100% full
FSP 2174	5	MS70R	150mm Concrete Slab	60mm OD PVC Conduit (100mm above and below the slab) filled with 3x6mm ² 3C+E power cables 3x16mm ² 3C+E power cables	100% full
FSP 2049	4	MS70R	120mm Concrete Slab	3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 4C+E round power cable and 20mm PN12 Pressure PVC	A bead of sealant which the manufacturer has stated to be the identical to Snap Fire Seal FRAS
FSP 2203	5	MS70R	150mm Concrete Slab	20 x 11mm and 10 x 6mm diameter Garland Optical Fibre cable	100% full
FSP 2225	2	MS70R	150mm Concrete Slab	32mm PN12 uPVC pipe(42.3-mm OD x 2.6mm) with 19-mm thick Armaflex FRV nitrile rubber lagging	
FSP 2225	4	MS70R	150mm Concrete Slab	DN 25 (Type B 25.4mm OD x 1.22mm) copper pipe with 19-mm thick E-Flex ST Nitrile Foam lagging and a 2.5-mm ² 3-core TPS power cable	

Report	Pen. #	Collar Code	Element	Service	Details
FSP 2225	5	MS70R	150mm Concrete Slab	DN 25 (Type B 25.4mm OD x 1.22mm) copper pipe with 19-mm thick Armaflex FRV nitrile rubber lagging and a 2.5-mm ² 3-core TPS cable	
FSP 2225	6	MS70R	150mm Concrete Slab	Bundle of 60 Category 7 network cables	
FSP 2231	2	MS70R	150mm Concrete Slab	DN 25 (Type B 25.4mm OD x 1.22mm) copper pipe with 19 mm thick SuperMax foam lagging and a 2.5-mm ² 3-core TPS power cable	A bead of sealant which the manufacturer has stated to be the identical to Snap Fire Seal FRAS
FSP 2231	5	MS70R	150mm Concrete Slab	DN 25 (Type B 25.4mm OD x 1.22mm) copper pipe with 19 mm thick K-Flex ST Foam lagging and a 2.5-mm ² 3-core TPS power cable	67 mm diameter aperture A bead of sealant which the manufacturer has stated to be the identical to Snap Fire Seal FRAS
FSP 2231	6	MS70R	150mm Concrete Slab	DN20 (Type B 19.5mm OD x 1.02mm) copper pipe with 9 mm thick Armaflex FRV nitrile rubber lagging and a 2.5-mm ² 3-core TPS power cable	67 mm diameter aperture 10mm deep sealant which the manufacturer has stated to be the identical to Snap Fire Seal FRAS
FSP 2135	5	MS70R	150mm Concrete Slab	3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	A bead of sealant which the manufacturer has stated to be the identical to Snap Fire Seal FRAS
FSP2174	3	MS70R	150mm Concrete Slab	65mm PVC Pipe (100mm above slab) (2.62mm) filled with 1in copper pipe(1.4mm) with 19mm F/R lagging (F/R ArmaFlex) and a 2.5mm ² 3C TPC Cable	PVC 100mm above slab
FSP2174	4	MS70R	150mm Concrete Slab	1in copper pipe(1.4mm) with 19mm F/R lagging (F/R ArmaFlex) and a 2.5mm ² 3C TPC Cable	100% full
FSP2203	4	MS70R	150mm Concrete Slab	1in copper pipe with 25mm Foil Faced Sekisui lagging	100% full

Table 9: Conduit and Cable details

Service	Min - Max	Details
PVC Conduit Light to Medium Duty Conduit Wall Thickness 1.6mm to 3mm	20mm – 50mm PVC conduit (empty)	Sealant Optional
PVC Conduit 100mm above and below the slab Light to Medium Duty Conduit Wall Thickness 1.6mm to 3mm	20mm – 50mm PVC conduit (empty to full of power cables, data and comms cables and fibre optics)	Sealant Optional
Data and Comms Cables Cat5e	Up to 100 Cables in the collar or in PVC conduit	When gap $\leq 5\text{mm}$: sealant optional When gap 5-10mm: Snap Fire Seal FRAS to fill gaps to a minimum depth of 10mm depth and finished off flush with the slab
Data and Comms Cables Cat6, Cat 7, RG-6	Up to 60 Cables in the collar or in PVC conduit	When gap $\leq 5\text{mm}$: sealant optional When gap 5-10mm: Snap Fire Seal FRAS to fill gaps to a minimum depth of 10mm depth and finished off flush with the slab
Fibre Optic Cables As tested in FSP 2203 Specimen 5	20 x 11mm and 10 x 6mm diameter Garland Optical Fibre cable in the collar or in PVC conduit	When gap $\leq 5\text{mm}$: sealant optional When gap 5-10mm: Snap Fire Seal FRAS to fill gaps to a minimum depth of 10mm depth and finished off flush with the slab
Power Cables	Up to 3 of 6mm ² 3C+E Cables and Up to 6 of 16mm ² 3C+E	When gap $\leq 5\text{mm}$: sealant optional When gap 5-10mm: Snap Fire Seal FRAS to fill gaps to a minimum depth of 10mm depth and finished off flush with the slab
Power Cables in PVC Conduit	Up to 3 of 6mm ² 3C+E Cables and Up to 3 of 16mm ² 3C+E	Sealant Optional
Mix services	Various cables in the collar or in PVC conduit	When gap $\leq 5\text{mm}$: sealant optional When gap 5-10mm: Snap Fire Seal FRAS to fill gaps to a minimum depth of 10mm depth and finished off flush with the slab

Table 10 – Lagged pipe services

FR Lagging	Lagging Thickness	Services	Gap treatment
K Flex ST Nitrile Foam lagging or Thermotec E- Flex Nitrile Foam lagging or SuperMax F/R lagging or Armaflex FRV nitrile rubber lagging	9mm-25mm	Copper paircoil installation One up to 25mm PVC pipe, one 2.5-mm ² 3-core TPS power cable and two copper pipes of either ¼ inch & 3/8 inch or 3/8 inch & ¾ inch	In 5-10mm, an annular gap between the collar and services to a minimum depth of 10mm and finished off flush with the slab
		Small lagged copper/steel pipe ¼ inch to ¾ inch	
	19mm-25mm	Large lagged copper/steel pipe Up to 1 inch (max. 1.22mm thick wall)	Sealant Optional
Foil Faced Sekisui foam Lagging (Thermobreak tube) with vertical joints taped and then two turns of radial tapes at 100mm centres	25mm	Copper paircoil installation One up to 25mm PVC pipe, one 2.5-mm ² 3-core TPS power cable and two copper pipes of either ¼ inch & 3/8 inch or 3/8 inch & ¾ inch	In 5-10mm, an annular gap between the collar and services to a minimum depth of 10mm and finished off flush with the slab
		Small lagged copper/steel pipe ¼ inch to ¾ inch	
		Large lagged copper/steel pipe Up to 1 inch (max. 1.22mm thick wall)	Sealant Optional
		16-32mm PN12 PVC	Sealant Optional
		16-32mm lagged PN12 PVC pipes	Sealant Optional

Table 11: Separating elements

Elements	Applications
Minimum 150mm thick slab in accordance with 3600 - 2018	180 minutes
Minimum 175mm thick slab in accordance with 3600 - 2018	240 minutes

Table 12: Fixings for MS70R into slabs

Elements	Fixing options
Concrete slabs	5mmx30mm Concrete Screw Bolts
	5mm x 32mm Mushroom Head Spike
	6.5mm x 40mm Steel Sleeve Anchor
	6mm x 40mm Steel Wedge Anchor

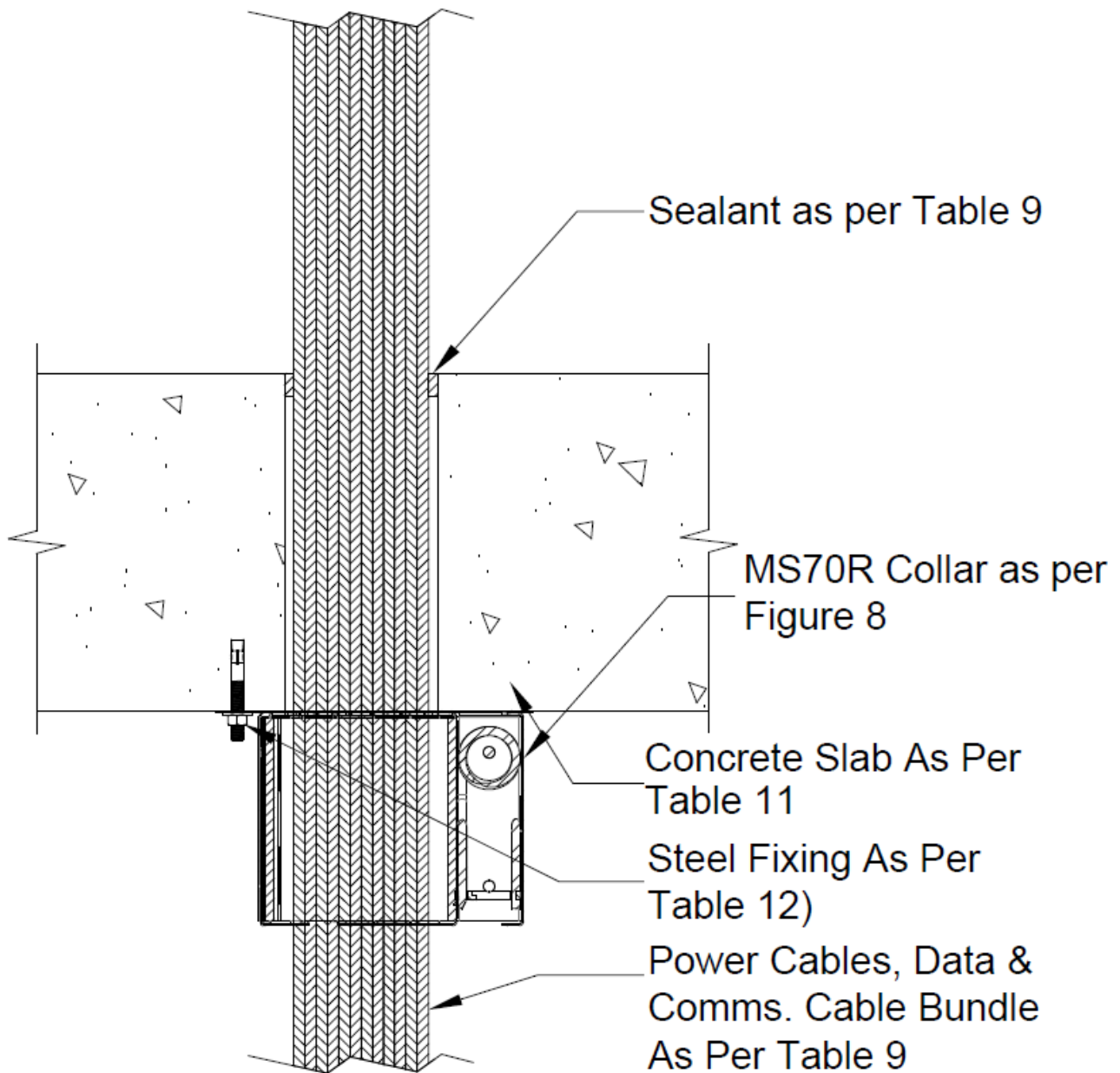


Figure 9: Cable services in slabs

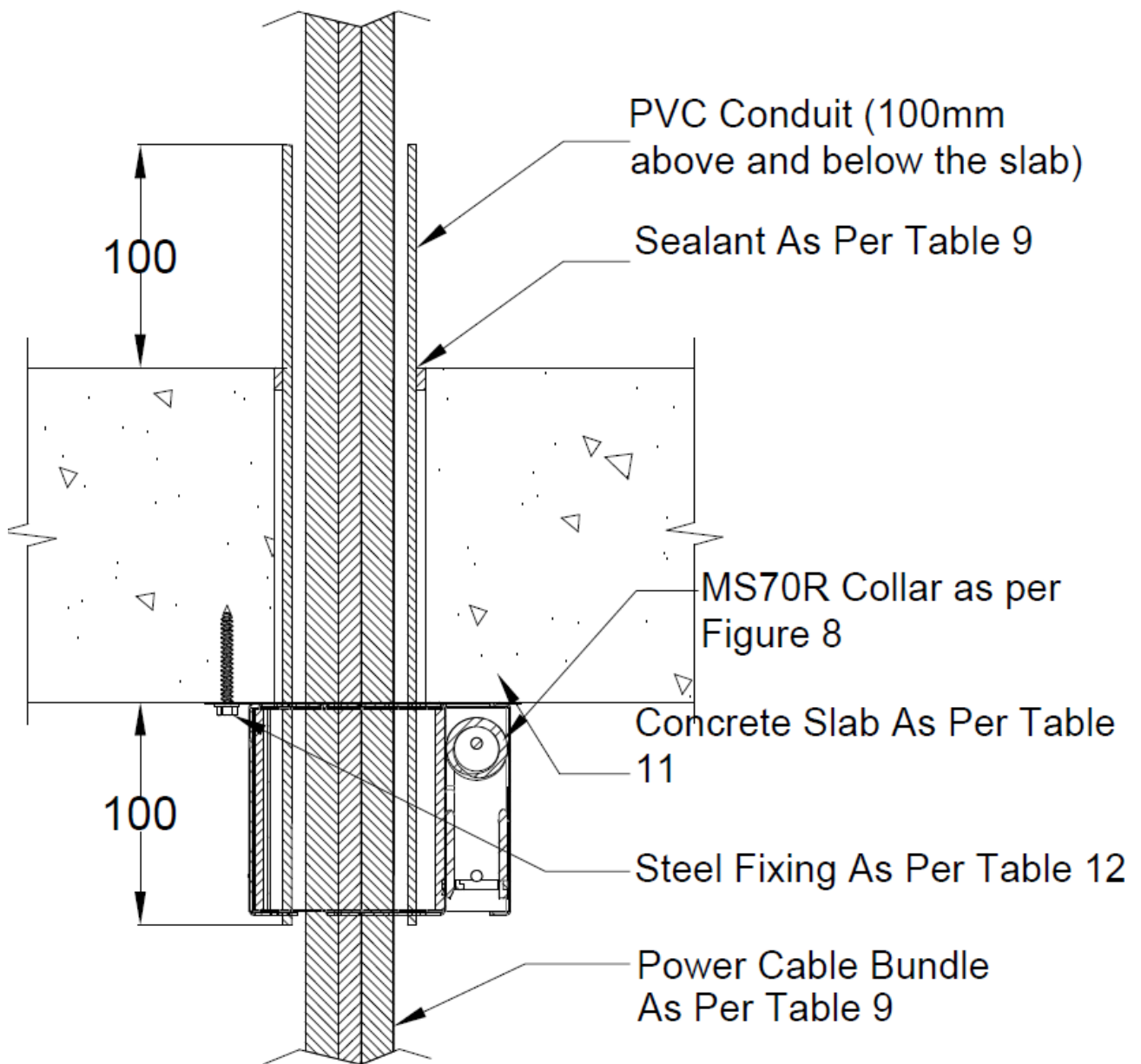


Figure 10: PVC conduit filled cable services in slabs

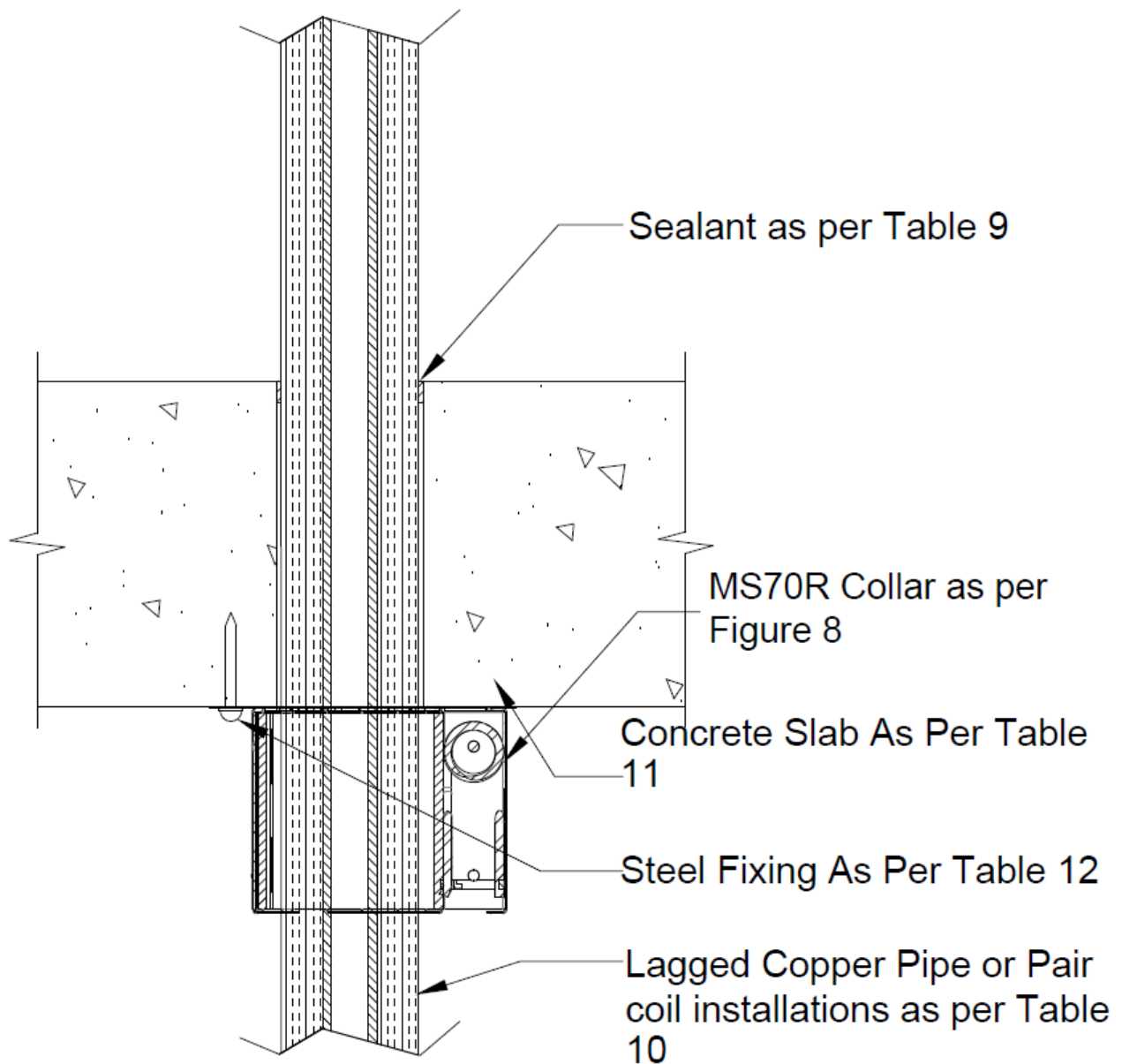


Figure 11: Lagged services in slabs

4 Referenced Standards

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

5 Conclusion

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

Table 13 – Fire Resistance of SNAP MS70R collars 40mm apart in walls (Figure 6)

Wall Types	Service in MS70R Collar (Figure 8)						Mix services from Tables 4 and 5
	SEE TABLE 4		SEE TABLE 5				
	Pair Coil bundles	Lagged PN12 PVC, Copper and Steel Pipes	PVC Conduit with or without cables	Fibre Optic Cable bundle	Data and Comms Cable bundle	Power Cable bundle	
Plasterboard (Figure 1) and Masonry Walls (Figure 3)							
≥ 90mm Plasterboard wall (1 x 13mm + 64mm stud)	-/60/60						-/60/60
≥ 96mm Plasterboard wall (1 x 16mm + 64mm stud)	-/90/60					-/90/90	-/90/60
≥ 116mm Plasterboard wall (2 x 13mm + 64mm stud) And ≥ 120mm Concrete or Masonry Wall	-/120/120						-/120/120
≥ 128mm Plasterboard wall (2 x 16mm + 64mm stud)	-/120/120	-/180/120			-/180/180		-/120/120
AAC Concrete Wall Systems (Figures 2 and 4)							
75mm Hebel PowerPanel (90 minute system)	-/90/90						-/90/90
75mm Hebel Power Panel (120 minute system)	-/120/90		-/120/120		-/120/90	-/120/90	
78mm SpeedPanel with PB patch (Figure 5)	-/120/90		-/120/120		-/120/90	-/120/90	
Framed MgO Wall Systems (Figure 1)							
FireCrunch MgO Board Wall (10mm)	-/90/60					-/90/90	-/90/60
Multiboard MgO Wall (2 x 7.5mm)	-/90/60					-/90/90	-/90/60

Table 14 – Fire Resistance of SNAP MS70R collars flange to flange in walls (Figure 7)

Wall Types	Service in MS70R Collar (Figure 8)					
	SEE TABLE 4		SEE TABLE 5			
	Pair Coil bundles	Lagged PN12 PVC, Copper and Steel Pipes	PVC Conduit with or without cables	Fibre Optic Cable bundle	Data and Comms Cable bundle	Power Cable bundle
Plasterboard (Figure 1) and Masonry Walls (Figure 3)						
≥ 90mm Plasterboard wall (1 x 13mm + 64mm stud)	-/60/60					
≥ 96mm Plasterboard wall (1 x 16mm + 64mm stud)	-/90/60					
≥ 116mm Plasterboard wall (2 x 13mm + 64mm stud) And ≥ 120mm Concrete or Masonry Wall	-/120/120					
≥ 128mm Plasterboard wall (2 x 16mm + 64mm stud)	-/180/120					
AAC Concrete Wall Systems (Figures 2 and 4)						
75mm Hebel PowerPanel (90 minute system)	-/90/90					
75mm Hebel Power Panel (120 minute system)	-/120/90					
78mm SpeedPanel with 13mm PB patch (Figure 5)	-/120/90					
Framed MgO Wall Systems (Figure 1)						
FireCrunch MgO Board Wall (10mm)	-/90/60					
Multiboard MgO Wall (2 x 7.5mm)	-/90/60					

Table 15 – Fire Resistance of SNAP MS70R collars with cables in slabs

Conduit and Cable services as per Table 9 and Figures 9 - 10	FRL	
	Minimum 150mm slab	Minimum 175mm slab
PVC Conduit without cables	-/180/180	-/240/240
Data and Comms Cables (CAT5e) with or without conduit	-/180/180	-/240/240
Data and Comms Cables (Cat6, Cat 7, RG-6) with or without conduit	-/180/120	-/240/120
Fibre Optic Cables with or without conduit	-/180/180	-/240/240
Power Cables within the conduit	-/180/180	-/240/180
Power Cables without conduit	-/180/60	-/240/60
Mix services with or without conduit	-/180/60	-/240/60

Table 16 – Fire Resistance of SNAP MS70R collars with lagged pipes in min. 150mm thick slabs

Lagged pipe as per Table 10 and Figure 11	FRL for each lagging type				
	K Flex ST Nitrile Foam lagging	Thermotec E-Flex Nitrile Foam lagging	SuperMax F/R lagging	Armaflex FRV nitrile rubber lagging	Foil Faced Sekisui foam Lagging (Thermobreak tube)
Copper paircoil installation	-/180/60	-/180/120	-/180/90	-/180/90	-/180/90
Small lagged copper/steel pipe			-/180/120	-/180/180	
Large lagged copper/steel pipe				-/180/90	
Lagged PN12 PVC pipes	-/180/180	-/180/180	-/180/180	-/180/180	-/180/180

Table 17 – Fire Resistance of SNAP MS70R collars with lagged pipes in min. 175mm thick slabs

Lagged pipes as per Table 10 and Figure 11	FRL for each lagging type				
	K Flex ST Nitrile Foam lagging	Thermotec E-Flex Nitrile Foam lagging	SuperMax F/R lagging	Armaflex FRV nitrile rubber lagging	Foil Faced Sekisui foam Lagging (Thermobreak tube)
Copper paircoil installation	-/240/60	-/240/120	-/240/90	-/240/90	-/180/90
Small lagged copper/steel pipe			-/240/120	-/240/180	
Large lagged copper/steel pipe				-/240/90	
Lagged PN12 PVC pipes	-/240/240	-/240/240	-/240/240	-/240/240	-/180/180

6 Direct Field of Application of Results

The results of this report are applicable to walls exposed to fire from either side and to slabs when exposed from below.

7 Requirements

It is required that the supporting construction is tested or assessed to achieve the required FRL based on the assessed design in accordance with AS 1530.4.

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

8 Term of Validity

This assessment report will lapse on 31st May 2026. Should you wish us to re-examine this report with a view to the possible extension of its term of validity, would you please apply to us three to four months before the date of expiry. This Division reserves the right at any time to amend or withdraw this assessment in the light of new knowledge.

9 Limitations

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

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

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

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

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

Appendix A Supporting Test Data

A.1. Test report FSP 1990 Revision B

On 21 March 2019, CSIRO North Ryde conducted a fire resistance test on an 1160-mm x 1160-mm x 116-mm thick wall penetrated by two (2) pipes protected by retrofitted Snap Fire Systems fire collars. The relevant specimens are summaries in Table A1 below.

A.2. Test report FSP 1902 VerOct18

On 5 April 2018, CSIRO North Ryde conducted a fire resistance test on nine (9) retrofit Fire Collars protecting a steel framed plasterboard wall system. The relevant specimens are summaries in Table A1 below.

A.3. Test report FSP 2049 Revision D

On 24 September 2019, CSIRO North Ryde conducted a fire resistance test on an 1150-mm x 1150-mm x 120-mm thick concrete slab penetrated by three (3) floor wastes and two (2) stack pipes with multiple services protected by three (3) cast-in and two (2) retrofit fire collars. The relevant specimens are summaries in Table A2 below.

A.4. Test report FSP 2058 Revision D

On 7 November 2019, CSIRO North Ryde conducted a fire resistance test on an 1150-mm x 1150-mm x 75-mm thick Hebel PowerPanel wall penetrated by five (5) services protected by retro-fitted Snap Fire Systems fire collars. The relevant specimens are summaries in Table A1 below.

A.5. Test report FSP 2118 Revision B

On 23 June 2020, CSIRO North Ryde conducted a fire resistance test on an 1150-mm x 1150-mm x 75-mm thick Hebel PowerPanel wall penetrated by six (6) services protected by retro-fitted Snap Fire Systems fire collars. The relevant specimens are summaries in Table A1 below.

A.6. Test report FSP 2120 Revision C

On 29 June 2020, CSIRO North Ryde conducted a fire resistance test on an 1150-mm x 1150-mm x 90-mm thick plasterboard wall system penetrated by six (6) services protected by retro-fitted Snap Fire Systems fire collars. The relevant specimens are summaries in Table A1 below.

A.7. Test report FSP 2126 Revision C

On 6 July 2020, CSIRO North Ryde conducted a fire resistance test on an 1150-mm x 1150-mm x 116-mm thick plasterboard wall system penetrated by six (6) services protected by retro-fitted Snap Fire Systems fire collars. The relevant specimens are summaries in Table A1 below.

A.8. Test report FSP 2135 Revision D

On 6 August 2020, CSIRO North Ryde conducted a fire resistance test on an 1150-mm x 1150-mm x 150-mm thick concrete slab. The slab was penetrated by 7 services protected with various SNAP fire collars. The relevant specimens are summaries in Table A2 below.

A.9. Test report FSP 2174 Revision D

On 11 January 2021, CSIRO North Ryde conducted a fire resistance test on an 1150-mm x 1150-mm x 150-mm thick concrete slab. The slab was penetrated by 7 services protected with various SNAP fire collars. The relevant specimens are summaries in Table A2 below.

A.10. Test report FSP 2188 Revision A

On 11 March 2021, CSIRO North Ryde conducted a fire resistance test on a steel framed plasterboard wall system penetrated by 8 services protected with various SNAP fire collars. The relevant specimens are summaries in Table A1 below.

A.11. Test report FSP 2203 Revision B

On 26 May 2021, CSIRO North Ryde conducted a fire resistance test on an 1150-mm x 1150-mm x 150-mm thick concrete slab. The slab was penetrated by multiple services protected by four cast-in fire collars and two retrofit fire collars. The relevant specimens are summaries in Table A2 below.

A.12. Test report FSP 2206 Revision C

On 6 June 2021, CSIRO North Ryde conducted a fire resistance test on a steel framed plasterboard wall system penetrated by 9 services protected with various SNAP fire collars. The relevant specimens are summaries in Table A1 below.

A.13. Test report FSP 2213 Revision C

On 26 June 2021, CSIRO North Ryde conducted a fire resistance test on an 1150-mm x 1150-mm x 150-mm thick concrete slab. The slab was penetrated by multiple services protected by seven cast-in fire collars. Their details and performances are summarised in Table A2 below.

A.14. Test report FSP 2216 Revision B

On 15 July 2021, CSIRO North Ryde conducted a fire resistance test on a steel framed plasterboard wall system penetrated by 8 services protected with various SNAP fire collars. The relevant specimens are summaries in Table A1 below.

A.15. Test report FSP 2225 Revision B

On 12 August 2021, CSIRO North Ryde conducted a fire resistance test on an 1150-mm x 1150-mm x 150-mm thick concrete slab. The slab was penetrated by multiple services protected by three cast-in collars and four retrofit fire collars. The relevant specimens are summaries in Table A2 below.

A.16. Test report FSP 2231 Revision A

On 2 September 2021, CSIRO North Ryde conducted a fire resistance test on an 1150-mm x 1150-mm x 150-mm thick concrete slab. The slab was penetrated by multiple services protected by four cast-in collars and three retrofit fire collars. The sealant which the manufacturer has stated to be the identical to Snap Fire Seal FRAS was applied to the services to seal gaps as per Table below. The relevant specimens are summaries in Table A2 below.

A.17. Table A1: Summary of test reports for wall penetrations

Report	Pen. #	Collar Code	Element	Service	Details	Integrity/ insulation (minutes)
FSP 1990	2	MS50R	2x13mm plasterboard sheets on each side of a 64mm steel stud	3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 4C+E round power cable and 20mm Pressure PVC	100% full	-/122/59 (¾-inch insulated copper pair coil pipe)
FSP 1902	5	SNAP 32R	2x13mm plasterboard sheets on each side of a 64mm steel stud	5 x Optical Fibres cables in 26.75mm PVC conduit	Partial full	-/181/170
FSP 2049	4	MS70R	120mm concrete slab	3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 3C+E round power cable and 20mm Pressure PVC	100% full Snap Fire Seal FRAS filled gaps	-/241/162 (electric cable)
FSP 2058	3	MS70R	75mm Hebel PowerPanel	3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 3C+E round power cable and 25mm Pressure PVC	100% full Snap Fire Seal FRAS filled gaps	-/121/99 (¾-inch insulated copper pair coil pipe) 176°C rise at 119 minutes
FSP 2118	1	MS70R	75mm Hebel PowerPanel	50 PN6 PVC		-/121/121
	2	MS70R		50mm Medium Duty Conduit filled with 2x6mm ² 3C+E power cables 2x16mm ² 3C+E power cables	Conduit 100% full	-/121/121
	3	MS70R		20x Cat5e	20% full	-/121/120 (Hebel)
	4	MS70R		100x Cat5e	100% full	-/121/117 (Hebel)
	5	MS70R		1in copper pipe with 19mm F/R lagging (Thermotec E-flex ST FRV) and 2.5mm ² 3C TPS flat power cable	100% full	-/121/118 (collar)
	6	MS70R		3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	100% full Snap Fire	-/121/119 (16-mm ² power cables)

Report	Pen. #	Collar Code	Element	Service	Details	Integrity/ insulation (minutes)
					Seal FRAS filled gaps	
FSP 2120	1	MS70R	1x13mm plasterboard sheets on each side of a 64mm steel stud	1in copper pipe with 19mm F/R lagging (Thermotec E-flex ST FRV) and 2.5mm ² 3C TPS flat power cable	100% full	-/91/78 (plasterboard)
	2	MS70R		50mm Medium Duty Conduit filled with 2x16mm ² 3C+E power cables 2x6mm ² 3C+E power cables	Conduit 100% full	-/91/77 (collar)
	3	MS70R		20x Cat5e	20% full	-/91/79 (plasterboard)
	4	MS70R		100x Cat5e	100% full	-/91/80 (plasterboard)
	5	MS70R		3/8in & 3/4in copper pair coil lagged in 9mm non-F/R lagging, 2.5mm ² 3C+E round power cable and 25mm Pressure PVC	100% full Snap Fire Seal FRAS filled gaps	-/91/82 (plasterboard)
	6	MS70R		3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	100% full Snap Fire Seal FRAS filled gaps	-/91/91
FSP 2126	1	MS70R	2x13mm plasterboard sheets on each side of a 64mm steel stud	1 inch copper pipe with 19mm F/R lagging (Thermotec E-flex ST FRV) and 2.5mm ² 3C TPS flat power cable	100% full	-/181/123 (lagging)
	2	MS70R		50mm Medium Duty Conduit filled with 2x16mm ² 3C+E power cables 2x6mm ² 3C+E power cables	Conduit 100% full	-/181/151 (Collar)
	3	MS70R		20xCat5e	20% full	-/181/180 (plasterboard)
	4	MS70R		100xCat5e	100% full	-/181/166 (plasterboard)
	5	MS70R		3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 3C+E round power cable and 25mm Pressure PVC	100% full Snap Fire Seal FRAS filled gaps	-/181/175 (plasterboard) 162°C rise on 3/8 pipe at 124 minutes
	6	MS70R		3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	100% full Snap Fire Seal FRAS filled gaps	-/181/146 (16-mm ² power cable)

Report	Pen. #	Collar Code	Element	Service	Details	Integrity/ insulation (minutes)
FSP 2188	2	MS70R	1x13mm plasterboard sheets on each side of a 64mm steel stud	1in (25mm OD x 1.34mm) copper pipe with 25mm thick foil faced Sekisui foam lagging	100% full	91NF/46 (lagging) (75 collar)
FSP 2216	2	MS70R		32mm (43.2mm OD x 2.2mm) PN12 PVC Pipe with 19mm F/R lagging (Armaflex FRV nitrile rubber)	100% full	-/91NF/71 (on the wall, 91 collars and 91NF pipe)
FSP 2206	7	MS70R	2x13mm plasterboard sheets on each side of a 64mm steel stud	1inch (25.36mm OD x 1.27mm) copper pipe with 25mm thick foil faced Sekisui foam lagging (Thermobreak tube)	100% full	-/181NF/ 75 (exposed pipe)
	9	MS70R		32mm (42.2mm OD x 2.57mm) PN12 PVC Pipe with 19mm F/R lagging (Armaflex FRV nitrile rubber)	100% full	-/181NF/ 181NF

A.18. Table A2: Summary of test reports for slab penetrations

Report	Pen. #	Collar Code	Element	Service	Details	Integrity/ insulation (minutes)
FSP 2135	1	MS70R + SNAP H50S blank cast-in collar	150mm Concrete Slab	60mm OD Medium Duty Conduit(continuous) filled with 2x6mm ² 3C+E power cables 2x16mm ² 3C+E power cables	100% full	-/241NF/ 241NF
	2	MS70R		Cat5 (approx. 100)	100% full	-/241NF/ 241NF
	3	MS70R		Cat5e (approx. 20)	20% full in 70mm diameter aperture Snap Fire Seal FRAS to fill large gap 6mm deep bead of sealant on 22mm diameter PE backing rod	-/241NF/ 241NF
	4	MS70R + SNAP H50S blank cast-in collar		60mm OD PN6 PVC Pipe	100% full	-/241NF/ 241NF
FSP 2174	5	MS70R	150mm Concrete Slab	60mm OD PVC Conduit (100mm above and below the slab) filled with 3x6mm ² 3C+E power cables 3x16mm ² 3C+E power cables	100% full	-/241NF/ 239(6mm cable)

Report	Pen. #	Collar Code	Element	Service	Details	Integrity/ insulation (minutes)
FSP 2049	4	MS70R	120mm Concrete Slab	3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 4C+E round power cable and 20mm PN12 Pressure PVC	A bead of Snap Fire Seal FRAS	- /241NF/48 (lagging)
FSP 2203	5	MS70R	150mm Concrete Slab	20 x 11mm and 10 x 6mm diameter Garland Optical Fibre cable		-/241NF/237(slab)
FSP 2225	2	MS70R	150mm Concrete Slab	32mm PN12 uPVC pipe (42.3-mm OD x 2.6mm) with 19-mm thick Armaflex FRV nitrile rubber lagging	NA	-/241NF/241NF
FSP 2225	4	MS70R	150mm Concrete Slab	DN 25 (Type B 25.4mm OD x 1.22mm) copper pipe with 19-mm thick E-Flex ST Nitrile Foam lagging and a 2.5-mm ² 3-core TPS power cable	NA	-/241NF/141(E-flex)
FSP 2225	5	MS70R	150mm Concrete Slab	DN 25 (Type B 25.4mm OD x 1.22mm) copper pipe with 19-mm thick Armaflex FRV nitrile rubber lagging and a 2.5-mm ² 3-core TPS cable	NA	-/241NF/118 (TPS cable)
FSP 2225	6	MS70R	150mm Concrete Slab	Bundle of 60 Category 7 network cables	NA	-/241NF/160(CAT 7)
FSP 2231	2	MS70R	150mm Concrete Slab	DN 25 (Type B 25.4mm OD x 1.22mm) copper pipe with 19 mm thick SuperMax foam lagging and a 2.5-mm ² 3-core TPS power cable	A bead of Snap Fire Seal FRAS	-/241NF/115(cable) 120 (lagging)
FSP 2231	5	MS70R	150mm Concrete Slab	DN 25 (Type B 25.4mm OD x 1.22mm) copper pipe with 19 mm thick K-Flex ST Foam lagging and a 2.5-mm ² 3-core TPS power cable	67 mm diameter aperture A bead of Snap Fire Seal FRAS	- /241NF/85 (exposed copper pipe)
FSP 2231	6	MS70R	150mm Concrete Slab	DN20 (Type B 19.5mm OD x 1.02mm) copper pipe with 9 mm thick Armaflex FRV nitrile rubber lagging and a 2.5-mm ² 3-core TPS power cable	67 mm diameter aperture 10mm deep Snap Fire Seal FRAS	- /241NF/189 (lagging)
FSP 2135	5	MS70R	150mm Concrete Slab	3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	A bead of Snap Fire Seal FRAS	-/240/87 (16mm cable)
FSP 2174	3	MS70R	150mm Concrete Slab	65mm PVC Pipe (100mm above slab) (2.62mm) filled with 1in copper pipe(1.4mm) with 19mm F/R lagging (F/R ArmaFlex) and a 2.5mm ² 3C TPC Cable	PVC 100mm above slab	-/240/100 (lagging above conduit) (188 on conduit)

Report	Pen. #	Collar Code	Element	Service	Details	Integrity/ insulation (minutes)
FSP 2174	4	MS70R	150mm Concrete Slab	1in copper pipe(1.4mm) with 19mm F/R lagging (F/R ArmaFlex) and a 2.5mm ² 3C TPC Cable	100% full	-/240/116 (rover on copper pipe)
FSP 2203	4	MS70R	150mm Concrete Slab	1in the copper pipe with 25mm Foil Faced Sekisui lagging	100% full	-/182 (cotton pad) /81 (copper pipe)
FSP 2213	2	MS70C	150mm Concrete Slab	1in the copper pipe (25.6mm x 1.35mm) with 25mm foil faced Sekisui PE lagging (Thermobreak tube) with tapping along the vertical joint	100% full	- /187(flame)/ 146 (foil lagging)

Appendix B Analysis of Variations

B.1 Variation to wall support construction

The proposed construction shall be MS70R collars tested in Table 2, and subject to the following variations:

- The wall constructions tested shall vary from that tested to one of the following types as listed in Table 3
- The aperture to aperture spacing in the substrate shall be at least 40mm as shown in Figures 6 and 7

Up to 90 minutes stud lined walls

The proposed wall types consist of stud walls lined with one layer of 13 fire rated plasterboard or 16mm fire rated plasterboard or 10mm FIRECRUNCH board or 2 layers of 7.5mm Multiboard walls.

The test results of services tested in one layer of 13mm Fire rated plasterboard lined system as shown in section A8 are applied to one layer of 16mm fire rated plasterboard lined system as well as one layer of 10mm FIRECRUNCH board lined wall system and 2 layers of 7.5mm Multiboard lined wall.

This is based on the fact that these applied cavity wall systems are all thicker in wall thicknesses than that of the tested 13mm fire rated plasterboard lined wall system in FSP 2120, thus allowing the services and the collars to have a slightly longer conduction path, and thus perform slightly better in insulation performance on the unexposed side.

Therefore it is expected that when installed in a thicker lined wall system with the required FRL as shown in Table 3, the collars will also be able to allow these various services to maintain insulation for up to the insulation performance of the tested penetration or the wall type, whichever is the lesser.

The ability of this MS70R collar to close off services and prevent hot gas from leaking to the unexposed side to fail cotton pad is demonstrated across various services installed in a 90mm thick wall in FSP 2120 for a minimum of 90 minutes, and a 96mm thick wall in FSP 1990 for a minimum of 180 minutes for smaller 65mm high version of the MS70R called an MS50R.

Therefore it is expected that when installed in a thicker lined wall system with the required FRL as shown in Table 3, the collars will also be able to allow these various services to maintain integrity for up to the integrity performance of the tested penetration or the wall type, whichever is the lesser.

With reference to FSP 2120, where 6 service types all maintain the integrity of 90 minutes, and insulation of at least 60 minutes, with the exception of specimen 6 which comprised 3x6mm² 3C+E and 6x16mm² 3C+E power cables, which were able to maintain insulation for up to 90 minutes.

Based on the above discussion, it is expected that the proposed variation will be able to achieve the integrity and insulation performance shown in Table B1 when tested in accordance with AS 1530.4 - 2014 and assessed in accordance with AS 4072.1 – 2005.

Confirmation of service spacing

AS 4072.1 -2005 clause 4.9.3 states that “the minimum distance between penetrations in a modular system shall be not less than 40 mm unless otherwise tested in specimen form.” It is noted also in clause 1.4.10 which defines a “penetration” as “An aperture through a fire-separating element for the passage of a service or services”

Based on the above, it is considered that AS 4072.1 -2005 Amdt 1 clause 4.9.3 applies to the specimens considered in this assessment. The minimum aperture to aperture spacing of the proposed specimens is 40mm.

However, where the collar flanges are touching each other as shown in Figure 7, the collars may interfere with the adjacent collar insulation performance. Therefore, the performance of the penetrations is then dictated by the lowest performing penetration in the proposed substrate as shown in Table B1.

Table B1: Up to 90minutes lined wall systems

Collar spacing	Services in MS70R collar	FRL			
		Wall ID (Table 3)			
		1	3	4	5
Collar flange min. 40mm apart See Figure 6	3/8in & 3/4in copper pair coil lagged in PE or F/R lagging, 2.5mm ² 3C+E round power cable and up to 25mm Pressure PVC pipe	-/60/60	-/90/60	-/90/60	-/90/60
	1 inch copper pipe with 19mm F/R lagging (F/R Armaflex) and 2.5mm ² 3C TPS flat power cable	-/60/60	-/90/60	-/90/60	-/90/60
	Up to 100 Cat5e cables	-/60/60	-/90/60	-/90/60	-/90/60
	3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	-/60/60	-/90/90	-/90/90	-/90/90
	50mm Medium Duty Conduit filled with 2x6mm ² 3C+E power cables, 2x16mm ² 3C+E power cables	-/60/60	-/90/60	-/90/60	-/90/60
Collar flange side by side See Figure 7	3/8in & 3/4in copper pair coil lagged in PE or F/R lagging, 2.5mm ² 3C+E round power cable and up to 25mm Pressure PVC pipe	-/60/60	-/90/60	-/90/60	-/90/60
	1 inch copper pipe with 19mm F/R lagging (F/R Armaflex) and 2.5mm ² 3C TPS flat power cable	-/60/60	-/90/60	-/90/60	-/90/60
	Up to 100 Cat5e cables	-/60/60	-/90/60	-/90/60	-/90/60
	3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	-/60/60	-/90/60	-/90/60	-/90/60
	50mm Medium Duty Conduit filled with 2x6mm ² 3C+E power cables, 2x16mm ² 3C+E power cables	-/60/60	-/90/60	-/90/60	-/90/60

Up to 120 and 180 minutes stud lined walls

The proposed wall types consist of stud walls lined with two layers of 13 fire rated plasterboard or 16mm fire rated plasterboard walls and a minimum of 116mm thick concrete and masonry walls.

The test results of services tested in 2 layers of 13mm Fire rated plasterboard lined system as shown in section A8 are applied to 2 layers of 13mm 16mm fire rated plasterboard lined system.

This is based on the fact that the applied cavity wall system is thicker in wall thicknesses than that of the tested 13mm fire rated plasterboard lined wall in FSP 2126, thus allowing the services and the collars to have a slightly longer conduction path, and thus perform slightly better in insulation performance on the unexposed side.

Therefore it is expected that when installed in a thicker lined wall system with the required FRL as shown in Table 3, the collars will also be able to allow these various services to maintain insulation for up to the insulation performance of the tested penetration or the wall type, whichever is the lesser.

The ability of this MS70R collar to close off services and prevent hot gas from leaking to the unexposed side to fail cotton pad is demonstrated across various services installed in a 116 mm thick wall in FSP 2126 for a minimum of 180 minutes.

Therefore it is expected that when installed in a thicker lined wall system with the required FRL as shown in Table 3, the collars will also be able to allow these various services to maintain integrity for up to the integrity performance of the tested penetration or the wall type, whichever is the lesser.

With reference to FSP 2126, where 6 service types all maintain an integrity of 180 minutes and insulation of at least 120 minutes. Some of the penetrations failed insulation on the actual services or the collars. The insulation performance of these penetrations remains the same when installed onto a thicker wall.

However, FSP 2126 Specimen 4 failed on the wall substrate, with a maximum shortfall of 14 minutes, it was found that the CAT 5 cable services were able to maintain insulation at 180 minutes. Therefore, by having 2 layers of 16mm fire rated plasterboard on each side of the wall, which results in a 12mm increase in fire rated plasterboard material compared to the tested system, it is expected that this will allow the wall substrates to also maintain insulation for at least another 15 minutes.

Also, with FSP 2126 Specimen 6 it was found that it failed insulation momentarily on the 16mm² cable when the cable reached 180°C rise at 146 and 147 minutes before the temperature decreased slightly for the remainder of the test. It then failed insulation on the collar at 172 minutes. Therefore, by having 2 layers of 16mm fire rated plasterboard on each side of the wall, which results in a 12mm increase in fire rated plasterboard material compared to the tested system, it is expected that this will allow the collar to also maintain insulation for at least another 15 minutes and also increase the distance of the fireside to the non fire side slightly such that the cable will not reach the insulation failure temperature for 180 minutes.

The test results of services tested in 2 layers of 13mm fire rated plasterboard lined system which has a total thickness of 116mm as shown in section A8 are also applicable to a minimum 116mm thick concrete and masonry walls since it is expected that the proposed masonry and concrete wall will act to cool the penetration temperature on the unexposed side due to its heat sink effect.

Based on the above discussion, it is expected that the proposed variation will be able to achieve the integrity and insulation performance shown in Table B2 when tested in accordance with AS 1530.4 - 2014 and assessed in accordance with AS 4072.1 – 2005.

Table B2: Up to 120 and 180 minutes lined wall systems

Collar spacing	Service in MS70R collar	FRL	
		Wall ID Table 3	
		7	11
Collar flange min. 40mm apart See Figure 6	3/8in & 3/4in copper pair coil lagged in PE or F/R lagging, 2.5mm ² 3C+E round power cable and up to 25mm Pressure PVC pipe	-/120/120	-/180/120
	1 inch copper pipe with 19mm F/R lagging (F/R Armaflex) and 2.5mm ² 3C TPS flat power cable	-/120/120	-/180/120
	Up to 100 Cat5e cables	-/120/120	-/180/180
	3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	-/120/120	-/180/180
	50mm Medium Duty Conduit filled with 2x6mm ² 3C+E power cables, 2x16mm ² 3C+E power cables	-/120/120	-/180/120
Collar flange side by side See Figure 7	3/8in & 3/4in copper pair coil lagged in PE or F/R lagging, 2.5mm ² 3C+E round power cable and up to 25mm Pressure PVC pipe	-/120/120	-/180/120
	1 inch copper pipe with 19mm F/R lagging (F/R Armaflex) and 2.5mm ² 3C TPS flat power cable	-/120/120	-/180/120
	Up to 100 Cat5e cables	-/120/120	-/180/120
	3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	-/120/120	-/180/120
	50mm Medium Duty Conduit filled with 2x6mm ² 3C+E power cables, 2x16mm ² 3C+E power cables	-/120/120	-/180/120

Solid wall systems

The proposed wall types consist of solid walls made from concrete, masonry, Hebel or Speedpanel.

The test results of services tested in 75mm Hebel walls with an FRL of -/90/90 as shown in section A8 are applied to 75mm thick Hebel walls with an FRL of -/120/120 as well as to 78mm Speedpanel and 90mm concrete/masonry walls.

All of the 6 services in FSP 2118, as well as specimen 3 in FSP 2058, were able to maintain integrity for 120 minutes when installed on a 75mm thick Hebel wall.

The proposed wall types are either the same thickness or thicker than that of the tested 75mm Hebel. They are also of greater density than the tested 75mm Hebel which has a nominal dry density of 510 kg/m³.

Therefore, it is expected that these wall types will provide a greater heat sink effect than the tested Hebel panel, to allow the penetration temperature on the unexposed side to be lower than that tested.

Also, FSP 2118 specimen 4, which comprised 100 Cat 5e cables, failed insulation on the Hebel panel, with an FRL of -90/90, at 117 minutes. It is expected that when installed onto substrates with a higher insulation performance of 120 minutes, this specimen will maintain insulation for at least 120 minutes.

The proposed Speedpanel, when installed with a 13mm plasterboard patch on each side, would prevent venting from the Speedpanel core from affecting the performance of the collar since the patch provides a flat surface for the collars. The presence of the patch would provide slightly more insulation performance to the wall substrate area of the penetration.

A 50mm PVC conduit was tested empty in FSP 2118 specimen 1, it demonstrated that the MS70R collars can close off the PVC pipes and prevent integrity and insulation failure for at least 120 minutes. With reference to FSP 2126 specimen 2, which comprised a 50mm PVC conduit filled with cable services and installed in a section of plasterboard wall with an FRL of -/120/120, it was also able to maintain integrity for 181 minutes and insulation of 151 minutes.

The significance of FSP 2126 specimen 2 is that it demonstrated that even when the conduit was filled with irregular cable services the MS70R collar was able to close off all gaps around the conduit and the cable services to prevent gap formation of 180 minutes. It is expected that without these irregular cable Services, the collar would also be able to completely close off the conduit for a period of up to 180 minutes such that it maintains integrity for 180 minutes.

Therefore, it is expected that when installed onto a plasterboard wall with an FRL of -/180/180, the empty PVC conduit will also be able to maintain integrity for at least 180 minutes and insulation for at least 120 minutes.

As discussed previously, it is expected that when installed in a thicker wall system with the required FRL as shown in Table 3, the collars will also able to allow these various services to maintain integrity and insulation for up to the performance of the tested penetration or the wall type, whichever is the lesser.

Based on the above discussion, it is expected that the proposed variation will be able to achieve the integrity and insulation performance shown in Table B3 when tested in accordance with AS 1530.4 - 2014 and assessed in accordance with AS 4072.1 – 2005.

Table B3: Solid wall systems

Collar spacing	Service in MS70R collar	FRL			
		Wall ID (Table 3)			
		2	6	8	9
Collar flange min. 40mm apart See Figure 6	3/8in & 3/4in copper pair coil lagged in PE or F/R lagging, 2.5mm ² 3C+E round power cable and up to 25mm Pressure PVC pipe	-/60/60	-/90/90	-/120/90	-/120/90
	1 inch copper pipe with 19mm F/R lagging (F/R Armaflex) and 2.5mm ² 3C TPS flat power cable	-/60/60	-/90/90	-/120/90	-/120/90
	Up to 100 Cat5e cables	-/60/60	-/90/90	-/120/120	-/120/120
	Empty 50mm PVC conduit	-/60/60	-/90/90	-/120/120	-/120/120
	3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	-/60/60	-/90/90	-/120/90	-/120/90
	50mm Medium Duty Conduit filled with 2x6mm ² 3C+E power cables, 2x16mm ² 3C+E power cables	-/60/60	-/90/90	-/120/120	-/120/120
Collar flange side by side See Figure 7	3/8in & 3/4in copper pair coil lagged in PE or F/R lagging, 2.5mm ² 3C+E round power cable and up to 25mm Pressure PVC pipe	-/60/60	-/90/90	-/120/90	-/120/90
	1 inch copper pipe with 19mm F/R lagging (F/R Armaflex) and 2.5mm ² 3C TPS flat power cable	-/60/60	-/90/90	-/120/90	-/120/90
	Up to 100 Cat5e cables	-/60/60	-/90/90	-/120/90	-/120/90
	Empty 50mm PVC conduit	-/60/60	-/90/90	-/120/90	-/120/90

Collar spacing	Service in MS70R collar	FRL			
		Wall ID (Table 3)			
		2	6	8	9
	3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	-/60/60	-/90/90	-/120/90	-/120/90
	50mm Medium Duty Conduit filled with 2x6mm ² 3C+E power cables, 2x16mm ² 3C+E power cables	-/60/60	-/90/90	-/120/90	-/120/90

B.1 Variation to PVC conduits within collars protecting openings in walls

The proposed variation comprises the inclusion of 20mm to 50mm PVC conduits as shown in Table 4 across all wall types as listed in Table 3, filled with Cat5e, Cat6, Cat 7, RG6 cables, optic cables as well as power cables as listed in Table 4 to 0 - 100% fullness of the conduit.

Empty PVC conduit

FSP 2118 specimen 1 demonstrated that the MS70R collar can close off an empty 50mm diameter PVC conduit with a wall thickness of 1.84mm and allow the specimen to maintain integrity and insulation for at least 120 minutes when installed in a 75mm thick Hebel panel wall.

The pipe temperature had stabilised and plateaued at around 75 minutes into the test, which demonstrated the full closure of the collar around the plastic pipe on the exposed side. It is expected that further 28% furnace exposure from 120 minutes to 180 minutes duration will not introduce gaps in the activated collar on the exposure side. Even if gaps were introduced in the exposure side, the furnace gas that leaks through will then activate the collar on the exposure side such that the specimen will be able to maintain integrity for up to 180 minutes.

The tested specimen was installed in a 75mm thick Hebel wall, while the proposed wall types are all thicker than 75mm. Therefore, it is expected that the pipe temperature on the unexposed side will not be any hotter than that tested, allowing the specimen to be able to maintain insulation in these wall types for at least 120 minutes.

The small variation in the wall thicknesses of the proposed 50mm pipe is also not expected to detrimentally affect the performance of the specimen. Further confidence in the MS70R to close off the proposed maximum PVC thickness of 2.85mm is found in FSP 2118 specimen 2 that demonstrated that the MS70R collar was able to close off a fully filled 50mm PVC conduit with a wall thickness of 2.71mm without integrity failure for 120 minutes. The proposed 20mm, 25mm, 32mm and 40mm PVC conduits pipe, with wall thickness similar to that tested in FSP 2118 specimen 1, is expected to behave similarly to the 50mm pipe.

Based on the above, it is expected that the proposed empty 20mm to 50mm PVC conduits as shown in Table 4 when installed across all wall types as listed in Table 3, will be able to achieve integrity of up to 180 minutes and insulation of up to 120 minutes based on design.

Partial to full fill of conduit

With reference to the PVC conduits tested fully of power cables in FSP 2126 Specimen 2, it demonstrated that the MS70R collars can close off the PVC conduit when fully filled with large cable services and prevent integrity failure for at least 181 minutes. It also demonstrated that with large cable services in the conduit, the maximum insulation performance of the specimen is at least 120 minutes.

The proposed reduction in the number of power cable services will only improve the insulation performance of the penetration as there will be less copper content to conduct heat to the unexposed side.

With reference to the MS70R collar tested partially and fully of smaller CAT5e cables in FSP 2126 Specimen 3 and 4 respectively, they demonstrated that the MS70R collars can close off the PVC conduit partially and when fully filled with CAT5e cables, and prevent integrity failure for at least 181 minutes. It also demonstrated that with many cable services in the collar, the maximum insulation performance of the specimen is at least 120 minutes. Therefore, when these cables are inside a PVC conduit, it is expected that they will achieve similar performances to when they were just in the collar without conduits.

The proposed reduction in the number of CAT5e cables from the minimum 20 tested, will only improve the integrity performance of the penetration as there will be less plastic content to induce flaming on the unexposed side.

The proposed RG6 cables are slightly larger than the CAT5e cables, with a similar amount of plastic sheathing, and contain a single 1mm diameter copper core instead of an 8 x 0.5mm copper core. Therefore, when the RG6 cables substitute the tested CAT 5e cables in a PVC conduit and are protected by an MS70R collar, there will be less conductive material and a similar amount of plastic components.

It is therefore expected that RG6 cables will perform similarly or better in insulation than CAT5e cables due to their lower conductor content.

The proposed CAT6 cables are slightly larger than the CAT5e cables with a thicker sheath and may include a plastic core in the middle. The extra plastic may increase the risk of flaming the cables when heated.

The proposed CAT7 cables are slightly larger than the CAT5e cables and have shielded foil twisted pairs. This will increase the conductivity of the cables when heated.

With no signs of integrity failure observed in the reference test and the margin on the insulation of the CAT 5e cables in a 90mm plasterboard lined stud wall, it is expected that the proposed RG6, CAT6 and CAT 7 cables will also achieve in a similar result to the tested CAT5e cables

These 3 services were installed in 116mm thick plasterboard lined walls. The change in wall thickness and wall types will affect the insulation performance of the penetrations.

With reference to FSP 2120 specimen 2 which comprised power cables in a 50mm PVC conduit installed in a 90mm stud wall, its insulation failure on the collar at 77 minutes demonstrated that in thinner stud walls, collar failure can occur before the cable. Therefore, the insulation performance of the proposed partially or fully filled PVC conduit in these wall types is limited to 60 minutes.

With reference to FSP 2126 specimen 2 which comprised power cables in a 50mm PVC conduit installed in a 116mm stud wall, its insulation failure on the collar at 151 minutes demonstrated that in thicker stud walls, collar failure can also occur before the cable. Therefore, the insulation performance of the proposed partially to fully-filled PVC conduit in these wall types is limited to 120 minutes.

With reference to FSP 2118 specimen 2 which comprised power cables in 50mm PVC conduit installed in a 75mm thick Hebel wall, it was able to maintain insulation for 121 minutes. This insulation performance is thus applied to the proposed solid wall types of equal or greater thickness.

With reference to FSP 1902 specimen 5, which comprised five optical fibre cables partially filling a 20mm PVC conduit penetrated a 116mm thick plasterboard line wall and protected by a 32R Retrofit collar. The penetration was able to maintain integrity for 181 minutes duration of the test and failed insulation on the plasterboard wall at 170 minutes.

The ability of the MS70R collar to close off large and small services in PVC pipes is demonstrated in the referenced tests summarised in Section A8. It is expected that MS70R would also be able to close off these fibre optic cables when they partially or fully fill the PVC conduit such that it will not fail integrity for up to 180 minutes.

Though FSP 1902 specimen 5 contains a different collar, the significance of the low PVC temperature on the unexposed side is that it shows the fibre optic cables on the fireside have been mostly melted away leaving little material for conduction of heat to the unexposed side. Therefore, it is expected that when protected by MS70R collars, it will also be able to maintain insulation for up to 120 minutes in a 116mm thick plasterboard lined wall.

As discussed previously, it is expected that when installed in a wall system with the required FRL as shown in Table 3, the MS70R collar will also be able to allow 0% to fully filled PVC conduits containing Cat5e cables, fibre optic cables as well as power cables, to maintain integrity and insulation for up to the performance of the tested penetration or the wall type, whichever is the lesser.

Based on the above discussion, it is expected that the proposed variation will be able to achieve the integrity and insulation performance shown in Table B4 when tested in accordance with AS 1530.4 - 2014 and assessed in accordance with AS 4072.1 – 2005.

Table B4: PVC pipes 0-100% filled

Collar spacing	Service in MS70R collar	Variation to	Collar/conduit fill	FRL						
				1 and 2	3 and 4	5	6	7	8 and 9	10 and 11
See Figure 6	20mm to 50 PVC pipe	See Table 4	0 - 100%	-/60/60	-/90/60	-/90/60	-/90/90	-/120/120	-/120/120	-/120/120
See Figure 7				-/60/60	-/90/60	-/90/60	-/90/90	-/120/120	-/120/90	-/120/120

B.2 Variation to cables within collars protecting openings in walls

The proposed variation comprises an MS70R collar, either empty, partially or when fully filled with Cat 5e, Cat6, Cat 7 cables, fibre optic cables, power cables, and RG6 cables.

When the collar is empty, there is a potential for furnace gas to escape the un-activated collar to ignite the cotton pad. However, from FSP 2118 specimen 1 which comprised an empty 50mm diameter PVC conduit, its collar was able to close at around 4 minutes to prevent smoke from exiting the pipe. Before 4 minutes, the low temperature of the furnace gas is not enough to ignite a cotton pad. Therefore, it is expected that the empty MS70R collar will be able to maintain integrity and insulation for up to 180 minutes.

With reference to Table B5, these results demonstrated that when MS70R collars are partially or fully filled with Cat 5e cables across 3 wall types, the integrity performance of the penetrations was not affected by how much the collar is filled. The penetrations' cable insulation performance however does differ in that more cables reduce the insulation performance of the system. However, since the maximum number of 100 20xCat5e cables were tested, their insulation performance is then set as the upper limit for this type of cable.

Table B5: Collar partially and when fully filled

Report	Pen. #	Collar Code	Element	Service	Details	Integrity/insulation (minutes.)
FSP 2118	3	MS70R	75mm Hebel PowerPanel	20xCat5e	20% full	-/121/120 (Hebel)
FSP 2118	4	MS70R	75mm Hebel PowerPanel	100xCat5	100% full	-/121/117 (Hebel)
FSP 2120	3	MS70R	1x13mm plasterboard sheets on each side of a 64mm steel stud	20xCat5e	20% full	-/91/79 (plasterboard)
FSP 2120	4	MS70R	1x13mm plasterboard sheets on each side of a 64mm steel stud	100xCat5	100% full	-/91/80 (plasterboard)

Report	Pen. #	Collar Code	Element	Service	Details	Integrity/ insulation (minutes.)
FSP 2126	3	MS70R	2x13mm plasterboard sheets on each side of a 64mm steel stud	20xCat5e	20% full	-/181/180 (plasterboard)
FSP 2126	4	MS70R	2x13mm plasterboard sheets on each side of a 64mm steel stud	100xCat5	100% full	-/181/166 (plasterboard)

The above observations can also be applied to power cables which when reduced in number, will improve the overall insulation performance of the system without reducing the integrity performance.

The proposed variation also includes fibre optic cables. As discussed in Section B2, is expected that these cables will be less conductive than the copper-cored CAT5e cables discussed above, and therefore it is expected that they will be able to maintain insulation for at least up to 120 minutes.

The proposed RG6 cables are slightly larger than the CAT5e cables, with a similar amount of plastic sheathing, and contain a single 1mm diameter copper core instead of an 8 x 0.5mm copper core. Therefore, when the RG6 cables substitute the tested CAT 5e cables in an MS70R collar, there will be less conductive material and a similar amount of plastic components. It is therefore expected that RG6 cables will perform similarly or better in insulation than CAT5e cables due to their lower conductor content.

As discussed previously, the ability of the MS70R collar to close off large and small services without PVC conduit is demonstrated in the referenced tests summarised in Section A8. It is expected that MS70R would also be able to close off these fibre optic cables when they partially or fully fill the MS70R collar such that it will not fail integrity for up to 180 minutes.

Based on the above discussion, it is expected that the proposed variation will not detrimentally affect the integrity and insulation performance of the services shown in Tables B1, B2, and B3 when tested in accordance with AS 1530.4 -2014, and assessed in accordance with AS 4072.1 – 2005.

B.3 Variation to lagged metal pipes within collars protecting openings in walls

The proposed variation comprises copper and steel pipe of various sizes with either PE or Thermotec E-flex ST FRV lagging of various thicknesses or 25mm foil-faced Sekisui lagging (Thermobreak tube) with vertical joints taped and then two turns of radial tapes at 100mm centres and protected with MS70R collar as shown in Table 4.

Table B6: relevant test data for lagged copper pipes

Report	Pen. #	Collar Code	Element	Service	Integrity/ insulation (min.)	Maximum temperature rise on copper pipe
FSP 2118	5	MS70R	75mm Hebel PowerPanel	1 inch(DN25B) copper pipe with 19mm F/R lagging (F/R Armaflex) and 2.5mm ² 3C TPS flat power cable	-/121/118 (collar)	72°C rise at 120 minutes
FSP 2120	1	MS70R	1x13mm plasterboard sheets on each side of a 64mm steel stud	1 inch copper pipe with 19mm F/R lagging (F/R Armaflex) and 2.5mm ² 3C TPS flat power cable	-/91/78 (plasterboard)	136°C rise at 90 minutes

Report	Pen. #	Collar Code	Element	Service	Integrity/ insulation (min.)	Maximum temperature rise on copper pipe
FSP 2126	1	MS70R	2x13mm plasterboard sheets on each side of a 64mm steel stud	1 inch(DN25B) copper pipe with 19mm F/R lagging (F/R Armaflex) and 2.5mm ² 3C TPS flat power cable	-/181/123 (insulated pipe)	156°C rise at 120 minutes
FSP 2049	4	MS70R	120mm concrete slab	3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 3C+E round power cable and 20mm Pressure PVC pipe	-/241/162 (electric cable)	104°C rise at 120 minutes
FSP 2058	3	MS70R	75mm Hebel PowerPanel	3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 3C+E round power cable and 25mm Pressure PVC pipe	-/121/99 (¾-inch insulated copper pair coil pipe)	176°C at 89 minutes
FSP 2120	5	MS70R	1x13mm plasterboard sheets on each side of a 64mm steel stud	3/8in & 3/4in copper pair coil lagged in 9mm non-F/R lagging, 2.5mm ² 3C+E round power cable and 25mm Pressure PVC pipe	-/91/82 (plasterboard)	112°C rise on ¾ pipe at 57 Min. (Rover) 208°C rise on ¾ pipe at 85 Min. (Rover)
FSP 2126	5	MS70R	2x13mm plasterboard sheets on each side of a 64mm steel stud	3/8in & 3/4in copper pair coil lagged in 10mm non-F/R lagging, 2.5mm ² 3C+E round power cable and 25mm Pressure PVC	-/181/175 (plasterboard)	177°C rise on 3/8 pipe at 124 minutes
FSP 2206	7	MS70R	2x13mm plasterboard sheets on each side of a 64mm steel stud	1inch (25.36mm OD x 1.27mm) copper pipe with 25mm thick foil faced Sekisui foam lagging (Thermobreak tube)	-/181NF/ 75 (exposed pipe, 161 on lagging)	116°C rise on lagging at 120 minutes
FSP 2188	2	MS70R	1x13mm plasterboard sheets on each side of a 64mm steel stud	1in (25mm OD x 1.34mm) copper pipe with 25mm thick foil faced Sekisui foam lagging (Thermobreak tube)	91NF/46 (lagging) (75 collar)	168°C rise on lagging at 60 minutes

With reference to Table B6, the temperature measurement on FSP 2118 specimen 5, the lagging is relatively cool compared with the rest of the specimen. The oscillation behaviour of the temperature measured by the thermocouples on the lagging shows the heating behaviour of the Thermotec E-flex ST FRV lagging after 50 minutes. When it swells, there is a drop in measured temperature due to the thermocouple being further away from the copper pipe. When it then melts, the thermocouple is closer to the pipe, and so the measured temperature increases. This swelling-melting behaviour of the Thermotec E-flex ST FRV lagging was also observed in FSP 2126 specimen 1.

The significance of these tests demonstrated that the Thermotec E-flex ST FRV lagging on the copper pipe can sustain the heat from a hot copper pipe for up to 181 minutes without causing flaming.

Also, the swelling and melting behaviour of the Thermotec E-flex ST FRV lagging would allow a thicker Thermotec E-flex ST FRV lagging to provide more thermo-insulation to the pipe such that during its melting phase, the temperature measured on a thicker Thermotec E-flex ST FRV lagged pipe would be lower than that of a thinner Thermotec E-flex ST FRV lagged pipe.

FSP 2118 Specimen 5 and FSP 2126 Specimen 1 demonstrated that pipes up to 1 inch with at least 19mm Thermotec E-flex ST FRV lagging can maintain insulation for up to 120 minutes with some margin.

It is expected that the larger 1 inch copper pipes are hotter than the smaller $\frac{3}{4}$ inch copper pipes due to them having more cross-sectional conduction area.

Based on the above, the proposed $\frac{3}{4}$ inch and 1 inch copper pipe lagged with 25mm Thermotec E-flex ST FRV lagging would perform better in insulation performance than the tested 1 inch lagged copper pipe with 19mm Thermotec E-flex ST FRV lagging as tested in FSP 2126 Specimen 1, and thus able to maintain insulation for at least 120 minutes.

With reference to Table B6, in FSP 2126 specimen 5, the $\frac{3}{8}$ inch copper pair coil lagged in 10mm non-F/R lagging was only measuring a maximum temperature rise of 177°C at 124 minutes into the test when installed in a 116mm plasterboard system. With reference to Table B6, in FSP 2058 specimen 3, the $\frac{3}{8}$ and $\frac{3}{4}$ inch copper pair coil lagged in 10mm non-F/R lagging was only measuring a maximum temperature rise of 176°C at 89 minutes into the test when installed in a 75mm thick Hebel PowerPanel wall system. With reference to Table B6, in FSP 2120 specimen 5, the $\frac{3}{8}$ inch & $\frac{3}{4}$ inch copper pair coil lagged in 9mm non-F/R lagging failed insulation at 82 minutes into the test when installed in a 90mm plasterboard system.

The significance of these tests demonstrated that the non-F/R PE lagging on the copper pipe can sustain the heat from a hot copper pipe for up to 181 minutes without causing flaming. Also, the $\frac{3}{8}$ inch copper pipe only reached a maximum of 177°C temperature rise at 124 minutes in a 116mm thick plasterboard wall system

The $\frac{3}{4}$ inch copper pipe failed insulation at 82 minutes in a 90mm thick plasterboard wall system and 99 minutes in a 75mm Hebel wall system. It is expected that the tested $\frac{3}{8}$ inch copper pipe will be cooler than the proposed $\frac{3}{4}$ inch copper pipe.

The photographic records of FSP 2126 specimen 5 and FSP 2058 specimen 5 show that the PE lagging softens and disintegrates when heated. This softening and disintegrating behaviour of the PE lagging would allow a thicker PE lagging to provide more thermo-insulation to the pipe such that during its softening phase, the temperature measured on a thicker PE lagged pipe would be lower than that of a thinner PE lagged pipe. Therefore the proposed $\frac{3}{4}$ inch pipe with a 5mm thick PE lagging than the tested 10mm PE lagging, would provide more insulation protection to the pipe.

Also with a 3°C margin at 124 minutes on the smaller $\frac{3}{8}$ inch copper pipe protected with 10mm PE lagging, it is expected that the proposed $\frac{3}{4}$ inch pipe protected with 15mm PE lagging, will also be able to maintain insulation for 120 minutes when installed in a minimum 116mm thick wall.

Based on the above, the proposed $\frac{3}{4}$ inch copper pipe lagged with at least 15mm PE foam lagging would maintain insulation for at least 120 minutes.

It is expected that the tested $\frac{3}{8}$ inch copper pipe will be hotter than the proposed $\frac{1}{4}$ inch copper pipes and therefore it is expected that the proposed $\frac{1}{4}$ inch pipe will also be able to maintain insulation for 120 minutes when installed in a minimum 116mm thick wall

Confidence in the 1mm reduction in PE thickness for the smaller $\frac{1}{4}$ inch pair coil pipe is provided by the 3°C margin in insulation performance at 124 minutes of the larger $\frac{3}{8}$ inch copper pipe in FSP 2126 specimen 5.

Based on the above, the proposed $\frac{1}{4}$ and $\frac{3}{8}$ inch copper pipe lagged with at least 9mm PE foam lagging would perform similarly in insulation performance as the tested $\frac{3}{8}$ inch lagged copper pipe

with 10mm PE lagging in FSP 2126 Specimen 5, and thus able to maintain insulation for at least 120 minutes.

A comparison of the heated behaviour of the PE foam lagging and the Thermotec E-flex ST FRV lagging would see Thermotec E-flex ST FRV lagging of the same thickness perform better in insulation performance than that of PE lagging as the F/R lagging tend to swell and melt rather than disintegrate. Therefore, it is expected that for smaller 3/8 and 1/4 inch copper pipe, a 9mm thick Thermotec E-flex ST FRV lagging would perform the same in insulation performance as the tested 3/4 inch lagged copper pipe with 9mm PE lagging as tested in FSP 2126 Specimen 5, and thus able to maintain insulation for at least 120 minutes.

It is expected that for medium size 3/8 and 3/4 inch copper pipe the proposed 25mm thick Thermotec E-flex ST FRV lagging would perform the same in insulation performance as the tested 3/4 inch lagged copper pipe with 9mm PE lagging as tested in FSP 2126 Specimen 5, and thus able to maintain insulation for at least 120 minutes. The proposed steel pipe is a poorer conductor compared to the tested copper pipe, and so is expected to perform better in insulation performance than the copper pipe discussed above.

The proposed construction also comprises 25mm foil faced Sekisui lagging (Thermobreak tube) with vertical joints taped and then two turns of radial tapes at 100mm centres, in replace of the Thermotec E-flex ST FRV lagging discussed above.

With reference to FSP 2206 specimen 7, a 1 inch copper pipe lagged with 25mm foil faced Sekisui lagging (Thermobreak tube) and was protected with an MS70R collar. It was able to maintain integrity for 181 minutes and failed insulation on the exposed pipe at 75 minutes. The lagging failed insulation at 161 minutes.

With reference to FSP 2213 specimen 2, a 1 inch copper pipe lagged with 25mm foil faced Sekisui lagging (Thermobreak tube) with tapped vertical joint and was protected with an MS70C collar. It failed integrity at 187 minutes and insulation on the lagging at 146 minutes.

Although the MS70C collar is different to the MS70R collar, the above two test specimens demonstrated that when 25mm foil faced Sekisui lagging (Thermobreak tube) is on hot copper pipe, it has a tendency to split open if not tapped along its vertical joint. It also demonstrated that the combination with hot copper pipe can lead to flaming failure of this lagging just after 180 minutes.

With reference to FSP 2188 specimen 2, a 1 inch copper pipe lagged with 25mm foil faced Sekisui lagging (Thermobreak tube) and was protected with an MS70R collar. It maintained integrity for 91 minutes and insulation on the top side of lagging at 46 minutes due to puffs of furnace gas through the gap created by shrunken lagging and collar. Aside from this puff of hot gas, the lagging measured a 168°C rise at 60 minutes. The thermocouple on the bottle side of the lagging was not significantly affected by hot gases for up to 60 minutes.

The significance of this test demonstrates the tendency for shrinkage of the Sekisui lagging which may lead to hot gas leaking to the unexposed side. The proposed construction comprises additional fire rated sealant between the wall opening and the pipe lagging. This will act to create a seal between the sagging lagging and increase the confidence in the lagging being able to maintain insulation without the effect of leaking furnace gas.

With reference to FSP 2126 specimen 1, a 1 inch copper pipe lagged with 19mm Thermotec E-flex ST FRV lagging and was protected with an MS70R collar. It maintained integrity for 181 minutes and failed insulation on the lagging at 123 minutes.

Comparing FSP 2126 specimen 1 and FSP 2206 specimen 7 it can be seen that where the lagging did not split the 25mm foil faced Sekisui lagging was more insulating than the 19mm Thermotec E-flex ST FRV lagging for up to 120 minutes. Therefore, it is reasonable to apply the performance of the Thermotec E-flex ST FRV lagging to 25mm foil faced Sekisui lagging (Thermobreak tube) taped with vertical joints. Based on the above discussion, it is expected that the proposed variation will not detrimentally affect the integrity and insulation performance of copper and steel pipes shown in Tables

B1, B2, and B3 when tested in accordance with AS 1530.4 -2014 and assessed in accordance with AS 4072.1 – 2005.

B.4 Variation to lagged PN12 PVC pipes in collars protecting openings in walls

The proposed variation comprises up to 32mm PN12 PVC pipe either 19-25mm Thermotec E-flex ST FRV lagging or 25mm foil faced Sekisui lagging (Thermobreak tube) with taped vertical joints and protected with MS70R collar as shown in Table 4.

Table B7: relevant test data for lagged copper pipes

Report	Pen. #	Collar Code	Element	Service	Integrity/ insulation (min.)	Maximum temperature rise on copper pipe
FSP 2206	9	MS70R	2x13mm plasterboard sheets on each side of a 64mm steel stud	32mm (42.2mm OD x 2.57mm) PN12 PVC Pipe with 19mm F/R lagging (Armaflex FRV nitrile rubber)	-/181NF/ 181NF	Pipe below 40oC for 180 minutes
FSP 2216	2	MS70R	1x13mm plasterboard sheets on each side of a 64mm steel stud	32mm (43.2mm OD x 2.2mm) PN12 PVC Pipe with 19mm F/R lagging (Armaflex FRV nitrile rubber)	-/91NF/71 (on the wall, 91 on the collar and 91NF on the pipe)	120°C rise on lagging at 120 minutes

With reference to Table B7, the MS70R collar was able to close off a lagged 32mm PN12 PVC pipe so that it does not fail integrity or insulation for up to 90 and 180 minutes.

This gives confidence that the MS70R collar will also be able to close off the proposed PN12 PVC pipe lagged with 19-25mm Thermotec E-flex ST FRV lagging or 25mm foil faced Sekisui lagging so that it maintains integrity and insulation for up to 180 minutes.

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

B.5 Variation to fixing of collars protecting openings in walls

The proposed construction includes the MS70R fire collars fixed to various substrates using these fixings listed in Table 5. With reference to test data in Appendix A, the tested MS70R collars were fixed to various substrates as summarised in Table B8 below.

Table B8: relevant test data for fixings

Report Reference	Substrate	Fixing	Fireside behaviour
FSP 1990	Double layered plasterboard lined stud wall	M4 expandable steel anchors	Held on
FSP 2049	Concrete slab	5-mm x 35-mm concrete screws	Held on
FSP 2058	Hebel Panel	14-10 65-mm hex head screws	Held on
FSP 2118	Hebel Panel	14-10 65-mm hex head screws	Held on

Report Reference	Substrate	Fixing	Fireside behaviour
FSP 2120	Single layered plasterboard lined stud wall	M4 expandable steel anchors	Some fell off, some held on
FSP 2126	Double layered plasterboard lined stud wall	M4 expandable steel anchors	Some fell off, some held on

Table B8 shows that the metal expandable steel anchors are effective fixings for holding MS70R collars in place on single or double-layered plasterboard wall systems. Even when the collars fell off, the activated intumescent in the exposed and unexposed side collars were able to provide a sufficient seal to the hole in the wall such that there was no flaming observed on the unexposed side in any of the tests.

The proposed FIRECRUNCH and Multiboard lined with metal expandable steel anchors are expected to also be able to behave similarly to the plasterboard wall in that they are both stud-lined wall systems. Table B8 shows that the 14-10 65mm Hex Head Screws are effective fixings for holding MS70R collar in place on Hebel wall systems such that no collar fell off. The proposed Speedpanel Wall with 14-10 65mm Hex Head Screws are expected to also be able to behave similarly to the Hebel wall in that they are both aerated core wall systems. Table B8 shows that the 5-mm x 35-mm concrete screws are effective fixings for holding the MS70R collar in place on a concrete slab such that the collar did not fall off.

The proposed concrete and masonry wall with 5mm x 30mm Concrete Screw Bolts is expected to also be able to behave similarly to the concrete slab in that they are solid ceramic substrates.

Based on the above discussion it is considered the proposed variation will not detrimentally affect the fire resistance of the tested collars if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005.

B.6 Variation to sealant around services in walls

The proposed variation comprises the Snap collars tested in Table 2, and subject to the following variations:

- Inclusion of Snap Fire Seal FRAS sealant to fill gaps when cable and services are protected by MS70R collar without PVC conduits.

With reference to Table A17, the presence of Snap Fire Seal FRAS which filled the gaps between cables and pair coils that penetrated the MS70R collar did not cause flaming for 180 minutes.

It is expected that when this sealant is applied to the gaps of other cable services that are protected by MS70R collar without PVC conduits, they will not detrimentally affect the integrity performance of the penetration.

The presence of sealant will act to prevent any venting of hot gas from the furnace side to the unexposed side, and thus it can slightly improve the insulation performance of the penetrations.

Based on the above discussion it is considered the proposed variation will not detrimentally affect the fire resistance of the tested collars if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005.

B.7 A mix of services within collar protecting openings in walls

The proposed variation comprises the Snap collars tested in Table 2, and subject to the following variations:

- Inclusion of mixed services from Tables 4 and 5 in MS70R collar

The proposed construction comprises mixing services from Table 4 and Table 5 into the MS70R collar when installed within one wall type.

In the referenced tests listed in Appendix A, none of the services failed integrity. It is expected that the mixing of the services will not detrimentally affect the integrity of these services.

The mode of failure for these services is only insulation failures. When the services are a mix, it is expected that the lowest performing services will determine the performance of the penetration.

Based on the above discussion it is considered the proposed variation will not detrimentally affect the integrity performance of the tested service penetrations, and will decrease the performance of the service penetration to the lowest performing service in the MS70R collar as discussed above if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005.

B.8 Variation to cables within collars protecting openings in floors

The proposed construction comprises MS70R collars as tested in Table 8, when either empty, filled partially or fully with services listed in Table 9

- Up to 100 x CAT5e cables
- Up to 60 x Cat6, Cat 7, RG6
- Up to 20 x 11mm and 10 x 6mm diameter Garland Optical Fibre cable
- Up to 3 x 6mm² 3C+E Cables 6 x 16mm² 3C+E Cables in collar

Table B9: Collar partially and when fully filled

Report	Pen. #	Collar Code	Element	Service	Details	Performance
FSP 2135	2	MS70R		Cat5 (approx. 100)	100% full	-/241NF/ 241NF
	3	MS70R		Cat5e (approx. 20)	20% full in 70mm diameter aperture Snap Fire Seal FRAS to fill large gap 6mm deep bead of sealant on 22mm diameter PE backing rod	-/241NF/ 241NF
	4	MS70R + SNAP H50S blank cast-in collar		60mm OD PN6 PVC Pipe	100% full	-/241NF/ 241NF
FSP 2203	5	MS70R	150mm Concrete Slab	20 x 11mm and 10 x 6mm diameter Garland Optical Fibre cable		-/241NF/ 237(slab)
FSP 2225	6	MS70R	150mm Concrete Slab	Bundle of 60 Category 7 network cables		-/241NF/ 160(CAT 7)

Report	Pen. #	Collar Code	Element	Service	Details	Performance
FSP 2135	5	MS70R	150mm Concrete Slab	3x6mm ² 3C+E power cables 6x16mm ² 3C+E power cables	A bead of sealant which the manufacturer has stated to be the identical to Snap Fire Seal FRAS	-/240/87 (16mm cable)

Collar partially or fully fill with CAT cables

With reference to the MS70R collar tested partially and fully filled with CAT7 cables in FSP 2225 Specimen 6, it demonstrated that the MS70R collars can close off when fully filled with CAT7 cables, and prevent integrity failure for at least 240 minutes. It also demonstrated that with many cable services in the collar, the maximum insulation performance of the specimen is at least 160 minutes. Therefore, when these cables are inside a PVC conduit, it is expected that they will achieve similar performances to when they were just in the collar without conduits.

The proposed reduction in the number of CAT7 cables from the 60 tested, will only improve the integrity performance of the penetration as there will be less plastic content to induce flaming on the unexposed side.

With reference to the MS70R collar tested partially and fully filled with CAT5e cables in FSP 2135 Specimen 2, it demonstrated that the MS70R collars can close off when fully filled with CAT5e cables, and prevent integrity failure for at least 240 minutes. It also demonstrated that with many cable services in the collar, the maximum insulation performance of the specimen is at least 240 minutes. Therefore, when these cables are inside a PVC conduit, it is expected that they will achieve similar performances to when they were just in the collar without conduits.

The proposed reduction in the number of CAT5e cables from the 100 tested, will only improve the integrity performance of the penetration as there will be less plastic content to induce flaming on the unexposed side. Confidence is found in FSP 2135 specimen 3 where only 20 x CAT5e cables were protected with an MS70R collar and were able to maintain integrity and insulation for up to 240 minutes.

The proposed CAT6 cables are of a smaller size than the CAT7 cables. Therefore, when the CAT6 cables substitute the tested CAT7 cables in a PVC conduit and are protected by an MS70R collar, there will be fewer plastic components. With 40 minutes margin in insulation performance, it is expected that CAT6 cables will be able to maintain insulation for up to 120 minutes.

The proposed RG6 cables are a similar size to the CAT7 cables, with a similar amount of sheathing, and contain a single 1mm diameter copper core. Therefore, when the RG6 cables substitute the tested CAT7 cables in a PVC conduit and are protected by an MS70R collar, there will be similar conductive material and a similar amount of plastic components. It is therefore expected that RG6 cables will perform similarly to CAT7 cables and be able to maintain insulation for up to 120 minutes.

Collar partially or fully fill with Fibre optic cables

With reference to FSP 2203 Specimen 5, it demonstrated that the MS70R collar can close off when fully filled with Garland Optical Fibre cables, and prevent integrity and insulation failure for at least 240 minutes on the cables.

Based on the above discussion, it is also expected that when the collar is partially filled with Garland Optical Fibre cables, it will also maintain integrity and insulation for up to 240 minutes.

Collar partially or fully fill with Power cables

With reference to FSP 2135 Specimen 5, it demonstrated that the MS70R collar can close off when fully filled with 3x6mm² 3C+E power cables and 6x16mm² 3C+E power cables, and prevent integrity failure for at least 240 minutes and insulation failure for at least 87 minutes.

Based on the above discussion, it is also expected that when the collar is partially filled with power cables, it will also maintain integrity and insulation for up to 240 and 60 minutes respectively.

Collar empty

When the collar is empty, there is a potential for furnace gas to escape the un-activated collar to ignite the cotton pad. However, from FSP 2135 specimen 4 which comprised an empty 50mm diameter PVC conduit, its collar was able to start closing off around 20 minutes into the test. It is expected at that time, the low temperature of the furnace gas is not enough to ignite a cotton pad through the hole in the 150mm thick slab. Therefore, it is expected that the empty MS70R collar will be able to maintain integrity and insulation for up to 240 minutes.

With reference to Table B1, these results demonstrated that when MS70R collars are partially or fully filled with various cables, the integrity performance of the penetrations was not affected by how much the collar is filled.

Based on the above discussion, it is expected that the proposed variation will not detrimentally affect the integrity and insulation performance of the services discussed above when tested in accordance with AS 1530.4 -2014 and assessed in accordance with AS 4072.1 – 2005.

B.9 Variation to cables in conduits within collars protecting openings in floors

The proposed construction comprises MS70R collars as tested in Table 8 when protecting 20mm to 50mm PVC conduits that are either empty, filled partially or fully with services listed in Table 9

- Up to 100 x CAT5e cables
- Up to 60 x Cat6, Cat 7, RG6
- Up to 20 x 11mm and 10 x 6mm diameter Garland Optical Fibre cable
- Up to 2 x 6mm² 3C+E Cables 2 x 16mm² 3C+E Cables in collar

Table B10: PVC conduit empty to fully filled and protected with collar

Report	Pen. #	Collar Code	Element	Service	Details	Performance
FSP 2135	1	MS70R + SNAP H50S blank cast-in collar	150mm Concrete Slab	60mm OD Medium Duty Conduit(continuous) filled with 2x6mm ² 3C+E power cables 2x16mm ² 3C+E power cables	100% full	-/241NF/ 241NF
	4	MS70R + SNAP H50S blank cast-in collar		60mm OD PN6 PVC Pipe	100% full	-/241NF/ 241NF
FSP 2174	5	MS70R	150mm Concrete Slab	60mm OD PVC Conduit (100mm above and below the slab) filled with 3x6mm ² 3C+E power cables 3x16mm ² 3C+E power cables	100% full	-/241NF/ 239(6mm cable)

Empty PVC conduit

FSP 2135 specimen 4 demonstrated that the MS70R collar can close off an empty 50mm PVC PN6 conduit with a wall thickness of 1.6mm and allow the specimen to maintain integrity and insulation for at least 240 minutes when installed in a 150mm thick concrete slab.

The small variation in the wall thicknesses of the proposed 50mm PVC pipe is also not expected to detrimentally affect the performance of the specimen. Further confidence in the MS70R to close off the proposed maximum PVC thickness of 3mm is found in FSP 2135 specimen 1 that demonstrated that the MS70R collar was able to close off a fully filled 50mm PVC conduit with a wall thickness of 2.7mm without integrity failure for 240 minutes. The proposed 20mm, 25mm, 32mm and 40mm PVC conduits pipe, with wall thickness similar to that tested in FSP 2135 specimen 1, is expected to behave similarly to the tested 50mm PVC pipe.

Based on the above, it is expected that the proposed empty 20mm to 50mm PVC conduits as shown in Table 9 when installed in slabs as listed in Table 11, will be able to achieve integrity and insulation of up to 240 minutes based on design.

Partial to full fill of conduit

With reference to the PVC conduits tested filled with power cables in FSP 2174 specimen 5, it demonstrated that the MS70R collars can close off the PVC conduit when filled with large cable services and prevent integrity failure for at least 240 minutes. It also demonstrated that with 3x6mm² 3C+E and 3x16mm² 3C+E power cables cable services in the conduit, the maximum insulation performance of the specimen is at least 180 minutes.

The proposed reduction in the number of power cable services and the smaller cables will only improve the integrity and insulation performance of the penetration as there will be less plastic content which reduces flaming risk and less copper content to conduct heat to the unexposed side.

Based on the above discussion, it is expected that the proposed variation will be able to achieve integrity and insulation performance for up to 240 minutes and 180 minutes respectively based on design when tested in accordance with AS 1530.4 -2014 and assessed in accordance with AS 4072.1 – 2005.

B.10 Variation to lagged metal pipes within collars protecting openings in floors

The proposed construction comprises MS70R collars as tested in Table 8, when protecting PN12 PVC pipes, copper and steel pipe of various sizes are protected with various types and thicknesses of lagging as shown in Table 10.

Table B11: relevant test data for lagged pipes

Report	Pen. #	Collar Code	Element	Service	Details	Performance
FSP 2225	4	MS70R	150mm Concrete Slab	DN 25 (Type B 25.4mm OD x 1.22mm) copper pipe with 19-mm thick E-Flex ST Nitrile Foam lagging and a 2.5-mm ² 3-core TPS power cable	NA	-/241NF/ 141(E-flex)
FSP 2225	5	MS70R	150mm Concrete Slab	DN 25 (Type B 25.4mm OD x 1.22mm) copper pipe with 19-mm thick Armaflex FRV nitrile rubber lagging and a 2.5-mm ² 3-core TPS cable	NA	-/241NF/ 118 (TPS cable)

Report	Pen. #	Collar Code	Element	Service	Details	Performance
FSP 2231	2	MS70R	150mm Concrete Slab	DN 25 (Type B 25.4mm OD x 1.22mm) copper pipe with 19 mm thick SuperMax foam lagging and a 2.5-mm ² 3-core TPS power cable	A bead of sealant which the manufacturer has stated to be the identical to Snap Fire Seal FRAS	-/241NF/115(cable) 120 (lagging)
FSP 2231	5	MS70R	150mm Concrete Slab	DN 25 (Type B 25.4mm OD x 1.22mm) copper pipe with 19 mm thick K-Flex ST Foam lagging and a 2.5-mm ² 3-core TPS power cable	67 mm diameter aperture A bead of sealant which the manufacturer has stated to be the identical to Snap Fire Seal FRAS	-/241NF/85 (exposed copper pipe)
FSP 2174	4	MS70R	150mm Concrete Slab	1in copper pipe(1.4mm) with 19mm F/R lagging (F/R ArmaFlex) and a 2.5mm ² 3C TPC Cable	100% full	-/240/116 (rover on copper pipe)
FSP 2231	6	MS70R	150mm Concrete Slab	DN20 (Type B 19.5mm OD x 1.02mm) copper pipe with 9 mm thick Armaflex FRV nitrile rubber lagging and a 2.5-mm ² 3-core TPS power cable	67 mm diameter aperture 10mm deep sealant which the manufacturer has stated to be the identical to Snap Fire Seal FRAS	-/241NF/189 (lagging)
FSP 2225	2	MS70R	150mm Concrete Slab	32mm PN12 uPVC pipe (42.3-mm OD x 2.6mm) with 19-mm thick Armaflex FRV nitrile rubber lagging	NA	-/241NF/241NF
FSP 2174	3	MS70R	150mm Concrete Slab	65mm PVC Pipe (100mm above slab) (2.62mm) filled with 1in copper pipe(1.4mm) with 19mm F/R lagging (F/R ArmaFlex) and a 2.5mm ² 3C TPC Cable	PVC 100mm above slab	-/240/100 (lagging above conduit) (188 on conduit)
FSP 2213	2	MS70C	150mm Concrete Slab	1in copper pipe (25.6mm x 1.35mm) with 25mm foil faced Sekisui PE lagging (Thermobreak tube) with tapping along the vertical joint	100% full	-/187(flame)/146 (foil lagging)

Lagged copper and steel pipes up to 1 inch in diameter

With reference to Table B3, 1 inch diameter copper pipes were lagged with 19mm thick K-flex, E-flex, Supermax and Armaflex lagging. Except for Sekisui PE lagging, the rest of the lagging was able to maintain integrity for up to 240 minutes when tested in a 150mm thick slab.

The different lagging demonstrated different abilities to insulate the hot copper pipe. All of the lagging also displayed a tendency to split and expose the hot copper pipe.

It is expected the proposed smaller 1/4 inch to 3/4 inch lagged copper pipes will perform better insulation wise compared to the tested 1 inch pipe due to the reduction in cross-sectional conduction area. This is evident in the tested 3/4 inch pipe in FSP 2231 specimen 6 which was lagged with thinner 9mm Armaflex lagging and yet perform better insulation wise than the 1 inch copper pipe lagged with 19mm thick Armaflex in FSP 2174 specimen 4.

Given the large difference in insulation performance of the 3/4 inch Armaflex lagged copper pipes compared to the 1 inch Armaflex lagged copper pipes, it is reasonable for the proposed K-flex, E-flex, and Supermax lagging when protecting a smaller 3/4 inch copper pipe would also have some margin over insulation such that it will be no less than the insulation performance of these brands of lagging protecting the 1 inch copper pipe.

Based on the above, the proposed 1/4 inch to 3/4 inch copper pipe lagged with 9-25mm lagging would perform better in terms of insulation performance than the tested 1 inch lagged copper pipe with the various branded F/R lagging, and thus be able to maintain insulation for at least 120 minutes based on design.

The proposed steel pipe would have less conductivity compared to the copper pipe, so it is reasonable to apply the result of the copper pipe to the steel pipe.

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

Lagged PN12 PVC pipes

With reference to FSP 2225 specimen 2, a 32mm PN12 PVC pipe was lagged with 19mm thick Armaflex lagging and protected with an MS70R collar. The specimen did not fail integrity or insulation for up to 240 minutes. The lagging remains below 60oC for the duration of the test. This demonstrates that the MS70R collar when able to close off the lagged PVC pipe such as the pipe lagging above the intumescent is not exposed to direct flame, the lagging will not flame and remain cool for up to 240 minutes. This behaviour is expected of the other proposed brands of lagging.

The proposed smaller pipes between 16mm-32mm will not detrimentally affect the ability of the collar to close off due to the spring loaded mechanism of the MS70R collar.

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

Lagged pair coil installation bundles with copper pipes up to 3/4inch in diameter

The proposed pair coil installation bundles would comprise one up to 25mm PVC pipe, one 2.5-mm² 3-core TPS power cable and two copper pipes of either ¼ inch & 3/8 inch or 3/8 inch & ¾ inch.

As discussed above, the MS70R collar is able to close off PVC pipes for up to 240 minutes. It is also demonstrated above the ability for various lagging to protect copper pipes up to ¾ inch in size. Therefore the limiting factor for the lagged pair coil installation bundle is the presence of the TPS cable.

With reference to Table B11, the TPS cables tested with a lagged metal pipe and protected with MS70R collars were able to maintain insulation between 90-120 minutes. Therefore, it is expected that the presence of a TPS cable will not detrimentally affect the insulation of the proposed paircoil configuration for up to 90 and 120 minutes based on design.

Inclusion of Sekisui lagging (Thermobreak tube)

The proposed construction comprises Sekisui lagging in place of the lagging discussed above for the lagged metal pipes, PVC pipes and pair coil installation.

With reference to FSP 2213 specimen 2, the 1 inch pipe was lagged with 25mm thick Foil Faced Sekisui foam lagging and protected with an MS70C collar. The lagging flamed at 187 minutes and had similar insulation performance to the other brands of lagging when the difference in thicknesses is factored in.

Although the MS70C collar is different from the proposed MS70R collar, it demonstrated that provided the collar intumescent can close off around the pipe for up to 180 minutes, Sekisui lagging will not flame for up to 180 minutes.

Given the margin in insulation performance of the other brands of lagging when applied to the proposed types of construction, it is expected that the proposed substitution with Foil Faced Sekisui foam lagging would not detrimentally affect the performance of the proposed metal pipe constructions for up to 180 minutes in integrity and 120 minutes in insulation and not detrimentally affect the performance of the proposed PVC pipe constructions for up to 180 minutes in integrity and insulation.

Based on the above discussion, it is expected that the proposed variation will be able to achieve integrity and insulation performance for up to 180 minutes based on design when tested in accordance with AS 1530.4 -2014 and assessed in accordance with AS 4072.1 – 2005.

B.11 Variation in the thickness of slabs

The proposed construction comprises an MS70R collar as tested in Table 8, with the variations as discussed above when penetrating a 150mm or 175mm thick slab.

The discussions above are for specimens tested in a 150mm thick slab. The proposed 175mm slab is thicker and thus has more heat sink effect than the 150mm slab, and therefore the results of the pipes tested in the 150mm thick slab also apply to the 175mm slab. It is therefore expected that the pipes installed in a 170mm thick slab will be able to maintain insulation for up to 240 minutes.

Confidence in the ability of the concrete slab to perform for the required FRL is offered by reference to AS 3600-2018 clause 5.5, where the required floor thicknesses by that standard are the same as those proposed for the given FRL.

B.12 Confirmation of spacing of services and in slabs

The proposed construction comprises MS70R collars as tested in Table 8, with the variations discussed above and subjected to the following variation:

- The collar to collar spacing in the substrate shall be at least 40mm as shown in Figure 6.

AS 4072.1 -2005 clause 4.9.3 states that “the minimum distance between penetrations in a modular system shall be not less than 40 mm unless otherwise tested in specimen form.” It is noted also in clause 1.4.10 which defines a “penetration” as “An aperture through a fire-separating element for the passage of a service or services”

Based on the above, it is considered that AS 4072.1 -2005 Amdt 1 clause 4.9.3 applies to the specimens considered in this assessment and the proposed spacing in figure 6 and 7 meet the minimum aperture to aperture spacing of the proposed specimens is 40mm.

B.13 Variation to sealant around services protecting openings in floors

The proposed variation comprises the MS70R collar as tested in Table 8, with the variations as discussed above and subjected to the following variation:

- Inclusion of Snap Fire Seal FRAS sealant to fill gaps when cable and services are protected by MS70R collar without PVC conduits as per Tables 9 and 10

With reference to Table A18, the presence of Snap Fire Seal FRAS which filled the gaps between power cables and pair coils that penetrated the MS70R collar did not cause flaming for 240 minutes.

It is expected that when this sealant is applied to the gaps of other cable services that are protected by MS70R collar without PVC conduits, they will not detrimentally affect the integrity performance of the penetration.

The presence of sealant will act to prevent any venting of hot gas from the furnace side to the unexposed side, and thus it can slightly improve the insulation performance of the penetrations.

Based on the above discussion it is considered the proposed variation will not detrimentally affect the fire resistance of the tested collars if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005.

B.14 A mix of services within collar protecting openings in floors

The proposed variation comprises the MS70R collar as tested in Table 8, with the variations as discussed above and subjected to the following variation:

- Inclusion of mixed services from Table 9 in an MS70R collar

The proposed construction comprises mixing services from Table 9 in an MS70R collar when installed within one wall type.

In the referenced tests listed in Appendix A, none of the cable services failed integrity for up to 240 minutes. It is expected that the mixing of the services will not detrimentally affect the integrity of these services.

The mode of failure for these services is only insulation failures. When the services are a mix, it is expected that the lowest performing services will determine the performance of the penetration.

Based on the above discussion it is considered the proposed variation will not detrimentally affect the integrity performance of the tested service penetrations, and will decrease the performance of the service penetration to the lowest performing service in the MS70R collar as discussed above if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005.

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