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Fire resistance of SNAP retrofit fire collars protecting various pipe penetrations in accordance with AS 1530.4-2014 and AS 4072.1-2005

Assessment Report

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Copyright and disclaimer

Important disclaimer

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1 Introduction

This report is an assessment of the fire resistance of a SNAP retrofit fire collars protecting various pipe penetrations in a Hebel wall when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005.

This report is prepared for the purpose of meeting the requirements of NCC 2019 Volume 1 Schedule 5 clauses 2b) and 2 c) or 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.

2 Supporting Data

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

Report Reference	Test Standard	Outline of Test Specimen
FSP 1783	AS 1530.4-2014	A fire resistance test on Snap Retrofit Fire Collars protecting a 75-mm thick Hebel autoclaved aerated concrete (AAC) panel wall system penetrated by 9 pipes
FSP 1807	AS 1530.4-2014	A fire resistance test on Snap Retrofit Fire Collars protecting a 75-mm thick Hebel autoclaved aerated concrete (AAC) panel wall system penetrated by 9 pipes
FSP 1822	AS 1530.4-2014	A fire resistance test on Snap Retrofit Fire Collars protecting a 75-mm thick Hebel autoclaved aerated concrete (AAC) panel wall system penetrated by 8 pipes

The reports FSV 1783 and FSP 1807 were undertaken by CSIRO and sponsored by Snap Fire Systems who has provided permission for CSIRO to refer to these reports in this assessment.

The report FSV 1822 was undertaken by CSIRO and sponsored by IG6 Pty Ltd.

This assessment is based on the test data listed above and it is confirmed that the parts of these test results relied upon in this assessment are equivalent to or more severe to that required by referenced test standard in Section 4 of this report.

3 Proposed Variations

The proposed construction includes the pipes and Snap retrofit fire collars tested in FSP 1783, FSP 1807 and FSP 1822 and subject to the following variations:

- The inclusion of single leaf 75mm or thicker Hebel Panel wall that is supported by a test or assessment as a wall and FRL of -/120/120
- Collars are as per Figures 1-6

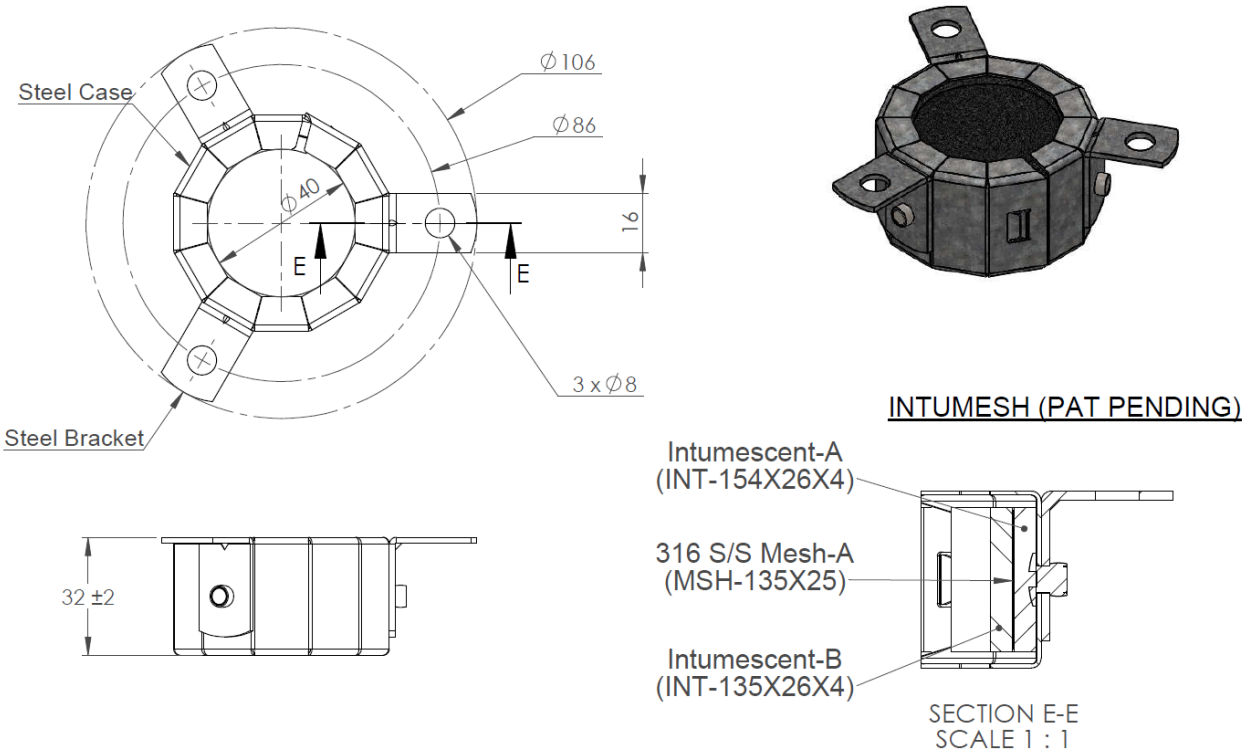

Figure 1: SNAP 32R collar

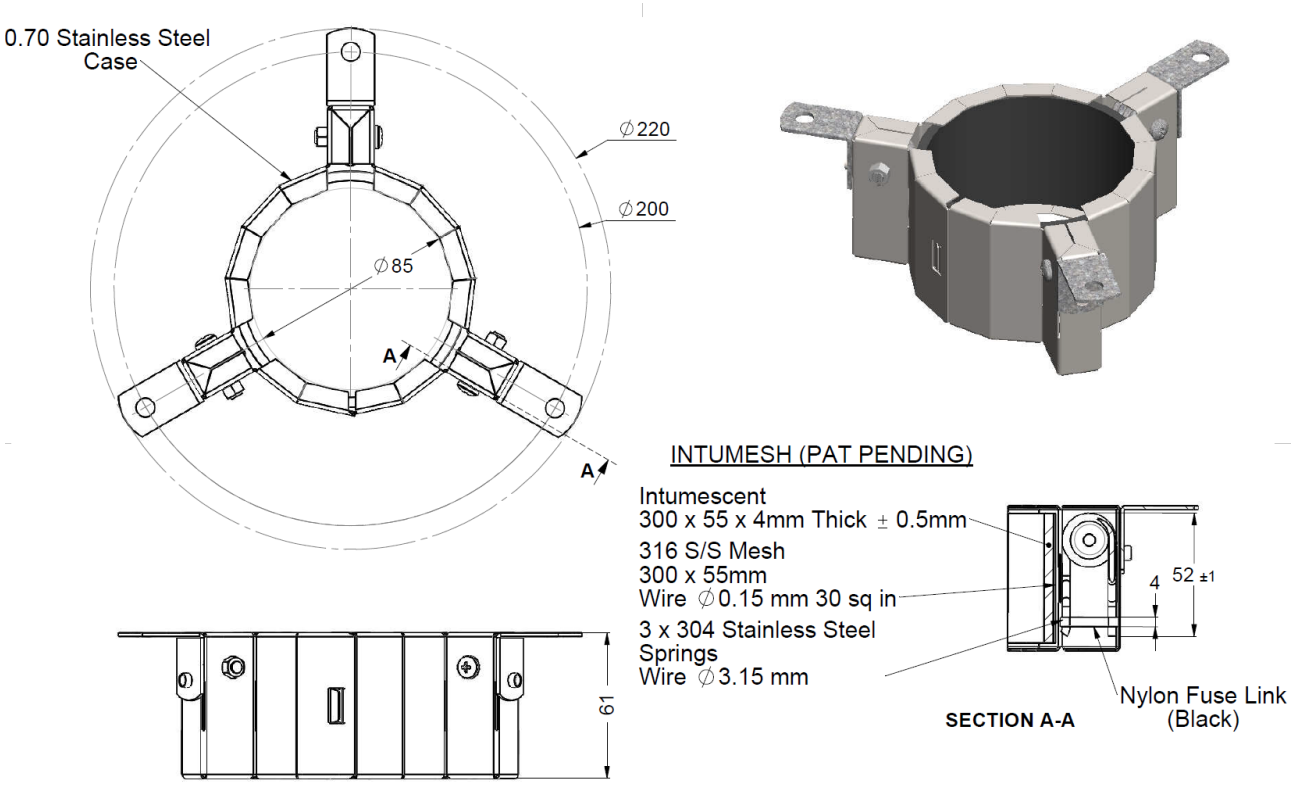

Figure 2: SNAP LP65R collar

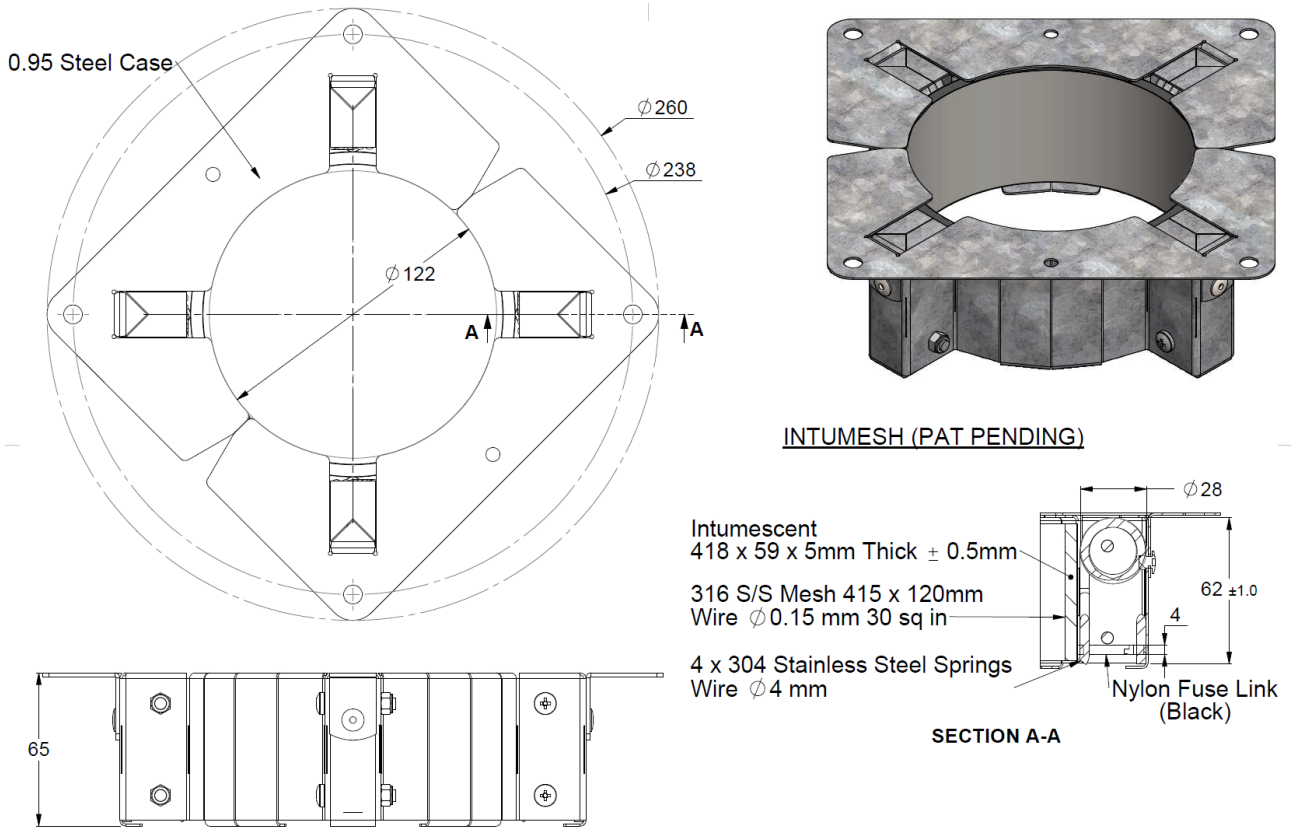

Figure 3: SNAP LP110R-D collar

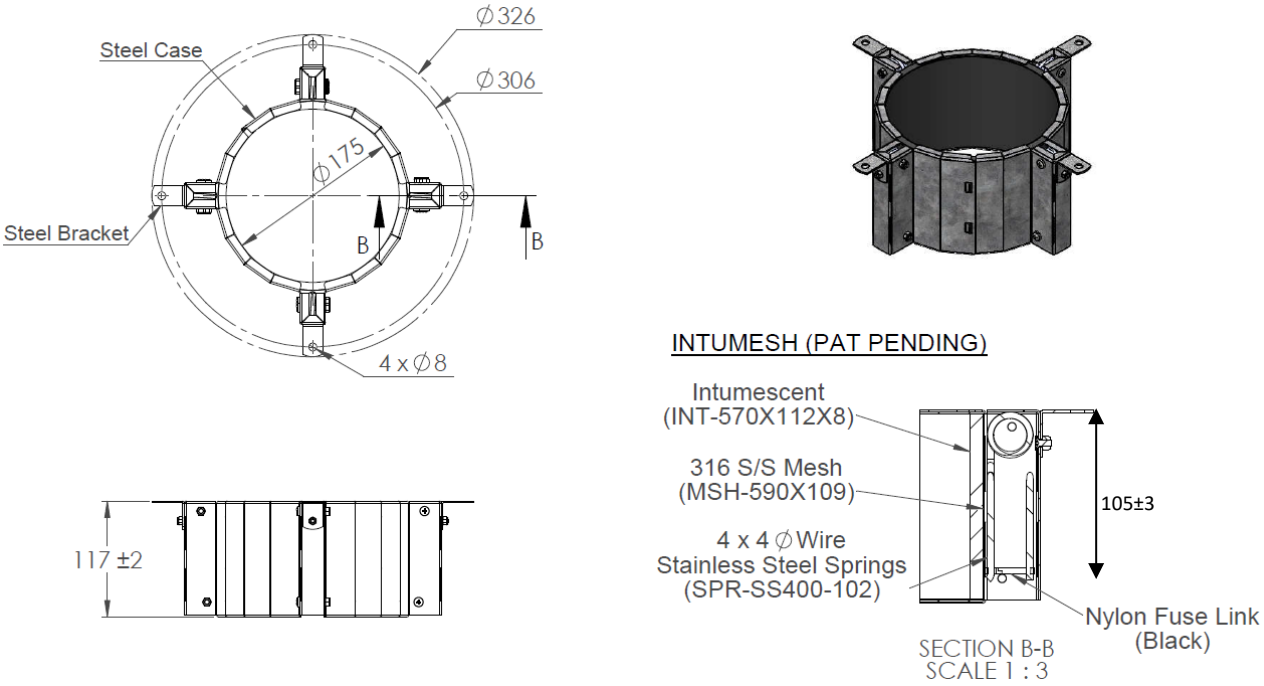

Figure 4: SNAP HP150R collar

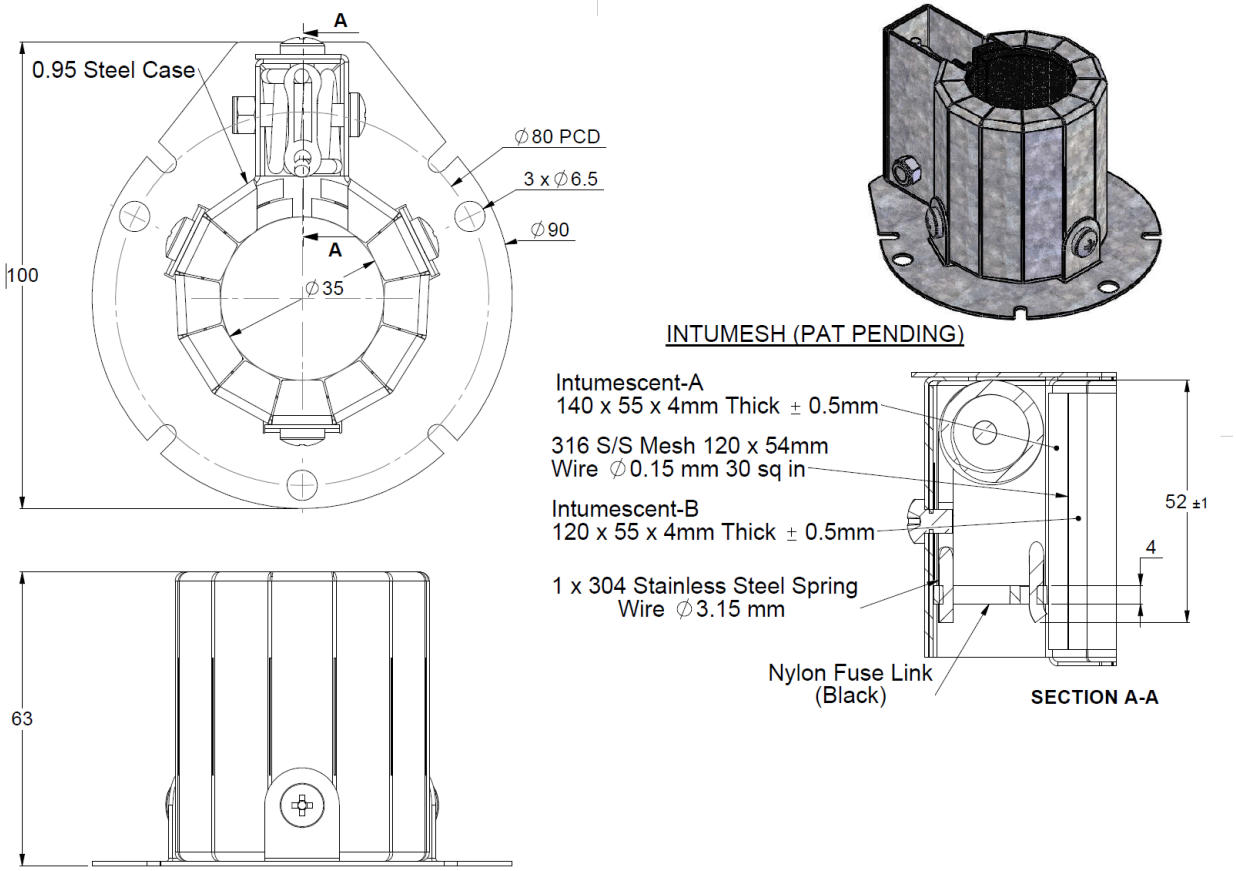

Figure 5: SNAP GAS32 collar

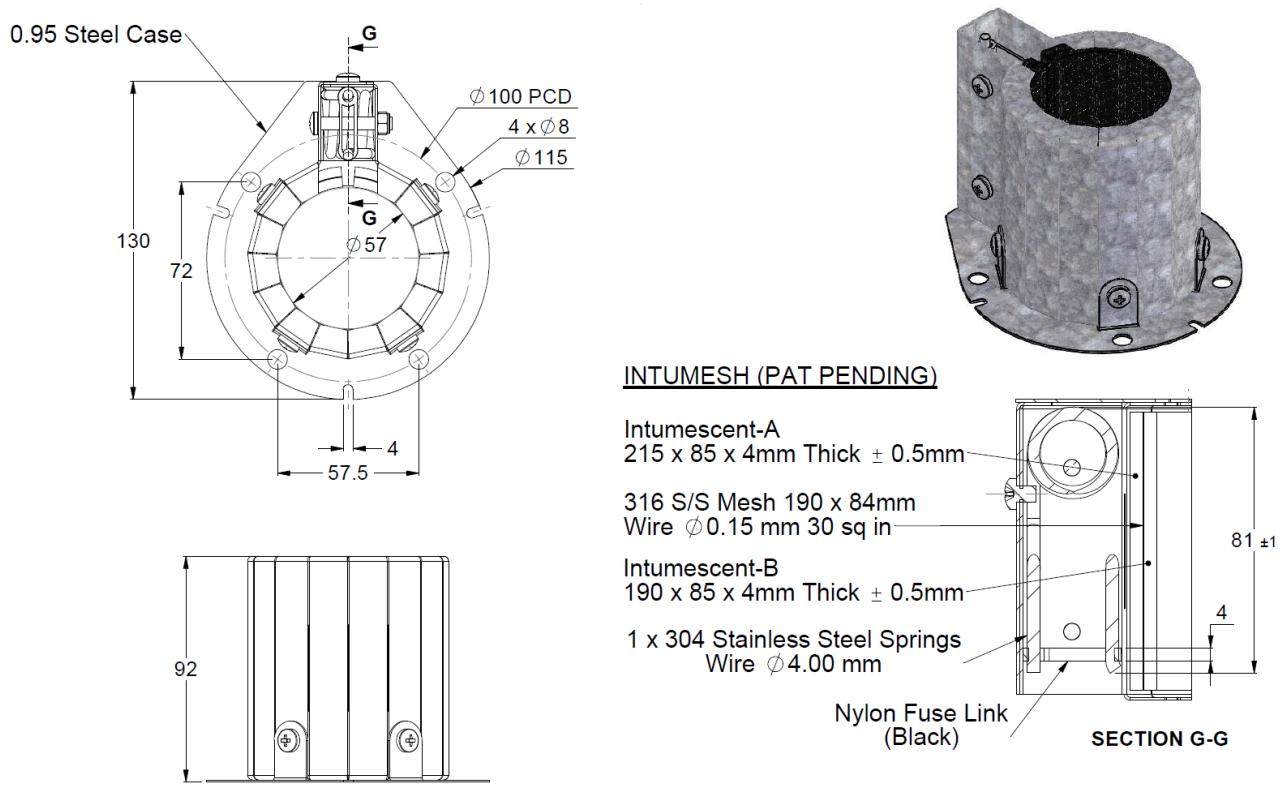

Figure 6: SNAP GAS50 collar

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.
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 1: FRL of pipe penetration protected by Snap retrofit collars

Penetration	Collar Name	Pipe Size	Pipe Material + filling	FRL	Figures	Substrate
PVC conduit	32R	27	PVC	-/120/120	1-6	A single leaf min.75mm Hebel Panel wall that is supported by a test or assessment as a wall and FRL of -/120/120
	32R	20	PVC	-/120/120		
PVC conduit with cables	32R	20	PVC + 3 core cables	-/120/120		
	32R	25	PVC + 3 core cables	-/120/120		
PVC pipe	LP65R	40	PVC + fitting	-/120/120		
	LP65R	50	PVC+ fitting	-/120/120		
	LP65R	65	PVC+ fitting	-/120/120		
	LP100R-D	80	PVC + fitting	-/120/120		
	LP100R-D	100	PVC + fitting	-/120/120		
	HP150R	150	PVC + fitting	-/120/120		
HDPE pipe	LP65R	32	HDPE	-/120/120		
	LP65R	63	HDPE	-/120/120		
	LP100R-D	75	HDPE	-/120/120		
	LP100R-D	110	HDPE	-/120/120		
	HP150R	160	HDPE	-/120/120		
Px-Al-Px pipe	GAS32	16	Px-Al-Px	-/120/120		
	GAS32	20	CXL Px-Al-Px	-/120/120		
	GAS32	25	CXL Px-Al-Px	-/120/120		
	GAS32	32	CXL Px-Al-Px	-/120/120		
	GAS50	50	Px-Al-Px	-/120/60		
Pex-b pipe	32R	16	Pex-b	-/120/120		
	32R	20	Pex-b	-/120/120		
	32R	32	Pex-b	-/120/120		
Raupiano pipe	LP65R	50	Raupiano	-/120/120		
	LP100R-D	110	Raupiano	-/120/120		

6 Direct Field of Application of Results

The results of this report are applicable to walls exposed to fire from either side.

7 Requirements

It is required that the supporting construction is tested or assessed to achieve the required FRL in accordance with AS 1530.4.It is also required that the supporting construction be designed to include an aperture while maintaining the required FRL.

Any variations with respect to 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 30th November 2028. 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. CSIRO Sponsored Investigation report numbered FSV 1783

On the 7 November 2016, this Division conducted a full-scale fire-resistance test in accordance with AS 1530.4 -2014 on a 75-mm thick Hebel autoclaved aerated concrete (AAC) panel wall system with an established fire resistance level (FRL) of -/90/90 as detailed in CSIRO test report FSV 0979. The wall was penetrated by nine (9) pipes protected by a retro-fitted Snap Fire Systems fire collar.

For the purpose of the test, the specimens were referenced as Penetrations # 1, 2, 3, 4, 5, 6, 7, 8 and 9.

Penetration # 1 – LP65R Retrofit fire collar protecting a nominal 32-mm High-density polyethylene (HDPE) Pipe

The SNAP Retrofit LP65R fire collar comprised a 0.7-mm stainless steel casing with an 85 mm inner diameter and a 222-mm diameter base flange. The 61-mm high collar casing incorporated a 300 mm x 55 mm x 4-mm thick Intumesh intumescent material. The closing mechanism comprised three stainless steel springs, with nylon fuse links and a 300 mm x 55-mm stainless steel mesh as shown in drawing numbered LP65R-T dated 13 June 2014, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 40-mm HDPE Pipe, with a wall thickness of 3.4 mm penetrating the wall through a 44-mm diameter cut-out hole as shown in drawing titled “Test Wall W-16-C Penetration # 1, 32-mm HDPE Pipe – LP65R Retrofit Collar, dated 15 October 2016”. The pipe incorporated an HDPE Coupling located on the exposed side of the wall. The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 2 – 32R Retrofit fire collar protecting a nominal 16-mm Pex-B Pipe

The 32R Retrofit collar comprised a 0.75-mm steel casing with a 40 mm inner diameter and a 106 mm diameter base flange. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 16-mm OD Pex-B Pipe, with a wall thickness of 2.5 mm fitted through the collar’s sleeve and penetrating the wall through a 20-mm diameter cut-out hole as shown in drawing titled “Test Wall W-16-C Penetration # 2, 16-mm Pex-B Pipe – 32R Collar, dated 15 October 2016”. The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 3 – LP100R-D Retrofit fire collar protecting a nominal 100-mm Polyvinyl Chloride (PVC-SC) Pipe with fitting inside the collar

The SNAP Retrofit LP100R-D collar comprised a 0.95-mm thick steel casing with a 122 mm inner diameter and a 260-mm x 260-mm square base flange. The 65-mm high collar casing incorporated a layer of 418 mm x 59 mm x 5-mm thick Intumescent material. The closing mechanism comprised 4 x 304 stainless steel springs bound with black nylon fuse links and a 316 stainless steel mesh measuring 415 x 120-mm as shown in drawing numbered LP100R-D-T dated 2 November 2016, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 110-mm OD PVC-SC Pipe, with a wall thickness of 3.5 mm fitted through the collar's sleeve and penetrating the wall through a 114-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-C Penetration # 3, 100-mm PVC-SC Pipe – LP100R-D Retrofit Collar – Fitting Inside Collar, dated 15 October 2016". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe incorporated a PVC Coupling located on the exposed side of the wall, fitted within the fire collars sleeve. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a PVC End Cap.

Penetration # 4 – LP65R Retrofit fire collar protecting a nominal 40-mm Polyvinyl Chloride (PVC) with fitting inside the collar

The SNAP Retrofit LP65R fire collar comprised a 0.7-mm steel casing with an 85 mm inner diameter and a 222-mm diameter base flange. The 61-mm high collar casing incorporated a 300 mm x 55 mm x 4-mm thick Intumesh intumescent material. The closing mechanism comprised three stainless steel springs, with nylon fuse links and a 300 mm x 55-mm stainless steel mesh as shown in drawing numbered LP65R-T dated 13 June 2014, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 43-mm OD PVC pipe, with a wall thickness of 2.1 mm fitted through the collar's sleeve and penetrating the wall through a 48-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-C Penetration # 4, 40-mm PVC Pipe – LP65R Retrofit Collar, dated 15 October 2016". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe incorporated a PVC Coupling located on the exposed side of the wall, fitted within the fire collars sleeve. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a PVC End Cap.

Penetration # 5 – LP65R Retrofit fire collar protecting a nominal 65-mm Polyvinyl Chloride (PVC) with fitting inside the collar

The SNAP Retrofit LP65R fire collar comprised a 0.7-mm steel casing with an 85 mm inner diameter and a 222-mm diameter base flange. The 61-mm high collar casing incorporated a 300 mm x 55 mm x 4-mm thick Intumesh intumescent material. The closing mechanism comprised three stainless steel springs, with nylon fuse links and a 300 mm x 55-mm stainless steel mesh as shown in drawing numbered LP65R-T dated 13 June 2014, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 69-mm OD PVC pipe, with a wall thickness of 3.2 mm fitted through the collar's sleeve and penetrating the wall through a 76-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-C Penetration # 5, 65-mm PVC Pipe – LP65R Retrofit Collar, dated 15 October 2016". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe incorporated a PVC Coupling located on the exposed side of the wall, fitted within the fire collars sleeve. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a PVC End Cap.

Penetration # 6 – 32R Retrofit fire collar protecting a 20-mm Polyvinyl Chloride (PVC) Conduit filled with 3-Core Cable

The SNAP Retrofit 32R fire collar comprised a 0.75-mm steel casing with a 40 mm inner diameter fitted with three fixing tabs. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 20-mm PVC Conduit filled with 3-Core Cable, with a wall thickness of 2.2 mm fitted through the collar's sleeve and penetrating the wall through a 25-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-C Penetration # 6, 20-mm PVC Conduit – 32R Retrofit Collar – Filled with 3-Core Cable, dated 15 October 2016". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 7 – LP100R-D Retrofit fire collar protecting a 110-mm High-density polyethylene (HDPE) Pipe

The SNAP Retrofit LP100R-D collar comprised a 0.95-mm thick steel casing with a 122 mm inner diameter and a 260-mm x 260-mm square base flange. The 65-mm high collar casing incorporated a layer of 418 mm x 59 mm x 5-mm thick Intumescent material. The closing mechanism comprised 4 x 304 stainless steel springs bound with black nylon fuse links and a 316 stainless steel mesh measuring 415 x 120-mm as shown in drawing numbered LP100R-D-T dated 2 November 2016, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 110-mm OD HDPE pipe, with a wall thickness of 4.6 mm fitted through the collar's sleeve and penetrating the wall through a 114-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-C Penetration # 7, 110-mm HDPE Pipe – LP100R-D Retrofit Collar, dated 15 October 2016". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber.

The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 8 – GAS32 retrofitted fire collar protecting a nominal 16-mm Px-Al-Px Pipe

The GAS32 Retrofit collar comprised a 0.95-mm thick galvanised steel casing with a 35 mm inner diameter and a 90-mm diameter base flange. The 63-mm high collar casing incorporated a layer of 140 mm x 55 mm x 4-mm thick Intumescent material and a layer of 120 mm x 55 mm x 4-mm thick Intumescent material. The closing mechanism comprised 1 x 304 stainless steel spring bound with a black nylon fuse link and a 316 stainless steel mesh measuring 120 x 54-mm as shown in drawing numbered GAS32-T dated 14 September 2016, by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 16-mm OD Px-Al-Px Pipe, with a wall thickness of 2.3 mm fitted through the collar's sleeve and penetrating the wall through a 20-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-C Penetration # 8, 16-mm Px-Al-Px Pipe – GAS32 Retrofit Collar, dated 15 October 2016". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 9 – LP65R retrofitted fire collar protecting a nominal 50-mm Polyvinyl Chloride (PVC) Pipe with fitting inside the collar

The SNAP Retrofit LP65R fire collar comprised a 0.7-mm steel casing with an 85 mm inner diameter and a 222-mm diameter base flange. The 61-mm high collar casing incorporated a 300 mm x 55 mm x 4-mm thick Intumesh intumescent material. The closing mechanism comprised three stainless steel springs, with nylon fuse links and a 300 mm x 55-mm stainless steel mesh as shown in drawing numbered LP65R-T dated 13 June 2014, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 56-mm OD PVC pipe, with a wall thickness of 2.4-mm fitted through the collar's sleeve and penetrating the wall through a 64-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-C Penetration # 9, 50-mm PVC Pipe – LP65R Retrofit Collar, dated 15 October 2016". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe incorporated a PVC Coupling located on the exposed side of the wall, fitted within the fire collars sleeve. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a PVC End Cap.

The test results are summarised in the table below:

Test Report	Specimen ID	Collar Name	Pipe Size	Pipe Material	FRL
FSP1783	1	LP65R	32	HDPE	-/121/114
	2	32R	16	Pex-B	-/121/121
	3	LP100R-D	100	PVC + fitting	-/121/117
	4	LP65R	40	PVC + fitting	-/121/121
	5	LP65R	65	PVC+ fitting	-/121/102
	6	32R	20	PVC + 3 core cables	-/121/121
	7	LP100R-D	110	HDPE	-/121/121
	8	GAS32	16	Px-Al-Px	-/121/121
	9	LP65R	50	PVC+ fitting	-/121/121

A.2. CSIRO Sponsored Investigation report numbered FSV 1807

On the 18 January 2017, this Division conducted a full-scale fire-resistance test in accordance with AS 1530.4 -2014 on a 75-mm thick Hebel autoclaved aerated concrete (AAC) panel wall system with an established fire resistance level (FRL) of -/90/90 as detailed in CSIRO test report FSV 0979. The wall was penetrated by nine (9) pipes protected by a retro-fitted Snap Fire Systems fire collar.

For the purpose of the test, the specimens were referenced as Penetrations # 1, 2, 3, 4, 5, 6, 7, 8 and 9. Eight specimens are included in this report (Penetration # 1, 2, 3, 4, 5, 7, 8 and 9).

Penetration # 1 – LP100R-D Retrofit fire collar protecting a nominal 75-mm High-density polyethylene (HDPE) Pipe

The SNAP Retrofit LP100R-D collar comprised a 0.95-mm thick steel casing with a 122 mm inner diameter and a 195-mm x 195-mm square base flange. The 65-mm high collar casing incorporated a layer of 418 mm x 59 mm x 5-mm thick Intumescent material. The closing mechanism comprised 4 x 304 stainless steel springs bound with black nylon fuse links and 316 stainless steel mesh measuring 415 x 120-mm as shown in drawing numbered LP100R-D-T dated 10 February 2017, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 75-mm HDPE Pipe, with a wall thickness of 3.5 mm penetrating the wall through a 79-mm diameter cut-out hole as shown in drawing titled “Test Wall W-16-D Penetration # 1, 75-mm HDPE Pipe – LP100R-D Retrofit Collar, dated 6 February 2017”, by Snap Fire Systems Pty Ltd. The pipe incorporated an HDPE Coupling located on the exposed side of the wall. The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 2 – LP65R Retrofit fire collar protecting a 63-mm High-density polyethylene (HDPE) Pipe

The SNAP Retrofit LP65R fire collar comprised a 0.7-mm stainless steel casing with an 85 mm inner diameter and a 222-mm diameter base flange. The 61-mm high collar casing incorporated a 300 mm x 55 mm x 4-mm thick Intumesh intumescent material. The closing mechanism comprised three stainless steel springs, with nylon fuse links and a 300 mm x 55-mm stainless steel mesh as shown in drawing numbered LP65R-T dated 13 June 2014, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 63-mm HDPE Pipe, with a wall thickness of 3.5 mm penetrating the wall through a 67-mm diameter cut-out hole as shown in drawing titled “Test Wall W-16-D Penetration # 2, 63-mm HDPE Pipe – LP65R Retrofit Collar, dated 6 February 2017”. The pipe incorporated an HDPE Coupling located on the exposed side of the wall. The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 3 – 32R Retrofit fire collar protecting a nominal 25-mm Polyvinyl Chloride (PVC) Conduit with 3-Core Cable

The 32R Retrofit collar comprised a 0.75-mm steel casing with a 40 mm inner diameter and a 106 mm diameter base flange. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 25-mm PVC Conduit with 3-Core Cable, with a wall thickness of 1.8 mm penetrating the wall through a 29-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-D Penetration # 3, 25-mm PVC Conduit with 3-Core Cable – 32R Retrofit Collar, dated 6 February 2017". The conduit projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The conduit was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The conduit was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 4 – LP100R-D Retrofit fire collar protecting a nominal 80-mm Polyvinyl Chloride (PVC) Pipe with a fitting inside the collar

The SNAP Retrofit LP100R-D collar comprised a 0.95-mm thick steel casing with a 122 mm inner diameter and a 195-mm x 195-mm square base flange. The 65-mm high collar casing incorporated a layer of 418 mm x 59 mm x 5-mm thick Intumescent material. The closing mechanism comprised 4 x 304 stainless steel springs bound with black nylon fuse links and 316 stainless steel mesh measuring 415 x 120-mm as shown in drawing numbered LP100R-D-T dated 10 February 2017, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised an 82-mm OD PVC Pipe, with a wall thickness of 3 mm fitted through the collar's sleeve and penetrating the wall through a 89-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-D Penetration # 4, 80-mm PVC Pipe with fitting inside the collar – LP100R-D Retrofit Collar, dated 6 February 2017". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe incorporated an 80-mm PVC Coupling inside the collar located on the exposed side of the wall. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with an 80-mm PVC End Cap.

Penetration # 5 – GAS50 collar protecting a 50-mm Px-Al-Px Pipe

The SNAP Retrofit GAS50 collar comprised a 0.95-mm thick steel casing with a 57 mm inner diameter and a 130-mm diameter base flange. The 92-mm high collar casing incorporated a layer of 215 mm x 85 mm x 4-mm thick Intumescent material and a layer of 190 mm x 85 mm x 4-mm thick Intumescent material. The closing mechanism comprised 1 x 304 stainless steel spring bound with a black nylon fuse link and a 316 stainless steel mesh measuring 190 x 84-mm as shown in drawing numbered GAS50-T dated 16 September 2016, by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 50-mm OD Px-Al-Px Pipe, with a wall thickness of 5 mm fitted through the collar's sleeve and penetrating the wall through a 56-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-D Penetration # 5, 50-mm Px-Al-Px Pipe – Gas 50 Collar, dated 6 February 2017". The annular gap between the pipe and opening was sealed with a 10-mm bead of fire rated sealant on both sides of the wall. The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug. A 10-mm bead of fire rated sealant was used around both sides of the pipe.

Penetration # 7 – 32R Retrofit fire collar protecting a nominal 32-mm Pex-b pipe

The 32R Retrofit collar comprised a 0.75-mm steel casing with a 40 mm inner diameter and a 106 mm diameter base flange. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 32-mm Pex-b pipe, with a wall thickness of 3.2 mm penetrating the wall through a 35-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-D Penetration # 7, 32-mm Pex-b pipe – 32R Retrofit Collar, dated 6 February 2017". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 8 – 32R Retrofit fire collar protecting a nominal 20-mm Pex-b pipe

The 32R Retrofit collar comprised a 0.75-mm steel casing with a 40 mm inner diameter and a 106 mm diameter base flange. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 20-mm Pex-b pipe, with a wall thickness of 2 mm penetrating the wall through a 25-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-D Penetration # 8, 20-mm Pex-b pipe – 32R Retrofit Collar, dated 6 February 2017". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 9 – HP150R Retrofit fire collar protecting a nominal 150-mm Polyvinyl Chloride (PVC) Pipe with a fitting inside the collar

The SNAP retrofitted HP150R collar comprised a 0.95-mm thick steel casing with a 175 mm inner diameter and a 326-mm base flange. The 117-mm high collar casing incorporated a strip of 570 mm x 112 mm x 8-mm thick Intumesh intumescent material. The closing mechanism comprised four 304 stainless steel springs bound with nylon fuse links, and a 596 mm x 112-mm stainless steel mesh as shown in drawing numbered HP 150R-T dated 2 October 2015, by Snap Fire Systems Pty. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 160-mm OD PVC Pipe, with a wall thickness of 4 mm fitted through the collar's sleeve and penetrating the wall through a 168-mm diameter cut-out hole as shown in drawing titled "Test Wall W-16-D Penetration # 9, 150-mm PVC Pipe with fitting inside the collar – HP150R Retrofit Collar, dated 6 February 2017". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe incorporated a 150-mm PVC Coupling located inside the collar on the exposed side of the wall. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a 150-mm PVC End Cap.

The test results are summarised in the table below:

Test Report	Specimen ID	Collar Name	Pipe Size	Pipe Material	FRL
FSP1807	1	LP100R-D	75	HDPE	-/121/121
	2	LP65R	63	HDPE	-/121/91
	3	32R	25	PVC +3 core cables	-/121/121
	4	LP100R-D	80	PVC + fitting	-/121/114
	5	GAS50	50	Px-Al-Px	-/121/79
	7	32R	32	Pex-b	-/121/121
	8	32R	20	Pex-b	-/121/121
	9	HP150R	150	PVC + fitting	-/121/121

A.3. CSIRO Sponsored Investigation report numbered FSV 1822

On the 22 March 2017, this Division conducted a full-scale fire-resistance test in accordance with AS 1530.4 -2014 on a 75-mm thick Hebel autoclaved aerated concrete (AAC) panel wall system with an established fire resistance level (FRL) of -/90/90 as detailed in CSIRO test report FSV 0979. The wall was penetrated by eight (8) pipes protected by a retro-fitted Snap Fire Systems fire collar.

For the purpose of the test, the specimens were referenced as Penetrations # 1, 2, 3, 4, 5, 6, 7 and 8.

Penetration # 1 – LP65R Retrofit fire collar protecting a 50-mm Raupiano Pipe

The SNAP Retrofit LP65R fire collar comprised a 0.7-mm stainless steel casing with an 85 mm inner diameter and a 222-mm diameter base flange. The 61-mm high collar casing incorporated a 300 mm x 55 mm x 4-mm thick Intumesh intumescent material. The closing mechanism comprised three stainless steel springs bound with nylon fuse links and a 300 mm x 55-mm stainless steel mesh as shown in drawing numbered LP65R-T dated 13 June 2014, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 50-mm Raupiano Pipe, with a wall thickness of 1.9 mm penetrating the wall through a 54-mm diameter cut-out hole as shown in drawing titled "Test Wall W-17-A Penetration # 1, 50-mm Raupiano Pipe – LP65R Retrofit Collar, dated 16 May 2017". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 2 – GAS32 Retrofit collar protecting a 32-mm diameter CXL Px-Al-Px Pipe

The GAS32 Retrofit collar comprised a 0.95-mm thick galvanised steel casing with a 35 mm inner diameter and a 100-mm diameter base flange. The 63-mm high collar casing incorporated a layer of 140 mm x 55 mm x 4-mm thick Intumescent material and a layer of 120 mm x 55 mm x 4-mm thick Intumescent material. The closing mechanism comprised 1 x 304 stainless steel spring bound with a black nylon fuse link and a 316 stainless steel mesh measuring 120 x 54-mm as shown in drawing numbered GAS32-T dated 14 September 2016, by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 32-mm CXL Px-Al-Px pipe, with a wall thickness of 3.2 mm penetrating the wall through a 35-mm diameter cut-out hole as shown in drawing titled "Test Wall W-17-A Penetration # 2, 32-mm Px-Al-Px Pipe – 32Gas Retrofit Collar, dated 16 May 2017". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 3 – LP100R-D Retrofit fire collar protecting a nominal 110-mm Raupiano Pipe

The SNAP Retrofit LP100R-D collar comprised a 0.95-mm thick steel casing with a 122 mm inner diameter and a 195-mm x 195-mm square base flange. The 65-mm high collar casing incorporated a layer of 418 mm x 59 mm x 5-mm thick Intumescent material. The closing mechanism comprised 4 x 304 stainless steel springs bound with black nylon fuse links and 316 stainless steel mesh measuring 415 x 120-mm as shown in drawing numbered LP100R-D-T dated 10 February 2017, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 110-mm OD Raupiano Pipe, with a wall thickness of 3.3mm penetrating the wall through a 114-mm diameter cut-out hole as shown in drawing titled "Test Wall W-17-A Penetration # 3, 110-mm Raupiano Pipe – LP100R-D Retrofit Collar, dated 16 October 2017". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 4 – 32R Retrofit fire collar protecting a 27-mm Telstra PVC Conduit

The 32R Retrofit collar comprised a 0.75-mm steel casing with a 40 mm inner diameter and a 106 mm diameter base flange. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 27-mm OD Telstra PVC Conduit, with a wall thickness of 1.9 mm penetrating the wall through a 32-mm diameter cut-out hole as shown in drawing titled "Test Wall W-17-A Penetration # 4, 205-mm Telstra PVC Conduit – 32R Retrofit Collar, dated 16 May 2017". The conduit projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The conduit was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The conduit was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 5 – 32R Retrofit fire collar protecting a 20-mm Telstra PVC Conduit

The 32R Retrofit collar comprised a 0.75-mm steel casing with a 40 mm inner diameter and a 106 mm diameter base flange. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 20-mm Telstra PVC Conduit, with a wall thickness of 1.9 mm penetrating the wall through a 32-mm diameter cut-out hole as shown in drawing titled "Test Wall W-17-A Penetration # 5, 20-mm Telstra PVC Conduit – 32R Retrofit Collar, dated 16 May 2017". The conduit projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The conduit was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The conduit was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 6 – GAS32 Retrofit collar protecting a 25-mm diameter CXL Px-Al-Px Pipe

The GAS32 Retrofit collar comprised a 0.95-mm thick galvanised steel casing with a 35 mm inner diameter and a 100-mm diameter base flange. The 63-mm high collar casing incorporated a layer of 140 mm x 55 mm x 4-mm thick Intumescent material and a layer of 120 mm x 55 mm x 4-mm thick Intumescent material. The closing mechanism comprised 1 x 304 stainless steel spring bound with a black nylon fuse link and a 316 stainless steel mesh measuring 120 x 54-mm as shown in drawing numbered GAS32-T dated 14 September 2016, by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 25-mm CXL Px-Al-Px pipe, with a wall thickness of 3.2 mm penetrating the wall through a 29-mm diameter cut-out hole as shown in drawing titled "Test Wall W-17-A Penetration # 6, 25-mm CXL Px-Al-Px Pipe – 32Gas Retrofit Collar, dated 16 May 2017". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 7 – GAS32 Retrofit collar protecting a 20-mm diameter CXL Px-Al-Px Pipe

The GAS32 Retrofit collar comprised a 0.95-mm thick galvanised steel casing with a 35 mm inner diameter and a 100-mm diameter base flange. The 63-mm high collar casing incorporated a layer of 140 mm x 55 mm x 4-mm thick Intumescent material and a layer of 120 mm x 55 mm x 4-mm thick Intumescent material. The closing mechanism comprised 1 x 304 stainless steel spring bound with a black nylon fuse link and a 316 stainless steel mesh measuring 120 x 54-mm as shown in drawing numbered GAS32-T dated 14 September 2016, by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 20-mm CXL Px-Al-Px pipe, with a wall thickness of 2.5 mm penetrating the wall through a 25-mm diameter cut-out hole as shown in drawing titled "Test Wall W-17-A Penetration # 7, 20-mm CXL Px-Al-Px Pipe – 32Gas Retrofit Collar, dated 16 May 2017". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

Penetration # 8 – HP150R Retrofit fire collar protecting a 160-mm High-density polyethylene (HDPE) Pipe

The SNAP retrofitted HP150R collar comprised a 0.95-mm thick steel casing with a 175 mm inner diameter and a 326-mm base flange. The 117-mm high collar casing incorporated a strip of 570 mm x 112 mm x 8-mm thick Intumesh intumescent material. The closing mechanism comprised four 304 stainless steel springs bound with nylon fuse links, and a 596 mm x 112-mm stainless steel mesh as shown in drawing numbered HP 150R-T dated 2 October 2015, by Snap Fire Systems Pty. One collar was fixed to each side of the wall in a back-to-back configuration using 14-10 65-mm Hex Head Screws.

The penetrating service comprised a 162-mm OD HDPE pipe, with a wall thickness of 6.8 mm penetrating the wall through a 168-mm diameter cut-out hole as shown in drawing titled "Test Wall W-17-A Penetration # 8, 160-mm HDPE Pipe – HP150R Retrofit Collar, dated 16 May 2017". The pipe projected horizontally, 2000-mm away from the unexposed face of the wall and approximately 500 mm into the furnace chamber. The pipe was supported at nominally 500-mm and 1500 mm from the unexposed face of the wall by two support clamps spaced apart at nominally 1000-mm. The pipe was open at the unexposed end and capped on the exposed end with a ceramic fibre (Superwool) plug.

The test results are summarised in the table below:

Test Report	Specimen ID	Collar Name	Pipe Size	Pipe Material	FRL
FSP1822	1	LP65R	50	Raupiano	-/121/121
	2	GAS32	32	CXL Px-Al-Px	-/121/121
	3	LP100R-D	110	Raupiano	-/121/121
	4	32R	27	PVC	-/121/116
	5	32R	20	PVC	-/121/120
	6	GAS32	25	CXL Px-Al-Px	-/121/121
	7	GAS32	20	CXL Px-Al-Px	-/121/121
	8	HP150R	160	HDPE	-/121/121

A.4. Summary of test data

Penetration	Test Report	Specimen ID	Collar Name	Pipe Size	Pipe Material + filling	FRL	Insulation failure
PVC conduit	FSP1822	4	32R	27	PVC	-/121/116	On wall
	FSP1822	5	32R	20	PVC	-/121/120	On wall
PVC conduit with cables	FSP1783	6	32R	20	PVC + 3 core cables	-/121/121	
	FSP1807	3	32R	25	PVC + 3 core cables	-/121/121	
PVC pipe	FSP1783	4	LP65R	40	PVC + fitting	-/121/121	
	FSP1783	9	LP65R	50	PVC+ fitting	-/121/121	
	FSP1783	5	LP65R	65	PVC+ fitting	-/121/102	On wall
	FSP1807	4	LP100R-D	80	PVC + fitting	-/121/114	On wall
	FSP1783	3	LP100R-D	100	PVC + fitting	-/121/117	On wall
	FSP1807	9	HP150R	150	PVC + fitting	-/121/121	
HDPE pipe	FSP1783	1	LP65R	32	HDPE	-/121/114	On wall
	FSP1807	2	LP65R	63	HDPE	-/121/91	On wall
	FSP1807	1	LP100R-D	75	HDPE	-/121/121	
	FSP1783	7	LP100R-D	110	HDPE	-/121/121	
	FSP1822	8	HP150R	160	HDPE	-/121/121	
Px-Al-Px pipe	FSP1783	8	GAS32	16	Px-Al-Px	-/121/121	
	FSP1822	7	GAS32	20	CXL Px-Al-Px	-/121/121	On wall
	FSP1822	6	GAS32	25	CXL Px-Al-Px	-/121/121	
	FSP1822	2	GAS32	32	CXL Px-Al-Px	-/121/121	
	FSP1807	5	GAS50	50	Px-Al-Px	-/121/79	On the wall, Fail on the collar at 93min.
Pex-b pipe	FSP1783	2	32R	16	Pex-b	-/121/121	
	FSP1807	8	32R	20	Pex-b	-/121/121	
	FSP1807	7	32R	32	Pex-b	-/121/121	
Raupiano pipe	FSP1822	1	LP65R	50	Raupiano	-/121/121	
	FSP1822	3	LP100R-D	110	Raupiano	-/121/121	

Appendix B Analysis of Variations

B.1 Variation to wall construction

The proposed construction shall be as tested in FSP 1783, FSP 1807 (except specimen 5) and FSP 1822 and subject to the following variations:

- The inclusion of single leaf 75mm or thicker Hebel Panel wall that is supported by a test or assessment as a wall and FRL of -/120/120

With reference to FSP 1783, FSP 1807 and FSP 1822, pipes of various size and material, with and without contents penetrated a 75mm thick Hebel panel and were protected with various kinds of Snap retrofit collars.

All the specimens were able to maintain integrity for 121 minutes duration of the test. Majority of the specimens were able to maintain insulation for the 121 minutes duration of the test. For the specimens that failed insulation prior to 121 minutes, their insulation failure occurred due to the substrate failing insulation. With the exception of FSP 1807 specimen 5, these specimens did not fail insulation on the collar or on the pipe for 121 minutes duration of the test.

It is expected when all of the tested specimens, with the exception of FSP 1807 specimen 5, are installed in a min. 75mm Hebel panel wall with a tested or assessed FRL of at least -120/120, they will all be able to maintain insulation for up to 120 minutes on the substrate also. With reference to FSP 1807 specimen 5, the insulation failure on substrate occurred at 79 minutes and on the collar occurred at 93 minutes. It is expected when it is installed in a min. 75mm Hebel panel wall with a tested or assessed FRL of at least -120/120, it will be able to maintain insulation for up to 60 minutes.

Based on the above, it is considered the proposed construction will achieve the FRL listed below when tested in accordance with AS 1530.4 – 2014 and assessed in accordance with AS 4072.1 – 2005.

Penetration	Collar Name	Pipe Size	Pipe Material + filling	FRL	Substrate
PVC conduit	32R	27	PVC	-/120/120	A single leaf 75mm or thicker Hebel Panel wall that is supported by a test or assessment as a wall and FRL of -/120/120
	32R	20	PVC	-/120/120	
PVC conduit with cables	32R	20	PVC + 3 core cables	-/120/120	
	32R	25	PVC + 3 core cables	-/120/120	
PVC pipe	LP65R	40	PVC + fitting	-/120/120	
	LP65R	50	PVC+ fitting	-/120/120	
	LP65R	65	PVC+ fitting	-/120/120	
	LP100R-D	80	PVC + fitting	-/120/120	
	LP100R-D	100	PVC + fitting	-/120/120	
	HP150R	150	PVC + fitting	-/120/120	
HDPE pipe	LP65R	32	HDPE	-/120/120	
	LP65R	63	HDPE	-/120/120	
	LP100R-D	75	HDPE	-/120/120	
	LP100R-D	110	HDPE	-/120/120	
	HP150R	160	HDPE	-/120/120	
Px-Al-Px pipe	GAS32	16	Px-Al-Px	-/120/120	
	GAS32	20	CXL Px-Al-Px	-/120/120	
	GAS32	25	CXL Px-Al-Px	-/120/120	
	GAS32	32	CXL Px-Al-Px	-/120/120	
	GAS50	50	Px-Al-Px	-/120/60	
Pex-b pipe	32R	16	Pex-b	-/120/120	
	32R	20	Pex-b	-/120/120	
	32R	32	Pex-b	-/120/120	
Raupiano pipe	LP65R	50	Raupiano	-/120/120	
	LP100R-D	110	Raupiano	-/120/120	

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