Fire resistance of SNAP Utility fire collars when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005

Assessment Report

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1 Introduction

This report is an assessment of fire resistance of SNAP Utility fire collars when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 Amdt. 1.

This report is prepared for meeting the requirements of NCC 2019 Volume 1 Schedule 5 clauses 2 c) or NCC 2022 Volume 1 Clauses S1C2 (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
FSP2333	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 120 mm thick concrete slab.
FSP2338	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 150 mm thick concrete slab.
FSP2347	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 120 mm thick concrete slab.
FSP2358	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 120 mm thick concrete slab.
FSP2366	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 150 mm thick concrete slab.
FSP 2371	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 120 mm thick concrete slab.
FSP2337	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 90mm thick plasterboard wall
FSP2354	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 90mm thick plasterboard wall
FSP2362	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 90mm thick plasterboard wall
FSP2374	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 90mm thick plasterboard wall
FSP2375	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 90mm thick plasterboard wall
FSP2320	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 116mm thick plasterboard wall
FSP2345	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 116mm thick plasterboard wall
FSP2361	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 116mm thick plasterboard wall
FSP2368	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 116mm thick plasterboard wall
FSP2336	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 75mm Hebel Powerpanel Wall
FSP2367	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 75mm Hebel Powerpanel Wall
FSP2369	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 75mm Hebel Powerpanel Wall
FSP2370	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 75mm Hebel Powerpanel Wall
FSP 1953	AS 1530.4 -2014	A fire resistance test of pipe penetrations in a 120 mm thick Bondek concrete slab.

The referenced tests were tested at CSIRO and sponsored by IG6 Pty Ltd.

3 Proposed Minor Variations

3.1 SNAP Utility collars protecting plastic pipes

The proposed construction shall be Snap Utility collars tested in Table 1 and as shown in Figures 1 and 2 and Table 2 subject to the following variations:

a. The inclusion of various plastic pipes
b. The inclusion of pipe coupling within or not within the collar made from same wall thickness as proposed pipe
c. Stack pipes in floor to have a straight pipe configuration below the floor
d. Above the floor, all services to be supported at maximum 500mm along the service, and if required with a second support at nominally 1000mm along the service from the first support.
e. On both side of a wall, all services to be supported at maximum 500mm along the service, and if required with a second support at nominally 1000mm along the service from the first support.

3.2 Various ways of installing SNAP Utility collars and pipes in combination

The proposed construction in Section 3.1 of this report may include the following variations in isolation or combination:

a. The inclusion of concrete floor as a separating element
    - Inclusion of min. 120mm, 150mm and 175mm thick concrete floor in accordance with AS 3600-2018
    - Inclusion of min. 120mm, 150mm and 175mm thick Bondek steel formwork concrete floor tested or assessed for an FRL of at least 120/120/120, 180/180/180 and 240/240/240 respectively and the channel next to collar to be fully filled with Snap Fire Seal FRAS as per Figure 4.
    - The pipework is to be vertically supported above the floor and straight under the floor as tested
b. The inclusion of the following walls as a separating element
    - Inclusion of 90mm thick plasterboard lined steel stud walls with glasswool in cavity as a support construction. The wall shall be symmetrically lined on each side. The wall shall be tested or assessed for an FRL of at least-/60/60.
    - Inclusion of 116mm thick plasterboard lined steel stud walls as a support construction. The wall shall be symmetrically lined on each side. The wall shall be tested or assessed for an FRL of at least -/120/120.
    - Inclusion of min. 116mm thick shaft liner walls as a support construction. The wall shall have min. 25mm thick Shaftliner panel on one side and 2 layers of min. 13mm fire rated plasterboard on the other side. The wall shall be tested or assessed for an FRL of at least -/120/120.
    - Inclusion of 75mm single cage and double caged Hebel walls as a support construction. The wall shall be tested or assessed for an FRL of at least-/90/90 and -/120/120 respectively
    - Inclusion of 75mm Walsc AAC panel walls as a support construction. The wall shall be tested or assessed for an FRL of at least -/90/90 and -/120/120
    - Inclusion of 78mm thick Speedpanel wall as a support construction. The wall shall be tested or assessed for an FRL of at least -/120/120
        - Inclusion of 250mm x 250mm plasterboard patch as per Table 36 over a section of Speedpanel wall at the location of the penetrating pipes.
        - A fillet of Snap Fire Seal FRAS to fully seal all gaps between plasterboard patch and Speedpanel wall.

        - Fixings for collars to plasterboard patch shall be 14g-10 65mm Hex Head Screws
        - Fixings for plasterboard patch to Speedpanel wall shall be 14g-10 65mm Hex Head Screws at maximum 100mm centres
    - Inclusion of 110mm Dincel wall or AFS Rediwall as a support construction with the Utility Collar fixed directly to the plastic shell. The wall shall be tested or assessed for an FRL of at least 90/90/90
        - Fixings to be away from any voids with a minimum of 25mm embedment into concrete part of the wall
    - Inclusion of 120mm thick AFS Logic wall as a support construction with the Utility Collar fixed directly to the fibre cement sheet. The wall shall be tested or assessed for an FRL of at least 120/120/120
        - Fixings to be away from any voids with a minimum of 25mm embedment into concrete part of the wall
    - Inclusion of 155mm Dincel wall as a support construction with the Utility Collar fixed directly to the plastic. The wall shall be tested or assessed for an FRL of at least 180/180/180
        - Fixings to be away from any voids with a minimum of 25mm embedment into concrete part of the wall
    - Inclusion of min. 90mm thick masonry wall as a support construction. The wall shall be in accordance with AS 3700-2018 for the required FRL
        - Fixings to be away from any voids with a minimum of 25mm embedment into concrete part of the wall
    - Inclusion of min. 80mm thick concrete wall as a support construction. The wall shall be in accordance with AS 3600-2018 for the required FRL
        - Fixings to be away from any voids with a minimum of 25mm embedment into concrete part of the wall
    - Inclusion of min. 90mm thick AAC block wall as a support construction. The wall shall be tested or assessed for the required FRL
        - Fixings to be away from any voids with a minimum of 25mm embedment into concrete part of the wall
    - Pipework is to be supported on each side of the wall at maximum 300mm from the wall
c. Variation to gap treatment between pipe and separating element as per Table 3
d. Fixings for each support construction type shall be as per Tables 4 and 5
e. Number of collar brackets shall be as per Table 2
f. Variations Installation methods including
    - Paint on collar body, though no paint is allowed on the active area of the collar
    - Collars can be installed with a minimum spacing of 40mm from outer edge of collar to outer edge of 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, Section 10 as appropriate for service penetrations.
AS 4072.1-2005 Amdt. 1	Components for the protection of openings in fire-resistant separating elements Part 1: Service penetrations and control joints. Section 10 as appropriate for service penetrations.

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.

5.1 Collar, sealant and fixing specification

Table 2: Utility collar and number of collar segments

<table>
<tr><th rowspan="2">Collar name</th><th rowspan="2">Number of Collar Segments</th><th colspan="2">Number of fixing brackets</th></tr>
<tr><th>Plasterboard lined steel stud walls, Shaft liner walls, Speedpanel & Hebel walls or Walsc AAC panel walls</th><th>Concrete floor, Bondek formwork concrete floor, Concrete/Masonry walls, AFS Rediwall, AFS Logicwall & Dincel</th></tr>
<tr><td>Utility 40</td><td>15</td><td rowspan="12">3</td><td rowspan="6">2</td></tr>
<tr><td>Utility 40 +</td><td>17</td></tr>
<tr><td>Utility 50</td><td>18</td></tr>
<tr><td>Utility 50 +</td><td>20</td></tr>
<tr><td>Utility 65</td><td>21</td></tr>
<tr><td>Utility 65 +</td><td>23</td></tr>
<tr><td>Utility 80</td><td>24</td><td rowspan="6">3</td></tr>
<tr><td>Utility 80 +</td><td>26</td></tr>
<tr><td>Utility 80 +</td><td>26</td></tr>
<tr><td>Utility 90 +</td><td>27</td></tr>
<tr><td>Utility 100</td><td>29</td></tr>
<tr><td>Utility 100 +</td><td>31</td></tr>
<tr><td>Utility 125</td><td>33</td><td rowspan="2">4</td><td rowspan="2">4</td></tr>
<tr><td>Utility 150</td><td>2 x 40</td></tr>
</table>

Table 3: Gap treatment between the plastic pipe and opening in separating element

Pipe Diameter (mm)	Annular Gap (mm)	Details
40-160	0 – 2	Optional
40-110	2-8.5	10mm Deep Bead Snap Fire Seal FRAS with PE foam backing rod
125-160	2-4	

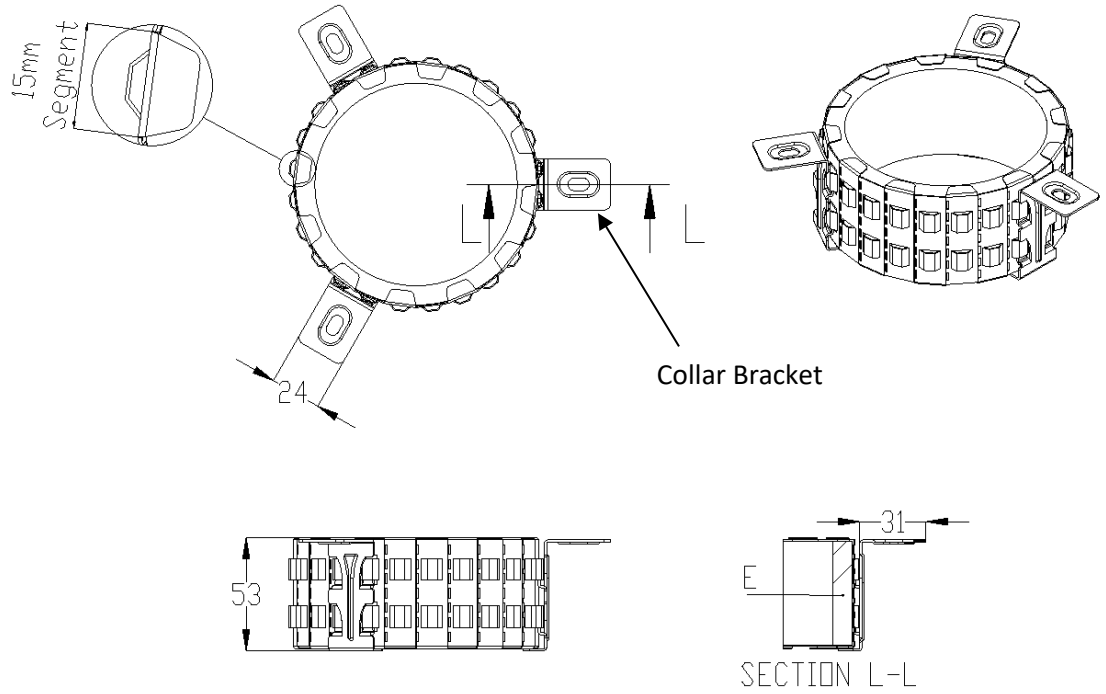

Figure 1: Single Utility collar

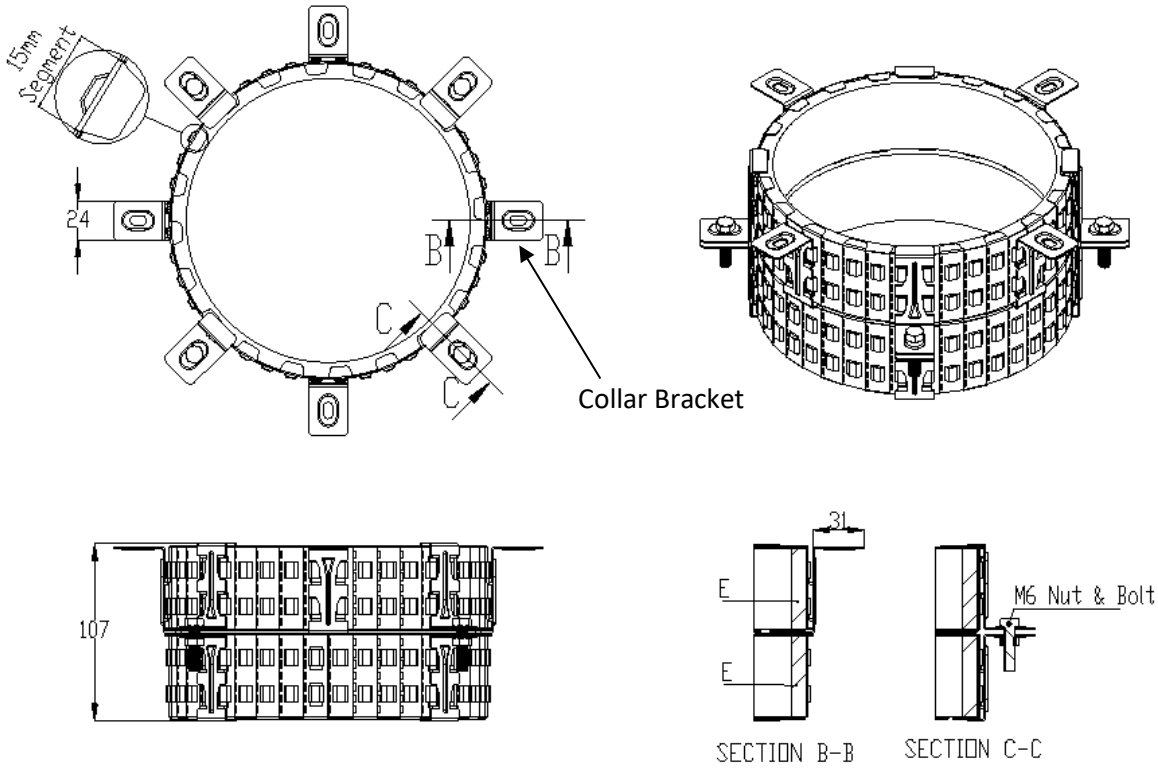

Figure 2: Double Utility 150 collar

Table 4: Fixing type for each support construction with PVC pipes

Element	Utility Collar Size (mm)	Collar Fixing type	
Concrete floor, Bondek formwork concrete floor, Dincel wall, AFS Rediwall, Logic wall, Concrete wall, Masonry wall	40-160	5x30mm Concrete Screw Bolt	
		6x35mm Steel Wedge Anchor	
		6.5x40mm Steel Sleeve Anchor	
		5x32mm Mushroom Head Spike	
Plasterboard line steel stud walls, Shaftliner walls	40-100	10G x 38mm Coarse Thread Laminating Screw	
	150-160	M4 16-23mm steel Expandable Anchor with stainless steel washer	
Hebel panel or block walls, Walsc AAC panel walls, Speedpanel walls	40-160	14g-10 65mm Hex Head Screws	

Table 5: Fixing type for each support construction with HDPE pipes

Element	Utility Collar Size (mm)	Collar Fixing type	
Concrete floor, Bondek formwork concrete floor, Dincel wall, AFS Rediwall, Logic wall, Concrete wall, Masonry wall	40-160	5x30mm Concrete Screw Bolt	
		6x35mm Steel Wedge Anchor	
		6.5x40mm Steel Sleeve Anchor	
		5x32mm Mushroom Head Spike	
Single layered Plasterboard line steel stud walls	40-110	M4 16-23mm steel Expandable Anchor with stainless steel washer	
Double layered Plasterboard line steel stud wall, Shaftliner walls	40-100	10G x 38mm Coarse Thread Laminating Screw	
		M4 16-23mm steel Expandable Anchor with stainless steel washer	
	125-160	M4 16-23mm steel Expandable Anchor with stainless steel washer	
Hebel walls, Walsc AAC panel walls, Speedpanel walls	40-160	14g-10 65mm Hex Head Screws	

5.2 Performance in Concrete floor or Bondek formwork concrete floor

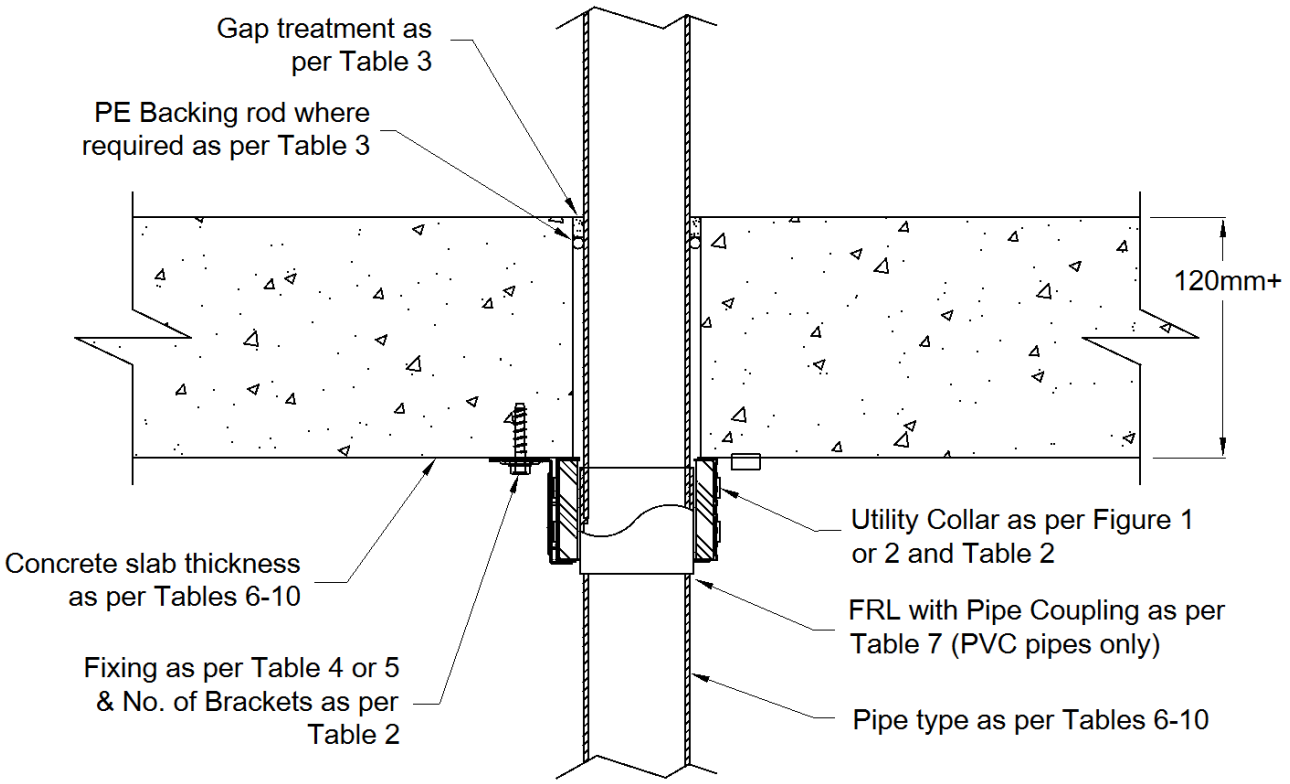

Figure 3: General installation of pipe in a concrete floor

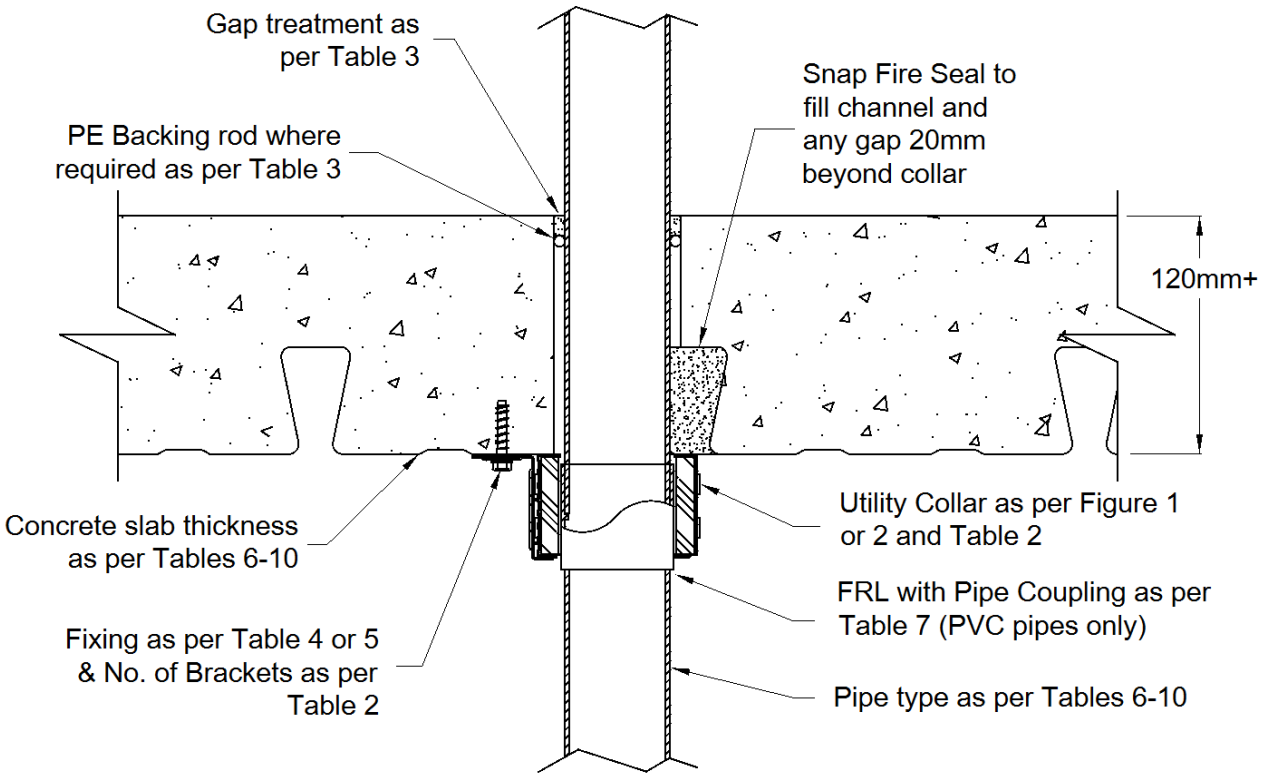

Figure 4: Bondek with pipe next to channel in a Bondek formwork concrete floor

Table 6: PVC pipes in concrete floor/Bondek formwork concrete floor

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL		
				Minimum floor thickness (X)		
				≥120mm	≥150mm	≥175mm
40	2.0-2.4	Utility 40	Figure 3 or 4	-/120/120	-/180/180	-/240/240
50	2.2.2-5	Utility 50		-/120/120	-/180/180	-/240/240
65	2.7-3.2	Utility 65		-/120/120	-/180/180	-/240/240
80	2.9-3.2	Utility 80		-/120/120	-/180/180	-/240/240
90	3.0-3.4	Utility 80+		-/120/120	-/180/180	-/240/240
100	3.0-3.4	Utility 100		-/120/120	-/180/180	-/240/240
150	4.2-4.5	2 x Utility 150		NA	-/180/180	-/240/240

Table 7: PVC pipes with coupling in collar in concrete floor/Bondek formwork concrete floor

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL		
				Minimum floor thickness (X)		
				≥120mm	≥150mm	≥175mm
40	2.0-2.4	Utility 40+	Figure 3 or 4	-/120/120	-/180/180	-/240/240
50	2.2.2-5	Utility 50+		-/120/120	-/180/180	-/240/240
65	2.7-3.2	Utility 65+		-/120/120	-/180/180	-/240/240
80	2.9-3.2	Utility 80+		-/120/120	-/180/180	-/240/240
90	3.0-3.4	Utility 90+		-/120/120	-/180/180	-/240/240
100	3.0-3.4	Utility 100+		-/120/120	-/180/180	-/240/240

Table 8: HDPE pipes in concrete floor/Bondek formwork concrete floor

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL		
				Minimum floor thickness (X)		
				≥120mm	≥150mm	≥175mm
40	3.0 - 3.4	Utility 40	Figure 3 or 4	-/120/120	-/180/180	-/240/240
50	3.0 - 3.4	Utility 50		-/120/120	-/180/180	-/240/240
56	3.0 - 3.4	Utility 50		-/120/120	-/180/180	-/240/240
63	3.0 - 3.4	Utility 50+		-/120/120	-/180/180	-/240/240
75	2.9 - 3.4	Utility 65+		-/120/120	-/180/180	-/240/240
90	3.5 - 4.0	Utility 80+		-/120/120	-/180/180	-/240/240
110	4.3 - 4.9	Utility 100		-/120/120	-/180/180	-/240/240
125	4.8 - 5.4	Utility 125		n/a	-/180/180	-/240/240
160	6.2 - 7.2	2 x Utility 150		n/a	-/180/180	-/240/240

Table 9: Valsir Triplus Polypropylene pipes in concrete floor/Bondek formwork concrete floor

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL		
				Minimum floor thickness (X)		
				≥120mm	≥150mm	≥175mm
40	1.8 - 2.2	Utility 40	Figure 3 or 4	-/120/120	-/180/180	-/240/240
50	1.8 - 2.2	Utility 50		-/120/120	-/180/180	-/240/240
75	2.6 - 3.1	Utility 65+		-/120/120	-/180/180	-/240/240
90	3.1 - 3.7	Utility 80+		-/120/120	-/180/180	-/240/240
110	3.7 – 4.0	Utility 100		-/120/120	-/180/180	-/240/240
160	4.9 - 5.6	2 x Utility 150		n/a	-/180/180	-/240/240

Table 10: Rehau Raupiano Polypropylene pipes in concrete floor/Bondek formwork concrete floor

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL		
				Minimum floor thickness (X)		
				≥120mm	≥150mm	≥175mm
40	1.8- 2.2	Utility 40	Figure 3 or 4	-/120/120	-/180/180	-/240/240
50	1.8 - 2.2	Utility 50		-/120/120	-/180/180	-/240/240
75	1.9 - 2.3	Utility 65+		-/120/120	-/180/180	-/240/240
110	2.7 - 3.2	Utility 100		-/120/120	-/180/180	-/240/240
160	3.9 - 4.5	2 x Utility 150		n/a	-/180/180	-/240/240

5.3 Performance in Plasterboard Steel Stud Wall

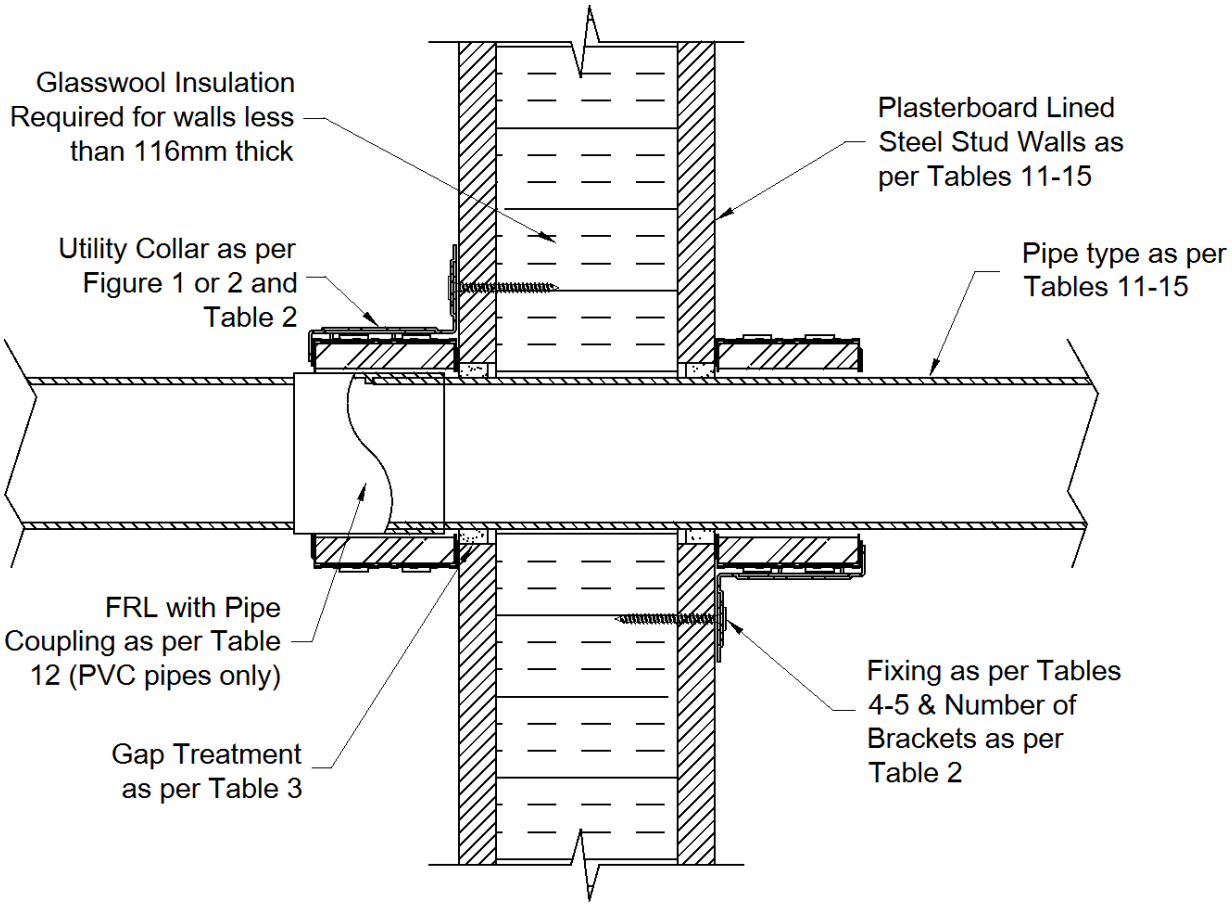

Figure 5: General installation of pipe in a plasterboard wall

Table 11: PVC pipes in Plasterboard lined steel stud wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL	
				Symmetrically lined stud wall	
				≥1x13mm sheets each side	≥2x13mm sheets each side
40	2.0-2.4	Utility 40	Figure 5	-/60/60	-/120/120
50	2.2.2-5	Utility 50		-/60/60	-/120/120
65	2.7-3.2	Utility 65		-/60/60	-/120/120
80	2.9-3.2	Utility 80		-/60/60	-/120/120
90	3.0-3.4	Utility 80+		-/60/60	-/120/120
100	3.0-3.4	Utility 100		-/60/60	-/120/120
150	4.2-4.5	2 x Utility 150		-/60/60	-/120/120

Table 12: PVC pipes with coupling in collar in Plasterboard lined steel stud wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL	
				Symmetrically lined stud wall	
				≥1x13mm sheets each side	≥2x13mm sheets each side
40	2.0-2.4	Utility 40+	Figure 5	-/60/60	-/120/120
50	2.2.2-5	Utility 50+		-/60/60	-/120/120
65	2.7-3.2	Utility 65+		-/60/60	-/120/120
80	2.9-3.2	Utility 80+		-/60/60	-/120/120
90	3.0-3.4	Utility 90+		-/60/60	-/120/120
100	3.0-3.4	Utility 100+		-/60/60	-/120/120

Table 13: HDPE pipes in plasterboard walls

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL	
				Symmetrically lined stud wall	
				≥1x13mm Sheets either side	≥2x13mm sheets either side
40	3.0 - 3.4	Utility 40	Figure 5	-/60/60	-/120/120
50	3.0 - 3.4	Utility 50		-/60/60	-/120/120
56	3.0 - 3.4	Utility 50		-/60/60	-/120/120
63	3.0 - 3.4	Utility 50+		-/60/60	-/120/120
75	2.9 - 3.4	Utility 65+		-/60/60	-/120/120
90	3.5 - 4.0	Utility 80+		-/60/60	-/120/120
110	4.3 - 4.9	Utility 100		-/60/60	-/120/120
125	4.8 - 5.4	Utility 125		n/a	-/120/90
160	6.2 - 7.2	2 x Utility 150		n/a	-/120/90

Table 14: Valsir Triplus Polypropylene pipes in plasterboard walls

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL	
				Symmetrically lined stud wall	
				≥1x13mm Sheets either side	≥2x13mm sheets either side
40	1.8 - 2.2	Utility 40	Figure 5	-/60/60	-/120/120
50	1.8 - 2.2	Utility 50		-/60/60	-/120/120
75	2.6 - 3.1	Utility 65+		-/60/60	-/120/120
90	3.1 - 3.7	Utility 80+		-/60/60	-/120/120
110	3.7 – 4.0	Utility 100		-/60/60	-/120/120
160	4.9 - 5.6	2 x Utility 150		-/60/60	-/120/120

Table 15: Rehau Raupiano Polypropylene pipes in plasterboard walls

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL	
				Symmetrically lined stud wall	
				≥1x13mm Sheets either side	≥2x13mm sheets either side
40	1.8- 2.2	Utility 40	Figure 5	-/60/60	-/120/120
50	1.8 - 2.2	Utility 50		-/60/60	-/120/120
75	1.9 - 2.3	Utility 65+		-/60/60	-/120/120
110	2.7 - 3.2	Utility 100		-/60/60	-/120/120
160	3.9 - 4.5	2 x Utility 150		-/60/60	-/120/120

5.4 Performance in Shaft Liner wall

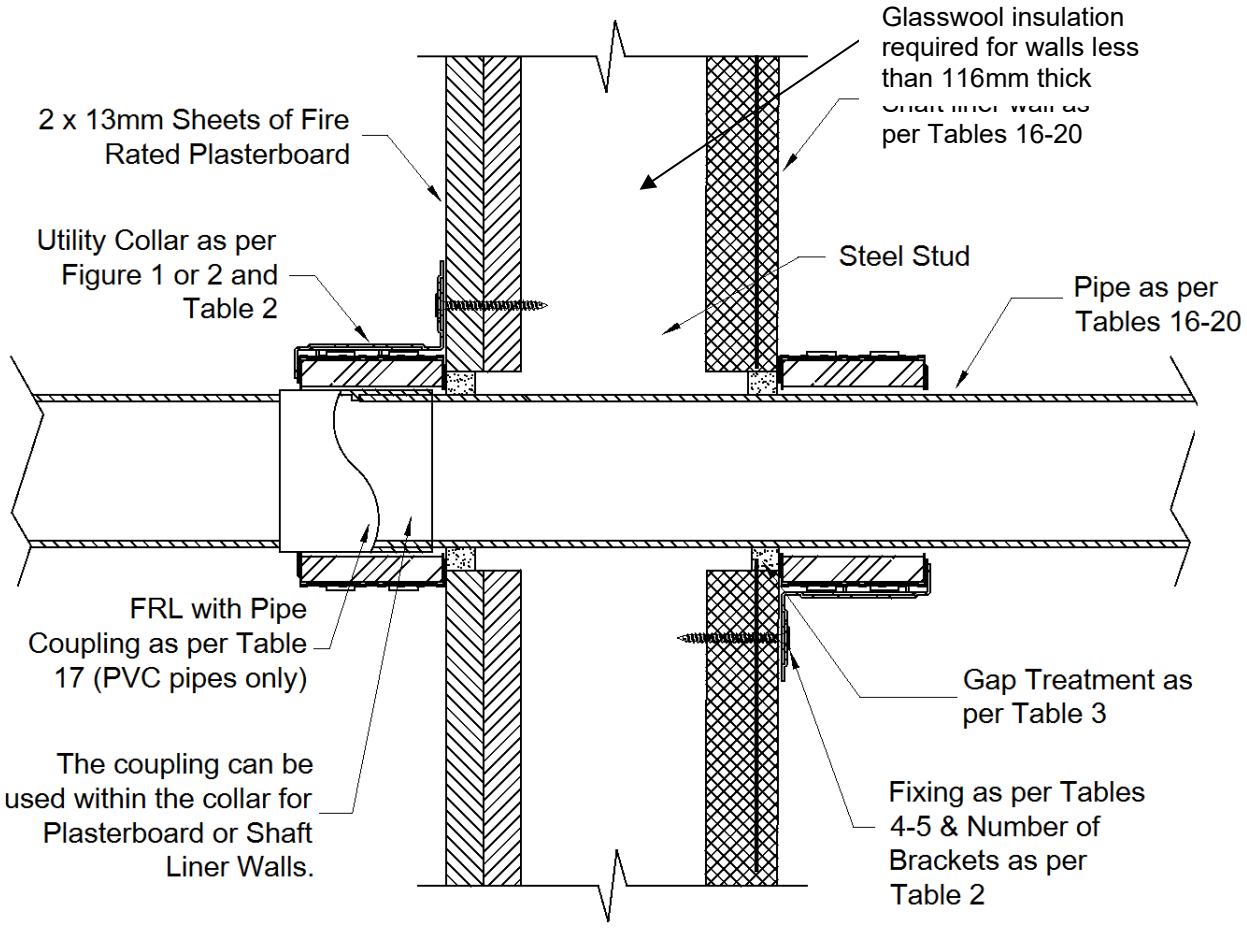

Figure 6: General installation of pipe in a Shaft Liner wall

Table 16: PVC pipes in min. 116mm thick Shaft liner wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL
40	2.0-2.4	Utility 40	Figure 6	-/120/120
50	2.2.2-5	Utility 50		-/120/120
65	2.7-3.2	Utility 65		-/120/120
80	2.9-3.2	Utility 80		-/120/120
90	3.0-3.4	Utility 80+		-/120/120
100	3.0-3.4	Utility 100		-/120/120
150	4.2-4.5	2 x Utility 150		-/120/120

Table 17: PVC pipes with coupling in collar in min. 116mm thick Shaft liner wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL
40	2.0-2.4	Utility 40+	Figure 6	-/120/120
50	2.2.2-5	Utility 50+		-/120/120
65	2.7-3.2	Utility 65+		-/120/120
80	2.9-3.2	Utility 80+		-/120/120
90	3.0-3.4	Utility 90+		-/120/120
100	3.0-3.4	Utility 100+		-/120/120

Table 18: HDPE pipes in min. 116mm thick Shaft liner wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL
40	3.0 - 3.4	Utility 40	Figure 6	-/120/120
50	3.0 - 3.4	Utility 50		-/120/120
56	3.0 - 3.4	Utility 50		-/120/120
63	3.0 - 3.4	Utility 50+		-/120/120
75	2.9 - 3.4	Utility 65+		-/120/120
90	3.5 - 4.0	Utility 80+		-/120/120
110	4.3 - 4.9	Utility 100		-/120/120
125	4.8 - 5.4	Utility 125		-/120/90
160	6.2 - 7.2	2 x Utility 150		-/120/90

Table 19: Valsir Triplus Polypropylene pipes in min. 116mm thick Shaft liner wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL
40	1.8 - 2.2	Utility 40	Figure 6	-/120/120
50	1.8 - 2.2	Utility 50		-/120/120
75	2.6 - 3.1	Utility 65+		-/120/120
90	3.1 - 3.7	Utility 80+		-/120/120
110	3.7 – 4.0	Utility 100		-/120/120
160	4.9 - 5.6	2 x Utility 150		-/120/120

Table 20: Rehau Raupiano Polypropylene pipes in min. 116mm thick Shaft liner wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL
40	1.8- 2.2	Utility 40	Figure 6	-/120/120
50	1.8 - 2.2	Utility 50		-/120/120
75	1.9 - 2.3	Utility 65+		-/120/120
110	2.7 - 3.2	Utility 100		-/120/120
160	3.9 - 4.5	2 x Utility 150		-/120/120

5.5 Performance in Hebel and Walsc AAC panel wall

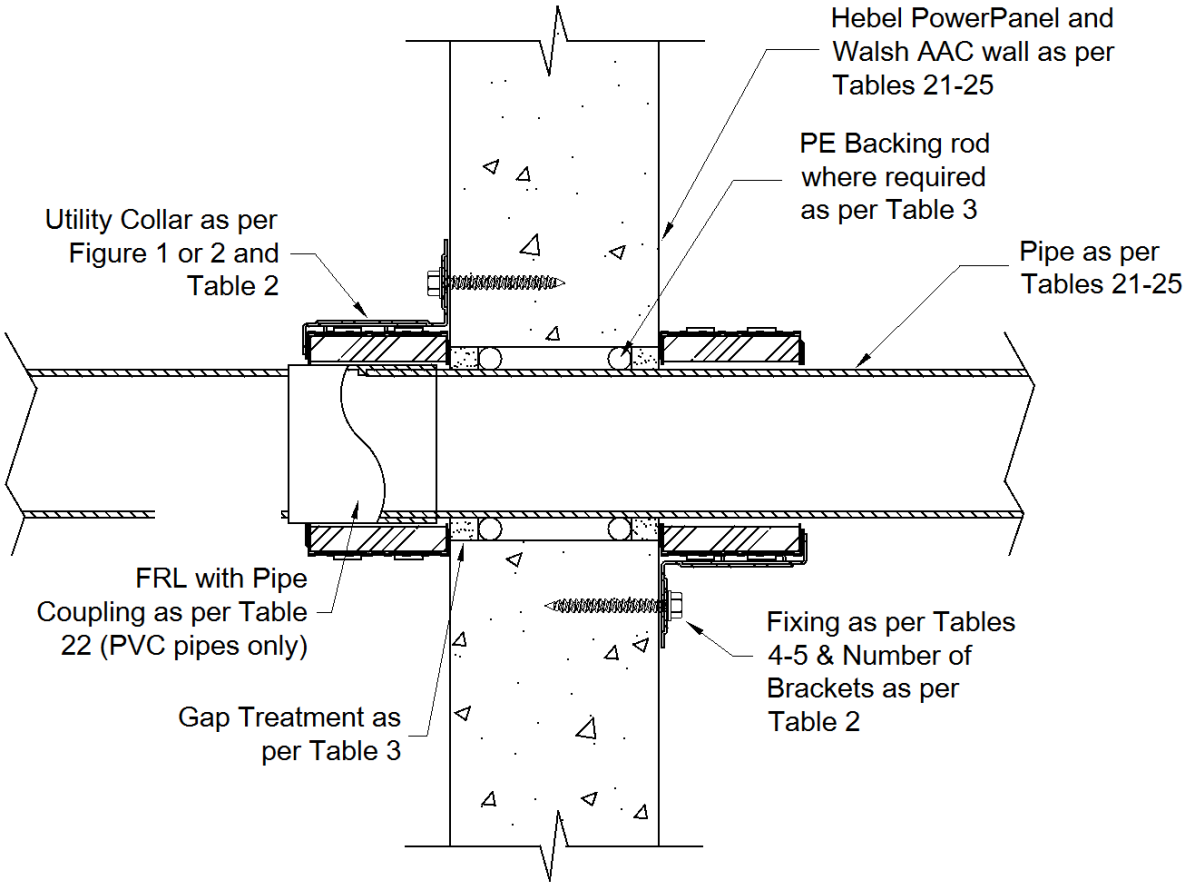

Figure 7: General installation of pipe in a Hebel or Walsc panel wall

Table 21: PVC pipes in Hebel or Walsc panel wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL	
				Type of AAC panel	
				75mm Hebel or Walsc panel wall (single mesh)	75mm Hebel panel wall (caged mesh)
40	2.0-2.4	Utility 40	Figure 7	-/90/90	-/120/120
50	2.2.2-5	Utility 50		-/90/90	-/120/120
65	2.7-3.2	Utility 65		-/90/90	-/120/120
80	2.9-3.2	Utility 80		-/90/90	-/120/120
90	3.0-3.4	Utility 80+		-/90/90	-/120/120
100	3.0-3.4	Utility 100		-/90/90	-/120/120
150	4.2-4.5	2 x Utility 150		-/90/90	-/120/90

Table 22: PVC pipes with coupling in collar in Hebe or Walsc panel wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL	
				Type of AAC panel	
				75mm Hebel or Walsc panel wall (single mesh)	75mm Hebel panel wall (caged mesh)
40	2.0-2.4	Utility 40+	Figure 7	-/90/90	-/120/120
50	2.2.2-5	Utility 50+		-/90/90	-/120/120
65	2.7-3.2	Utility 65+		-/90/90	-/120/120
80	2.9-3.2	Utility 80+		-/90/90	-/120/120
90	3.0-3.4	Utility 90+		-/90/90	-/120/120
100	3.0-3.4	Utility 100+		-/90/90	-/120/120

Table 23: HDPE pipes in Hebel or Walsc panel wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL	
				Type of AAC panel	
				75mm Hebel or Walsc panel wall (single mesh)	75mm Hebel panel wall (caged mesh)
40	3.0 - 3.4	Utility 40	Figure 7	-/90/90	-/120/120
50	3.0 - 3.4	Utility 50		-/90/90	-/120/120
56	3.0 - 3.4	Utility 50		-/90/90	-/120/120
63	3.0 - 3.4	Utility 50+		-/90/90	-/120/120
75	2.9 - 3.4	Utility 65+		-/90/90	-/120/120
90	3.5 - 4.0	Utility 80+		-/90/90	-/120/120
110	4.3 - 4.9	Utility 100		-/90/90	-/120/120
125	4.8 - 5.4	Utility 125		-/90/60	-/120/90
160	6.2 - 7.2	2 x Utility 150		-/90/60	-/120/90

Table 24: Valsir Triplus Polypropylene pipes in Hebel or Walsc panel wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL	
				Type of AAC panel	
				75mm Hebel or Walsc panel wall (single mesh)	75mm Hebel panel wall (single mesh)
40	1.8 - 2.2	Utility 40	Figure 7	-/90/90	-/120/120
50	1.8 - 2.2	Utility 50		-/90/90	-/120/120
75	2.6 - 3.1	Utility 65+		-/90/90	-/120/120
90	3.1 - 3.7	Utility 80+		-/90/90	-/120/120
110	3.7 – 4.0	Utility 100		-/90/90	-/120/120
160	4.9 - 5.6	2 x Utility 150		-/90/90	-/120/120

Table 25: Rehau Raupiano Polypropylene pipes in Hebel or Walsc panel wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL	
				Type of AAC panel	
				75mm Hebel or Walsc panel wall (single mesh)	75mm Hebel panel wall (single mesh)
40	1.8- 2.2	Utility 40	Figure 7	-/90/90	-/120/120
50	1.8 - 2.2	Utility 50		-/90/90	-/120/120
75	1.9 - 2.3	Utility 65+		-/90/90	-/120/120
110	2.7 - 3.2	Utility 100		-/90/90	-/120/120
160	3.9 - 4.5	2 x Utility 150		-/90/90	-/120/120

5.6 Performance in Dincel wall, Logicwall and AFS Logicwall Walls

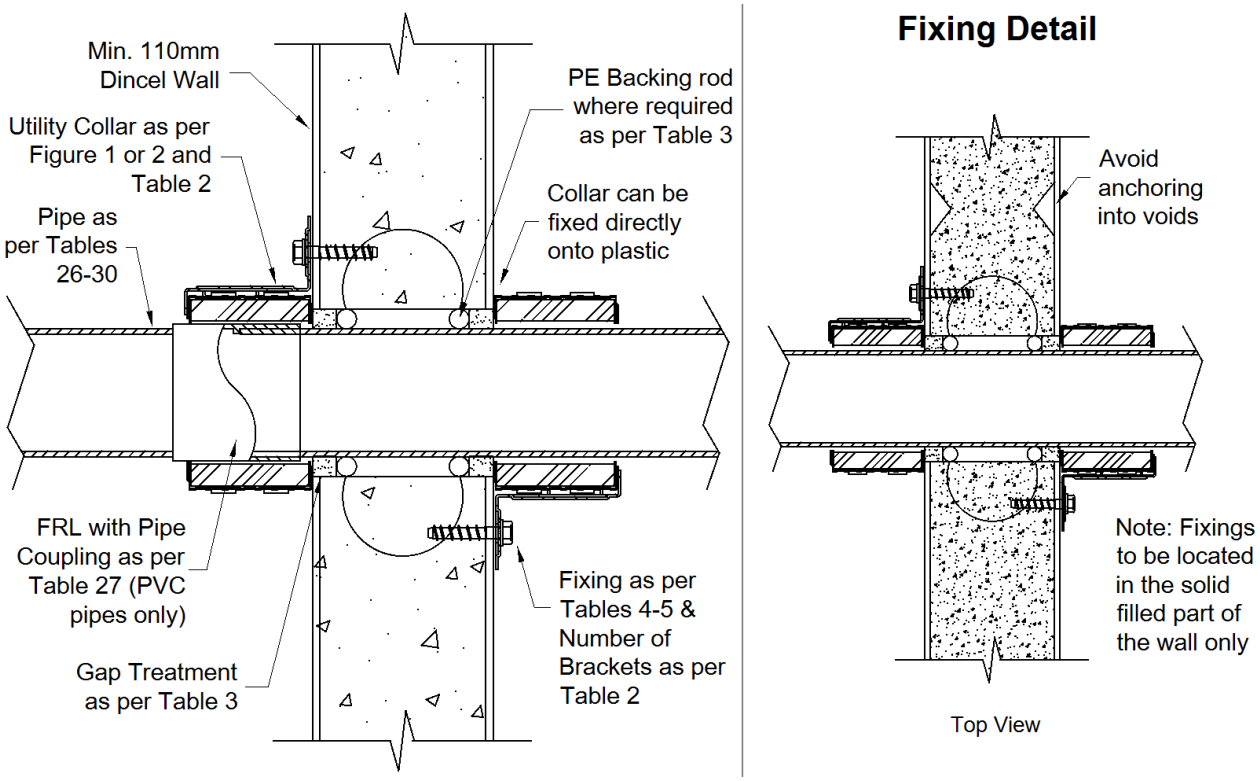

Figure 8: General installation of pipe in a Dincel wall

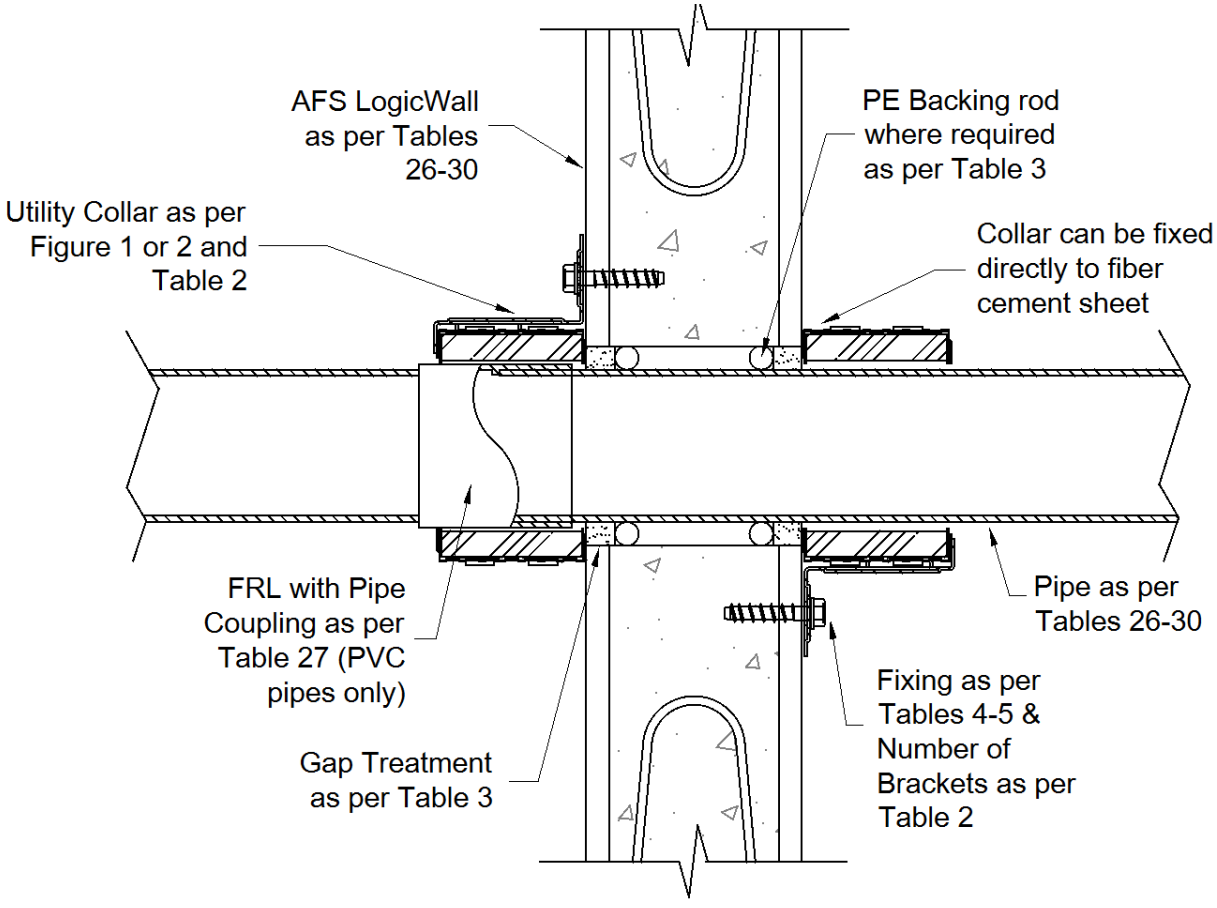

Figure 9: General installation of pipe in a AFS Logic wall

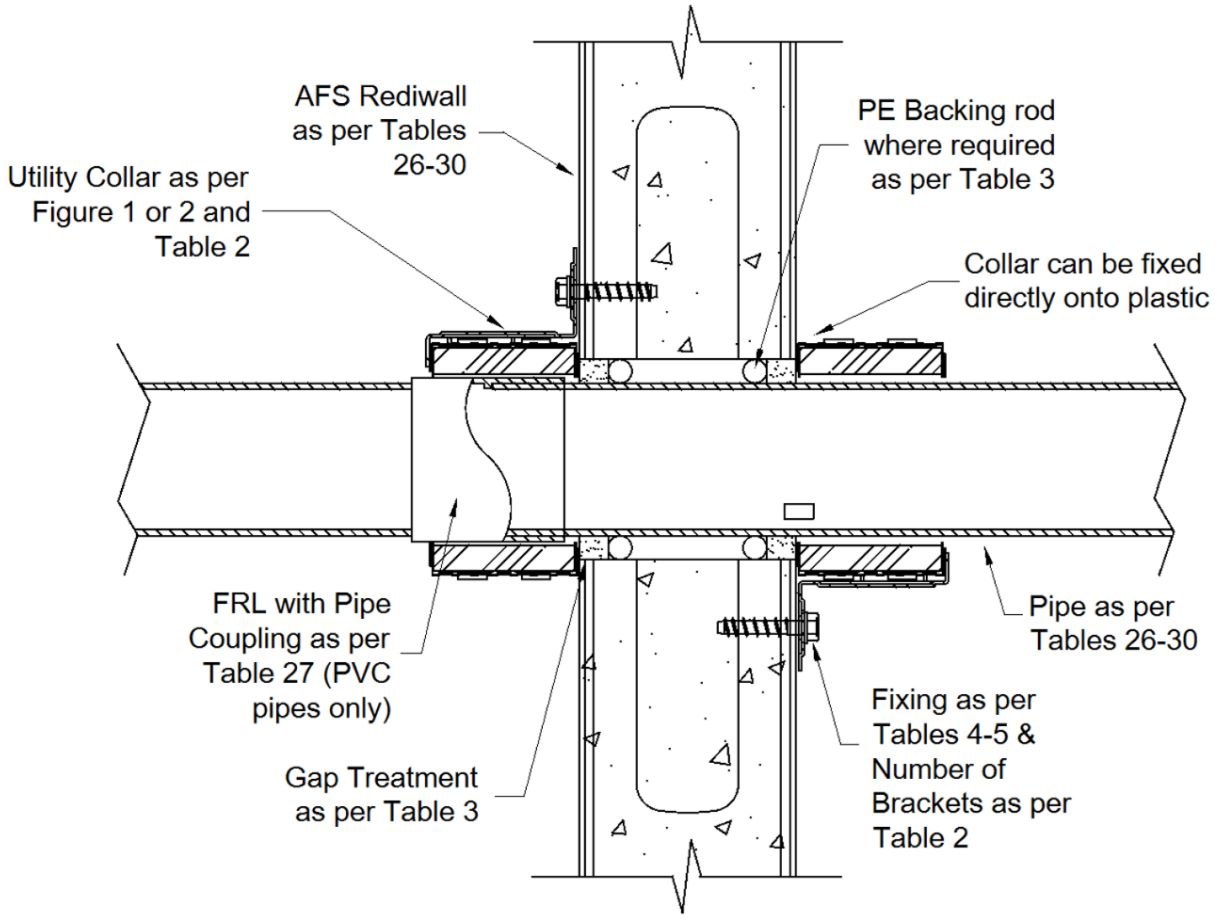

Figure 10: General installation of pipe in a AFS Rediwall

Table 26: PVC pipe in Dincel wall, AFS Logicwall and AFS Rediwall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL			
				Dincel	AFS Rediwall	AFS Logic Wall	Dincel
				110mm (90 minute)	110mm (90 minute)	120mm LW120 (120minute)	155mm (180 minute)
40	2.0-2.4	Utility 40	Figures 8, 9 or 10	-/90/90	-/90/90	-/120/120	-/180/180
50	2.2.2-5	Utility 50		-/90/90	-/90/90	-/120/120	-/180/180
65	2.7-3.2	Utility 65		-/90/90	-/90/90	-/120/120	-/180/180
80	2.9-3.2	Utility 80		-/90/90	-/90/90	-/120/120	-/180/180
90	3.0-3.4	Utility 80+		-/90/90	-/90/90	-/120/120	-/180/180
100	3.0-3.4	Utility 100		-/90/90	-/90/90	-/120/120	-/180/180
150	4.2-4.5	2 x Utility 150		-/90/90	-/90/90	-/120/120	-/180/120

Table 27: PVC pipe with coupling in collar in Dincel wall, AFS Logicwall and AFS Rediwall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL			
				Dincel	AFS Rediwall	AFS Logic Wall	Dincel
				110mm (90 minute)	110mm (90 minute)	120mm LW120 (120minute)	155mm (180 minute)
40	2.0-2.4	Utility 40+	Figures 8, 9 or 10	-/90/90	-/90/90	-/120/120	-/180/180
50	2.2.2-5	Utility 50+		-/90/90	-/90/90	-/120/120	-/180/120
65	2.7-3.2	Utility 65+		-/90/90	-/90/90	-/120/120	-/180/120
80	2.9-3.2	Utility 80+		-/90/90	-/90/90	-/120/120	-/180/120
90	3.0-3.4	Utility 90+		-/90/90	-/90/90	-/120/120	-/180/120
100	3.0-3.4	Utility 100+		-/90/90	-/90/90	-/120/120	-/180/120

Table 28: HDPE pipe in Dincel wall, AFS Logicwall and AFS Rediwall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL			
				Dincel	AFS Rediwall	AFS Logic Wall	Dincel
				110mm (90 minute)	110mm (90 minute)	120mm LW120 (120minute)	155mm (180 minute)
40	3.0 - 3.4	Utility 40	Figures 8, 9 or 10	-/90/90	-/90/90	-/120/120	-/180/120
50	3.0 - 3.4	Utility 50		-/90/90	-/90/90	-/120/120	-/180/120
56	3.0 - 3.4	Utility 50		-/90/90	-/90/90	-/120/120	-/180/120
63	3.0 - 3.4	Utility 50+		-/90/90	-/90/90	-/120/120	-/180/120
75	2.9 - 3.4	Utility 65+		-/90/90	-/90/90	-/120/120	-/180/120
90	3.5 - 4.0	Utility 80+		-/90/90	-/90/90	-/120/120	-/180/120
110	4.3 - 4.9	Utility 100		-/90/90	-/90/90	-/120/120	-/180/120
125	4.8 - 5.4	Utility 125		-/90/90	-/90/90	-/120/90	-/180/90
160	6.2 - 7.2	2 x Utility 150		-/90/90	-/90/90	-/120/90	-/180/90

Table 29: Valsir Triplus Polypropylene pipe in Dincel wall, AFS Logicwall and AFS Rediwall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL			
				Dincel	AFS Rediwall	AFS Logic Wall	Dincel
				110mm (90 minute)	110mm (90 minute)	120mm LW120 (120minute)	155mm (180 minute)
40	1.8 - 2.2	Utility 40	Figures 8, 9 or 10	-/90/90	-/90/90	-/120/120	-/180/120
50	1.8 - 2.2	Utility 50		-/90/90	-/90/90	-/120/120	-/180/120
75	2.6 - 3.1	Utility 65+		-/90/90	-/90/90	-/120/120	-/180/120
90	3.1 - 3.7	Utility 80+		-/90/90	-/90/90	-/120/120	-/180/120
110	3.7 - 4.0	Utility 100		-/90/90	-/90/90	-/120/120	-/180/120
160	4.9 - 5.6	2 x Utility 150		-/90/90	-/90/90	-/120/120	-/180/120

Table 30: Rehau Raupiano Polypropylene pipe in Dincel wall, AFS Logicwall and AFS Rediwall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL			
				Dincel	AFS Rediwall	AFS Logic Wall	Dincel
				110mm (90 minute)	110mm (90 minute)	120mm LW120 (120minute)	155mm (180 minute)
40	1.8- 2.2	Utility 40	Figures 8, 9 or 10	-/90/90	-/90/90	-/120/120	-/180/180
50	1.8 - 2.2	Utility 50		-/90/90	-/90/90	-/120/120	-/180/180
75	1.9 - 2.3	Utility 65+		-/90/90	-/90/90	-/120/120	-/180/180
110	2.7 - 3.2	Utility 100		-/90/90	-/90/90	-/120/120	-/180/180
160	3.9 - 4.5	2 x Utility 150		-/90/90	-/90/90	-/120/120	-/180/180

5.7 Performance in Concrete, Masonry, AAC Block Walls

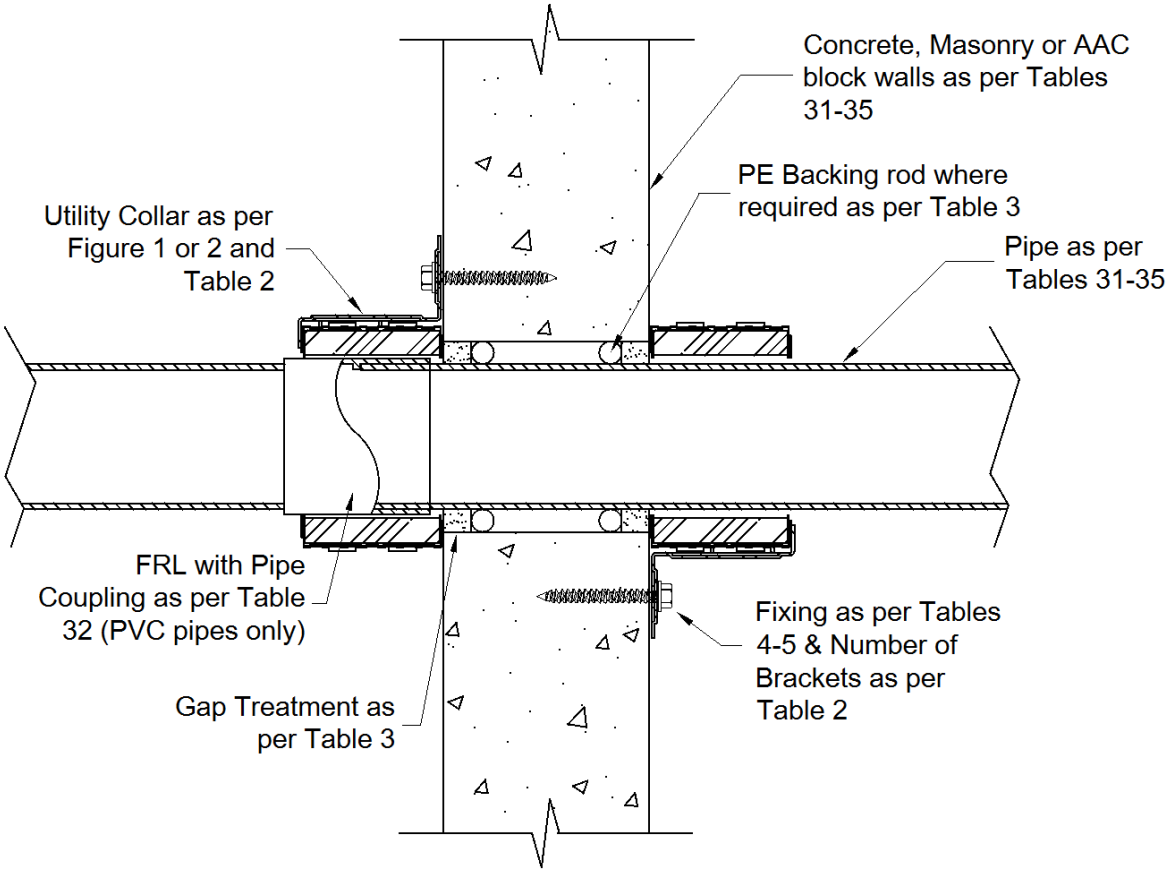

Figure 11: General installation of pipe in a solid concrete/masonry or AAC block wall

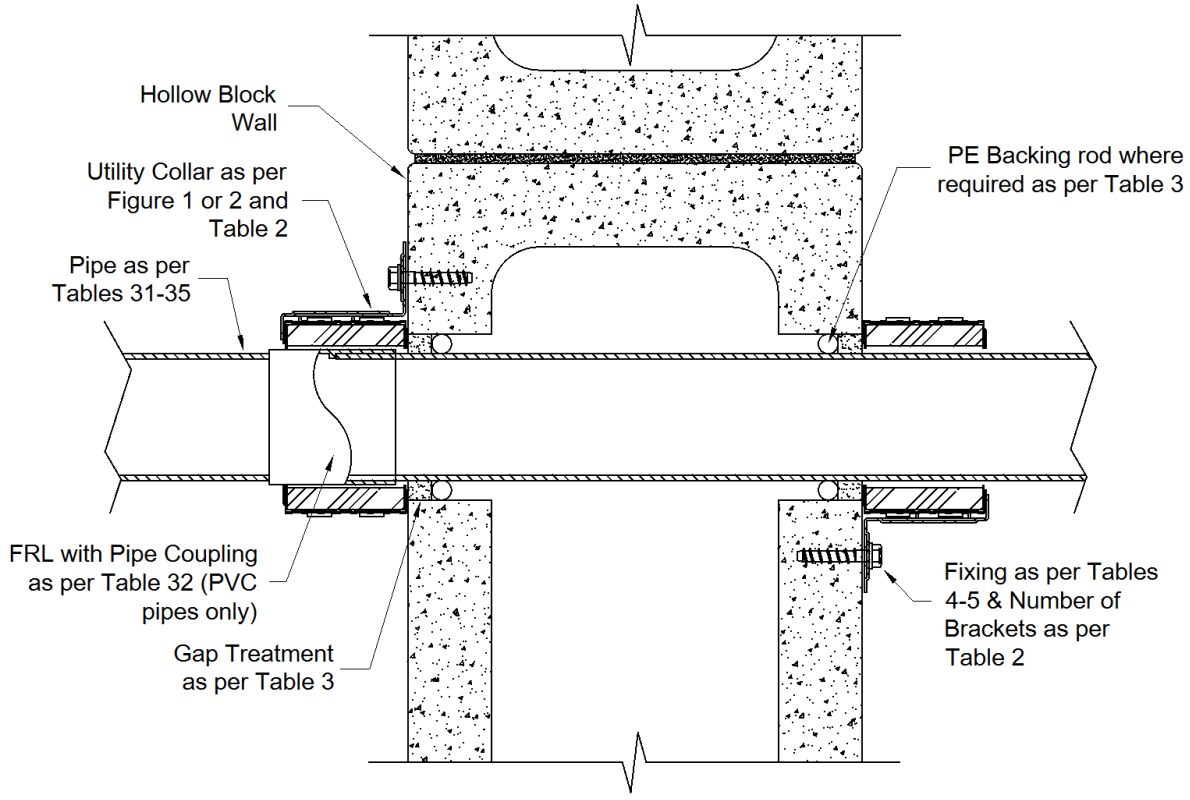

Figure 12: General installation of pipe in a hollow masonry block wall

Table 31: PVC pipe in Concrete, Masonry, AAC Block Walls

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL			
				Concrete wall	Masonry wall or AAC block wall	Concrete wall or AAC block wall	Masonry wall
				Min. 80mm	Min. 90mm	Min. 120mm	Min. 130mm
40	2.0-2.4	Utility 40	Figures 11 or 12	-/60/60	-/60/60	-/120/120	-/120/120
50	2.2.2-5	Utility 50		-/60/60	-/60/60	-/120/120	-/120/120
65	2.7-3.2	Utility 65		-/60/60	-/60/60	-/120/120	-/120/120
80	2.9-3.2	Utility 80		-/60/60	-/60/60	-/120/120	-/120/120
90	3.0-3.4	Utility 80+		-/60/60	-/60/60	-/120/120	-/120/120
100	3.0-3.4	Utility 100		-/60/60	-/60/60	-/120/120	-/120/120
150	4.2-4.5	2 x Utility 150		-/60/60	-/60/60	-/120/120	-/120/120

Table 32: PVC pipe with coupling in collar in Concrete, Masonry, AAC Block Walls

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL			
				Concrete wall	Masonry wall or AAC block wall	Concrete wall or AAC block wall	Masonry wall
				Min. 80mm	Min. 90mm	Min. 120mm	Min. 130mm
40	2.0-2.4	Utility 40+	Figures 11 or 12	-/90/90	-/90/90	-/120/120	-/180/180
50	2.2.2-5	Utility 50+		-/90/90	-/90/90	-/120/120	-/180/120
65	2.7-3.2	Utility 65+		-/90/90	-/90/90	-/120/120	-/180/120
80	2.9-3.2	Utility 80+		-/90/90	-/90/90	-/120/120	-/180/120
90	3.0-3.4	Utility 90+		-/90/90	-/90/90	-/120/120	-/180/120
100	3.0-3.4	Utility 100+		-/90/90	-/90/90	-/120/120	-/180/120

Table 33: HDPE pipe in Concrete, Masonry, AAC Block Walls

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL			
				Concrete wall	Masonry wall or AAC block wall	Concrete wall or AAC block wall	Masonry wall
				Min. 80mm	Min. 90mm	Min. 120mm	Min. 130mm
40	3.0 - 3.4	Utility 40	Figures 11 or 12	-/60/60	-/60/60	-/120/120	-/120/120
50	3.0 - 3.4	Utility 50		-/60/60	-/60/60	-/120/120	-/120/120
56	3.0 - 3.4	Utility 50		-/60/60	-/60/60	-/120/120	-/120/120
63	3.0 - 3.4	Utility 50+		-/60/60	-/60/60	-/120/120	-/120/120
75	2.9 - 3.4	Utility 65+		-/60/60	-/60/60	-/120/120	-/120/120
90	3.5 - 4.0	Utility 80+		-/60/60	-/60/60	-/120/120	-/120/120
110	4.3 - 4.9	Utility 100		-/60/60	-/60/60	-/120/120	-/120/120
125	4.8 - 5.4	Utility 125		-/60/60	-/60/60	-/120/90	-/120/90
160	6.2 - 7.2	2 x Utility 150		-/60/60	-/60/60	-/120/90	-/120/90

Table 34: Valsir Triplus Polypropylene pipe in Concrete, Masonry, AAC Block Walls

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL			
				Concrete wall	Masonry wall or AAC block wall	Concrete wall or AAC block wall	Masonry wall
				Min. 80mm	Min. 90mm	Min. 120mm	Min. 130mm
40	1.8 - 2.2	Utility 40	Figures 11 or 12	-/60/60	-/60/60	-/120/120	-/120/120
50	1.8 - 2.2	Utility 50		-/60/60	-/60/60	-/120/120	-/120/120
75	2.6 - 3.1	Utility 65+		-/60/60	-/60/60	-/120/120	-/120/120
90	3.1 - 3.7	Utility 80+		-/60/60	-/60/60	-/120/120	-/120/120
110	3.7 – 4.0	Utility 100		-/60/60	-/60/60	-/120/120	-/120/120
160	4.9 - 5.6	2 x Utility 150		-/60/60	-/60/60	-/120/120	-/120/120

Table 35: Rehau Raupiano Polypropylene pipe in Concrete, Masonry, AAC Block Walls

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL			
				Concrete wall	Masonry wall or AAC block wall	Concrete wall or AAC block wall	Masonry wall
				Min. 80mm	Min. 90mm	Min. 120mm	Min. 130mm
40	1.8- 2.2	Utility 40	Figures 11 or 12	-/60/60	-/60/60	-/120/120	-/120/120
50	1.8 - 2.2	Utility 50		-/60/60	-/60/60	-/120/120	-/120/120
75	1.9 - 2.3	Utility 65+		-/60/60	-/60/60	-/120/120	-/120/120
110	2.7 - 3.2	Utility 100		-/60/60	-/60/60	-/120/120	-/120/120
160	3.9 - 4.5	2 x Utility 150		-/60/60	-/60/60	-/120/120	-/120/120

5.7 Performance in SpeedPanel Walls

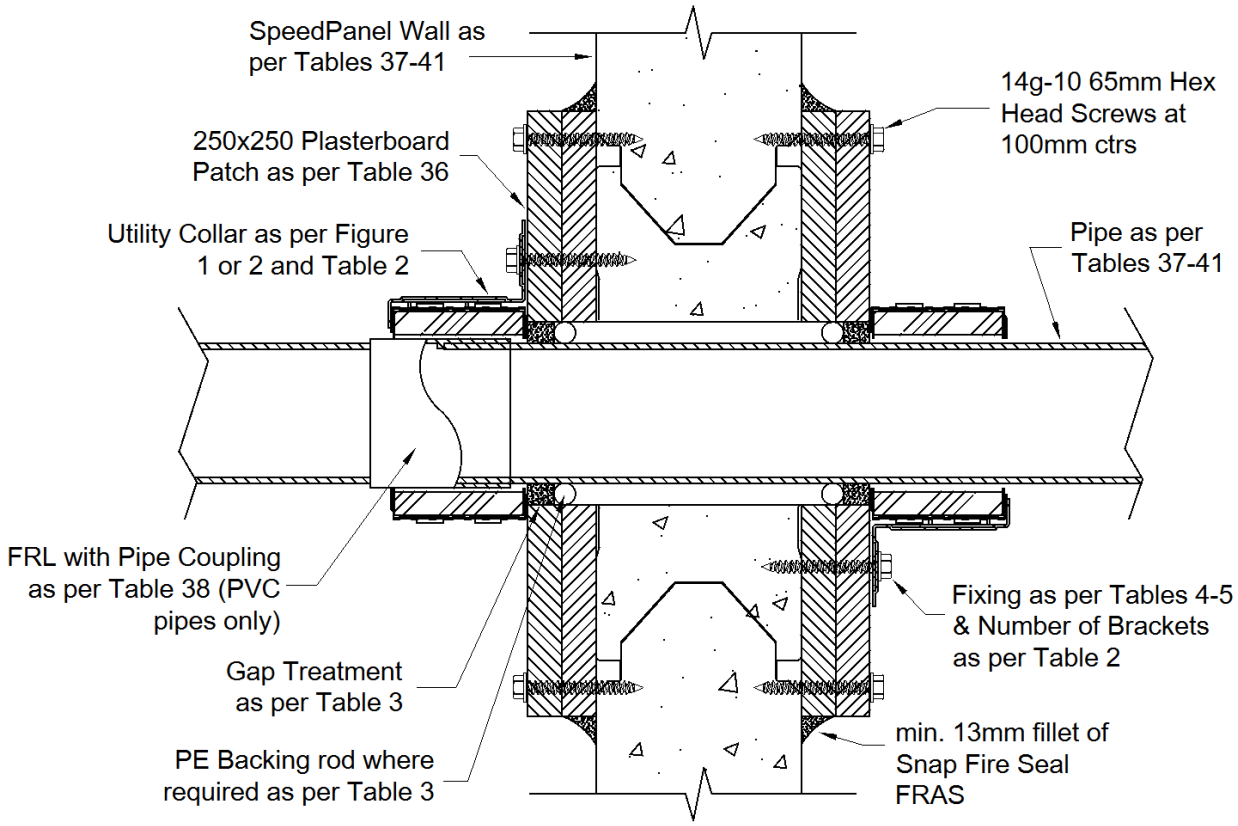

Figure 13: General installation of pipe in a Speedpanel wall

Table 36: Plasterboard patch for pipe penetrations in Speedpanel

Application	250mm x 250mm plasterboard patch
60 minutes	1 layer of minimum 13mm FR each side
90 minutes	1 layer of minimum 16mm FR each side
120 minutes	2 layers of minimum 13mm FR each side or 25mm FR Shaftliner panel

Table 37: PVC pipe in 78mm Speedpanel wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL		
				Plasterboard patching each side of wall		
				1 x min. 13mm FR	1 x min. 16mm FR	2 x min. 13mm FR
40	2.0-2.4	Utility 40	Figure 13	-/60/60	-/90/90	-/120/120
50	2.2.2-5	Utility 50		-/60/60	-/90/90	-/120/120
65	2.7-3.2	Utility 65		-/60/60	-/90/90	-/120/120
80	2.9-3.2	Utility 80		-/60/60	-/90/90	-/120/120
90	3.0-3.4	Utility 80+		-/60/60	-/90/90	-/120/120
100	3.0-3.4	Utility 100		-/60/60	-/90/90	-/120/120
150	4.2-4.5	2 x Utility 150		-/60/60	-/90/90	-/120/120

Table 38: PVC pipe with coupling in collar in 78mm Speedpanel wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL		
				Plasterboard patching each side of wall		
				1 x min. 13mm FR	1 x min. 16mm FR	2 x min. 13mm FR
40	2.0-2.4	Utility 40+	Figure 13	-/60/60	-/90/90	-/120/120
50	2.2.2-5	Utility 50+		-/60/60	-/90/90	-/120/120
65	2.7-3.2	Utility 65+		-/60/60	-/90/90	-/120/120
80	2.9-3.2	Utility 80+		-/60/60	-/90/90	-/120/120
90	3.0-3.4	Utility 90+		-/60/60	-/90/90	-/120/120
100	3.0-3.4	Utility 100+		-/60/60	-/90/90	-/120/120

Table 39: HDPE pipe in 78mm Speedpanel wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL		
				Plasterboard patching each side of wall		
				1 x min. 13mm FR	1 x min. 16mm FR	2 x min. 13mm FR
40	3.0 - 3.4	Utility 40	Figure 13	-/60/60	-/90/90	-/120/120
50	3.0 - 3.4	Utility 50		-/60/60	-/90/90	-/120/120
56	3.0 - 3.4	Utility 50		-/60/60	-/90/90	-/120/120
63	3.0 - 3.4	Utility 50+		-/60/60	-/90/90	-/120/120
75	2.9 - 3.4	Utility 65+		-/60/60	-/90/90	-/120/120
90	3.5 - 4.0	Utility 80+		-/60/60	-/90/90	-/120/120
110	4.3 - 4.9	Utility 100		-/60/60	-/90/90	-/120/120
125	4.8 - 5.4	Utility 125		-/60/60	-/90/90	-/120/90
160	6.2 - 7.2	2 x Utility 150		-/60/60	-/90/90	-/120/90

Table 40: Valsir Triplus Polypropylene pipe in 78mm Speedpanel wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL		
				Plasterboard patching each side of wall		
				1 x min. 13mm FR	1 x min. 16mm FR	2 x min. 13mm FR
40	1.8 - 2.2	Utility 40	Figure 13	-/60/60	-/90/90	-/120/120
50	1.8 - 2.2	Utility 50		-/60/60	-/90/90	-/120/120
75	2.6 - 3.1	Utility 65+		-/60/60	-/90/90	-/120/120
90	3.1 - 3.7	Utility 80+		-/60/60	-/90/90	-/120/120
110	3.7 - 4	Utility 100		-/60/60	-/90/90	-/120/120
160	4.9 - 5.6	2 x Utility 150		-/60/60	-/90/90	-/120/120

Table 41: Rehau Raupiano Polypropylene pipe in 78mm Speedpanel wall

Nominal diameter (mm)	Pipe wall thickness (mm)	Collar	Construction Details	FRL		
				Plasterboard patching each side of wall		
				1 x min. 13mm FR	1 x min. 16mm FR	2 x min. 13mm FR
40	1.8- 2.2	Utility 40	Figure 13	-/60/60	-/90/90	-/120/120
50	1.8 - 2.2	Utility 50		-/60/60	-/90/90	-/120/120
75	1.9 - 2.3	Utility 65+		-/60/60	-/90/90	-/120/120
110	2.7 - 3.2	Utility 100		-/60/60	-/90/90	-/120/120
160	3.9 - 4.5	2 x Utility 150		-/60/60	-/90/90	-/120/120

6 Direct Field of Application of Results

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

7 Requirements

Where concrete wall, masonry wall, concrete floor, Bondek formwork concrete floor, Hebel single or double mesh panel wall, Walsc AAC panel wall, Hebel block wall, Speedpanel wall, AFS Logic wall, AFS Rediwall, Dincel wall or plasterboard lined steel stud walls are specified in this report, it is required that they be designed, tested or assessed as a separating element for the required FRL when including the service penetration specified in Section 5.

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 August 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. FSP 2320

On 31 October 2022, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 116mm thick plasterboard wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.2. FSP 2333

On 1 Dec 2022, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 120-mm thick concrete slab penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.3. FSP 2336

On 3 Jan 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 75mm thick Hebel wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.4. FSP 2337

On 5 Jan 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 90mm thick plasterboard wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.5. FSP 2338

On 9 Jan 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 150-mm thick concrete slab penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.6. FSP 2345

On 6 Feb 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 116mm thick plasterboard wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.7. FSP 2347

On 16 Feb 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 120-mm thick concrete slab penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.8. FSP 2354

On 8 March 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 90mm thick plasterboard wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.9. FSP 2358

On 20 March 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 120-mm thick concrete slab penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.10. FSP 2361

On 3 April 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 116mm thick plasterboard wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.11. FSP 2362

On 5 April 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 90mm thick plasterboard wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.12. FSP 2366

On 20 April 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 150mm thick slab penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.13. FSP 2367

On 26 April 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 75mm thick Hebel wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.14. FSP 2368

On 1 May 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 116mm thick plasterboard wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.15. FSP 2369

On 3 May 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 75mm thick Hebel wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.16. FSP 2370

On 8 May 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 75mm thick Hebel wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.17. FSP 2371

On 15 May 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 120-mm thick concrete slab penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.18. FSP 2374

On 22 May 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 90mm thick plasterboard wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.19. FSP 2375

On 22 August 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 90mm thick plasterboard wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.20. FSP 2405

On 9 November 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 90mm thick plasterboard wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.21. FSP 2407

On 21 November 2023, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 116mm thick plasterboard wall penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

A.22. Supplementary test data FSP 1953

On 15 Nov 2018, CSIRO North Ryde conducted a fire-resistance test in accordance with AS 1530.4 – 2014 on a 120-mm thick Bondek concrete slab penetrated by pipes protected by Snap Fire Systems fire collars. The relevant specimens are summarised and discussed in Appendix B.

Appendix B Analysis of Variations

B.1 Variation to SNAP Utility collars protecting plastic pipes

The proposed construction shall be Snap Utility collars tested in Table 1 and as shown in Figures 1 and 2 and Table 2 subject to the following variations:

- The inclusion of various plastic pipes
- The inclusion of pipe coupling for PVC stack pipes within or not within the collar made from same wall thickness as proposed pipe
- Stack pipes in floor to have a straight pipe configuration below the floor
- Above the floor, all services to be supported at maximum 500mm along the service, and if required with a second support at nominally 1000mm along the service from the first support.

B1.1 PVC pipes in concrete floor

Table B1.1: PVC pipes in concrete floor

Test Report Number	Pen. #	Test Element	Collar	Pipe Type	Pipe Dia. (Nom.) (mm)	Pipe wall thickness (mm)	Coupling (mm)	Annular Gap (mm)	Sealant	Test Result
FSP2347	3	120mm Concrete Slab	Utility 40	PVC	40	2.2	0	4	10mm bead of Fullers Firesound	-/241/ 208 (slab)
FSP2358	3	120mm Concrete Slab	Utility 50	PVC	50	2.5	0	10	10mm bead of Fullers Firesound	-/241/ 235 (slab)
FSP2358	1	120mm Concrete Slab	Utility 65	PVC	65	2.9	0	6	10mm bead of Fullers Firesound	-/241/ 232 (slab)
FSP2358	2	120mm Concrete Slab	Utility 80	PVC	80	3.2	0	10	10mm bead of Fullers Firesound	-/241/ 221 (slab)
FSP2333	3	120mm Concrete Slab	Utility 100	PVC (SC)	100	3.21	0	2	None	-/241/ 219 (slab)
FSP2333	5	120mm Concrete Slab	Utility 40+	PVC	40	2.1	2	5	10mm bead of Fullers Firesound	-/241/ 230 (slab)
FSP2333	1	120mm Concrete Slab	Utility 100+	PVC (SC)	100	3.21	3.1	0	None	-/241/ 226 (slab)
FSP2371	1	120mm Concrete Slab	Utility 100+	PVC (SC)	100	3.21	3.1	5	10mm bead of Fullers Firesound	-/241/ 241
FSP2338	4	150mm Concrete Slab	2 x Utility 150	PVC (SC)	150	4.4	0	2	None	-/241/ 241

PVC stack pipes without coupling

The proposed construction comprises a Snap Utility collar protecting 40mm to 90mm PVC, 100mm and 150mm PVC (SC) stack pipes penetrating through 120mm and 150mm thick concrete floor.

It is required in section 7 of this report that the concrete floor be designed as per AS 3600-2018 for the required FRL.

With reference to test data summarised in Table B1.1, various sizes and thicknesses of plastic pipes made from AUS PVC, Sandwich Core PVC, penetrated 120mm and 150mm thick concrete floors and were protected with Utility collar.

It is observed that these specimens all were able to maintain integrity for up to 240 minutes without failure. When the specimen failed insulation, it was due to the failure of the supporting construction. The pipe was able to maintain insulation for up to 240 minutes.

The PVC pipe sizes that were tested in the 120mm thick concrete floors were 40mm, 50mm, 65mm, 80mm and 100mm(SC). The PVC pipe that was tested in the 150mm thick slab was 150mm PVC(SC).

Based on the above, it can be seen that the prequalification testing of the uPVC pipe sizes between 40 to 80mm and 100mm PVC SC have been met, and these pipes will be able to maintain integrity and insulation performance of up to 120 minutes in 120mm thick and 180minutes in 150mm thick concrete floor.

The proposed 90mm PVC pipe when protected with a Utility 80+ collar would result in an annular gap between the pipe and the inner diameter of the collar of 7.3mm, which is 2.8mm more than that in FSP2333 specimen 3. This difference in annular gap may affect the closure speed of the intumescent in the collar on the pipe which may lead to insulation failure of the pipe in the early stage of the test.

With reference to FSP2347 specimen 3 which comprised a 40mm PVC pipe protected with a Utility 40 and FSP2333 specimen 5 which comprised a 40mm PVC pipe with fitting was protected with a Utility 40+ collar. The annular gap difference between the two specimens was 2.7mm. Both specimens were able to maintain integrity for 240 minutes, and insulation on the pipe for 240 minutes.

The significance of this comparison demonstrates that that a difference in annular gap of 2.7mm did not affect the closure of the PVC pipe.

Therefore, it is expected the proposed 90mm PVC pipe protected with a Utility 80+ collar, with a similar annular gap difference to the 100mm PVC pipe specimen in FSP2333 specimen 3, will be able to maintain integrity and insulation performance of up to 120 minutes in 120mm thick and 180 minutes in 150mm thick concrete floor.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 and 180 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

PVC stack pipes with coupling

The proposed construction comprises a Snap Utility collar protecting 40mm to 90mm PVC and 100mm PVC (SC) stack pipes with pipe coupling penetrating through 120mm thick concrete floor.

The proposed variation to include a coupling inside the Utility collar may affect and or delay collar closure.

With reference to Table B1.1, the 40mm and 100mm pipes were tested with coupling inside the Utility collar. Both specimens were able to maintain integrity for up to 240 minutes and insulation on the pipe for up to 240 minutes. The difference in annular gap between the collar and these pipes compared to the collar and the 40mm and 100mm without coupling ranged from 1.8mm to 2.7mm.

With reference to Table B1.1, the 50mm, 65mm, 80mm pipe with their respective collars were tested and were able to maintain integrity for up to 240 minutes and insulation on the pipe for up to 240 minutes.

Compared to these tested pipes without couplings, the proposed 50mm, 65mm, 80mm pipe with couplings would have a difference in annular gap that is within the 1.8mm to 2.7mm range.

The proposed 90mm pipe with coupling inside a Utility 90+ collar would have an annular gap between the collar and the pipe that is similar to the 100mm pipes were tested with coupling inside the Utility collar 100+ collar.

Given the similarity in distance of collar intumescent to proposed pipe to that of the tested pipes, and the absence of any impending failure observed in the reference tests for up to 240 minutes, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 and 180 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Variation to pipe wall thickness penetrating concrete floor

The proposed construction comprises inclusion of 40mm to 150mm PVC pipes with slightly thinner and thicker pipe wall thicknesses compared to the tested pipes as shown below.

Nominal diameter (mm)	Tested pipe wall thickness (mm)	Proposed pipe wall thickness (mm)
40	2.2	2.0-2.4
50	2.5	2.2-2.5
65	2.9	2.7-3.2
80	3.2	2.9-3.2
100	3.2	3.0-3.4
150	4.4	4.2-4.5

40mm PVC pipe

With reference to FSP 2347 specimen 3, 40mm PVC pipe with pipe wall thickness of 2.2mm penetrated 120mm thick concrete floor and was protected with Utility 40 collar. When tested, the specimen maintained integrity for up to 241 minutes and failed insulation at 208 minutes after the thermocouple on the floor exceeded a temperature rise of more than 180^{o}K. It is observed that the collar closed off at 6 minutes and the maximum temperature rise on the pipe was recorded to be 63^{o}K at 120 minutes.

With reference to FSP 2333 specimen 5, 40mm PVC pipe with pipe wall thickness of 2.1mm and with 2mm thick coupling inside the collar penetrated 120mm thick concrete floor and was protected with Utility 40+ collar. When tested, the specimen maintained integrity for up to 241 minutes and failed insulation at 230 minutes after the thermocouple on the floor exceeded a temperature rise of more than 180^{o}K. It is observed that the collar closed off at 5 minutes (with less than 100^{o}K Rise) being a considerable margin on insulation failure and the maximum temperature rise on the pipe was recorded to be 46^{o}K at 120 minutes.

The proposed construction comprises of 40mm PVC pipes with wall thickness of 2mm to 2.4mm penetrating 120mm thick concrete floor and protected with Utility 40 and Utility 40+ collars. From the referenced tests, it is demonstrated that the collar closed off before 6 minutes with or without the coupling. For pipes with slightly thinner pipe wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in an increase of non-fire side temperature. However, with margin of more than 117^{o}K in insulation performance for PVC pipe without coupling and margin of more than 133^{o}K in insulation performance for the PVC pipe with coupling, it is expected that the proposed 40mm PVC pipe with 2.4mm wall thickness will be able to maintain integrity and insulation for up to 120 minutes.

Confidence is found from the FSP 2333 specimen 5, where the increased thickness of 2mm at the pipe and coupling junction located inside the collar did not affect the collar's closing off ability and was able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

50mm PVC pipe

With reference to FSP 2358 specimen 3, 50mm PVC pipe with pipe wall thickness of 2.5mm penetrated 120mm thick concrete floor and was protected with Utility 50 collar. When tested, the specimen maintained integrity for up to 241 minutes and failed insulation at 235 minutes after the thermocouple on the floor exceeded a temperature rise of more than 180°K. It is observed that the collar closed off at 6 minutes (with less than 50°K rise) being a considerable margin on insulation failure and the maximum temperature rise on the pipe was recorded to be 42°K and 120 minutes.

The proposed construction comprises of 50mm PVC pipe with variation to wall thickness from tested 2.5mm to between 2.2-2.5mm penetrating 120mm thick concrete floor and protected with Utility 50 collar. From the referenced test, it is demonstrated that the collar closed at 6 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. Therefore, it is expected that the proposed 50mm PVC pipes with will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

65mm PVC pipe

With reference to FSP 2358 specimen 1, 65mm PVC pipe with pipe wall thickness of 2.9mm penetrated 120mm thick concrete floor and was protected with Utility 65 collar. When tested, the specimen maintained integrity for up to 241 minutes and failed insulation at 232 minutes after the thermocouple on the floor exceeded a temperature rise of more than 180°K. It is observed that the collar closed off at 7 minutes (with less than 70°K Rise) being a considerable margin on insulation failure and the maximum temperature rise on the pipe was recorded to be 60°K at 120 minutes.

The proposed construction comprises of 65mm PVC pipes with wall thicknesses of 2.7mm to 3.2mm penetrating 120mm thick concrete floor and protected with Utility 65 collar. From the referenced test, it is demonstrated that the collar closed off at 7 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 119°K in insulation performance, it is expected that the proposed 65mm PVC pipes with 3.2mm pipe wall thickness will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

80mm PVC pipe

With reference to FSP 2358 specimen 2, 80mm PVC pipe with pipe wall thickness of 3.2mm penetrated 120mm thick concrete floor and was protected with Utility 80 collar. When tested, the specimen maintained integrity for up to 241 minutes and failed insulation at 221 minutes after the thermocouple on the floor exceeded a temperature rise of more than 180°K. It is observed that the collar closed off

at 8 minutes (with less than 70°K Rise) being a considerable margin on insulation failure and the maximum temperature rise on the pipe was recorded to be 55°K at 120 minutes.

The proposed construction comprises of 80mm PVC pipes with variation to wall thickness from tested 3.2mm to 2.9mm penetrating 120mm thick concrete floor and protected with Utility 80 collar. From the referenced test, it is demonstrated that the collar closed off at 10 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. Therefore, it is expected that the proposed 80mm PVC pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

100mm PVC pipe

With reference to FSP 2333 specimen 3, 100mm PVC pipe with pipe wall thickness of 3.2mm penetrated 120mm thick concrete floor and was protected with Utility 100 collar. When tested, the specimen maintained integrity for up to 241 minutes and failed insulation at 219 minutes after the thermocouple on the floor exceeded a temperature rise of more than 180°K. It is observed that the collar closed off at 7 minutes (with less than 115°K Rise) being a considerable margin on insulation failure and the maximum temperature rise on the pipe was recorded to be 42°K at 120 minutes.

With reference to FSP 2333 specimen 1, 100mm PVC pipe with pipe wall thickness of 3.2mm and with 3.1mm thick coupling inside the collar penetrated 120mm thick concrete floor and was protected with Utility 100+ collar. When tested, the specimen maintained integrity for up to 241 minutes and failed insulation at 226 minutes after the thermocouple on the floor exceeded a temperature rise of more than 180°K. It is observed that the collar closed off at 9 minutes and the maximum temperature rise on the pipe was recorded to be 49°K at 120 minutes.

The proposed construction comprises of 100mm PVC pipes with and without coupling with wall thickness of 3mm to 3.4mm penetrating 120mm thick concrete floor and protected with Utility 100 and Utility 100+ collars. From the referenced tests, it is demonstrated that the collars closed off before 9 minutes with or without the coupling. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 108°K in insulation performance for PVC pipe without coupling and margin of more than 65°K in insulation performance for the PVC pipe with coupling, it is expected that the proposed 100mm PVC pipes with wall thickness to 3.4mm will be able to maintain integrity and insulation for up to 120 minutes.

Confidence is found from the FSP 2333 specimen 1, where the increased thickness of 3.1mm at the pipe and coupling junction located inside the Utility 110+ collar did not affect the collar's closing off ability and was able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

90mm PVC pipe

The proposed construction comprises of 90mm PVC pipes with pipe wall thicknesses of 3mm to 3.4mm penetrating minimum 120mm thick concrete floor and protected with Utility 80+ collar.

With reference to discussions presented above for the 80mm and 100mm pipes, it is established that the collar was able to close off between 7 and 9 minutes and was able to maintain integrity and insulation for up to 120 minutes.

The proposed pipe wall thickness for the 90mm pipe is similar to that of the proposed 100mm pipe. Therefore, it is expected that the collar will be able to close off between 7 and 9 minutes, and the pipe will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

150mm PVC pipe

With reference to FSP 2338 specimen 4, 150mm PVC pipe with pipe wall thickness of 3.2mm penetrated 150mm thick concrete floor and was protected with 2 x Utility 150 collar. When tested, the specimen maintained integrity and insulation for up to 241 minutes. It is observed that the collar closed off at 10 minutes (with less than 50^{o}K rise) being a considerable margin on insulation failure and the maximum temperature rise on the pipe was recorded to be 48^{o}K at 180 minutes.

The proposed construction comprises of 150mm PVC pipes comprises pipe wall thickness of 4.2mm to 4.5mm penetrating 150mm thick concrete floor and protected with 2 x Utility 150 collar. From the referenced test, it is demonstrated that the collars closed off at 10 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 131^{o}K in insulation performance, it is expected that the proposed 150mm PVC pipes will be able to maintain integrity and insulation for up to 180 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 180 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

B1.2 PVC pipes in plasterboard walls

Table B1.2: PVC pipes in plasterboard walls

Test	Pen. #	Test Element	Collar	Pipe Type	Pipe Dia. (Nom.) (mm)	Pipe wall thickness (mm)	Coupling thickness (mm)	Annular Gap (mm)	Sealant	Test Result
FSP2354	4	90mm Plasterboard Wall (64mm stud, 13mm board either side, glasswool in cavity)	Utility 40	PVC	40	2.4	0	1	None	-/91/63 (wall)
FSP2337	4		Utility 40+	PVC	40	2.4	2.4	0	None	-/64/64
FSP2362	4		Utility 50	PVC	50	2.4	0	9	10mm bead of Fullers Firesound	-/71/71
FSP2362	5		Utility 65	PVC	65	3.2	0	7		-/71/71
FSP2362	2		Utility 80	PVC	80	3.1	0	9		-/71/71
FSP2337	2		Utility 100	PVC(SC)	100	3.1	0	2	None	-/64/64
FSP2337	5		Utility 100+	PVC(SC)	100	3.1	3.1	0	None	-/64/64
FSP2337	1		2 x Utility 150	PVC(SC)	150	4.2	0	4	10mm bead of Fullers Firesound	-/64/61(wall)
FSP 2405	2		Utility 40+	PVC	40	2.15	2.47	0	None	-/91NF/71 (wall)
FSP 2405	1		Utility 100+	PVC(SC)	100	3.22	3.15	0	None	-/91NF/76 (wall)
FSP2345	3	116mm Plasterboard Wall (64mm stud, 2 x 13mm board either side)	Utility 40	PVC	40	2.2	0	0.3	None	-/180/152 (wall)
FSP2368	5		Utility 50	PVC	50	2.56	0	8.5	10mm bead of Fullers Firesound	-/181/181
FSP2361	5		Utility 65	PVC	65	3	0	8.9	10mm bead of Fullers Firesound	-/181/181
FSP2345	5		Utility 80	PVC	80	3.2	0	9.45	10mm bead of Fullers Firesound	-/180/180
FSP2320	4		Utility 100	PVC(SC)	100	3.1	0	1.8	None	-/181/159 (wall)

Test	Pen. #	Test Element	Collar	Pipe Type	Pipe Dia. (Nom.) (mm)	Pipe wall thickness (mm)	Coupling thickness (mm)	Annular Gap (mm)	Sealant	Test Result
FSP2368	4		Utility 40+	PVC	40	2.34	2.5	5.5	10mm bead of Fullers Firesound	-/181/181
FSP2320	2		Utility 100+	PVC(SC)	100	3.1	3.1	10.2	10mm bead of Fullers Firesound	-/181/124 (pipe)
FSP2320	3		Utility 100+	PVC(SC)	100	3.1	3.1	0	None	-/181/146 (wall)
FSP2320	1		2 x Utility 150	PVC(SC)	150	4.45	0	3.5	10mm bead of Fullers Firesound	-/181/126 (collar)

PVC stack pipes without coupling

The proposed construction comprises a Snap Utility collar protecting 40mm to 90mm PVC, 100mm and 150mm PVC (SC) stack pipes penetrating through 90mm thick and 116mm thick plasterboard wall.

It is required in Section 7 of this report that the plasterboard walls be tested or assessed for the FRL when including aperture for services in the field of the wall.

With reference to test data summarised in Table B1.2, various size and thickness of plastic pipes made from AUS PVC, Sandwich Core PVC, penetrated 90mm thick and 116mm thick plasterboard walls and were protected with Utility collar.

With reference to the discussion in section B1.1 of this report for the 90mm PVC pipe protected with Utility 80+ in a slab, the proposed 90mm pipe with coupling inside a Utility 90+ collar would have an annular gap between the collar and the pipe that is similar to the 100mm pipes were tested with coupling inside the Utility collar 100+ collar when tested in slabs. Based on the available evidence for slabs for this minor variation, it is considered reasonable and conservative that 90mm PVC pipe protected with Utility 80+ will also work satisfactorily in a plasterboard line wall.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 and 120 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

PVC stack pipes with coupling in collar

The proposed construction comprises a Snap Utility collar protecting 40mm to 90mm PVC and 100mm PVC (SC) stack pipes with pipe coupling within the collar, penetrating through 90mm thick and 116mm thick plasterboard wall.

The reference test data in Table B1.2 where the specimen contained couplings all had the coupling installed within the collar on the fire side. The proposed construction comprises the installation of coupling on each side of the wall.

The proposed variation to include a coupling inside the Utility collar on the non-fire side may affect and or delay collar closure.

However, the comparison between the specimens with 100mm pipe with and without coupling on the fire side of a 116mm thick wall only saw one minute difference in the closure time of the collar.

Therefore, it is considered based on the low softening temperature of PVC, that if couplings were also installed on non-fire side wall, the Utility collar would have been able to close it as well.

The above discussion in section B1.1 for the proposed 50mm, 65mm, 80mm pipe with couplings and their respective collars in a slab also applies to these pipes in a plasterboard walls.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 and 120 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Variation to pipe wall thickness penetrating 90mm thick plasterboard walls

The proposed construction comprises inclusion of 40mm to 150mm PVC pipes penetrating the 90mm thick plasterboard wall discussed above with slightly thinner and thicker pipe wall thicknesses compared to the tested pipes as shown below.

Nominal diameter (mm)	Tested pipe wall thickness (mm)	Proposed pipe wall thickness (mm)
40	2.4	2.0-2.4
50	2.4	2.2-2.5
65	3.2	2.7-3.2
80	3.1	2.9-3.2
100	3.1	3.0-3.4
150	4.2	4.2-4.5

40mm PVC pipe

With reference to FSP 2354 specimen 4, 40mm PVC pipe with pipe wall thickness of 2.4mm penetrated 90mm thick plasterboard wall and was protected with Utility 40 collar on both sides. When tested, the specimen maintained integrity for up to 91 minutes and failed insulation at 63 minutes after the thermocouple on the wall exceeded a temperature rise of more than 180^{o}K. It is observed that the collar closed off at 6 minutes where pipe temperatures were well below PVC-U softening temperature of 80^{o}C with no pipe collapse and the maximum temperature rise on the pipe was recorded to be 141^{o}K at 60 minutes and 59^{o}K at 90 minutes.

With reference to FSP 2337 specimen 4, 40mm PVC pipe with pipe wall thickness of 2.4mm and with 2.4mm thick coupling inside the collar penetrated 90mm thick plasterboard and was protected with Utility 40+ collar on both sides. When tested, the specimen maintained integrity and insulation for up to 64 minutes. It is observed that the collar closed off at 6 minutes where pipe temperatures were below PVC-U softening temperature of 80^{o}C with no pipe collapse and the maximum temperature rise on the pipe was recorded to be 106^{o}K at 60 minutes.

The proposed construction comprises of 40mm PVC pipes with reduced wall thickness to 2mm from the tested 2.4mm penetrating 90mm thick plasterboard wall and protect with Utility 40 collars on both sides. From the referenced tests, it is demonstrated that the collar closed off at 6 minutes with or without the coupling. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

Confidence is found from the FSP 2337 specimen 4, where the increased thickness of 2.4mm at the pipe and coupling junction located inside the collar did not affect the collar's closing off ability and was able to maintain integrity and insulation similar to 40mm PVC pipe without the coupling.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

50mm PVC pipe

With reference to FSP 2362 specimen 4, 50mm PVC pipe with pipe wall thickness of 2.4mm penetrated 60mm thick plasterboard wall and was protected with Utility 50 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 71 minutes. It is observed that the collar closed off at 8 minutes where pipe temperatures were well above PVC_U softening temperature of 80C with no pipe collapse and the maximum temperature rise on the pipe was recorded to be 113^{o}K at 60 minutes.

The proposed construction comprises of 50mm PVC pipes with variation to pipe wall thickness from tested 2.4mm to be between 2.2-2.5mm penetrating 60mm thick plasterboard wall and protected with Utility 50 collars on both sides. From the referenced test, it is demonstrated that the collar closed off at 8 minutes.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 66^{o}K in insulation performance, it is expected that the proposed 50mm PVC pipe wall thickness will be able to maintain integrity and insulation for up to 60 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

65mm PVC pipe

With reference to FSP 2362 specimen 5, 65mm PVC pipe with pipe wall thickness of 3.2mm penetrated 90mm thick plasterboard wall and was protected with Utility 65 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 71 minutes. It is observed that the collar closed off at 8 minutes where pipe temperatures were below PVC-U softening temperature of 80^{o}C and the maximum temperature rise on the pipe was recorded to be 50^{o}K at 60 minutes.

The proposed construction comprises of 65mm PVC pipes with variation to pipe wall thicknesses from tested 3.2mm to between 2.7-3.2mm penetrating 60mm thick plasterboard wall and protected with Utility 65 collars on both sides. From the referenced test, it is demonstrated that the collar closed off at 8 minutes.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. Therefore, it is expected that the proposed 65mm PVC pipe wall thickness will be able to maintain integrity and insulation for up to 60 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

80mm PVC pipe

With reference to FSP 2362 specimen 2, 80mm PVC pipe with pipe wall thickness of 3.1mm penetrated 90mm thick plasterboard wall and was protected with Utility 80 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 71 minutes. It is observed that the collar closed off at 8 minutes and the maximum temperature rise on the pipe was recorded to be 118^{o}K at 60 minutes.

The proposed construction comprises of 80mm PVC pipes with variation to pipe wall thickness from tested 3.1mm to between 2.9-3.2mm penetrating 60mm thick plasterboard wall and protected with Utility 80 collars on both sides. From the referenced test, it is demonstrated that the collar closed off

at 10 minutes where pipe temperatures were above PVC-U softening temperature of 80°C with no pipe collapse.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 61°K in insulation performance, it is expected that the proposed 80mm PVC pipe wall thickness will be able to maintain integrity and insulation for up to 60 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

100mm PVC pipe

With reference to FSP 2337 specimen 2, 100mm PVC pipe with pipe wall thickness of 3.1mm penetrated 90mm thick plasterboard wall and was protected with Utility 100 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 64 minutes. It is observed that the collar closed off at 7 minutes where pipe temperatures were above PVC-U softening temperature of 80°C with no pipe collapse. and the maximum temperature rise on the pipe was recorded to be 168°K at 60 minutes.

With reference to FSP 2337 specimen 5, 100mm PVC pipe with pipe wall thickness of 3.1mm and with 3.1mm thick coupling inside the collar penetrated 90mm thick plasterboard wall and was protected with Utility 100+ collar on both sides. When tested, the specimen maintained integrity and insulation for up to 64 minutes. It is observed that the collar closed off at 9 minutes and the maximum temperature rise on the pipe was recorded to be 114°K.

The proposed construction comprises of 100mm PVC pipes with wall thickness of 3mm to 3.4mm penetrating 90mm thick plasterboard walls and protected with Utility 100 and Utility 100+ collars. From the referenced tests, it is demonstrated that the collars closed off before 9 minutes with or without the coupling.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 12°K in insulation performance for PVC pipe without coupling and margin of more than 65°K in insulation performance for the PVC pipe with coupling, it is expected that the proposed 100mm PVC pipes with wall thickness 3.4mm will be able to maintain integrity and insulation for up to 60 minutes.

Confidence is found from the FSP 2337 specimen 5, where the increased thickness of 3.1mm at the pipe and coupling junction located inside the Utility 110+ collar did not affect the collar's closing off ability and was able to maintain integrity and insulation for up to 64 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

90mm PVC pipe

The proposed construction comprises of 90mm PVC pipes with pipe wall thicknesses of 3mm to 3.4mm penetrating minimum 90mm thick plasterboard wall and protected with Utility 80+ collar on both sides.

With reference to discussions presented above for the 80mm and 100mm pipes, it is established that the collar was able to close off between 7 and 8 minutes and was able to maintain integrity and insulation for up to 60 minutes.

The proposed pipe wall thickness for the 90mm pipe is similar to that of the proposed 100mm pipe. Therefore, it is expected that the collar will be able to close off between 7 and 8 minutes, and the pipe will be able to maintain integrity and insulation for up to 60 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

150mm PVC pipe

With reference to FSP 2337 specimen 1, 150mm PVC pipe with pipe wall thickness of 4.2mm penetrated 90mm thick plasterboard wall and was protected with Utility 150 collars on both sides. When tested, the specimen maintained integrity for up to 64 minutes and insulation for up to 61 minutes. It is observed that the collar closed off at 9 minutes where pipe temperatures were above PVC-U softening temperature of 80^{o}C with no pipe collapse and the maximum temperature rise on the pipe was recorded to be 65^{o}K at 60 minutes.

The proposed construction comprises of 150mm PVC pipes with pipe wall thickness of 4.2mm to 4.5mm penetrating 150mm thick concrete floor and protected with Utility 150 collars on both sides. From the referenced tests, it is demonstrated that the collars closed off at 9 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 124^{o}K in insulation performance, it is expected that the proposed 150mm PVC pipes will be able to maintain integrity and insulation for up to 60 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Variation to pipe wall thickness penetrating 116mm thick plasterboard walls

The proposed construction comprises inclusion of 40mm OD to 100mm PVC pipes penetrating 120mm thick plasterboard wall discussed above with slightly thinner and thicker pipe wall thicknesses compared to the tested pipes as shown below.

Nominal diameter (mm)	Tested pipe wall thickness (mm)	Proposed pipe wall thickness (mm)
40	2.2	2.0-2.4
50	2.5	2.2-2.5
65	2.9	2.7-3.2
80	3.2	2.9-3.2
100	3.2	3.0-3.4
150	4.5	4.2-4.5

40mm PVC pipe

With reference to FSP 2345 specimen 3, 40mm PVC pipe with pipe wall thickness of 2.2mm penetrated 116mm thick plasterboard wall and was protected with Utility 40 collar on both sides. When tested, the specimen maintained integrity for up to 180 minutes and failed insulation at 152 minutes after the thermocouple on the wall exceeded a temperature rise of more than 180^{o}K. It is observed that the

collar closed off at 7 minutes where pipe temperatures were slightly below PVC-U softening temperature of 80°C with no pipe collapse and the temperature rise on the pipe was recorded to be 163°K at 109 minutes and 148°K at 120 minutes.

With reference to FSP 2368 specimen 4, 40mm PVC pipe with pipe wall thickness of 2.3mm and with 2.5mm thick coupling inside the collar penetrated 120mm thick plasterboard and was protected with Utility 40+ collar on both sides. When tested, the specimen maintained integrity and insulation for up to 181 minutes. It is observed that the collar closed off at 7 minutes where pipe temperatures were below PVC-U softening temperature of 80°C with no pipe collapse with the maximum temperature rise before collar closure on the pipe was recorded to be 39°K.

The proposed construction comprises of 40mm PVC pipes with wall thickness of 2mm to 2.4mm penetrating 116mm thick plasterboard walls and protected with Utility 40 and Utility 40+ collars on both sides. From the referenced tests, it is demonstrated that the collar closed off at 7 minutes with or without the coupling.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 139°K in insulation performance for PVC pipe without coupling and margin of more than 138°K in insulation performance for the PVC pipe with coupling, it is expected that the proposed 40mm PVC pipe with 2.4mm wall thickness will be able to maintain integrity and insulation for up to 120 minutes.

Confidence is found from the FSP 2368 specimen 4, where the increased thickness of 2.5mm at the pipe and coupling junction located inside the collar did not affect the collar's closing off ability and was able to maintain integrity and insulation similar to 40mm PVC pipe without the coupling for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

50mm PVC pipe

With reference to FSP 2368 specimen 5, 50mm PVC pipe with pipe wall thickness of 2.5mm penetrated 116mm thick plasterboard wall and was protected with Utility 50 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 181 minutes. It is observed that the collar closed off at 7 minutes where pipe temperatures were above PVC-U softening temperature of 80°C with no pipe collapse and the maximum temperature rise on the pipe was recorded to be 82°K at 120 minutes.

The proposed construction comprises of 50mm PVC pipe with variation to wall thickness from tested 2.5mm to be between 2.2-2.5mm. From the referenced tests, it is demonstrated that the collar closed off at 7 minutes.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. Therefore, it is expected that the proposed 50mm PVC pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

65mm PVC pipe

With reference to FSP 2361 specimen 5, 65mm PVC pipe with pipe wall thickness of 3mm penetrated 116mm thick plasterboard wall and was protected with Utility 65 collar on both sides. When tested,

the specimen maintained integrity and insulation for up to 181 minutes. It is observed that the collar closed off at 8 minutes where pipe temperatures were above PVC-U softening temperature of 80°C with no pipe collapse and the maximum temperature rise on the pipe was recorded to be 76°K at 120 minutes.

The proposed construction comprises of 65mm PVC pipes with reduced pipe wall thicknesses of 2.7mm and increased pipe wall thickness of 3.2mm from the tested 3mm penetrating 116mm thick plasterboard wall and protected with Utility 65 collars on both sides. From the referenced test, it is demonstrated that the collar closed off at 9 minutes.

For pipes with thinner pipe wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 103°K in insulation performance, it is expected that the proposed 65mm PVC pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

80mm PVC pipe

With reference to FSP 2345 specimen 5, 80mm PVC pipe with pipe wall thickness of 3.2mm penetrated 116mm thick plasterboard wall and was protected with Utility 80 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 180 minutes. It is observed that the collar closed off at 8 minutes where pipe temperatures were above PVC-U softening temperature of 80°C with no pipe collapse and the maximum temperature rise on the pipe was recorded to be 66°K.

The proposed construction comprises of 80mm PVC pipes with variation to wall thickness from tested 3.2mm to be between 2.9-3.2mm penetrating 116mm thick plasterboard wall and protected with Utility 80 collar on both sides. From the referenced test, it is demonstrated that the collar closed off at 8 minutes.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. Therefore, it is expected that the proposed 80mm PVC pipes with of 3.2mm pipe wall thickness will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

100mm PVC pipe

With reference to FSP 2320 specimen 4, 100mm PVC pipe with pipe wall thickness of 3.1mm penetrated 116mm thick plasterboard wall and was protected with Utility 100 collar on both sides. When tested, the specimen maintained integrity for up to 151 minutes and failed insulation at 159 minutes after the thermocouple on the wall recorded a temperature rise of more than 180°K. It is observed that the collar closed off at 9 minutes where pipe temperatures were briefly above PVC-U softening temperature of 80°C with no pipe collapse and the maximum temperature rise on the pipe was recorded to be 109°K by 120 minutes.

With reference to FSP 2320 specimen 2, 100mm PVC pipe with pipe wall thickness of 3.1mm and with 3.1mm thick coupling inside the collar penetrated 116mm thick plasterboard wall and was protected with Utility 100+ collar on both sides. When tested, the specimen maintained integrity for up to 181 minutes and failed insulation at 124 minutes after the thermocouple on the pipe recorded a temperature rise of more than 180°K. It is observed that the collar closed off at 9 minutes where pipe

temperatures were briefly above PVC-U softening temperature of 80°C with no pipe collapse and the maximum temperature rise on the pipe was recorded to be 147°K at 120 minutes.

The proposed construction comprises of 100mm PVC pipes with pipe wall thickness of 3mm to 3.4mm penetrating 116mm thick plasterboard wall and protected with Utility 100 and Utility 100+ collars. From the referenced tests, it is demonstrated that the collars closed off at 9 minutes with or without the coupling. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 104°K in insulation performance for PVC pipe without coupling and margin of more than 32°K in insulation performance for the PVC pipe with coupling, it is expected that the proposed 100mm PVC pipes with wall thickness of 3.4mm will be able to maintain integrity and insulation for up to 120 minutes.

Confidence is found from the FSP 2320 specimen 2, where the increased thickness of 3.1mm at the pipe and coupling junction located inside the Utility 110+ collar did not affect the collar's closing off ability and was able to maintain integrity and insulation for up to 120minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

90mm PVC pipe

The proposed construction comprises of 90mm PVC pipes with pipe wall thicknesses of 3mm to 3.4mm penetrating minimum 116mm thick plasterboard wall and protected with Utility 80+ collar on both sides.

With reference to discussions presented above for the 80mm and 100mm pipes, it is established that the collar was able to close off between 8 and 9 minutes and was able to maintain integrity and insulation for up to 120 minutes.

The proposed pipe wall thickness for the 90mm pipe is similar to that of the proposed 100mm pipe. Therefore, it is expected that the collar will be able to close off between 8 and 9 minutes, and the pipe will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

150mm PVC pipe

With reference to FSP 2320 specimen 1, 150mm PVC pipe with pipe wall thickness of 4.5mm penetrated 116mm thick plasterboard wall and was protected with 2 x Utility 150 collars on both sides. When tested, the specimen maintained integrity for up to 181 minutes and failed insulation at 126 minutes after the thermocouple on the collar recorded a temperature rise of more than 180°K. It is observed that the collar closed off at 19 minutes and the maximum temperature rise on the pipe was recorded to be 91°K at 120 minutes.

The proposed construction comprises of 150mm PVC pipes with variation to wall thickness from tested 4.5mm to be between 4.2-4.5mm penetrating 116mm thick plasterboard wall and was protected with 2 x Utility 150 collars on both sides. From the referenced tests, it is demonstrated that the collars closed off at 19 minutes.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

B1.3 PVC pipes in Hebel and Walsc AAC panel walls

Table B1.3: PVC pipes in Hebel walls

Test	Pen. #	Test Element	Collar	Pipe Type	Pipe Dia. (Nom.) (mm)	Pipe wall thickness (mm)	Coupling thickness (mm)	Annular Gap (mm)	Sealant	Test Result
FSP 2336	3	75mm Hebel Wall (90 min)	Utility 40	PVC	40	2.4	0	0	None	-/121/ 111 (wall)
FSP 2369	4	75mm Hebel Wall (120 min)	Utility 50	PVC	50	2.35	0	9	10mm bead of Fullers Firesound	-/121/ 121
FSP 2370	3		Utility 65	PVC	65	2.9	0	9		-/121/ 121
FSP 2369	5		Utility 80	PVC	80	3.1	0	8		-/121/ 121
FSP 2336	5	75mm Hebel Wall (90 min)	Utility 100	PVC (SC)	100	3.4	0	2	None	-/121/ 121 (wall)
FSP 2336	4		Utility 40+	PVC	40	2.4	2.3	6	10mm bead of Fullers Firesound	-/121/ 115 (wall)
FSP 2336	2		Utility 100+	PVC (SC)	100	3.4	3.1	5		-/121/ 117 (wall)
FSP 2336	1		2 x Utility 150	PVC (SC)	150	4.4	0	3		-/121/99 (collar, wall 105)
FSP 2367	1	75mm Hebel Wall (120 min)	2 x Utility 150	PVC	150	4.9	0	4	10mm bead of Fullers Firesound	-/121/ 119 (wall)

PVC stack pipes without coupling

The proposed construction comprises a Snap Utility collar protecting 40mm to 90mm PVC, 100mm and 150mm PVC (SC) stack pipes penetrating through 75mm thick Hebel walls with a tested or assessed FRL of -/90/90 and -/120/120.

It is required in Section 7 of this report that the Hebel walls be tested or assessed for the FRL when including aperture for services in the field of the wall.

With reference to test data summarised in Table B1.3, it is observed that the main failure of these specimens was instigated by the insulation performance of the supporting Hebel wall rather than the performance of the penetrating service. When tested, all installation maintains integrity and insulation for up 120 minutes, it is reasonable to evaluate the result of the pipes tested in the two types of 75mm Hebel panel walls together.

Based on the above, it can be seen that the prequalification testing of the uPVC pipe sizes between 40 to 80mm and 100mm PVC SC have been met in concrete slabs.

The discussion in section B1.1 for the 90mm PVC pipe protected with Utility 80+ in a slab also applies to 90mm PVC pipe protected with Utility 80+ in a Hebel walls.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

PVC stack pipes with coupling

The proposed construction comprises a Snap Utility collar protecting 40mm to 90mm PVC and 100mm PVC (SC) stack pipes with pipe coupling penetrating through 75mm thick Hebel walls with a tested or assessed FRL of -/90/90 and -/120/120.

The reference test data in Table B1.3 where the specimen contained couplings all had the coupling installed within the collar on the fire side. The proposed construction comprises the installation of coupling on each side of the wall.

The above discussion in section B1.2 for the proposed 50mm, 65mm, 80mm pipe with couplings and their respective collars in a plasterboard wall also applies to these pipes in a Hebel wall.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Variation to pipe wall thickness penetrating 75mm thick Hebel wall

The proposed construction comprises inclusion of 40mm OD to 100mm PVC pipes penetrating minimum 75mm thick Hebel walls discussed above with slightly thinner and thicker pipe wall thicknesses compared to the tested pipes as shown below.

Nominal diameter (mm)	Tested pipe wall thickness (mm)	Proposed pipe wall thickness (mm)
40	2.4	2.0-2.4
50	2.3	2.2-2.5
65	2.9	2.7-3.2
80	3.1	2.9-3.2
100	3.4	3.0-3.4
150	4.4	4.2-4.5

40mm PVC pipe

With reference to FSP 2336 specimen 3, 40mm PVC pipe with pipe wall thickness of 2.4mm penetrated 75mm thick Hebel wall and was protected with Utility 40 collar on both sides. When tested, the specimen maintained integrity for up to 121 minutes and failed insulation at 111 minutes after the thermocouple on the wall exceeded a temperature rise of more than 180^{o}K. It is observed that the collar closed off at 3 minutes and the maximum temperature rise on the pipe was recorded to be 51^{o}K at 120 minutes.

With reference to FSP 2336 specimen 4, 40mm PVC pipe with pipe wall thickness of 2.4mm and with 2.5mm thick coupling inside the collar penetrated 120mm thick plasterboard and was protected with Utility 40+ collar on both sides. When tested, the specimen maintained integrity for up to 121 minutes and failed insulation at 115 minutes after the thermocouple on the wall exceeded a temperature rise of more than 180^{o}K. It is observed that the collar closed off at 6 minutes and the maximum temperature rise on the pipe was recorded to be 77^{o}K at 120 minutes.

The proposed construction comprises of 40mm PVC pipes comprises with variation to pipe wall thickness from tested 2.4mm to be between 2-2.4mm penetrating 75mm thick Hebel wall and protected with Utility 40 and Utility 40+ collars. From the referenced tests, it is demonstrated that the collar closed off before 6 minutes with or without the coupling.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

50mm PVC pipe

With reference to FSP 2369 specimen 4, 50mm PVC pipe with pipe wall thickness of 2.3mm penetrated 75mm thick Hebel wall and was protected with Utility 50 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 121 minutes. It is observed that the collar closed off at 7 minutes and the maximum temperature rise on the pipe was recorded to be 60^{o}K at 120 minutes.

The proposed construction comprises of 50mm PVC pipe with variation to pipe wall thickness from tested 2.3mm to be between 2.2-2.5mm penetrating 75mm thick Hebel wall and was protected with Utility 50 collar on both sides. From the referenced tests, it is demonstrated that the collar closed off at 7 minutes.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 119^{o}K in insulation performance, it is expected that the proposed 50mm PVC pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

65mm PVC pipe

With reference to FSP 2370 specimen 3, 65mm PVC pipe with pipe wall thickness of 2.9mm penetrated 75mm thick Hebel wall and was protected with Utility 65 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 121 minutes. It is observed that the collar closed off at 7 minutes and the maximum temperature rise on the pipe was recorded to be 51^{o}K at 120 minutes.

The proposed construction comprises of 65mm PVC pipes with variation to pipe wall thicknesses from tested 2.9mm to 3.2mm penetrating 75mm thick Hebel wall and was protected with Utility 65 collar on both sides. From the referenced test, it is demonstrated that the collar closed off at 9 minutes.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 103^{o}K in insulation performance, it is expected that the proposed 65mm PVC pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

80mm PVC pipe

With reference to FSP 2369 specimen 5, 80mm PVC pipe with pipe wall thickness of 3.1mm penetrated 75mm thick Hebel wall and was protected with Utility 80 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 121 minutes. It is observed that the collar closed off at 8 minutes and the maximum temperature rise on the pipe was recorded to be 63^{o}K.

The proposed construction comprises of 80mm PVC pipes with variation to pipe wall thickness from tested 3.1mm to be between 2.9-3.2mm penetrating 75mm thick Hebel wall and protected with Utility 80 collar on both sides. From the referenced test, it is demonstrated that the collar closed off at 8 minutes.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 116^{o}K in insulation performance, it is expected that the proposed 80mm PVC pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

100mm PVC pipe

With reference to FSP 2336 specimen 5, 100mm PVC pipe with pipe wall thickness of 3.4mm penetrated 75mm thick Hebel wall and was protected with Utility 100 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 121 minutes. It is observed that the collar closed off at 8 minutes and the maximum temperature rise on the pipe was recorded to be 57^{o}K at 120 minutes.

With reference to FSP 2336 specimen 2, 100mm PVC pipe with pipe wall thickness of 3.4mm and with 3.1mm thick coupling inside the collar penetrated 75mm thick Hebel wall and was protected with Utility 100+ collar on both sides. When tested, the specimen maintained integrity for up to 121 minutes and failed insulation at 117 minutes after the thermocouple on the wall recorded a temperature rise of more than 180^{o}K. It is observed that the collar closed off at 7 minutes and the maximum temperature rise on the pipe was recorded to be 95^{o}K at 120 minutes.

The proposed construction comprises of 100mm PVC pipes with variation to pipe wall thickness from 3.4mm to be between 3-3.4mm. From the referenced tests, it is demonstrated that the collars closed off before 8 minutes with or without the coupling. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

90mm PVC pipe

The proposed construction comprises of 90mm PVC pipes with pipe wall thicknesses of 3mm to 3.4mm penetrating 75mm thick Hebel wall and protected with Utility 80+ collar on both sides.

With reference to discussions presented above for the 80mm and 100mm pipes, it is established that the collar was able to close off between 7 and 8 minutes and was able to maintain integrity and insulation for up to 120 minutes.

The proposed pipe wall thickness for the 90mm pipe is similar to that of the proposed 100mm pipe. Therefore, it is expected that the collar will be able to close off between 7 and 8 minutes, and the pipe will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

150mm PVC pipe

With reference to FSP 2336 specimen 1, 150mm PVC pipe with pipe wall thickness of 4.4mm penetrated 75mm thick Hebel wall and was protected with Utility 2 x 150 collars on both sides. When tested, the specimen maintained integrity for up to 121 minutes and failed insulation at 99 minutes after the thermocouple on the collar recorded a temperature rise of more than 180^{o}K. It is observed that the collar closed off at 15 minutes and the maximum temperature rise on the pipe was recorded to be 91^{o}K at 120 minutes.

The proposed construction comprises of 150mm PVC pipes with variation to pipe wall thickness from tested 4.4mm to be between 4.2-4.5mm penetrating 75mm thick Hebel wall and protected with Utility 150 collars on both sides. From the referenced tests, it is demonstrated that the collars closed off at 19 minutes and was able to maintain integrity for up to 120 minutes and insulation for up to 90 minutes.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

Based on the above, it can be expected the proposed construction will be able to maintain integrity for up to 120 minutes and insulation for up to 90 minutes based on design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Inclusion of Walsc AAC Panel wall

The proposed construction comprise the replacement of the Hebel panel walls discussed above with 75mm Walsc AAC panel wall system for up to 90 minutes application.

It is required in Section 7 of this report that the Hebel walls be tested or assessed for the FRL when including aperture for services in the field of the wall.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

B1.4 Various other pipe material in concrete floor

Table B1.4: HDPE, Raupiano, Triplus pipes in concrete floor

Test (Pen. #)	Test Element	Collar	Pipe Type	Pipe Dia. (Nom.) (mm)	Pipe wall thick. (mm)	Annular Gap (mm)	Sealant	Test Result	Fixing
FSP 2347 (4)	120mm Concrete Slab	Utility 40	HDPE (PE80)	40	3.38	0.85	None	-/241NF/209 (slab)	5x30mm Concrete Screw Bolts
FSP 2347 (1)	120mm Concrete Slab	Utility 100	HDPE (PE100)	110	4.6	2	None	-/241NF/199 (slab)	
FSP 2366 (1)	150mm Concrete Slab	Utility 150	HDPE (PE100)	160	7.1	1.5	None	-/241NF/241NF	6.5x40mm Steel Sleeve Anchor
FSP 2347 (5)	120mm Concrete Slab	Utility 40	Raupiano	40	2.1	8.4	10mm bead of Fullers Firesound	-/241NF/200 (slab)	
FSP 2347 (2)	120mm Concrete Slab	Utility 100	Raupiano	110	3.1	2	None	-/241NF/203 (slab)	6x40mm Steel Wedge Anchor
FSP 2366 (3)	150mm Concrete Slab	Utility 150	Raupiano	160	4.4	1.5	None	-/241NF/241NF	5x35mm Mushroom Head Spikes
FSP 2358 (5)	150mm Concrete Slab	Utility 40	Triplus	40	2.1	8.35	10mm bead of Fullers Firesound	-/241NF/241NF	5x30mm Concrete Screw Bolts
FSP 2333 (4)	120mm Concrete Slab	Utility 100	Triplus	110	3.97	2	None	-/241NF/241NF	6x40mm Steel Wedge Anchor
FSP 2366 (2)	150mm Concrete Slab	Utility 150	Triplus	160	5.8	1	None	-/241NF/241NF	

HDPE, Raupiano and Triplus stack pipes in concrete floor

The proposed construction comprises a Snap Utility collar protecting 40mm to 110mm and 160mm HDPE, Raupiano and Triplus stack pipes penetrating through 120mm and 150mm thick concrete floor.

It is required in section 7 of this report that the concrete floor be designed as per AS 3600-2018 for the required FRL.

With reference to test data summarised in Table B1.4, 40mm, 110mm and 160mm HDPE, Raupiano and Triplus pipes, penetrated 120mm and 150mm thick concrete floor and were protected with Utility collar.

It is observed that these specimens all were able to maintain integrity for up to 240 minutes without failure. When the specimen failed insulation, it was due to the failure of the supporting construction. The pipe was able to maintain insulation for up to 240 minutes.

The proposed construction comprises 50mm to 90mm HDPE pipe protected with various Utility sizes of collars. The annular gap between the proposed collar and the proposed pipe that is similar to the 40mm and 110mm HDPE pipes protected with Utility 40 and Utility collar 100 collar respectively.

The proposed construction comprises 50mm to 75mm Raupiano pipe protected with various Utility sizes of collars. The annular gap between the proposed collar and the proposed pipe that is similar to the 40mm and 110mm HDPE pipes protected with Utility 40 and Utility collar 100 collar respectively.

The proposed construction comprises 50mm to 90mm Triplus pipe protected with various Utility sizes of collars. The annular gap between the proposed collar and the proposed pipe that is similar to the 40mm and 110mm HDPE pipes protected with Utility 40 and Utility collar 100 collar respectively.

Given the similarity in distance of collar intumescent to proposed pipe to that of the tested pipes, and the absence of any impending failure observed in the reference tests for up to 240 minutes, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120, 180 and 240 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Variation to HDPE pipe wall thickness penetrating concrete floor

The proposed construction comprises inclusion of 40mm OD to 160mm OD HDPE pipes with slightly thinner and thicker pipe wall thicknesses compared to the tested pipes as shown below.

Nominal diameter (mm)	Tested pipe wall thickness (mm)	Proposed pipe wall thickness (mm)
40	3.4	3.0-3.4
110	4.6	4.6-4.9
160	7.1	6.2-7.2

40mm-75mm HDPE pipes

With reference to FSP 2347 specimen 4, 40mm HDPE pipe with pipe wall thickness of 3.4mm penetrated 120mm thick concrete floor and was protected with Utility 40 collar. When tested, the specimen maintained integrity for up to 241 minutes and failed insulation at 209 minutes after the thermocouple on the floor exceeded a temperature rise of more than 180^{o}K. It is observed that the collar closed off at 7 minutes and the maximum temperature rise on the pipe was recorded to be 79^{o}K at 120 minutes.

With reference to FSP 2347 specimen 1, 110mm HDPE pipe with pipe wall thickness of 4.6mm penetrated 120mm thick concrete floor and was protected with Utility 100 collar. When tested, the specimen maintained integrity for up to 241 minutes and failed insulation at 199 minutes after the thermocouple on the floor exceeded a temperature rise of more than 180^{o}K. It is observed that the collar closed off at 8 minutes and the maximum temperature rise on the pipe was recorded to be 65^{o}K at 120 minutes.

The proposed construction comprises of 40mm to 63mm HDPE pipes with a reduced pipe wall thickness to 3mm penetrating 120mm thick concrete floor and protected with Utility collar. The proposed 75mm HDPE pipe comprises reduction in pipe wall thickness to 2.9mm.

From the referenced test, it is demonstrated that the collar closed off before 7 minutes where pipe temperatures were around the softening temperature for HDPE of 70^{o}C. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at similar or slightly earlier time and therefore not detrimentally affect the performance of the specimen.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

110mm HDPE pipe

With reference to FSP 2347 specimen 1, 110mm HDPE pipe with pipe wall thickness of 4.6mm penetrated 120mm thick concrete floor and was protected with Utility 100 collar. When tested, the specimen maintained integrity for up to 241 minutes and failed insulation at 199 minutes after the thermocouple on the floor exceeded a temperature rise of more than 180^{o}K. It is observed that the

collar closed off at 8 minutes and the maximum temperature rise on the pipe was recorded to be 65°K at 120 minutes.

The proposed construction comprises of 110mm HDPE pipe with increased pipe wall thickness from tested 4.6mm to 4.9mm penetrating 120mm thick concrete floor and protected with Utility 100 collar. From the referenced test, it is demonstrated that the collar closed at 8 minutes.

For the pipes with a slightly thicker wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 114°K in insulation performance, it is expected that the proposed 110mm HDPE pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

160mm HDPE pipe

With reference to FSP 2366 specimen 1, 160mm HDPE pipe with pipe wall thickness of 7.1mm penetrated 150mm thick concrete floor and was protected with 2 x Utility 150 collar. When tested, the specimen maintained integrity and insulation for up to 241 minutes. It is observed that the collar closed off at 12 minutes and the maximum temperature rise on the pipe was recorded to be 39°K at 180 minutes.

The proposed construction comprises of 160mm HDPE pipes comprises pipe with wall thicknesses of 6.2mm to 7.2mm penetrating 150mm thick concrete floor and protected with 2 x Utility 150 collar. From the referenced test, it is demonstrated that the collar closed off at 12 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at a similar or slightly earlier time and therefore not detrimentally affect the performance of the specimen.

For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 140°K in insulation performance, it is expected that the proposed HDPE pipes will be able to maintain integrity and insulation for up to 240 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 180 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

90mm HDPE pipe

The proposed construction comprises of 90mm HDPE pipes comprises of pipe wall thickness of 3.5mm to 4mm penetrating 120mm thick concrete floor and protected with Utility 80+ collar. From the test of 110mm HDPE pipe, it is demonstrated that the collar closed off at 10 minutes.

The proposed construction comprises of 90mm HDPE pipe thinner wall thickness than the tested 110mm HDPE pipe. The collar's ability to close off before 8 minutes and maintain integrity and insulation of the pipe for up to 120 minutes has been demonstrated above. Therefore, it is expected that the collar will close off at a similar or slightly earlier time and therefore not detrimentally affect the performance of the specimen because of the thinner wall thickness. Therefore, it is expected that the proposed 90mm HDPE pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

125mm HDPE pipe

The proposed construction comprises of 125mm HDPE pipes comprises pipe wall thickness of 4.8mm to 5.4mm and being protected with Utility 125 collar penetrating 150mm thick concrete slab. From the 160mm HDPE pipe test with 7.1mm wall thickness discussed above, it is demonstrated that the collar can close off at 12 minutes and was able to maintain integrity and insulation for up to 180 minutes.

The proposed 125mm HDPE pipe is smaller in size with thinner wall thickness than the 160mm HDPE pipe. Therefore, it is expected that the collar will close off at a similar or slightly earlier time and therefore not detrimentally affect the performance of the specimen. Based on the test, it is expected that the collar will close off before 12 minutes and will be able to maintain integrity and insulation for up to 180 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 180 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Variation to Raupiano pipe wall thickness penetrating concrete floor

The proposed construction comprises inclusion of 40mm OD to 160mm OD Raupiano pipes with slightly thinner and thicker pipe wall thicknesses compared to the tested pipes as shown below.

Nominal diameter (mm)	Tested pipe wall thickness (mm)	Proposed pipe wall thickness (mm)
40	2.1	1.8-2.2
110	3.1	2.7-3.2
160	4.4	3.9-4.5

40mm-75mm Raupiano pipes

With reference to FSP 2347 specimen 5, 40mm Raupiano pipe with pipe wall thickness of 2.1mm penetrated 120mm thick concrete floor and was protected with Utility 40 collar. When tested, the specimen maintained integrity for up to 241 minutes and failed insulation at 200 minutes after the thermocouple on the floor exceeded a temperature rise of more than 180^{o}K. It is observed that the collar closed off at 6 minutes and the maximum temperature rise on the pipe was recorded to be 62^{o}K at 120 minutes.

The proposed construction comprises of 40mm to 75mm Raupiano pipes with variation to pipe wall thickness from tested 2.1mm to be between 1.8-2.2mm penetrating 120mm thick concrete floor and protected with Utility collars. From the referenced test, it is demonstrated that the collar closes off at 6 minutes.

While the sizes of the proposed pipes are bigger than tested, the pipe wall thickness remains uniform and therefore the collar is expected to perform similarly as tested. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at a similar or slightly earlier time and therefore not detrimentally affect the performance of the specimen.

For pipes with slighter thicker wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 117^{o}K in insulation performance, it is expected that the proposed Raupiano pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

110mm Raupiano pipe

With reference to FSP 2347 specimen 2, 110mm Raupiano pipe with pipe wall thickness of 3.1mm penetrated 120mm thick concrete floor and was protected with Utility 100 collar. When tested, the specimen maintained integrity for up to 241 minutes and failed insulation at 203 minutes after the

thermocouple on the floor exceeded a temperature rise of more than 180°K. It is observed that the collar closed off at 9 minutes and the maximum temperature rise on the pipe was recorded to be 43°K at 120 minutes.

The proposed construction comprises of 110mm Raupiano pipe with variation to pipe wall thickness from tested 3.1mm to be between 2.7-3.2mm penetrating 120mm thick concrete floor and protected with Utility 100 collar. From the referenced test, it is demonstrated that the collar closed at 9 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at a similar or slightly earlier time and therefore not detrimentally affect the performance of the specimen.

For pipes with slighter thicker wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 136°K in insulation performance, it is expected that the proposed 110mm Raupiano pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

160mm Raupiano pipe

With reference to FSP 2366 specimen 3, 160mm Raupiano pipe with pipe wall thickness of 4.4mm penetrated 150mm thick concrete floor and was protected with 2 x Utility 150 collar. When tested, the specimen maintained integrity and insulation for up to 241 minutes. It is observed that the collar closed off at 9 minutes and the maximum temperature rise on the pipe was recorded to be 64°K at 180 minutes.

The proposed construction comprises of 160mm Raupiano pipes with pipe wall thicknesses of 3.9mm to 4.5mm penetrating 150mm thick concrete floor and protected with 2 x Utility 150 collar. From the referenced test, it is demonstrated that the collar closed off at 9 minutes.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at a similar or slightly earlier time and therefore not detrimentally affect the performance of the specimen. For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 115°K in insulation performance, it is expected that the proposed Raupiano pipes will be able to maintain integrity and insulation for up to 180 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 180 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

B1.5 Various other pipe material in plasterboard walls

Table B1.51: HDPE, Raupiano, Triplus pipes in 90mm plasterboard walls

Test (Pen. #)	Collar	Pipe Type	Pipe Dia. (Nom.) (mm)	Pipe wall thickness (mm)	Annular Gap (mm)	Sealant	Test Result	Fixing
FSP 2362 (3)	Utility 40	HDPE	40	3.34	8.14	10mm bead of Fullers Firesound	-/71NF/ 69(wall)	3 x 10G x 38mm Coarse Thread Laminating Screws
FSP 2378 (1)	Utility 100	HDPE (PE100)	110	4.9	8.4		-/65NF/ 65NF	3 x M4 Expandable Metal Anchors (Steel)
FSP 2354 (5)	Utility 40	Raupiano	40	2.1	8.5	10mm bead of Fullers Firesound	-/91NF/ 82(wall)	M4 x 3-16 Expandable Steel Anchors with stainless steel washer
FSP 2354 (1)	Utility 100	Raupiano	110	3.1	8.35		-/91NF/ 82(wall)	10G x 38mm Coarse Thread Laminating Screws
FSP 2375 (2)	2 x Utility 150	Raupiano	160	4.23	4.2		-/91NF/ 72(wall)	M4 x 16-23mm Expandable Steel Anchors with stainless steel washer
FSP 2354 (3)	Utility 40	Triplus	40	2	2	None	-/91NF/ 61(pipe)	M4 x 16-23mm Expandable Steel Anchors with stainless steel washer
FSP 2354 (2)	Utility 100	Triplus	110	4.1	1.85	None	-/91NF/ 83(wall)	
FSP 2375 (1)	2 x Utility 150	Triplus	160	4.95	3.85	10mm bead of Fullers Firesound	-/91NF/ 71(wall)	

HDPE, Raupiano and Triplus stack pipes in 90mm thick plasterboard wall

The proposed construction comprises a Snap Utility collar protecting 40mm to 110mm and 160mm HDPE, Raupiano and Triplus stack pipes penetrating through 90mm thick plasterboard wall with a tested or assessed FRL of at least -/60/60.

It is required in Section 7 of this report that the plasterboard walls be tested or assessed for the FRL when including aperture for services in the field of the wall.

With reference to test data summarised in Table B1.51, 40mm, 110mm and 160mm HDPE, Raupiano and Triplus pipes, penetrated 90mm thick plasterboard walls and were protected with Utility collar.

It is observed that these specimens all were able to maintain integrity and insulation for up to at least 60 minutes.

The proposed construction comprises 50mm to 90mm HDPE pipe protected with various Utility sizes of collars. The annular gap between the proposed collar and the proposed pipe that is similar to the 40mm and 110mm HDPE pipes protected with Utility 40 and Utility collar 100 collar respectively.

The proposed construction comprises 50mm to 75mm Raupiano pipe protected with various Utility sizes of collars. The annular gap between the proposed collar and the proposed pipe that is similar to the 40mm and 110mm HDPE pipes protected with Utility 40 and Utility collar 100 collar respectively.

The proposed construction comprises 50mm to 90mm Triplus pipe protected with various Utility sizes of collars. The annular gap between the proposed collar and the proposed pipe that is similar to the 40mm and 110mm HDPE pipes protected with Utility 40 and Utility collar 100 collar respectively.

Given the similarity in distance of collar intumescent to proposed pipe to that of the tested pipes, and the absence of any impending integrity or insulation failure observed in the reference tests for at least 60 minutes, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 60 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Variation to HDPE pipe wall thickness penetrating 90mm thick Plasterboard wall

The proposed construction comprises inclusion of 40mm OD to 110mm OD HDPE pipes with slightly thinner and thicker pipe wall thicknesses compared to the tested pipes as shown below.

Nominal diameter (mm)	Tested pipe wall thickness (mm)	Proposed pipe wall thickness (mm)
40	3.4	3.0-3.4
110	4.9	4.6-4.9

40mm-75mm HDPE pipes

With reference to FSP 2362 specimen 3, 40mm HDPE pipe with pipe wall thickness of 3.4mm penetrated 90mm thick plasterboard wall and was protected with Utility 40 collar on both sides. When tested, the specimen maintained integrity for up to 71 minutes and failed insulation at 69 minutes after the thermocouple on the wall exceeded a temperature rise of more than 180^{o}K. It is observed that the collar did not completely close off but it acted to limit the temperature rise on the non-fire side. The maximum temperature rise on the pipe was recorded to be 42^{o}K at 60 minutes.

The proposed construction comprises of 40mm to 63mm HDPE pipes with reduced pipe wall thickness of 3mm penetrating 90mm thick plasterboard wall and protected with Utility 40 collar on both sides. The proposed 75mm HDPE pipe comprises reduction in pipe wall thickness to 2.9mm.

From the referenced test, it is demonstrated that the collar was able to limit the temperature rise on the non-fire side below 180^{o}K for up to 60 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will perform similarly or better than tested to limit the temperature rise on the non-fire side below 180^{o}K for up to 60 minutes. While the sizes of the proposed pipes are bigger than tested, the pipe wall thickness remains uniform and therefore the collar is expected to perform similarly as tested.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

110mm HDPE pipe

With reference to FSP 2378 specimen 1, 110mm HDPE pipe with pipe wall thickness of 4.9mm penetrated 60mm thick plasterboard wall and was protected with Utility 100 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 65 minutes. It is observed

that the collar did not completely close off but it acted to limit the temperature rise on the non-fire side. The maximum temperature rise on the pipe was recorded to be 37°K at 60 minutes.

The proposed construction comprises 110mm HDPE pipe with reduced pipe wall thickness from tested 4.9mm to 4.6mm penetrating 60mm thick plasterboard wall and protected with Utility 100 collar on both sides . From the referenced test, it is demonstrated that the collar closed at 8 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will be able to limit the temperature rise on the non-fire side more effectively.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

90mm HDPE pipe

The proposed construction comprises of 90mm HDPE pipes with wall thickness of 3.5mm to 4mm penetrating 90mm thick plasterboard wall and protected with Utility 80+ collar on both sides. From the test of 110mm HDPE pipe, it is demonstrated that the collar was able to limit the temperature rise on the non-fire side below 180°K for up to 60 minutes.

The proposed 90mm HDPE pipe has thinner wall thickness than the tested 110mm HDPE pipe. The collar's ability to limit the temperature rise below 180°K for up to 60 minutes has been demonstrated above. Therefore, it is expected that the collar will close off a similar or slightly earlier time and will be able to maintain integrity and insulation for up to 60 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Variation to Raupiano pipe wall thickness penetrating 90mm thick plasterboard wall

The proposed construction comprises inclusion of 40mm OD to 160mm OD Raupiano pipes with slightly thinner and thicker pipe wall thicknesses compared to the tested pipes as shown below.

Nominal diameter (mm)	Tested pipe wall thickness (mm)	Proposed pipe wall thickness (mm)
40	2.1	1.8-2.2
110	3.1	2.7-3.2
160	4.2	3.9-4.5

40mm-75mm Raupiano pipes

With reference to FSP 2354 specimen 5, 40mm Raupiano pipe with pipe wall thickness of 2.1mm penetrated 90mm thick plasterboard wall and was protected with Utility 40 collar on both sides. When tested, the specimen maintained integrity for up to 91 minutes and failed insulation at 82 minutes after the thermocouple on the wall exceeded a temperature rise of more than 180°K. It is observed that the collar closed off at 7 minutes and the maximum temperature rise on the pipe was recorded to be 22°K at 60 minutes.

The proposed construction comprises of 40mm to 75mm Raupiano pipes with variation to pipe wall thickness from tested 2.1mm to be between 1.8-2.2mm penetrating 90mm thick plasterboard wall and protected with Utility collars on both sides. While the sizes of the proposed pipes are bigger than tested, the pipe wall thickness remains uniform and therefore the collar is expected to perform similarly as tested. From the referenced test, it is demonstrated that the collar closes off at 7 minutes.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will perform similarly or better than tested and will close off a similar or slightly earlier time and therefore not detrimentally affect the performance of the specimen.

For pipes with slighter thicker wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 157°K in insulation performance, it is expected that the proposed Raupiano pipes will be able to maintain integrity and insulation for up to 60 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

110mm Raupiano pipe

With reference to FSP 2354 specimen 1, 110mm Raupiano pipe with pipe wall thickness of 3.1mm penetrated 90mm thick plasterboard wall and was protected with Utility 100 collar. When tested, the specimen maintained integrity for up to 91 minutes and failed insulation at 82 minutes after the thermocouple on the wall exceeded a temperature rise of more than 180°K. It is observed that the collar closed off at 7 minutes and the maximum temperature rise on the pipe was recorded to be 62°K at 60 minutes.

The proposed construction comprises of 110mm Raupiano pipe with variation to pipe wall thickness form tested 3.1mm to be between 2.7-3.2mm 90mm thick plasterboard wall and protected with Utility 100 collars on both sides. From the referenced test, it is demonstrated that the collar closed off at 7 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

For pipes with slighter thicker wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 117°K in insulation performance, it is expected that the proposed 110mm Raupiano pipes will be able to maintain integrity and insulation for up to 60 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

160mm Raupiano pipe

With reference to FSP 2375 specimen 2, 160mm Raupiano pipe with pipe wall thickness of 4.2mm penetrated 90mm thick plasterboard wall and was protected with 2 x Utility 150 collar on both sides. When tested, the specimen maintained integrity for up to 91 minutes and failed insulation at 72 minutes after the thermocouple on the wall recorded a temperature rise of more than 180°K. It is observed that the collar closed off at 8 minutes and the maximum temperature rise on the pipe was recorded to be 59°K at 60 minutes.

The proposed construction comprises of 160mm Raupiano pipes with pipe wall thicknesses of 3.9mm to 4.5mm penetrating 90mm thick plasterboard wall and protected with 2 x Utility 150 collar on both sides . From the referenced test, it is demonstrated that the collar closed off at 8 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 120°K in insulation performance, it is expected that the proposed Raupiano pipes will be able to maintain integrity and insulation for up to 60 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 60 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Alternative fixings for collar protecting PVC, Raupiano and Triplus pipes in 90mm thick plasterboard wall

The proposed construction comprises the inclusion of laminating screws instead Expandable Anchor for fixing collars protecting 40-100mm PVC (with and without fitting), Triplus and Raupiano pipes to 60 and 120 minutes plasterboard walls.

With reference to FSP 2405 specimen 1 and 2, where 40mm and 100mm PVC pipes were protected with Utility collars that were fixed to a single layered 60 minutes plasterboard wall system with 3 of 10G x 38mm Coarse Thread Laminating Screw. Both specimens were able to maintain integrity and insulation for at least 60 minutes.

Similarly, in FSP 2320 specimens 2, a 100mm PVC pipe was protected with Utility collars that were fixed to a double layered 120 minutes plasterboard wall system with 3 of 10G x 38mm Coarse Thread Laminating Screw. The specimen was able to maintain integrity and insulation for at least 120 minutes.

Therefore, it is reasonable to concluded that 3 of 10G x 38mm Coarse Thread Laminating Screw is sufficient to allow collars protecting up to 100mm PVC pipe with or without coupling in the collar such that the specimens can achieve up to 60 and 120 minutes performance in plasterboard walls based on design.

Based on the observation of the behaviour of the PVC pipes with coupling vs the Raupiano and Triplus pipes in the referenced tests, it is also reasonable to apply the result of the more onerous PVC pipes with coupling test specimens to that for piano and Triplus pipes for up to 60 and 120 minutes performance in plasterboard walls based on design.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 60 and 120 minutes based on design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Table B1.52: HDPE, Raupiano, Triplus pipes in 116mm plasterboard wall

Test (Pen. #)	Collar	Pipe Type	Pipe Dia. (Nom.) (mm)	Pipe wall thickness (mm)	Annular Gap (mm)	Sealant	Test Result	Fixing
FSP 2368 (3)	Utility 40	HDPE	40	3.35	8.2	10mm bead of Fullers Firesound	-/181NF/ 166 (wall)	3 x M4 Expandable Metal Anchors (Steel)
FSP 2407 (6)	Utility 40	HDPE (PE80)	40	3.25	2	0	-/181NF /181NF	3 X 10G x 38mm Coarse Thread Laminating Screws
FSP 2345 (1)	Utility 100	HDPE (PE100)	110	4.6	1.85	None	-/181NF /158 (wall)	3 X 10G x 38mm Coarse Thread Laminating Screws
FSP 2368 (1)	2 x Utility 150	HDPE (PE100)	160	6.68	3.7	10mm bead of Fullers Firesound	-/181NF/ 118 (collar)	4 x M4 Expandable Metal Anchors (Steel)
FSP 2381 (1)	2 x Utility 150	HDPE (PE100)	160	6.68	3.7		-/151NF/ 109 (collar)	5 x M4 Expandable Metal Anchors (Steel)
FSP 2361 (3)	Utility 40	Raupiano	40	2.1	8.5		-/181/ 165 (wall)	10G x 38mm Coarse Thread Laminating Screws

Test (Pen. #)	Collar	Pipe Type	Pipe Dia. (Nom.) (mm)	Pipe wall thickness (mm)	Annular Gap (mm)	Sealant	Test Result	Fixing
FSP 2345 (4)	Utility 100	Raupiano	110	3.09	8.5		-/181NF/ 181NF	M4 x 16-23mm Expandable Steel Anchors with stainless steel washer
FSP 2361 (2)	2 x Utility 150	Raupiano	160	4.28	3.75		-/181NF/ 181NF	
FSP 2361 (4)	Utility 40	Triplus	40	2.1	8.5		-/181/ 145(pipe)	10G x 38mm Coarse Thread Laminating Screws
FSP 2345 (2)	Utility 100	Triplus	110	3.9	1.8	None	-/180NF /171 (wall)	M4 x 16-23mm Expandable Steel Anchors with stainless steel washer
FSP 2368 (2)	2 x Utility 150	Triplus	160	5.1	3.9	10mm bead of Fullers Firesound	-/181NF/ 144 (collar)	

HDPE, Raupiano and Triplus stack pipes in 116mm thick plasterboard wall

The proposed construction comprises a Snap Utility collar protecting 40mm to 110mm and 160mm HDPE, Raupiano and Triplus stack pipes penetrating through 116mm thick plasterboard wall with a tested or assessed FRL of at least -/120/120.

With reference to test data summarised in Table B1.52, 40mm, 110mm and 160mm HDPE, Raupiano and Triplus pipes, penetrated 116mm thick plasterboard walls and were protected with Utility collar.

It is observed that these specimens all were able to maintain integrity and insulation for up to at least 120 minutes.

The proposed construction comprises 50mm to 90mm HDPE pipe protected with various Utility sizes of collars. The annular gap between the proposed collar and the proposed pipe that is similar to the 40mm and 110mm HDPE pipes protected with Utility 40 and Utility collar 100 collar respectively.

The proposed construction comprises 50mm to 75mm Raupiano pipe protected with various Utility sizes of collars. The annular gap between the proposed collar and the proposed pipe that is similar to the 40mm and 110mm HDPE pipes protected with Utility 40 and Utility collar 100 collar respectively.

The proposed construction comprises 50mm to 90mm Triplus pipe protected with various Utility sizes of collars. The annular gap between the proposed collar and the proposed pipe that is similar to the 40mm and 110mm HDPE pipes protected with Utility 40 and Utility collar 100 collar respectively.

Given the similarity in distance of collar intumescent to proposed pipe to that of the tested pipes, and the absence of any impending integrity or insulation failure observed in the reference tests for at least 120 minutes, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Variation to HDPE pipe wall thickness penetrating 116mm thick Plasterboard wall

The proposed construction comprises inclusion of 40mm OD to 160mm OD HDPE pipes with slightly thinner and thicker pipe wall thicknesses compared to the tested pipes as shown below.

Nominal diameter (mm)	Tested pipe wall thickness (mm)	Proposed pipe wall thickness (mm)
40	3.4	3.0-3.4
110	4.9	4.6-4.9
160	7.1	6.2-7.2

40mm-75mm HDPE pipes

With reference to FSP 2368 specimen 3, 40mm HDPE pipe with pipe wall thickness of 3.4mm penetrated 116mm thick plasterboard wall and was protected with Utility 40 collar on both sides. When tested, the specimen maintained integrity for up to 181 minutes and failed insulation at 166 minutes after the thermocouple on the wall exceeded a temperature rise of more than 180^{o}K. It is observed that the collar did not completely close off but it acted to limit the temperature rise on the non-fire side. The maximum temperature rise on the pipe was recorded to be 33^{o}K at 120 minutes.

The proposed construction comprises of 40mm to 63mm HDPE pipes with reduced pipe wall thickness of 3mm penetrating 116mm thick plasterboard wall and protected with Utility collars on both sides. The proposed 75mm HDPE pipe comprises reduction in pipe wall thickness to 2.9mm. While the sizes of the proposed pipes are bigger than tested, the pipe wall thickness remains uniform and therefore the collar is expected to perform similarly as tested.

From the referenced test, it is demonstrated that the collar was able to limit the temperature rise on the non-fire side below 180^{o}K for up to 120 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will perform similarly or better than tested to limit the temperature rise on the non-fire side below 180^{o}K for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

110mm HDPE pipe

With reference to FSP 2345 specimen 1, 110mm HDPE pipe with pipe wall thickness of 4.6mm penetrated 116mm thick plasterboard wall and was protected with Utility 100 collar on both sides. When tested, the specimen maintained integrity for up to 181 minutes and failed insulation at 158 minutes after the thermocouple on the wall exceeded a temperature rise of more than 180^{o}K. It is observed that the collar did not completely close off but it acted to limit the temperature rise on the non-fire side. The maximum temperature rise on the pipe was recorded to be 63^{o}K at 120 minutes.

The proposed construction comprises of 110mm HDPE pipe with increased pipe wall thickness from tested 4.6mm to 4.9mm penetrating 116mm thick plasterboard wall and protected with Utility 100 collars on both sides. From the referenced test, it is demonstrated that the collar was able to limit the temperature rise on the non-fire side below 180^{o}K for up to 181 minutes.

For pipes with slighter thicker wall thickness than tested than tested, it is expected that the intumescent expansion and its ability to plug gaps will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 116^{o}K in insulation performance, it is expected that the proposed HDPE pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

160mm HDPE pipe

With reference to FSP 2368 specimen 1, 160mm HDPE pipe with pipe wall thickness of 6.7mm penetrated 116mm thick plasterboard wall and was protected with 2 x Utility 150 collar on both sides. When tested, the specimen maintained integrity for up to 181 minutes and failed insulation at 118 minutes after the thermocouple on the collar exceeded a temperature rise of more than 180^{o}K.

The proposed construction comprises of 160mm HDPE pipes comprises with wall thicknesses of 6.2mm to 7.2mm penetrating 116mm thick plasterboard wall and protected with 2 x Utility 150 collar on both sides. From the referenced test, it is demonstrated that the collar was able to limit the temperature rise on the non-fire side below 180^{o}K for up to 90 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will perform similarly or better than tested to limit the temperature rise on the non-fire side below 180^{o}K for up to 90 minutes.

For pipes with slighter thicker wall thickness than tested, it is expected that the intumescent expansion will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 28 minutes in insulation performance, it is expected that the proposed HDPE pipes will be able to maintain insulation for up to 90 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity for up to 120 minutes and insulation for up to 90 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

90mm HDPE pipe

The proposed construction comprises of 90mm HDPE pipes with pipe wall thickness of 3.5mm to 4mm penetrating 116mm thick plasterboard wall and protected with Utility 80+ collar on both sides.

The proposed 90mm HDPE pipe has thinner wall thickness than the tested 110mm HDPE pipe. From the test of 110mm HDPE pipe, it is demonstrated that the collar was able to limit the temperature rise on the non-fire side below 180^{o}K for up to 158 minutes. Therefore, it is expected that the collar will perform similarly or better because of the thinner pipe wall thickness and will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

125mm HDPE pipe

The proposed 125mm HDPE pipes comprises pipe wall thickness of 4.8mm to 5.4mm and being protected with Utility 125 collar penetrating 116mm thick plasterboard wall. From the 160mm HDPE pipe test with 7.1mm pipe wall thickness and 110mm HDPE pipe with pipe wall thickness of 4.6mm discussed above, it is demonstrated that the collar intumescent was able to expand and prevent the hot gases from heating the non-fire side limiting the temperature rise on the non-fire side below 180^{o}K for up to 118 minutes.

The proposed 125mm HDPE pipe is smaller in size with thinner wall thickness than the 160mm HDPE pipe but greater in size with slightly thicker pipe wall thickness than the tested 110mm HDPE pipe. Therefore, it is expected that the collar will perform similarly as the Utility 150 collar. Based on this, it is expected that the pipe will be able to maintain integrity for up to 120 minutes and insulation for up to 90 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity for up to 120 minutes and insulation for up to 90 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Variation to Raupiano pipe wall thickness penetrating 116mm thick plasterboard wall

The proposed construction comprises inclusion of 40mm OD to 160mm OD Raupiano pipes with slightly thinner and thicker pipe wall thicknesses compared to the tested pipes as shown below.

Nominal diameter (mm)	Tested pipe wall thickness (mm)	Proposed pipe wall thickness (mm)
40	2.1	1.8-2.2
110	3.1	2.7-3.2
160	4.2	3.9-4.5

40mm-75mm Raupiano pipes

With reference to FSP 2361 specimen 3, 40mm Raupiano pipe with pipe wall thickness of 2.1mm penetrated 116mm thick plasterboard wall and was protected with Utility 40 collar on both sides. When tested, the specimen maintained integrity for up to 181 minutes and failed insulation at 165 minutes after the thermocouple on the wall exceeded a temperature rise of more than 180^{o}K. It is observed that the collar closed off at 13 minutes and the maximum temperature rise on the pipe was recorded to be 82^{o}K at 120 minutes.

The proposed construction comprises of 40mm to 75mm Raupiano pipes with variation to pipe wall thickness from tested 2.1mm to be between 1.8-2.2mm penetrating 116mm thick plasterboard wall and protected with Utility collars. From the referenced test, it is demonstrated that the collar closes off at 13 minutes. While the sizes of the proposed pipes are bigger than tested, the pipe wall thickness remains uniform and therefore the collar is expected to perform similarly as tested.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen. For pipes with slighter thicker wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 157^{o}K in insulation performance, it is expected that the proposed Raupiano pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

110mm Raupiano pipe

With reference to FSP 2345 specimen 4, 110mm Raupiano pipe with pipe wall thickness of 3.1mm penetrated 116mm thick plasterboard wall and was protected with Utility 100 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 181 minutes. It is observed that the collar closed off at 8 minutes where pipe temperatures were above PP softening temperature of 90^{o}C with pipe collapse though no holes and the maximum temperature rise on the pipe was recorded to be 20^{o}K at 120 minutes.

The proposed construction comprises of 110mm Raupiano pipe with variation to pipe wall thickness from tested 3.1mm to be between 2.7-3.2mm penetrating 116mm thick plasterboard wall and protected with Utility 100 collars on both sides. From the referenced test, it is demonstrated that the collar closed off at 8 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and otherwise behave in a similar manner therefore not detrimentally affect the performance of the specimen.

For pipes with slighter thicker wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 159^{o}K in insulation performance, it is expected that the proposed 110mm Raupiano pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

160mm Raupiano pipe

With reference to FSP 2361 specimen 2, 160mm Raupiano pipe with pipe wall thickness of 4.3mm penetrated 116mm thick plasterboard wall and was protected with Utility 2 x 150 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 181 minutes . It is observed that the collar closed off at 10 minutes where pipe temperatures were above PP softening temperature of 90^{o}C with some pipe collapse though no holes and the maximum temperature rise on the pipe was recorded to be 25^{o}K at 120 minutes.

The proposed construction comprises of 160mm Raupiano pipes with pipe wall thicknesses of 3.9mm to 4.5mm penetrating 116mm thick plasterboard wall and protected with Utility 2 x 150 collar on both sides. From the referenced test, it is demonstrated that the collar closed off at 10 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 164^{o}K in insulation performance, it is expected that the proposed Raupiano pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

B1.6 Various other pipe material in Hebel walls

Table B1.6: HDPE, Raupiano, Triplus pipes in 75mm Hebel walls

Test Report Number	Pen. #	Test Element	Collar	Pipe Type	Pipe Dia. (Nom.) (mm)	Pipe wall thickness (mm)	Annular Gap (mm)	Sealant	Test Result
FSP 2367	3	75mm Hebel Powerpanel Wall (120 min)	Utility 40	HDPE (PE80)	40	3.2	8.5	10mm bead of Fullers Firesound	-/121/121
FSP 2370	4	75mm Hebel Powerpanel Wall (120 min)	Utility 100	HDPE	110	4.68	8.5	10mm bead of Fullers Firesound	-/121/121
FSP 2367	2	75mm Hebel Powerpanel Wall (120 min)	2 x Utility 150	HDPE (PE100)	160	7.2	4	10mm bead of Fullers Firesound	-/121/96 (collar, wall at 113)
FSP 2369	3	75mm Hebel Powerpanel Wall (120 min)	Utility 40	Raupiano	40	2.1	8.5	10mm bead of Fullers Firesound	-/121/121
FSP 2369	2	75mm Hebel Powerpanel Wall (120 min)	Utility 100	Raupiano	110	3	8.4	10mm bead of Fullers Firesound	-/121/121
FSP 2369	1	75mm Hebel Powerpanel Wall (120 min)	Utility 150	Raupiano	160	4	4	10mm bead of Fullers Firesound	-/121/121
FSP 2367	4	75mm Hebel Powerpanel Wall (120 min)	Utility 40	Triplus	40	2.2	8.5	10mm bead of Fullers Firesound	-/121/121
FSP 2370	2	75mm Hebel Powerpanel Wall (120 min)	Utility 100	Triplus	110	3.68	8.1	10mm bead of Fullers Firesound	-/121/121
FSP 2370	1	75mm Hebel Powerpanel Wall (120 min)	Utility 150	Triplus	160	5.15	3.85	10mm bead of Fullers Firesound	-/121/121

HDPE, Raupiano and Triplus stack pipes in Hebel walls

The proposed construction comprises a Snap Utility collar protecting 40mm to 110mm and 160mm HDPE, Raupiano and Triplus stack pipes penetrating through 75mm thick Hebel walls with a tested or assessed FRL of at least -/120/120.

It is required in Section 7 of this report that the Hebel walls be tested or assessed for the FRL when including aperture for services in the field of the wall.

With reference to test data summarised in Table B1.6, 40mm, 110mm and 160mm HDPE, Raupiano and Triplus pipes, penetrated 75mm thick Hebel walls with a tested or assessed FRL of at least -/120/120. and were protected with Utility collar.

It is observed that these specimens all were able to maintain integrity for up to 121 minutes without failure. When the specimen failed insulation, it was due to the failure of the supporting construction and collar. The pipe was able to maintain insulation for up to 120 minutes.

The proposed construction comprises 50mm to 90mm HDPE pipe protected with various Utility sizes of collars. The annular gap between the proposed collar and the proposed pipe that is similar to the 40mm and 110mm HDPE pipes protected with Utility 40 and Utility collar 100 collar respectively.

The proposed construction comprises 50mm to 75mm Raupiano pipe protected with various Utility sizes of collars. The annular gap between the proposed collar and the proposed pipe that is similar to the 40mm and 110mm HDPE pipes protected with Utility 40 and Utility collar 100 collar respectively.

The proposed construction comprises 50mm to 90mm Triplus pipe protected with various Utility sizes of collars. The annular gap between the proposed collar and the proposed pipe that is similar to the 40mm and 110mm HDPE pipes protected with Utility 40 and Utility collar 100 collar respectively.

Given the similarity in distance of collar intumescent to proposed pipe to that of the tested pipes, and the absence of any impending failure observed in the reference tests for up to 120 minutes, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

The proposed construction comprises a Snap Utility collar protecting 40mm to 110mm and 160mm HDPE, Raupiano and Triplus stack pipes penetrating through 75mm thick Hebel walls with a tested or assessed FRL of at least -/90/90.

With reference to Table B1.4, the 150mm PVC pipe tested in 75mm thick Hebel walls with a tested or assessed FRL of at least -/90/90 vs 75mm thick Hebel walls with a tested or assessed FRL of at least -/120/120 showed that the formal wall resulted in the earlier failure of the collar.

Similar behaviour early heating of the collars is expected for the proposed pipes and collars in the 75mm thick Hebel walls with a tested or assessed FRL of at least -/90/90.

With 30 minutes margin in insulation, it is expected that the proposed construction will be able to maintain integrity for up to 90 minutes and insulation for up to 60 and 90 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Variation to HDPE pipe wall thickness penetrating 75mm thick Hebel wall

The proposed construction comprises inclusion of 40mm OD to 160mm OD HDPE pipes with slightly thinner and thicker pipe wall thicknesses compared to the tested pipes as shown below.

Nominal diameter (mm)	Tested pipe wall thickness (mm)	Proposed pipe wall thickness (mm)
40	3.4	3.0-3.4
110	4.7	4.6-4.9
160	7.1	6.2-7.2

40mm-75mm HDPE pipes

With reference to FSP 2367 specimen 3, 40mm HDPE pipe with pipe wall thickness of 3.2mm penetrated 75mm thick Hebel wall and was protected with Utility 40 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 121 minutes. It was observed that the fireside collar closed off around 6-7 minutes where pipe temperatures were below the softening

temperature for HDPE of 70°C. The maximum temperature rise on the pipe was recorded to be 46°K at 120 minutes.

The proposed construction comprises of 40mm to 63mm HDPE pipes with reduced pipe wall thickness to 3mm and increase in pipe wall thickness to 3.4mm from the tested 3.2mm, penetrating 75mm thick Hebel wall and protected with Utility collars on both sides. The proposed 75mm HDPE pipe comprises reduction in pipe wall thickness of 2.9mm and increase in pipe wall thickness to 3.4mm. From the referenced test, it is demonstrated that the collar was able to limit the temperature rise on the non-fire side below 180°K for up to 181 minutes.

While the sizes of the proposed pipes are bigger than tested, the pipe wall thickness remains uniform and therefore the collar is expected to perform similarly as tested. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will perform similarly or better than tested to limit the temperature rise on the non-fire side below 180°K.

For pipes with slighter thicker wall thickness than tested, it is expected that the intumescent expansion and its ability to plug gaps will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 133°K in insulation performance, it is expected that the proposed HDPE pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

110mm HDPE pipe

With reference to FSP 2370 specimen 4, 110mm HDPE pipe with pipe wall thickness of 4.7mm penetrated 75mm thick Hebel wall and was protected with Utility 100 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 121 minutes. It was observed that the fireside collar closed off around 6-7 minutes where pipe temperatures was approximately the softening temperature for HDPE of 70°C. The maximum temperature rise on the pipe was recorded to be 57°K at 120 minutes.

The proposed construction comprises 110mm HDPE pipe with variation to pipe wall thickness from tested 4.7mm to be between 4.6- 4.9mm penetrating 75mm thick Hebel wall and protected with Utility 100 collars on both sides. From the referenced test, it is demonstrated that the collar was able to limit the temperature rise on the non-fire side below 180°K for up to 121 minutes.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will perform similarly or better than tested to limit the temperature rise on the non-fire side below 180°K.

For pipes with slighter thicker wall thickness than tested, it is expected that the intumescent expansion will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 116°K in insulation performance, it is expected that the proposed HDPE pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

160mm HDPE pipe

With reference to FSP 2367 specimen 2, 160mm HDPE pipe with pipe wall thickness of 7.2mm penetrated 116mm thick plasterboard wall and was protected with 2 x Utility 150 collar on both sides. When tested, the specimen maintained integrity for up to 121 minutes and failed insulation at 96 minutes after the thermocouple on the collar exceeded a temperature rise of more than 180°K. The maximum temperature rise on the pipe was recorded to be 61°K at 120 minutes.

The proposed construction comprises of 160mm HDPE pipes with variation to pipe wall thicknesses from tested 7.2mm to be between 6.2-7.2mm. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will perform similarly or better than tested to limit the temperature rise on the non-fire side below 180°K for up to 90 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity for up to 121 minutes and insulation for up to 90 minutes based on design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

90mm HDPE pipe

The proposed construction comprises 90mm HDPE pipes comprises of pipe wall thickness of 3.5mm to 4mm penetrating 75mm thick Hebel wall and protected with Utility 80+ collar on both sides.

From the test of 110mm HDPE pipe, it is demonstrated that the collar was able to limit the temperature rise on the non-fire side below 180°K for up to 121 minutes. The proposed 90mm HDPE pipe has thinner wall thickness than the tested 110mm HDPE pipe. The collar's ability to limit the temperature rise below 180°K for up to 121 minutes has been demonstrated above. Therefore, it is expected that the collar will perform similarly or better because of the thinner pipe wall thickness and will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

125mm HDPE pipe

The proposed construction comprises 125mm HDPE pipes with pipe wall thickness of 4.8mm to 5.4mm penetrating 75mm thick Hebel wall and being protected with Utility 125 collars on both sides. From the 160mm HDPE pipe test with 7.2mm pipe wall thickness and 110mm HDPE pipe with pipe wall thickness of 4.6mm discussed above, it is demonstrated that the collar intumescent was able to expand and prevent the hot gases from heating the non-fire side limiting the temperature rise on the non-fire side below 180°K for up to 90 minutes while maintaining the integrity for up to 121 minutes.

The proposed 125mm HDPE pipe is smaller in size with thinner wall thickness than the 160mm HDPE pipe but greater in size with slightly thicker pipe wall thickness than the 110mm HDPE pipe. Therefore, it is expected that the collar will perform similarly as the Utility 160 collar. Based on this, it is expected that the pipe will be able to maintain integrity for up to 121 minutes and insulation for up to 90 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity for up to 121 minutes and insulation for up to 90 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Variation to Raupiano pipe wall thickness penetrating 75mm thick Hebel wall

The proposed construction comprises inclusion of 40mm OD to 160mm OD Raupiano pipes with slightly thinner and thicker pipe wall thicknesses compared to the tested pipes as shown below.

Nominal diameter (mm)	Tested pipe wall thickness (mm)	Proposed pipe wall thickness (mm)
40	2.1	1.8-2.2
110	3	2.7-3.2
160	4	3.9-4.5

40mm-75mm Raupiano pipes

With reference to FSP 2369 specimen 3, 40mm Raupiano pipe with pipe wall thickness of 2.1mm penetrated 75mm thick Hebel wall and was protected with Utility 40 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 121 minutes. It is observed that the collar

closed off at 9 minutes and the maximum temperature rise on the pipe was recorded to be 48°K at 120 minutes.

The proposed construction comprises of 40mm to 75mm Raupiano pipes with variation to pipe wall thickness from tested 2.1mm to be between 1.8-2,2mm penetrating 75mm thick Hebel wall and protected with Utility collars. From the referenced test, it is demonstrated that the collar closes off at 9 minutes. While the sizes of the proposed pipes are bigger than tested, the pipe wall thickness remains uniform and therefore the collar is expected to perform similarly as tested.

For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

For pipes with slighter thicker wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 131°K in insulation performance, it is expected that the proposed Raupiano pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

110mm Raupiano pipe

With reference to FSP 2369 specimen 2, 110mm Raupiano pipe with pipe wall thickness of 3mm penetrated 116mm thick plasterboard wall and was protected with Utility 100 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 121 minutes. It is observed that the collar closed off at 8 minutes and the maximum temperature rise on the pipe was recorded to be 37°K at 120 minutes.

The proposed construction comprises 110mm Raupiano pipe with variation to pipe wall thickness from tested 3mm to be between 2.7-3.2mm penetrating 75mm thick Hebel wall and protected with Utility 100 collars on both sides.

From the referenced test, it is demonstrated that the collar closed off at 8 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

For pipes with slighter thicker wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 142°K in insulation performance, it is expected that the proposed 110mm Raupiano pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

160mm Raupiano pipe

With reference to FSP 2369 specimen 1, 160mm Raupiano pipe with pipe wall thickness of 4.3mm penetrated 116mm thick plasterboard wall and was protected with 2 x Utility 150 collar on both sides. When tested, the specimen maintained integrity and insulation for up to 121 minutes. It is observed that the collar closed off at 9 minutes and the maximum temperature rise on the pipe was recorded to be 39°K at 120 minutes.

The proposed construction comprises of 160mm Raupiano pipes with pipe wall thicknesses of 3.9mm to 4.5mm penetrating 75mm thick Hebel wall and protected with 2 x Utility 150 collars on both sides. From the referenced test, it is demonstrated that the collars closed off at 9 minutes. For pipes with slightly thinner wall thickness than tested, it is expected that the collar will close off at the same time and therefore not detrimentally affect the performance of the specimen.

For the pipes with slightly thicker pipe wall thickness than tested, it is expected that the closing off of the pipe will be slightly delayed allowing the hot gas to vent off on the non-fire side resulting in increase of non-fire side temperature. However, with margin of more than 140°K in insulation performance, it is expected that the proposed Raupiano pipes will be able to maintain integrity and insulation for up to 120 minutes.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 90 and 120 minutes based on design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

B.2 Variation to ways of installing SNAP Utility collars and pipes

The proposed construction in Section 3.1 of this report may include the following variations in isolation or combination:

a. The inclusion of concrete floor as a separating element
    - Inclusion of min. 120mm, 150mm and 175mm thick concrete floor in accordance with AS 3600-2018
    - Inclusion of min. 120mm, 150mm and 175mm thick Bondek steel formwork concrete floor tested or assessed for an FRL of at least 120/120/120, 180/180/180 and 240/240/240 respectively and the channel next to collar to be fully filled with Snap Fire Seal FRAS as per Figure 4.
    - The pipework is to be vertically supported above the floor and straight under the floor as tested

b. The inclusion of the following walls as a separating element
    - Inclusion of 90mm thick plasterboard lined steel stud walls with glasswool in cavity as a support construction. The wall shall be symmetrically lined on each side. The wall shall be tested or assessed for an FRL of at least-/60/60.
    - Inclusion of 116mm thick plasterboard lined steel stud walls as a support construction. The wall shall be symmetrically lined on each side. The wall shall be tested or assessed for an FRL of at least -/120/120.
    - Inclusion of min. 116mm thick shaft liner walls as a support construction. The wall shall have min. 25mm thick Shaftliner panel on one side and 2 layers of min. 13mm fire rated plasterboard on the other side. The wall shall be tested or assessed for an FRL of at least -/120/120.
    - Inclusion of 75mm single cage and double caged Hebel walls as a support construction. The wall shall be tested or assessed for an FRL of at least-/90/90 and -/120/120 respectively
    - Inclusion of 78mm thick Speedpanel wall as a support construction. The wall shall be tested or assessed for an FRL of at least -/120/120
        - Inclusion of 250mm x 250mm plasterboard patch as per Table 36 over a section of Speedpanel wall at the location of the penetrating pipes.
        - A fillet of Snap Fire Seal FRAS to fully seal all gaps between plasterboard patch and Speedpanel wall.
        - Fixings for collars to plasterboard patch shall be 14g-10 65mm Hex Head Screws
        - Fixings for plasterboard patch to Speedpanel wall shall be 14g-10 65mm Hex Head Screws at maximum 100mm centres
    - Inclusion of 110mm Dincel wall or AFS Rediwall as a support construction with the Utility Collar fixed directly to the plastic. The wall shall be tested or assessed for an FRL of at least 90/90/90
        - Fixings to be away from any voids with a minimum of 25mm embedment into concrete part of the wall

- Inclusion of 120mm thick AFS Logic wall as a support construction with the Utility Collar fixed directly to the fibre cement sheet. The wall shall be tested or assessed for an FRL of at least 120/120/120
  - Fixings to be away from any voids with a minimum of 25mm embedment into concrete part of the wall
- Inclusion of 155mm Dincel wall as a support construction with the Utility Collar fixed directly to the plastic. The wall shall be tested or assessed for an FRL of at least 180/180/180
  - Fixings to be away from any voids with a minimum of 25mm embedment into concrete part of the wall
- Inclusion of min. 90mm thick masonry wall as a support construction. The wall shall be in accordance with AS 3700-2018 for the required FRL
  - Fixings to be away from any voids with a minimum of 25mm embedment into concrete part of the wall
- Inclusion of min. 80mm thick concrete wall as a support construction. The wall shall be in accordance with AS 3600-2018 for the required FRL
  - Fixings to be away from any voids with a minimum of 25mm embedment into concrete part of the wall
- Inclusion of min. 90mm thick AAC block wall as a support construction. The wall shall be tested or assessed for the required FRL
  - Fixings to be away from any voids with a minimum of 25mm embedment into concrete part of the wall
- Pipework is to be supported on each side of the wall at maximum 300mm from the wall

c. Variation to gap treatment between pipe and separating element as per Table 3
d. Fixings for each support construction type shall be as per Tables 4 and 5
e. Number of collar brackets shall be as per Table 2
f. Variations Installation methods including
   - Paint on collar body, though no paint is allowed on the active area of the collar
   - Collars can be installed with a minimum spacing of 40mm from outer edge of collar to outer edge of collar

B2.1 Pipes in 150mm and 175mm thick concrete floor

The proposed construction comprises a Snap Utility collar protecting PVC, HDPE, Raupiano and Triplus stack pipes discussed in section B.1 penetrating 150mm and 175mm thick concrete floor.

It is required in section 7 of this report that the concrete floor be designed as per AS 3600-2018 for the required FRL.

The proposed construction comprises the plastic pipes from installed in 120mm thick concrete floors to 150mm and 175mm. The proposed construction also comprises the 150mm PVC(SC) specimen from installed in 150mm thick slab to 175mm.

It is expected that with the increase in slab thickness, the thermal mass of the system will be increased resulting in a greater heat sink effect and thus leading to a lesser increase in pipe temperature throughout the test. It is therefore expected that the pipes installed in a 150mm and 175mm thick slab will be able to maintain insulation for up to 180 and 240 minutes respectively.

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.

Based on the above, it can be expected the proposed construction will be able to maintain integrity and insulation for up to 120, 180 and 240 minutes based on the design if tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005 AMDT.1.

Inclusion of min. 120mm, 150mm and 175mm thick Bondek steel formwork concrete floor

The proposed construction comprises the inclusion of concrete with Bondek permanent formwork with an effective thickness of 120, 150 and 175mm as a support construction in place of concrete floor and the channel next to collar to be fully filled with Snap Fire Seal FRAS as per Figure 4.

It is required in section 7 of this report that the Bondek floor be designed, tested or assessed as a separating element for the required FRL when including the service penetration specified in Section 5.

In the referenced to the supplementary test report FSP 1953, various retrofit collars were installed on the underside of a 120mm thick Bondek slab. Where the collar interests the channels in the Bondek profile, the channel was fully filled with Fuller Firesound sealant.

It is observed that when pipes were able to maintain integrity for up to 241 minutes without failure. With the stack pipes in concrete with Bondek permanent formwork, the points of insulation failure were on the slabs after 180 minutes.

Although the tested retrofit collars in FSP 1953 are of a different design to the Utility collar, the supplementary test report FSP 1953 gives confidence that the Bondek permanent formwork floor would not interfere with collar closure nor fail insulation on the floor before the designed insulation performance for each slab thickness.

Based on the above, it is expected that the proposed construction will be able to maintain integrity and insulation for up to 120, 180 and 240 minutes based on design when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1 -2005.

B2.2 Pipes in 78mm Speedpanel walls

The proposed construction comprises a Snap Utility collar protecting 40mm to 110mm and 160mm PVC, HDPE, Raupiano and Triplus stack pipes penetrating through 78mm thick Speedpanel wall without lining or framing on each side, tested or assess. The wall shall be lined with additional patching as per Table 36.

It is required in Section 7 of this report that the Speedpanel walls be tested or assessed for the FRL when including aperture for services in the field of the wall.

The proposed configuration with two layers of 13mm patching each side of the 78mm Speedpanel wall is similar to a 116mm stud wall in that the 78mm Speedpanel act as a frame separator for the two layers of 13mm fire rated plasterboard on each side of the wall.

Therefore, it is expected that the proposed configuration will allow the collar to remain fixed to the wall and close the pipe in the same manner as when the two layers of 13mm fire rated plasterboard lining each side of stud lined wall without introducing a weakness between the wall construction and the collar.

As the Speedpanel undergoes heating, there will be evaporation of free water in the Speedpanel concrete core during the first 60 minutes of the test which will result in a relatively lower temperature of the fire collar on the unexposed side compared to when collars on in a plasterboard wall, which may delay the activation of the non-fire side collar leading to early specimen failure.

It is observed that the 75mm Hebel panel also undergoes similar evaporation of free water during the first 60 minutes of the test, and with reference to the tests of 40-150/160mm pipes in Hebel walls in Tables B1.31 and B1.61, the unexposed side collar was not activated. However, the collar on the fire side was sufficient to close off the pipe such that the non-fire side collar, were not required to activate for the duration of the test to allow the pipe to maintain insulation performance for up to 120 minutes.

Therefore, this behaviour can also be applied to Speedpanel, such that a reduced temperature of the non-fire side collar will not detrimentally affect the performance of the specimen for up to 120 minutes.

The proposed configuration also comprises Fuller Firesound sealant sealing off the gap between the Speedpanel and the plasterboard patch. This will stop the fluing of furnace gas leaking through the gap between the plasterboard patch and the Speedpanel wall profile, allowing the wall to maintain insulation at the location of the patch for at least 120 minutes.

The proposed single layer of 16mm or single layer of 13mm as patching will reduce the conduction length of the heat patch through the wall, and as such will increase the temperature of the wall, collar and pipe at the penetration location. With 30 and 60 minutes margin on performance, it is expected that these configurations will not detrimentally affect the performance of the proposed specimen for up to 90 minutes and 60 minutes respectively.

Based on the above, it is expected that the proposed construction will maintain integrity and insulation for up to 60, 90 and 120 minutes based on design when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1 -2005.

B2.3 Pipes in 110 mm thick Dincel and AFS Rediwall

The proposed construction comprises a Snap Utility collar protecting 40mm to 110mm and 160mm PVC, HDPE, Raupiano and Triplus stack pipes penetrating through 110mm thick Dincel and AFS Rediwall with the Utility Collar fixed directly to the plastic lining.

It is required in Section 7 of this report that the Dincel, AFS Rediwall and AFS Logic walls be tested or assessed for the FRL when including aperture for services in the field of the wall. It is also required that the collar fixings be away from any voids with a minimum of 25mm embedment into concrete part of the wall.

With reference to Tables B1.21 and B1.51, the 40-150/160mm pipes of various materials were tested in plasterboard lined stud walls. The specimens referenced in these tables demonstrated that the Utility collars were able to close off the pipes without coupling in the collar and 40mm pipe with coupling in the collar for up to 180 minutes, such that the pipe and collar temperature remained collar by the end of the 180 minutes tests. The specimens referenced in these tables demonstrated that the Utility collars were able to close off the pipes with coupling in the collar for up to 120 minutes, such that the pipe and collar temperature remained collar by the end of the 120 minutes tests.

Therefore, it is expected that the insulation performance of the pipe to collar combination in plasterboard walls for up to 180 minutes can be applied to the same specimens in the proposed solid walls.

The proposed wall constructions are also similar to the tested 75mm Hebel panel in terms of being a solid wall filled with concrete. Since the proposed wall systems are all filled with concrete that would act to absorb heat, it is expected the wall on the unexposed side would be able to maintain insulation performance in a similar manner to when it is not penetrated with plastic pipes.

Based on the above, it is expected that the proposed construction will maintain integrity and insulation for up to 90, 120 and 180 minutes based on design when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1 -2005.

B2.4 Pipes in 120 mm thick AFS Logicwall

The proposed construction comprises a Snap Utility collar protecting 40mm to 110mm and 160mm PVC, HDPE, Raupiano and Triplus stack pipes penetrating through 120mm thick AFS Logicwall with the Utility Collar fixed directly to the fibre cement sheet.

It is required in Section 7 of this report that the AFS Logic wall be tested or assessed for the FRL when including aperture for services in the field of the wall.

With reference to Tables B1.21 and B1.51, the 40-150/160mm pipes of various materials were tested in plasterboard lined stud walls. The specimens referenced in these tables demonstrated that the Utility collars were able to close off the pipes without coupling in the collar and 40mm pipe with

coupling in the collar for up to 180 minutes, such that the pipe and collar temperature remained collar by the end of the 180 minutes tests. The specimens referenced in these tables demonstrated that the Utility collars were able to close off the pipes with coupling in the collar for up to 120 minutes, such that the pipe and collar temperature remained collar by the end of the 120 minutes tests.

Therefore, it is expected that the insulation performance of the pipe to collar combination in plasterboard walls for up to 180 minutes can be applied to the same specimens in the proposed solid walls.

The proposed wall constructions are also similar to the tested 75mm Hebel panel in terms of being a solid wall filled with concrete. Since the proposed wall systems are all filled with concrete that would act to absorb heat, it is expected the wall on the unexposed side would be able to maintain insulation performance in a similar manner to when it is not penetrated with plastic pipes.

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

B2.5 Pipes in 90mm thick masonry and 80mm thick concrete wall

The proposed construction comprises a Snap Utility collar protecting 40mm to 110mm and 160mm PVC, HDPE, Raupiano and Triplus stack pipes penetrating through 90mm thick Masonry wall and 80mm thick concrete wall.

It is required in section 7 of this report that the 80mm thick concrete wall be designed as per AS 3600-2018 and 90mm thick masonry wall be designed as per AS3700-2018 for the required FRL.

With reference to the discussion in sections B1.2 and B1.5 of this report for the plastic pipes in 90mm thick plasterboard walls, it is demonstrated that the proposed pipes when protected with SNAP Utility collars will be able to maintain integrity and insulation for up to 60 minutes.

The proposed masonry wall is of same thickness and the concrete wall is slightly thinner but stiffer than the tested 90mm thick plasterboard wall. Since the proposed wall system is comprised of concrete and masonry that would act to absorb heat, it is expected the wall on the unexposed side would be able to maintain insulation performance in a similar manner to when it is not penetrated with plastic pipes.

Based on the above, it is expected that the proposed construction will maintain integrity and insulation for up to 60 minutes when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1 -2005.

B2.6 Pipes in 90mm thick AAC block wall

The proposed construction comprises a Snap Utility collar protecting 40mm to 110mm and 160mm PVC, HDPE, Raupiano and Triplus stack pipes penetrating through 90mm thick AAC block wall.

It is required in section 7 of this report that the AAC wall be tested or assessed for the FRL when including aperture for services in the field of the wall. It is also required that the collar fixings be away from any voids with a minimum of 25mm embedment into concrete part of the wall.

With reference to the discussion in sections B1.2 and B1.5 of this report for the plastic pipes in 90mm thick plasterboard walls, it is demonstrated that the proposed pipes when protected with SNAP Utility collars will be able to maintain integrity and insulation for up to 60 minutes.

The proposed AAC block wall is of same thickness but stiffer than the tested 90mm thick plasterboard wall. It is expected that the proposed AAC block wall would deflect less than the tested plasterboard wall and therefore improve the stability of the junction between the collar and the wall, leading to less gap formation.

Based on the above, it is expected that the proposed construction will maintain integrity and insulation for up to 60 minutes when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1 -2005.

B2.7 Pipes in minimum 116mm thick Shaftliner wall

The proposed construction comprises a Snap Utility collar protecting 40mm to 110mm and 160mm PVC, HDPE, Raupiano and Triplus stack pipes penetrating through minimum 116mm thick Shaftliner wall comprised of min. 25mm thick Shaftliner panel on one side and 2 layers of min. 13mm fire rated plasterboard on the other side as shown in Figure 6.

It is required in section 7 of this report that the Shaftliner wall be tested or assessed for the FRL when including aperture for services in the field of the wall.

With reference to the discussion in sections B1.1 and B1.5 of this report for the plastic pipes in 116mm thick plasterboard walls, it is demonstrated that the proposed pipes when protected with SNAP Utility collars will be able to maintain integrity and insulation for up to 120 minutes.

The proposed shaftliner wall is of same thickness as the tested 116mm thick plasterboard wall. It is expected that the proposed wall would therefore behave similarly.

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

B2.8 Pipes in 155mm thick Dincel wall

The proposed construction comprises a Snap Utility collar protecting 40mm to 110mm and 160mm PVC, HDPE, Raupiano and Triplus stack pipes penetrating through 155mm thick Dincel wall.

It is required in section 7 of this report that the Dincel wall be tested or assessed for the FRL when including aperture for services in the field of the wall.

With reference to the discussion in sections B1.1 and B1.5 of this report for the plastic pipes in 116mm thick plasterboard walls, it is demonstrated that the proposed pipes when protected with SNAP Utility collars will be able to maintain integrity for up to 180 and insulation for up to 120 minutes and 180 minutes as per Tables 26 to 30.

The proposed Dincel wall is thicker than the tested 116mm thick plasterboard wall. Since the proposed wall system is filled with concrete that would act to absorb heat, it is expected the wall on the unexposed side would be able to maintain insulation performance in a similar manner to when it is not penetrated with plastic pipes.

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

B2.9 Variation to gap treatment

The proposed variation comprises Snap collars as discussed in Section B1 have its annular gap treated as per Table 9.

With reference to the test data in Section B1, it is observed that when gaps were 2mm and under between the pipe and the support construction opening, no sealant were applied. When gaps were between 2mm to 10mm, 10mm bead of Fuller Firesound sealant was applied. It was observed that these gap treatment methods did not contribute to the failure of the specimen.

Based on the above, it is expected that the proposed variation will not detrimentally affect the integrity and insulation performance of the proposed construction for up to 240 minutes based on design when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1 -2005.

B2.10 Minor “onsite” modifications to Snap collars and features

Paint of collar flange

By observation, the painting of the collars is limited to the metal sections of the collar where no intumescent material is held.

It is expected that the paint applied to the collar flange will not have a significant effect on the temperature of the collar body and thus will not affect the function of the intumescent material in the collar whilst the collar maintains insulation performance.

B2.11 Separation between collars

It is proposed that services are separated by at least 40mm and located within the support construction by at least 40mm. AS 4072. 1-2005, clause 4.9.3 states that: "the minimum distance between penetrations in a modular system shall be not less than 40mm unless otherwise tested in specimen form". It is noted that AS 4072. 1-2005 (clause 1.4.10) defines a "penetration" as "an aperture through a fire-separating element for the passage of a service or services".

In light of the above, it is considered that AS 4072.1-2005, clause 4.9.3 applies to services that achieve the required insulation performance for the required integrity period and are separated by at least 40mm.

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