



## **TEST REPORT**

Fire resistance test in accordance with AS1530.4-2014 of various pipes and cables services protected with variuos of BOSS penetration protection systems in a 118mm fire rated wall system

### **EWFA Report No:**

49527300.2

### **Report Sponsor:**

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# 1 CONSTRUCTION DETAILS

## TEST ASSEMBLY

The test assembly comprised a nominal 1600mm wide × 1600mm high × 118mm thick USG Boral Firestop wall system with Fletcher Insulation Pink Partition 14 R1.3 insulation in the wall cavity.

The wall was restrained along both vertical and horizontal edges.

## TEST SPECIMENS

The test specimen comprised a 92mm thick steel frame system cladded with 13mm USG Boral Firestop plasterboard on both exposed and unexposed side. The wall cavity was filled with Fletcher Insulation Pink Partition 14 R1.3 insulation.

There was 20mm gap between the test frame and the top edge of the wall, 15mm gap between the test frame and the vertical edge of the wall and 10mm gap between the test frame and the bottom edge of the wall. The gaps were protected by BOSS FM300 sealant.

The wall system was penetrated by 11-off various pipe services and 2-off cable services. The pipe and cable services were protected by various collars, wraps, sealants and penetration patches. The test assembly is summarised in the table below.

The full description of the specimen is provided in Figures A1.1 to A1.15 and the 'Schedule of Components' in Section 2.

Service No.	Service	Service size (mm)	Core hole Size (mm)	No. of service/s	Primary Fire Protection	Sealant
1	PEX/AL/ PEX pipe	Ø25	30	1	BOSS 32mm MaxiCollar™	FireMastic -HPE
2	PEX pipe	Ø 25	35	1	BOSS UniWrap® in metal sleeve	None
3	PEX pipe	Ø 25	30	1	BOSS 32mm MaxiCollar™	FireMastic -HPE
4	PEX pipe	Ø 20	40	1	BOSS 40mm MaxiCollar™	FireMastic -HPE
5	PP-R pipe	Ø 20	32	1	BOSS 32mm MaxiCollar™	FireMastic -HPE
6	uPVC pipe	Ø 40	50	1	BOSS 40mm MaxiCollar™	None
7	uPVC pipe	Ø 50	65	1	BOSS 50mm MaxiCollar™	FireMastic -300
8	CPVC pipe	Ø 50	60	1	BOSS 50mm MaxiCollar™	None
9	PEX pipe	Ø 16	20	1	BOSS PenoPatch	None
10	CAT 6 cables	Ø 5.8	20	5	BOSS PenoPatch	None
11	TPS cables	12mm × 5.6mm	25	3	BOSS PenoPatch™	None
12	uPVC pipe	Ø 80	90	1	BOSS 80mm MaxiCollar™	None
13	PP-R pipe	Ø 32	38	1	BOSS 32mm MaxiCollar™	FireMastic -HPE

## **ASSEMBLY AND INSTALLATION METHODS**

The wall system and penetration service were constructed between 29 May 2018 to 05 July 2018 by representatives of Boss fire.

## **ORIENTATION**

The wall system was asymmetrical as the services supports were installed on the unexposed side only.

## 2 SCHEDULE OF COMPONENTS

Item	Description	
Separating element		
1	Product	13mm fire rated plasterboard (USG Boral Firestop) with 92mm steel frame and Fletcher Insulation Pink Partition 14 R1.3 insulation.
	Size	1600mm wide × 1600mm high × 118mm thick
	Density	USG Boral Firestop: 923kg/m <sup>3</sup> Insulation: 68kg/m <sup>3</sup>
	Specification	<p>The wall system comprised of 92mm thick steel framing.</p> <p>The wall system was clad with a layer of 13mm fire rated plasterboard (USG Boral Firestop) on both the exposed and unexposed side using 6g self-drilling, bugle head, 45mm plasterboard screws at 200mm centres. The steel frame was secured to the concrete brickwork and lintel with 6.5mm masonry anchors. The masonry anchors were installed at middle of the tracks and 30mm in from either end of the tracks.</p> <p>The cavity in the wall steel frame system was filled with Fletcher Insulation Pink Partition 14 R1.3 Glasswool Batt insulation</p> <p>There was a 20mm gap between the top edge of the plasterboard and the concrete lintel.</p> <p>There were a 15mm gap on both vertical edge between the plasterboard and the concrete blockwork.</p> <p>There was a 10mm gap between the bottom edge of the plasterboard and the concrete sill.</p> <p>The gaps between the perimeter of the wall system and the block lintel/blockwork/sill were filled with BOSS FireMastic 300.</p>
Service protection		
2	Product name	BOSS FireMastic-HPE
	Installation	BOSS FireMastic-HPE was installed into the aperture between the service and collar on both the exposed and the unexposed sides.
3	Product name	BOSS FireMastic-300
	Installation	<p>BOSS FireMastic-300 was installed into the aperture between the service and collar on both the exposed and the unexposed sides.</p> <p>BOSS FireMastic-300 was installed at the wall edges between blockwork and plasterboard.</p>
4	Product name	BOSS 32mm MaxiCollar™ Collar
	Size	<p>ID: Ø35mm</p> <p>OD: Ø47mm</p> <p>Height: 31.6mm</p> <p>Collar metal thickness: 1mm</p> <p>Mounting bracket: 24mm × 15mm × 1mm</p> <p>No. of mounting brackets: 3</p> <p>No. of intumescent strips: 2</p>
	Intumescent Density	1121kg/m <sup>3</sup> (measured)

Item	Description	
	<b>Installation</b>	The collars were installed on both the exposed and the unexposed side of the wall system with three-off M4 x 8mm Zinc hollow wall anchors.
5	<b>Product name</b>	BOSS 40mm MaxiCollar™ Collar
	<b>Size</b>	ID: Ø43mm OD: Ø55mm Height: 31.6mm Collar metal thickness: 1mm Mounting bracket: 24mm x 15mm x 1mm No. of mounting brackets: 3 No. of intumescent strips: 3
	<b>Intumescent Density</b>	1121kg/m <sup>3</sup> (measured)
	<b>Installation</b>	The collars were installed on both the exposed and the unexposed of the wall system with three-off M4 x 8mm Zinc hollow wall anchors.
6	<b>Product name</b>	BOSS 50mm MaxiCollar™ Collar
	<b>Size</b>	ID: Ø55mm OD: Ø71mm Height: 31.6mm Collar metal thickness: 1mm Mounting bracket: 24mm x 15mm x 1mm No. of mounting brackets: 3 No. of intumescent strips: 3
	<b>Intumescent Density</b>	1121kg/m <sup>3</sup> (measured)
	<b>Installation</b>	The collars were installed on both the exposed and the unexposed of the wall system with three-off M4 x 8mm Zinc hollow wall anchor
7	<b>Product name</b>	BOSS 60mm MaxiCollar™ Collar
	<b>Size</b>	ID: Ø64mm OD: Ø79mm Height: 31.6mm Collar metal thickness: 1mm Mounting bracket: 24mm x 15mm x 1mm No. of mounting brackets: 3 No. of intumescent strips: 3
	<b>Intumescent Density</b>	1121kg/m <sup>3</sup> (measured)
	<b>Installation</b>	The collars were installed on both the exposed and the unexposed of the wall system with three-off M4 x 8mm Zinc hollow wall anchor.
8	<b>Product name</b>	BOSS 80mm MaxiCollar™ Collar

Item	Description	
	<b>Size</b>	ID: Ø85mm OD: Ø105mm Height: 31.6mm Collar metal thickness: 1mm Mounting bracket: 24mm x 15mm x 1mm No. of mounting brackets: 3 No. of intumescent strips: 4
	<b>Intumescent Density</b>	1121kg/m <sup>3</sup> (measured)
	<b>Installation</b>	The collars were installed on both the exposed and the unexposed of the wall system with three three-off M4 x 8mm Zinc hollow wall anchor.
9	<b>Product name</b>	BOSS UniWrap® in metal sleeve
	<b>Size</b>	Nominal: 40mm width x 2mm thick Steel sleeve: 118mm length x 1mm thick
	<b>Density</b>	Nominal: 1300kg/m <sup>3</sup> (measured)
	<b>Installation</b>	2-off, 2 layers of BOSS UniWrap® were wrapped around the pipe flush to the plasterboard on the exposed side and the unexposed sides. There was 38mm gap between the exposed side BOSS UniWrap® and the unexposed side BOSS UniWrap®. The UniWrap® were secured to the pipe with plastic electrical tape. Metal sleeve was constructed from 118mm long 1mm thick steel.
10	<b>Product name</b>	BOSS PenoPatch™
	<b>Size</b>	Ø70mm diameter x 3.1mm thick
	<b>Density</b>	1592kg/m <sup>3</sup> (measured)
	<b>Installation</b>	The PenoPatch patched the annular gap around the services on the exposed side and unexposed side. The PenoPatch was wrapped around the circumference of the service and joined at the two cut edges. The PenoPatch was pressed firmly against the plasterboard, completely sealing the annular gap around service.
<b>Service</b>		
11	<b>Item Name</b>	25mm PEX-AL-PEX pipe
	<b>Product Name</b>	VelPEX: Gas AS 4176:8 LIC # Watermark AM174520 DN25x2.5 Class 500 PEX-AL-PEX
	<b>Size</b>	OD: Ø24.6mm ID: Ø19.3mm
12	<b>Item Name</b>	25mm PEX pipe
	<b>Product Name</b>	AusPEX. DN25 PN16 SDR9 PE-xb 80 AS/NZS 2492 RWC DSIA. LN 2058
	<b>Size</b>	OD: Ø25.2mm ID: Ø19.0mm
13	<b>Item Name</b>	20mm PEX pipe
	<b>Product</b>	SharkBite DN20 PN16 SDR-9 PE-Xb 80 AS/NZS 2492 RWL DS2B LN2058



Item	Description	
	<b>Size</b>	OD: Ø20mm ID: Ø13.7mm
14	<b>Item Name</b>	20mm PP-R pipe
	<b>Product</b>	Aquatherm fusiotherm® 20×1.9mm PP-R
	<b>Size</b>	OD: Ø20.2mm ID: Ø15.6mm
15	<b>Item Name</b>	40mm uPVC pipe
	<b>Product</b>	Pipe King BEP PVC 40 DWV PVCU AS/NZS 1260
	<b>Size</b>	OD: Ø42.4mm ID: Ø37.4mm
16	<b>Item Name</b>	50mm uPVC pipe
	<b>Product</b>	Vinidex Quality BEP PVC DWV 50 PVCU LIC No 1010 AS/NZS 1260 SL19
	<b>Size</b>	OD: Ø55.6mm ID: Ø51.1mm
17	<b>Item Name</b>	50mm CPVC pipe
	<b>Product</b>	753-TFP 2" (50mm) SDR 13.5 WP 175 PSI 150F(65°C) Listed 67CN CPVC SPRINKLER PIPE 4120-06 TFP 331711132112 F-442 320PSI @ 73F 100PSI @ 180F. MEA 185-02-E
	<b>Size</b>	OD: Ø60.2mm ID: Ø50.1mm
18	<b>Item Name</b>	16mm PEX pipe
	<b>Product</b>	RAUTITAN platinum 11132320 PN16 SDR7.4 PE-Xa 80
	<b>Size</b>	OD: Ø16.1mm ID: Ø11.2mm
19	<b>Item Name</b>	CAT6 Cable
	<b>Product</b>	Serveredge CAT6 Cable
	<b>Size</b>	OD: Ø5.8mm
20	<b>Item Name</b>	TPS cable
	<b>Product</b>	Advance cable 2.5mm <sup>2</sup> Cu 2 Core + Earth 450/750V V90/3V90
	<b>Size</b>	12mm × 5.6mm
21	<b>Item Name</b>	80mm uPVC pipe
	<b>Product</b>	Vinidex Quality BEP PVC DWV 80 PVCU LIC no 1010 AS/NZS 1260 SL15
	<b>Size</b>	OD: Ø82.0mm ID: Ø75.6mm
22	<b>Item Name</b>	32mm PP-R pipe
	<b>Product</b>	Aquatherm green pipe SDR11 s 32×2.9 PP-R
	<b>Size</b>	OD: Ø32.0mm ID: Ø26.2mm
Penetration Service		

Item	Description	
SERVICE 1		
23	Service	
	Item name	25mm PEX-Al-PE pipe
	Core hole size	Ø30mm
	Annular gap	2.5mm
	Installation	The pipe was installed at the centre of the core hole with 2.5mm annular gap. The pipe protruded 500mm from the exposed side and 2000mm from the unexposed side of the wall system. The pipe was supported at 500mm and 1500mm away from the unexposed side of the wall system. The pipe was sealed on the exposed side only.
	Penetration Protection	
	Product Name	BOSS 32mm MaxiCollar™ BOSS FireMastic-HPE
	Mastic depth	25mm (full depth of the collar)
	Installation	The Maxi collar was installed on both the exposed side and the unexposed side of the wall system. The MaxiCollar™ was fixed to the wall with 3-off M4 x 8mm zinc hollow wall anchors. The gap between the collar and the pipe was filled up with BOSS FireMastic-HPE on both the exposed and the unexposed side.
SERVICE 2		
24	Service	
	Item name	25mm PEX pipe
	Core hole size	Ø35mm
	Annular gap	5mm
	Installation	The pipe was installed at the centre of the core hole with 5mm annular gap. The pipe protruded 500mm from the exposed side and 2000mm from the unexposed side of the wall system. The pipe was supported at 500mm and 1500mm away from the unexposed side of the wall system. The pipe was sealed on the exposed side only.
	Penetration Protection	
	Product Name	BOSS UniWrap® in metal sleeve
	Installation	The BOSS UniWrap® in metal sleeve was install in the annular gap between the pipe and the wall system. The BOSS UniWrap® in metal sleeve was pre-installed on the pipe and slide into the wall system. The end of the BOSS UniWrap® in metal sleeve was flushed with the wall surface on both exposed and unexposed side.
SERVICE 3		
25	Service	
	Item name	25mm PEX pipe
	Core hole size	Ø30mm
	Annular gap	2.5mm

Item	Description	
	<b>Installation</b>	The pipe was installed at the centre of the core hole with 2.5mm annular gap. The pipe protruded 500mm from the exposed side and 2000mm from the unexposed side of the wall system. The pipe was supported at 500mm and 1500mm away from the unexposed side of the wall system. The pipe was sealed on the exposed side only.
	<b>Penetration Protection</b>	
	<b>Product Name</b>	BOSS 32mm MaxiCollar™ BOSS FireMastic-HPE
	<b>Mastic depth</b>	25mm (full depth of the collar)
	<b>Installation</b>	The Maxi collar was installed on both the exposed side and the unexposed side of the wall system. The MaxiCollar™ was fixed to the wall with 3-off M4 x 8mm zinc hollow wall anchors. The gap between the collar and the pipe was filled up with BOSS FireMastic-HPE on both the exposed and the unexposed side.
<b>SERVICE 4</b>		
26	<b>Service</b>	
	<b>Item name</b>	20mm PEX pipe
	<b>No. of pipes</b>	2
	<b>Core hole size</b>	Ø40mm
	<b>Annular gap</b>	0-10mm
	<b>Installation</b>	The pair of the pipes were installed at the mid-height of the core hole and have nominal 10mm annular gap between top edge and bottom edge of the core hole. The pipes contacted the east and west side of the core hole. The pipe protruded 500mm from the exposed side and 2000mm from the unexposed side of the wall system. The pipe was supported at 500mm and 1500mm away from the unexposed side of the wall system. The pipe was sealed on the exposed side only.
	<b>Penetration Protection</b>	
	<b>Product Name</b>	BOSS 40mm MaxiCollar™ BOSS FireMastic-HPE
	<b>Mastic depth</b>	25mm (full depth of the collar)
	<b>Installation</b>	The Maxi collar was installed on both the exposed side and the unexposed side of the wall system. The MaxiCollar™ was fixed to the wall with 3-off M4 x 8mm zinc hollow wall anchors. The gap between the collar and the pipe was filled up with BOSS FireMastic-HPE on both the exposed and the unexposed side.
<b>SERVICE 5</b>		
27	<b>Service</b>	
	<b>Item name</b>	20mm PP-R pipe
	<b>Core hole size</b>	Ø32mm
	<b>Annular gap</b>	6mm

Item	Description	
	<b>Installation</b>	The pipe was installed at the centre of the core hole with 6mm annular gap. The pipe protruded 500mm from the exposed side and 2000mm from the unexposed side of the wall system. The pipe was supported at 500mm and 1500mm away from the unexposed side of the wall system. The pipe was sealed on the exposed side only.
	<b>Penetration Protection</b>	
	<b>Product Name</b>	BOSS 32mm MaxiCollar™ BOSS FireMastic-HPE
	<b>Mastic depth</b>	25mm (full depth of the collar)
	<b>Installation</b>	The Maxi collar was installed on both the exposed side and the unexposed side of the wall system. The MaxiCollar™ was fixed to the wall with 3-off M4 x 8mm zinc hollow wall anchors. The gap between the collar and the pipe was filled up with BOSS FireMastic-HPE on both the exposed and the unexposed side.
<b>SERVICE 6</b>		
28	<b>Service</b>	
	<b>Item name</b>	40mm uPVC pipe
	<b>Core hole size</b>	Ø50mm
	<b>Annular gap</b>	3.8mm
	<b>Installation</b>	The pipe was installed at the centre of the core hole with 3.8mm annular gap. The pipe protruded 500mm from the exposed side and 2000mm from the unexposed side of the wall system. The pipe was supported at 500mm and 1500mm away from the unexposed side of the wall system. The pipe was sealed on the exposed side only.
	<b>Penetration Protection</b>	
	<b>Product Name</b>	BOSS 40mm MaxiCollar™
	<b>Installation</b>	The Maxi collar was installed on both the exposed side and the unexposed side of the wall system. The MaxiCollar™ was fixed to the wall with 3-off M4 x 8mm zinc hollow wall anchors.
<b>SERVICE 7</b>		
29	<b>Service</b>	
	<b>Item name</b>	50mm uPVC pipe
	<b>Core hole size</b>	Ø65mm
	<b>Annular gap</b>	5mm
	<b>Installation</b>	The pipe was installed at the centre of the core hole with 5mm annular gap. The pipe protruded 500mm from the exposed side and 2000mm from the unexposed side of the wall system. The pipe was supported at 500mm and 1500mm away from the unexposed side of the wall system. The pipe was sealed on the exposed side only.
	<b>Penetration Protection</b>	
	<b>Product Name</b>	BOSS 50mm MaxiCollar™ BOSS FireMastic 300

Item	Description	
	<b>Mastic depth</b>	25mm (Full depth of the collar)
	<b>Installation</b>	The Maxi collar was installed on both the exposed side and the unexposed side of the wall system. The MaxiCollar™ was fixed to the wall with 3-off M4 x 8mm zinc hollow wall anchors. The gap between the collar and the pipe was filled up with BOSS FireMastic 300 on both the exposed and the unexposed side.
<b>SERVICE 8</b>		
30	<b>Service</b>	
	<b>Item name</b>	50mm CPVC pipe
	<b>Core hole size</b>	Ø65mm
	<b>Annular gap</b>	2.5mm
	<b>Installation</b>	The pipe was installed at the centre of the core hole with 2.5mm annular gap. The pipe protruded 500mm from the exposed side and 2000mm from the unexposed side of the wall system. The pipe was supported at 500mm and 1500mm away from the unexposed side of the wall system. The pipe was sealed on the exposed side only.
	<b>Penetration Protection</b>	
	<b>Product Name</b>	BOSS 50mm MaxiCollar™
	<b>Installation</b>	The Maxi collar was installed on both the exposed side and the unexposed side of the wall system. The MaxiCollar™ was fixed to the wall with 3-off M4 x 8mm zinc hollow wall anchors.
<b>SERVICE 9</b>		
31	<b>Service</b>	
	<b>Item name</b>	16mm PEX pipe
	<b>Core hole size</b>	Ø20mm
	<b>Annular gap</b>	2mm
	<b>Installation</b>	The pipe was installed at the centre of the core hole with 2mm annular gap. The pipe protruded 500mm from the exposed side and 2000mm from the unexposed side of the wall system. The pipe was supported at 500mm and 1500mm away from the unexposed side of the wall system. The pipe was sealed on the exposed side only.
	<b>Penetration Protection</b>	
	<b>Product Name</b>	BOSS PenoPatch
	<b>Installation</b>	The BOSS PenoPatch was applied on the surface of the wall system around the pipe on both the exposed and the unexposed side.
<b>SERVICE 10</b>		
32	<b>Service</b>	
	<b>Item name</b>	Bundle of CAT 6 cables
	<b>No. of cable</b>	5 cables held together using electrical tape
	<b>Core hole size</b>	Ø20mm
	<b>Annular gap</b>	Approximately 5mm

Item	Description	
	<b>Installation</b>	The bundle of cables was installed at the centre of the core hole with approximately 5mm annular gap The bundle of cables protruded 500mm from the exposed side and 500mm from the unexposed side of the wall system. The bundle of cables was supported at 400mm away from the unexposed side of the wall system.
	<b>Penetration Protection</b>	
	<b>Product Name</b>	BOSS PenoPatch
	<b>Installation</b>	The BOSS PenoPatch was applied on the surface of the wall system around the bundle of cables on both the exposed and the unexposed side.
<b>SERVICE 11</b>		
33	<b>Service</b>	
	<b>Item name</b>	Bundle of TPS cable
	<b>No. of cable</b>	3 cables held together using electrical tape
	<b>Core hole size</b>	Ø25mm
	<b>Annular gap</b>	Approximately 5mm
	<b>Installation</b>	The bundle of cables was installed at the centre of the core hole with approximately 5mm annular gap The bundle of cables protruded 500mm from the exposed side and 500mm from the unexposed side of the wall system. The bundle of cables was supported at 400mm away from the unexposed side of the wall system.
	<b>Penetration Protection</b>	
	<b>Product Name</b>	BOSS PenoPatch™
	<b>Installation</b>	The BOSS PenoPatch was applied on the surface of the wall system around the bundle of cables on both the exposed and the unexposed side.
<b>SERVICE 12</b>		
34	<b>Service</b>	
	<b>Item name</b>	80mm uPVC pipe
	<b>Core hole size</b>	Ø90mm
	<b>Annular gap</b>	4mm
	<b>Installation</b>	The pipe was installed at the centre of the core hole with 4mm annular gap. The pipe protruded 500mm from the exposed side and 2000mm from the unexposed side of the wall system. The pipe was supported at 500mm and 1500mm away from the unexposed side of the wall system. The pipe was capped on the exposed side only.
	<b>Penetration Protection</b>	
	<b>Product Name</b>	BOSS 80mm MaxiCollar™
	<b>Installation</b>	The Maxi collar was installed on both the exposed side and the unexposed side of the wall system. The MaxiCollar™ was fixed to the wall with 3-off M4 × 8mm zinc hollow wall anchors.
<b>SERVICE 13</b>		
35	<b>Service</b>	

Item	Description	
	<b>Item name</b>	32mm PP-R pipe
	<b>Core hole size</b>	Ø38mm
	<b>Annular gap</b>	3mm
	<b>Installation</b>	The pipe was installed at the centre of the core hole with 3mm annular gap. The pipe protruded 500mm from the exposed side and 2000mm from the unexposed side of the wall system. The pipe was supported at 500mm and 1500mm away from the unexposed side of the wall system. The pipe was sealed on the exposed side only.
	<b>Penetration Protection</b>	
	<b>Product Name</b>	BOSS 32mm MaxiCollar™ BOSS FireMastic-HPE
	<b>Mastic depth</b>	25mm (Full depth of the collar)
	<b>Installation</b>	The Maxi collar was installed on both the exposed side and the unexposed side of the wall system. The MaxiCollar™ was fixed to the wall with 3-off M4 x 8mm zinc hollow wall anchors. The gap between the collar and the pipe was filled up with BOSS FireMastic-HPE on both the exposed and the unexposed side.

### **3 TEST PROCEDURE**

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#### **STATEMENT OF COMPLIANCE**

The test was performed in accordance with the requirements of AS1530.4-2014 Sections 2 & 10 as subject to the variations below.

#### **VARIATIONS TO TEST METHOD**

None

#### **PRE-TEST CONDITIONING**

The construction of the specimen was finished on the 05 July 2018 and was tested on 12 July 2018. During this period, the test specimen was subject to normal laboratory temperatures and relative humidity conditions.

#### **SAMPLING / SPECIMEN SELECTION**

The laboratory was not involved in the sampling or selection of the test specimen for the fire resistance test.

#### **AMBIENT TEMPERATURE**

The ambient temperature at the start of the test was 11°C and did not vary significantly during the test.

#### **TEST DURATION**

The test duration was 61 minutes.

#### **INSTRUMENTATION AND EQUIPMENT**

The instrumentation was provided in accordance with AS 1530.4-2014 and as detailed below:

The furnace temperature was measured by 4-off mineral insulated metal sheathed Type K thermocouples with wire diameters not greater than 1mm and overall diameter of 3mm with the measuring junction insulated from the sheath. The thermocouples protruded a minimum of 25mm from steel supporting tubes.

The non-fire side specimen temperatures were measured by Type K thermocouples with wire diameters less than 0.5mm soldered to 12mm diameter x 0.2mm thick copper discs covered by 30mm x 30mm x 2.0 mm inorganic insulating pads. The thermocouple positions are described in Table A4.1, and are shown on Figure A4.1 in Appendix 4.

A roving thermocouple was available to measure temperatures at positions that appeared hotter than the positions monitored by the fixed thermocouples.

The furnace pressure was measured at approximately 120mm above the centre of the lowest penetration service.

Cotton pads were available during the test to assess the performance under the criteria for integrity.



## 4 TEST MEASUREMENTS

### FURNACE TEMPERATURE AND PRESSURE MEASUREMENTS

Furnace temperature and pressure data are provided in Figure A5.1 and Table A5.1 in Appendix 5.

### SPECIMEN TEMPERATURES

Specimen temperature data is provided in Figure A5.2 to Figure A5.19 and Table A5.2 in Appendix 5.

### OBSERVATIONS

A table that includes observations of the significant behaviour of the specimen and details of the occurrence of the various performance criteria specified in AS 1530.4-2014 is provided in Appendix 2. Photographs of the specimen are included in Appendix 6.

## 5 TEST RESULTS

The specimen tested achieved the following performance with respect to the performance criteria listed in AS 1530.4-2014, Section 2 & 10.

Service	Criteria	Result
1	Structural Adequacy	-
	Integrity	No failure at 61 minutes
	Insulation	Failure at 45 minutes
	<b>FRL</b>	<b>-/60/30</b>
2	Structural Adequacy	-
	Integrity	No failure at 61 minutes
	Insulation	No failure at 61 minutes
	<b>FRL</b>	<b>-/60/60</b>
3	Structural Adequacy	-
	Integrity	No failure at 61 minutes
	Insulation	Failure at 47 minutes
	<b>FRL</b>	<b>-/60/30</b>
4	Structural Adequacy	-
	Integrity	No failure at 61 minutes
	Insulation	Failure at 41 minutes
	<b>FRL</b>	<b>-/60/30</b>
5	Structural Adequacy	-
	Integrity	No failure at 61 minutes
	Insulation	No failure at 61 minutes
	<b>FRL</b>	<b>-/60/60</b>
6	Structural Adequacy	-
	Integrity	No failure at 61 minutes
	Insulation	No failure at 61 minutes
	<b>FRL</b>	<b>-/60/60</b>
7	Structural Adequacy	-
	Integrity	No failure at 61 minutes

Service	Criteria	Result
	Insulation	No failure at 61 minutes
	<b>FRL</b>	<b>-/60/60</b>
8	Structural Adequacy	-
	Integrity	No failure at 61 minutes
	Insulation	Failure at 54 minutes
	<b>FRL</b>	<b>-/60/30</b>
9	Structural Adequacy	-
	Integrity	No failure at 61 minutes
	Insulation	No failure at 61 minutes
	<b>FRL</b>	<b>-/60/60</b>
10	Structural Adequacy	-
	Integrity	No failure at 61 minutes
	Insulation	Failure at 31 minutes
	<b>FRL</b>	<b>-/60/30</b>
11	Structural Adequacy	-
	Integrity	No failure at 61 minutes
	Insulation	No failure at 61 minutes
	<b>FRL</b>	<b>-/60/60</b>
12	Structural Adequacy	-
	Integrity	No failure at 61 minutes
	Insulation	No failure at 61 minutes
	<b>FRL</b>	<b>-/60/60</b>
13	Structural Adequacy	-
	Integrity	No failure at 61 minutes
	Insulation	No failure at 61 minutes
	<b>FRL</b>	<b>-/60/60</b>

## **6 APPLICATION OF TEST RESULTS**

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### **TEST LIMITATIONS**

The results of this fire test may be used to directly assess fire hazard, but it should be recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions. The results only relate to the behaviour of the specimen of the element of the construction under the particular conditions of the test; they are not intended to be the sole criteria for assessing the potential fire performance of the element in use nor do they necessarily reflect the actual behaviour in fires.

### **VARIATIONS FROM THE TESTED SPECIMENS**

This report details the methods of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the general procedure outlined in AS1530.4. Any significant variation with respect to size, constructional details, loads, stresses, edge or end conditions, other than those allowed under the field of direct application in the relevant test method, is not addressed by this report. It is recommended that any proposed variation to the tested configuration should be referred to the test sponsor in the first instance to obtain appropriate documentary evidence of compliance from Exova Warringtonfire Aus Pty Ltd or another Registered Testing Authority.

### **UNCERTAINTY OF MEASUREMENT**

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

## APPENDIX 1 DRAWINGS OF TEST ASSEMBLY

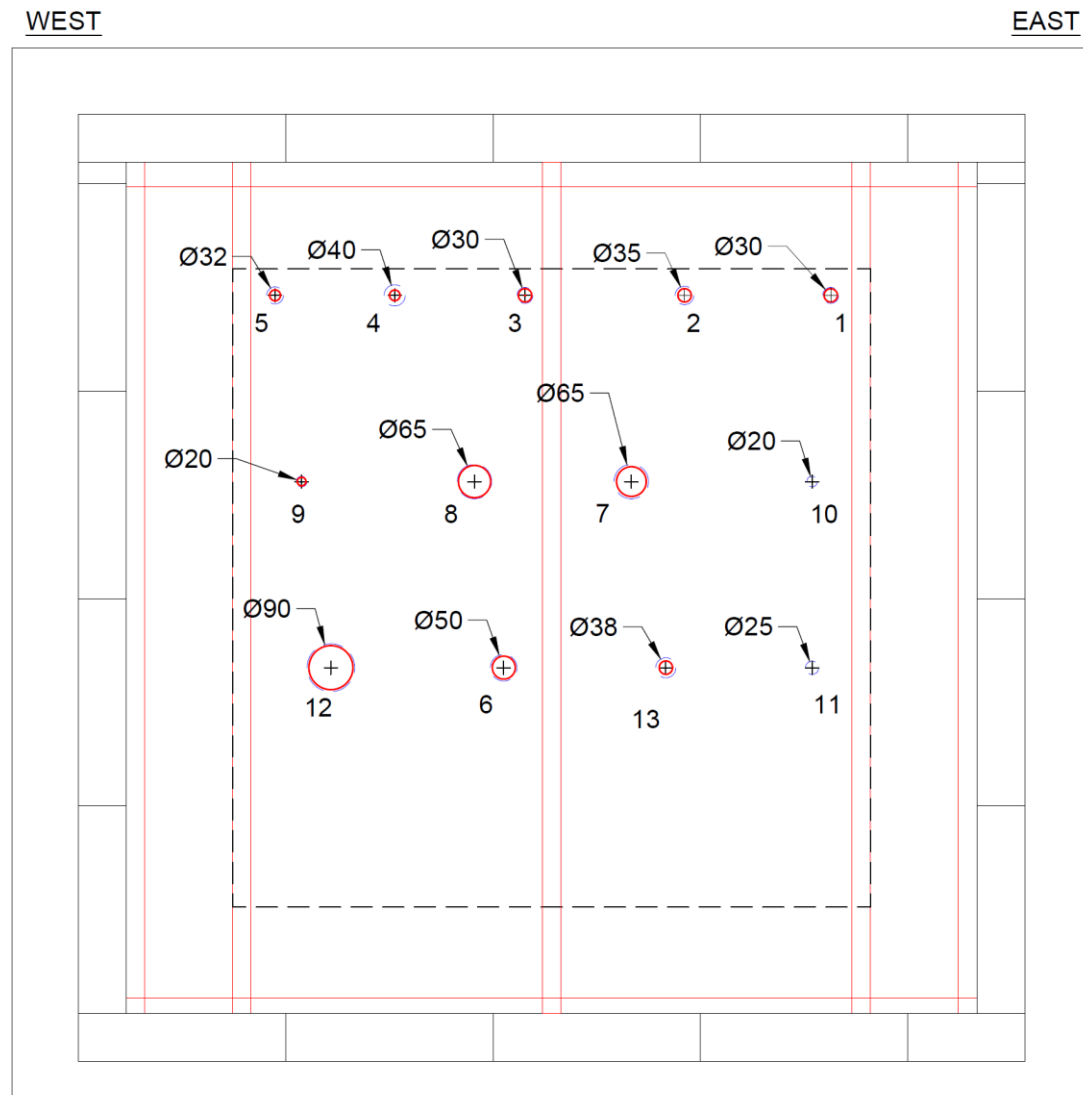


Figure A1.1: Elevation of Test Specimen (core hole)

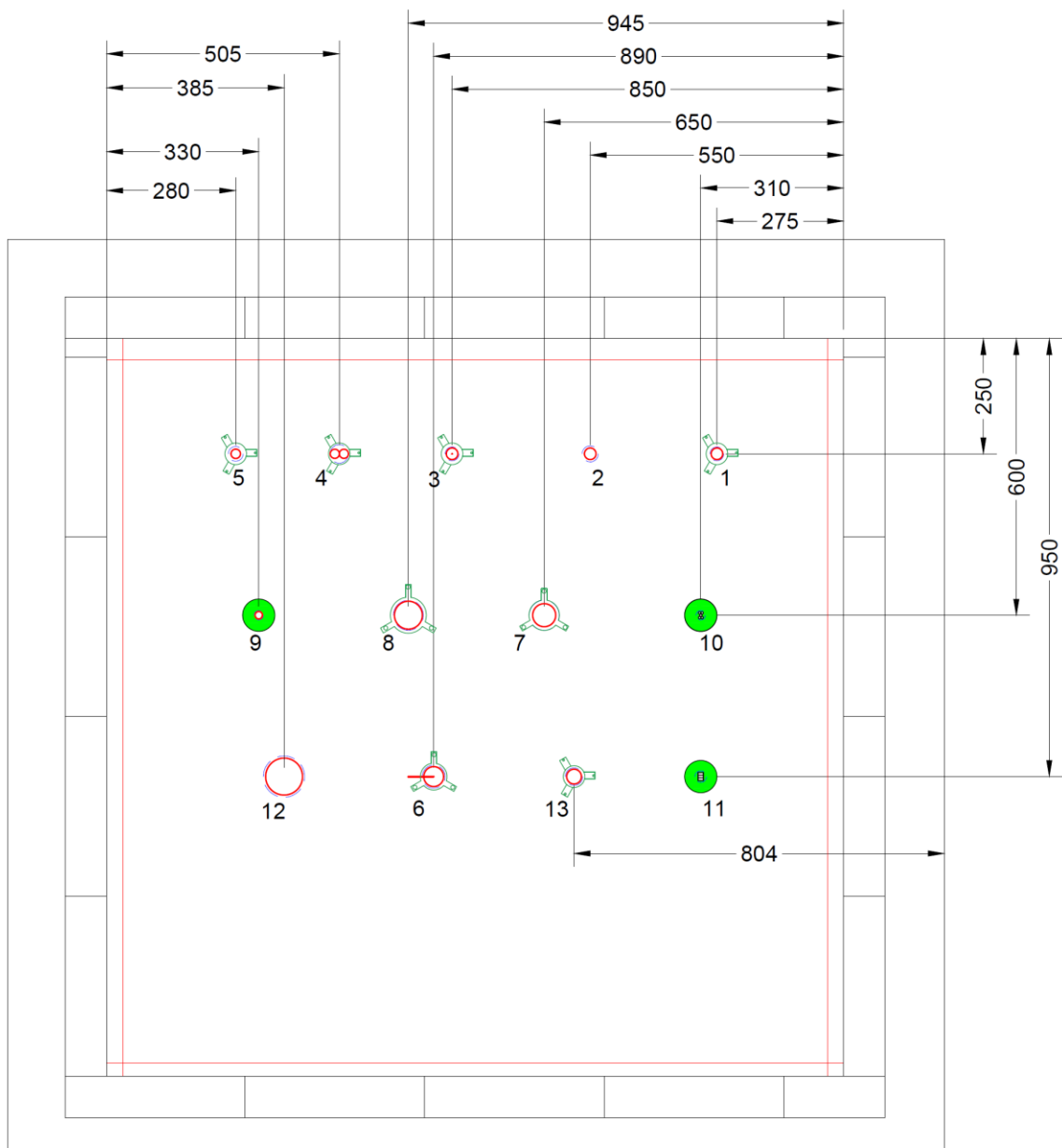


Figure A1.2: Elevation of Test Specimen Unexposed side

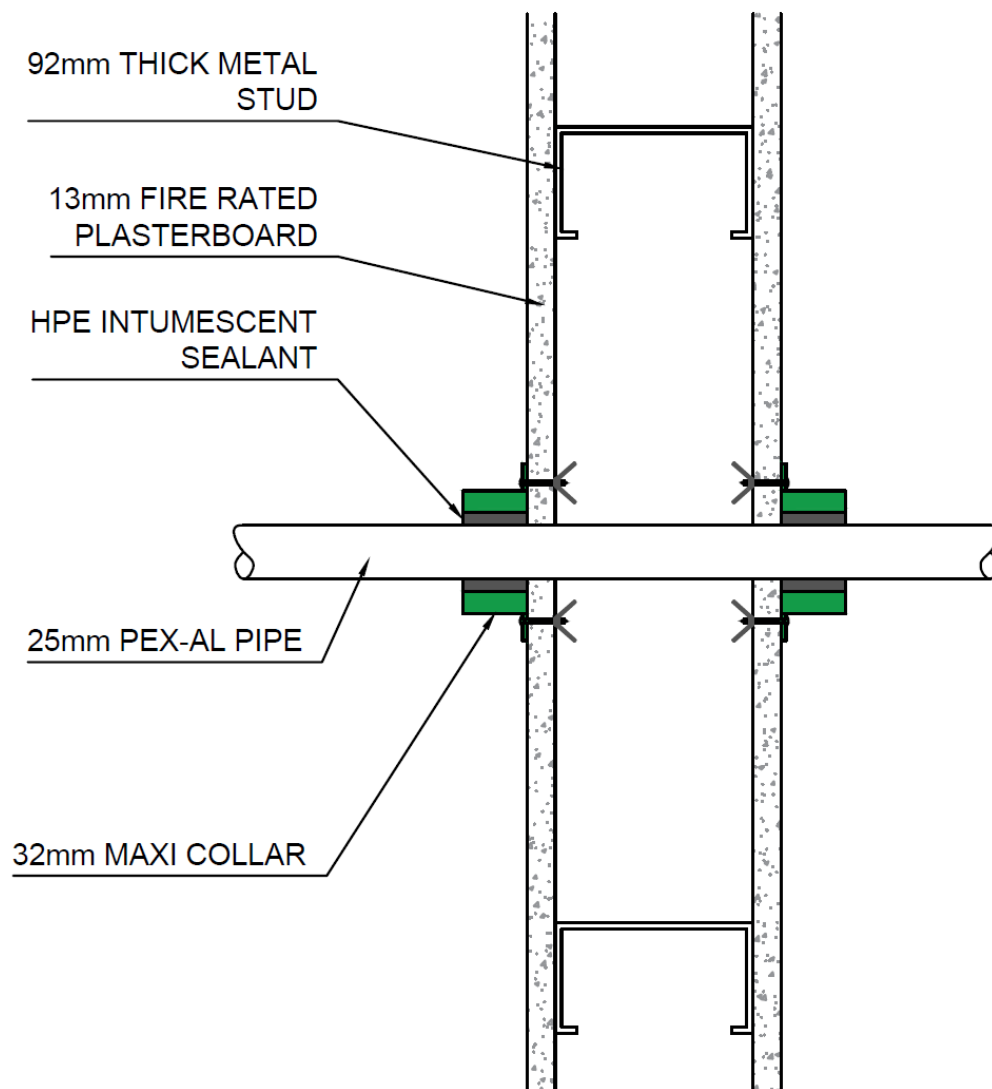


Figure A1.3: Vertical Cross section (Specimen 1)

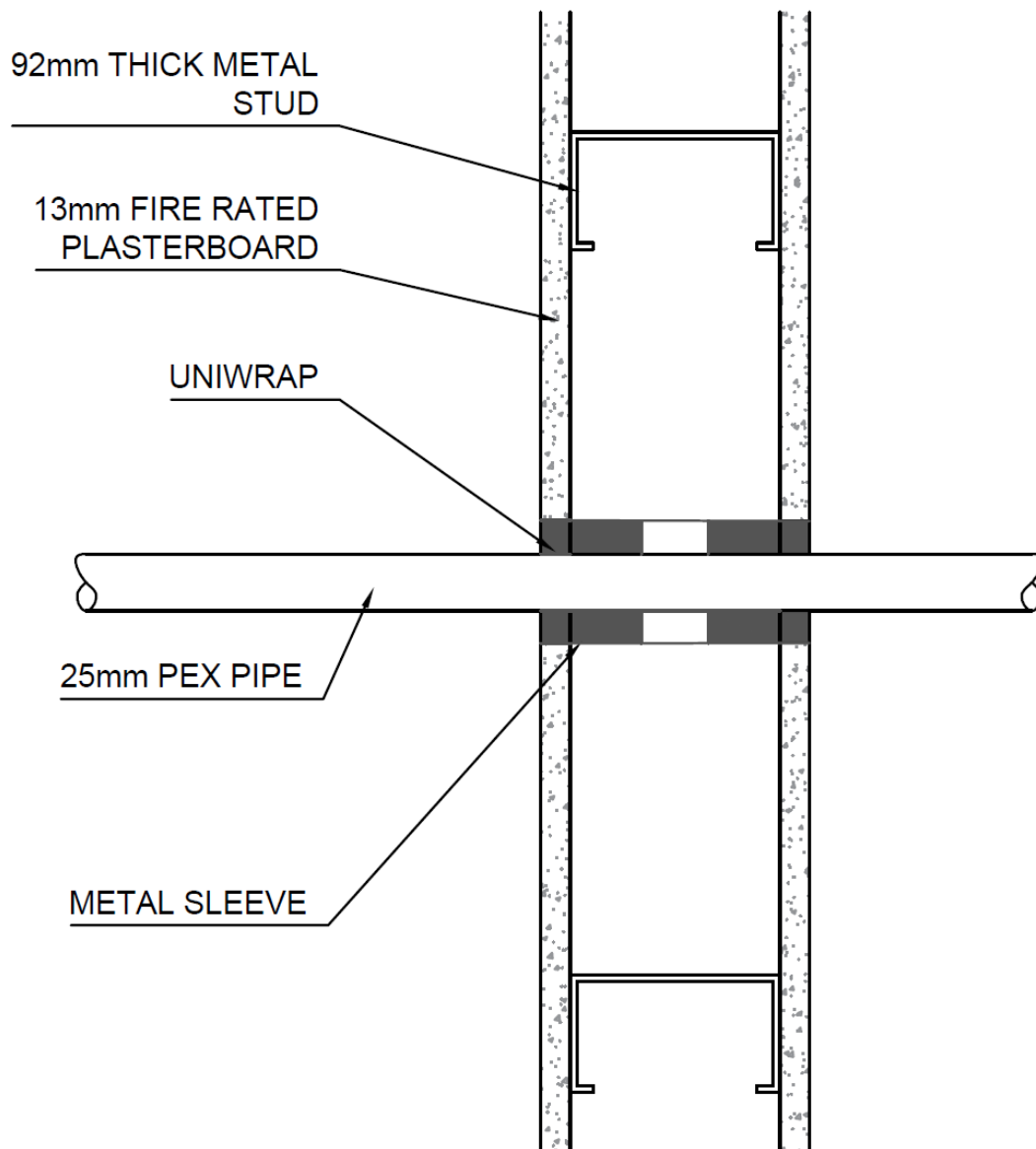


Figure A1.4: Vertical Cross section (Specimen 2)

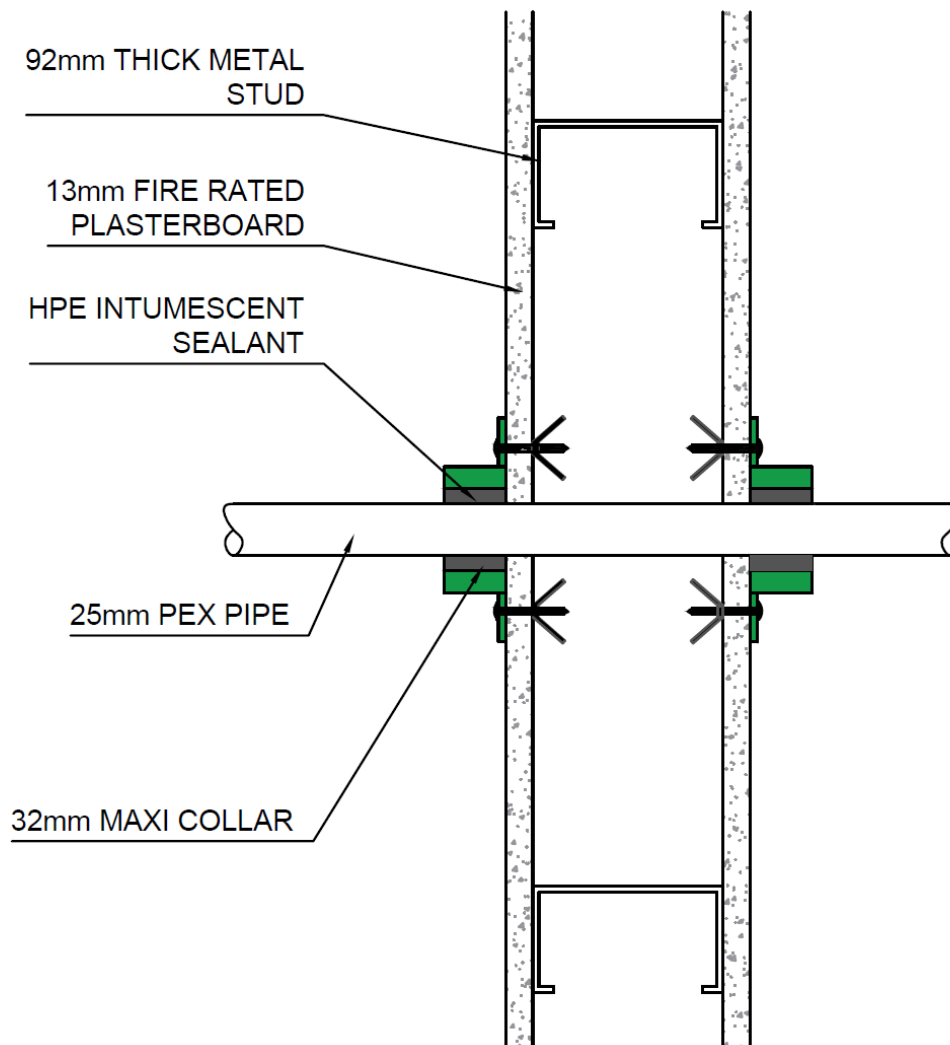


Figure A1.5: Vertical Cross section (Specimen 3)



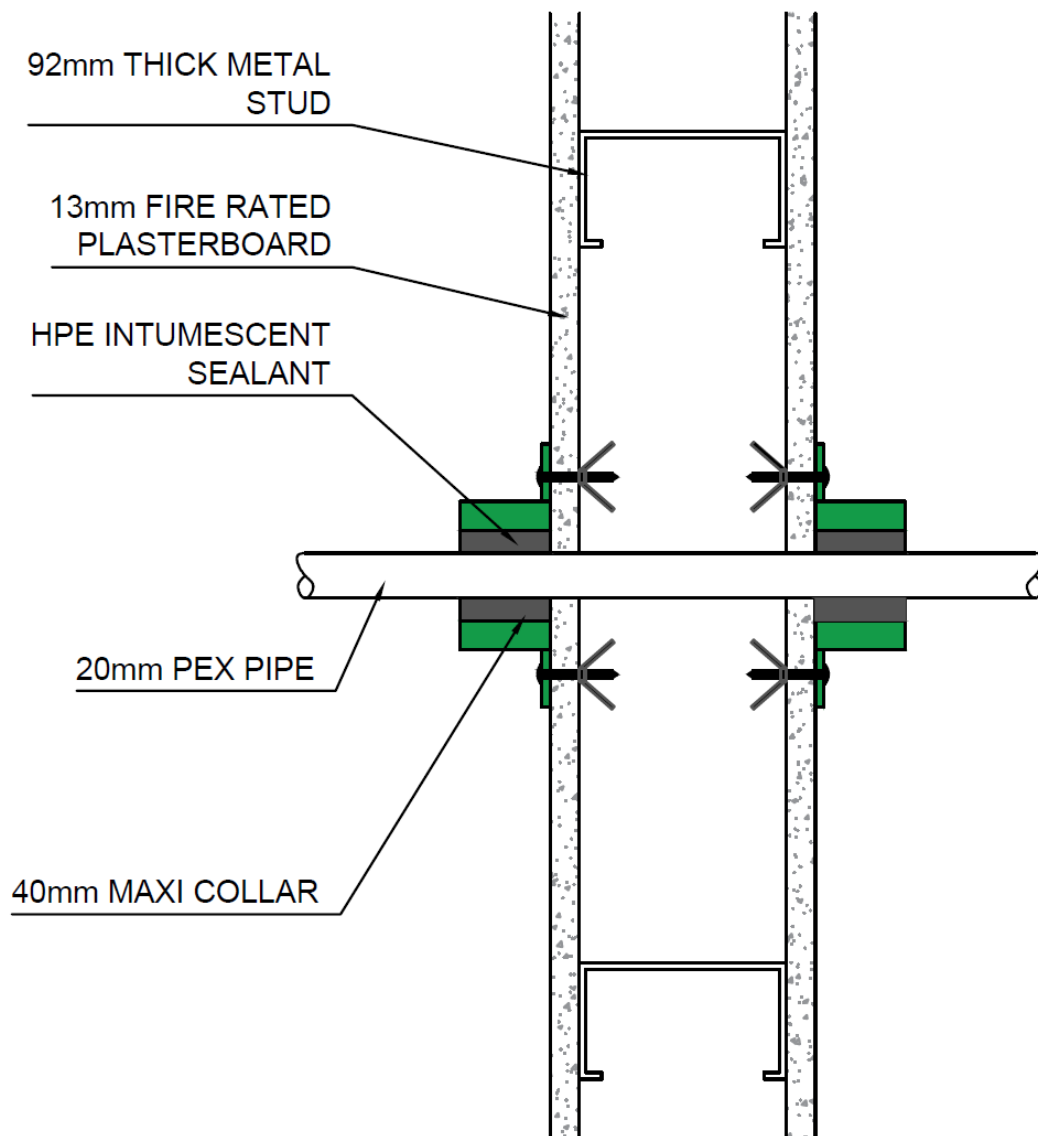


Figure A1.6: Vertical Cross section (Specimen 4)

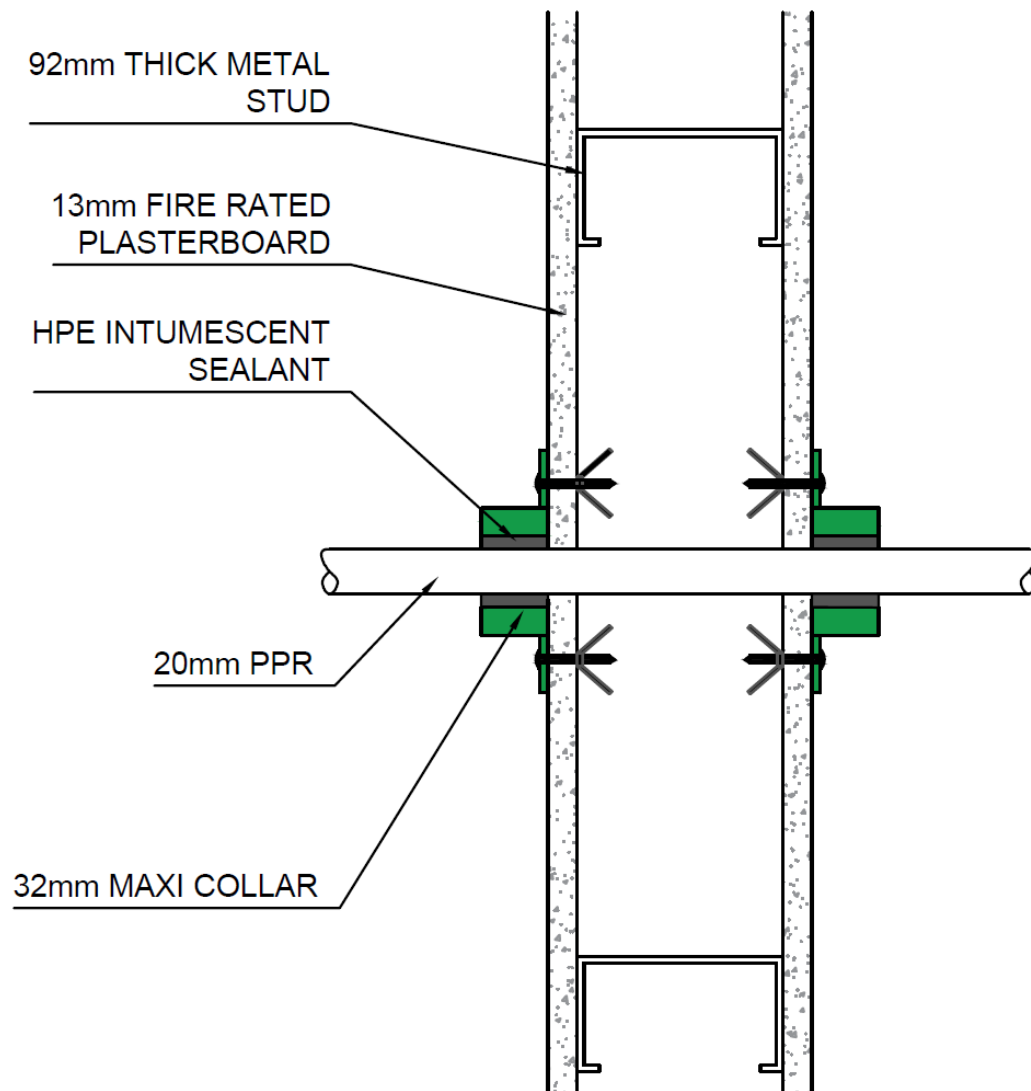


Figure A1.7: Vertical Cross section (Specimen 5)

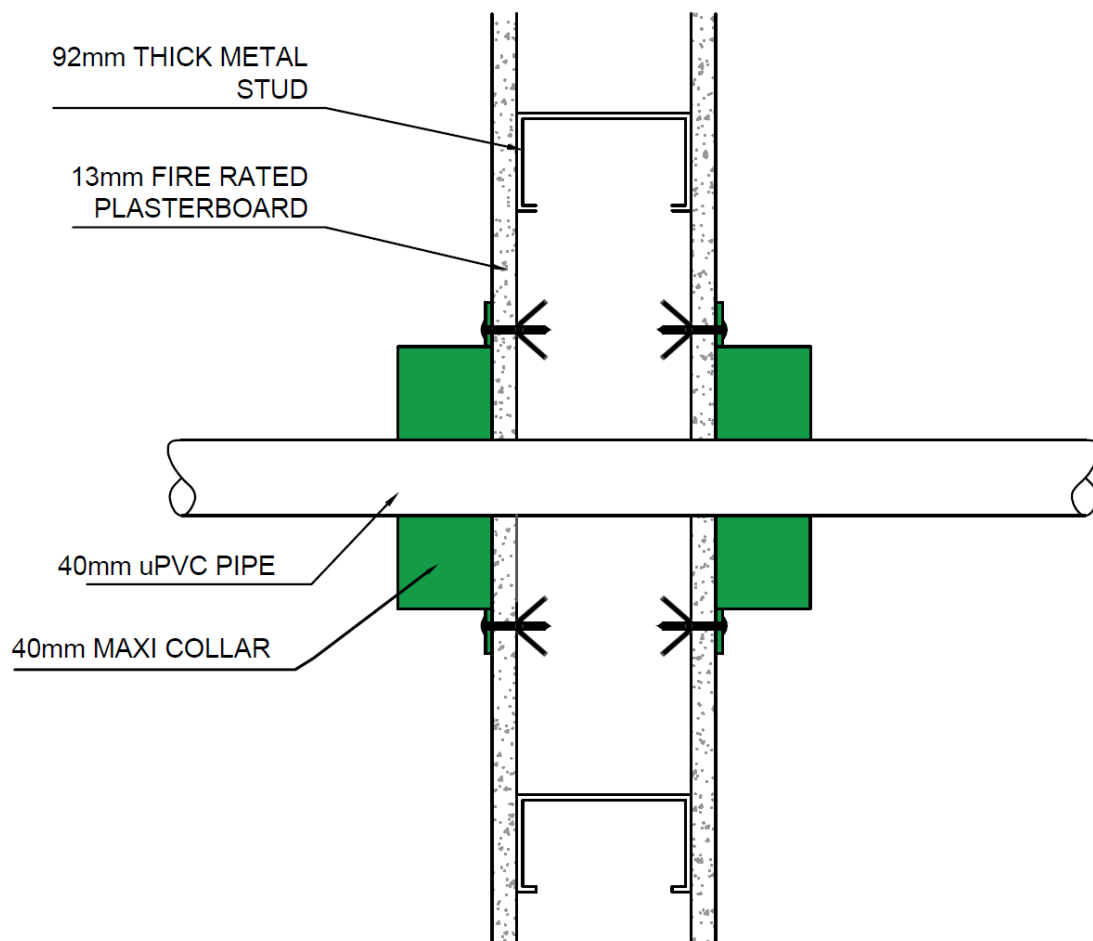


Figure A1.8: Vertical Cross section (Specimen 6)

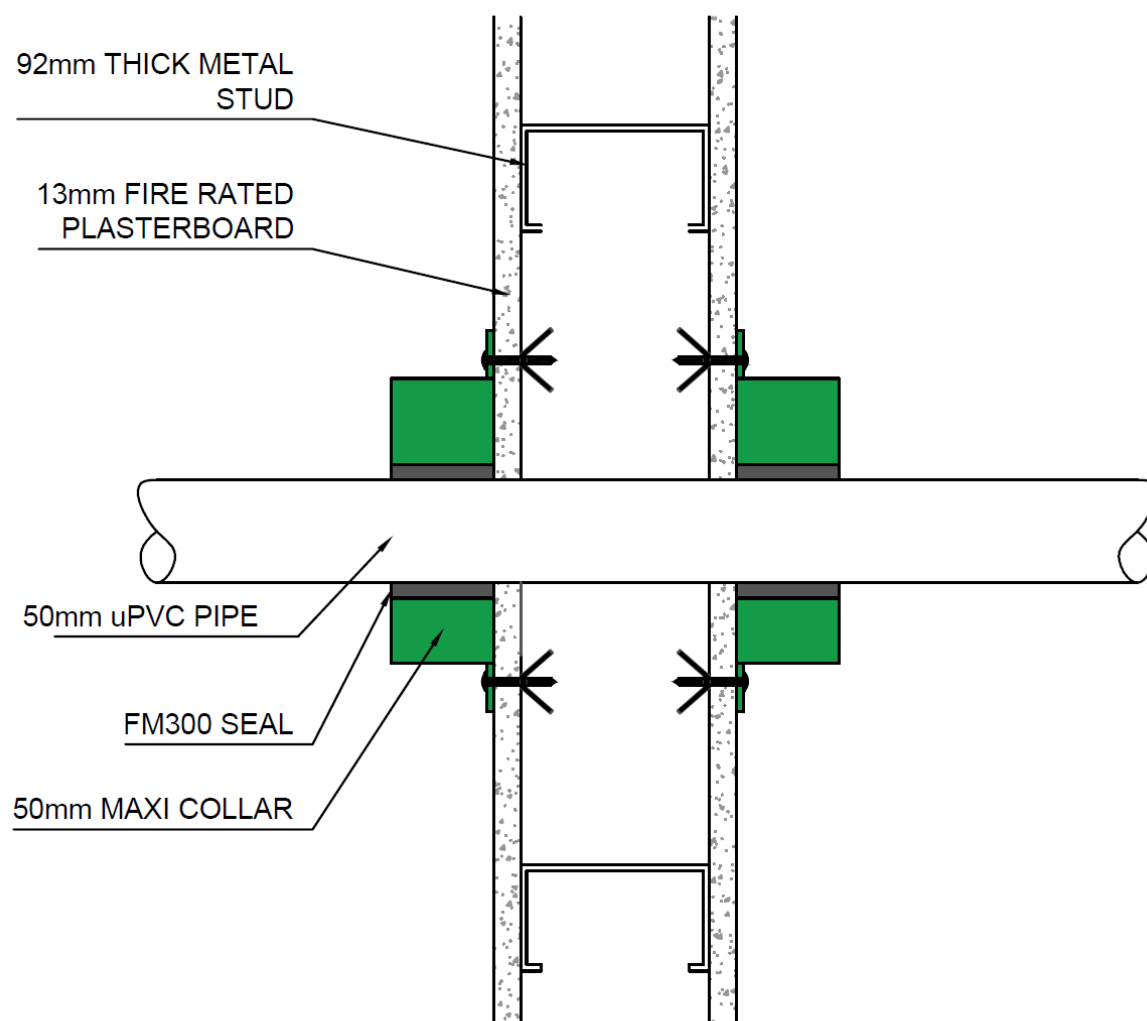


Figure A1.9: Vertical Cross section (Specimen 7)

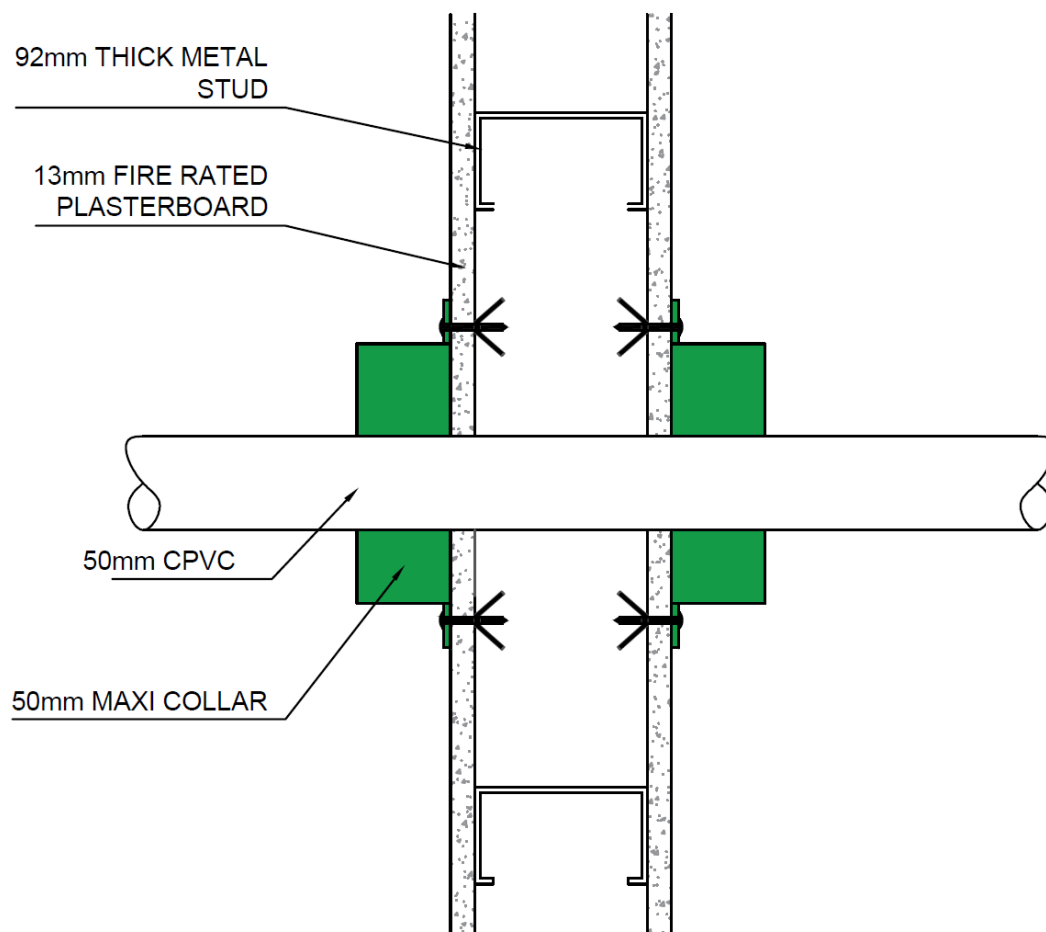


Figure A1.10: Vertical Cross section (Specimen 8)

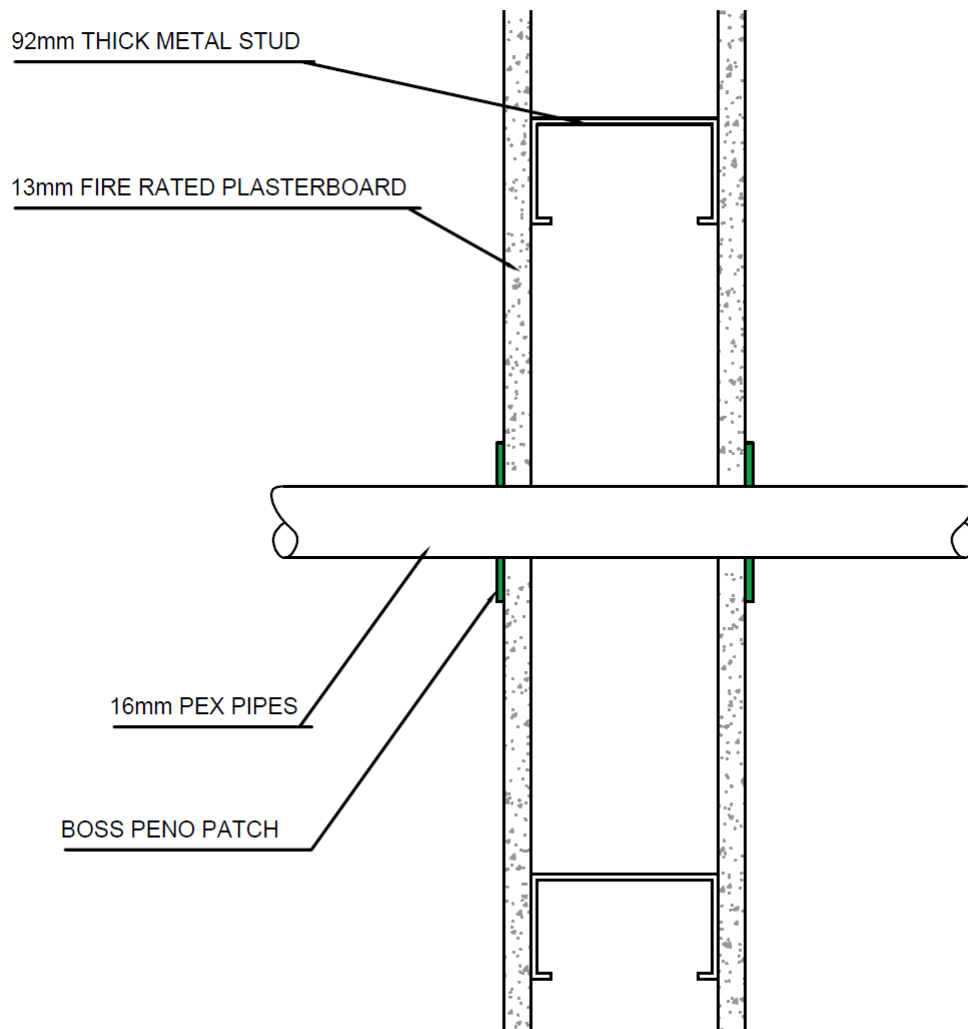


Figure A1.11: Vertical Cross section (Specimen 9)

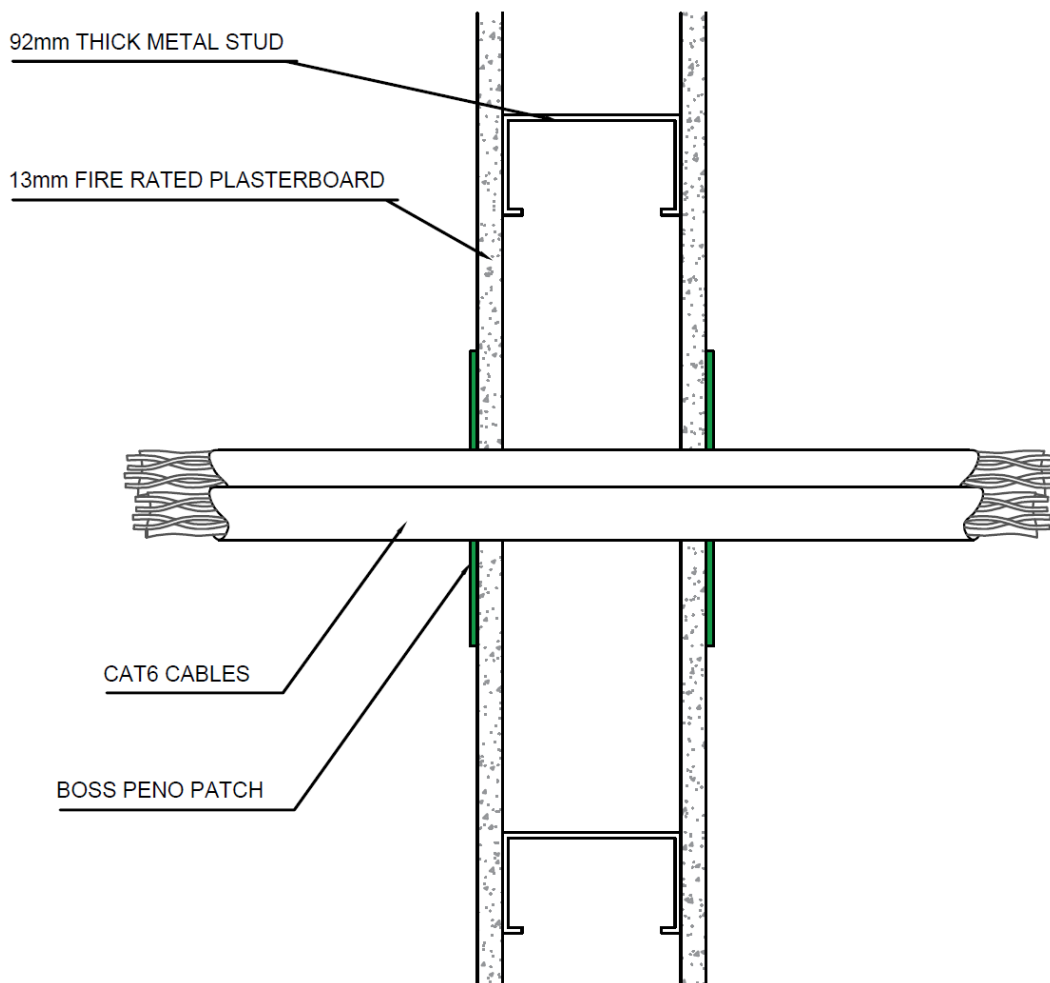


Figure A1.12: Vertical Cross section (Specimen 10)

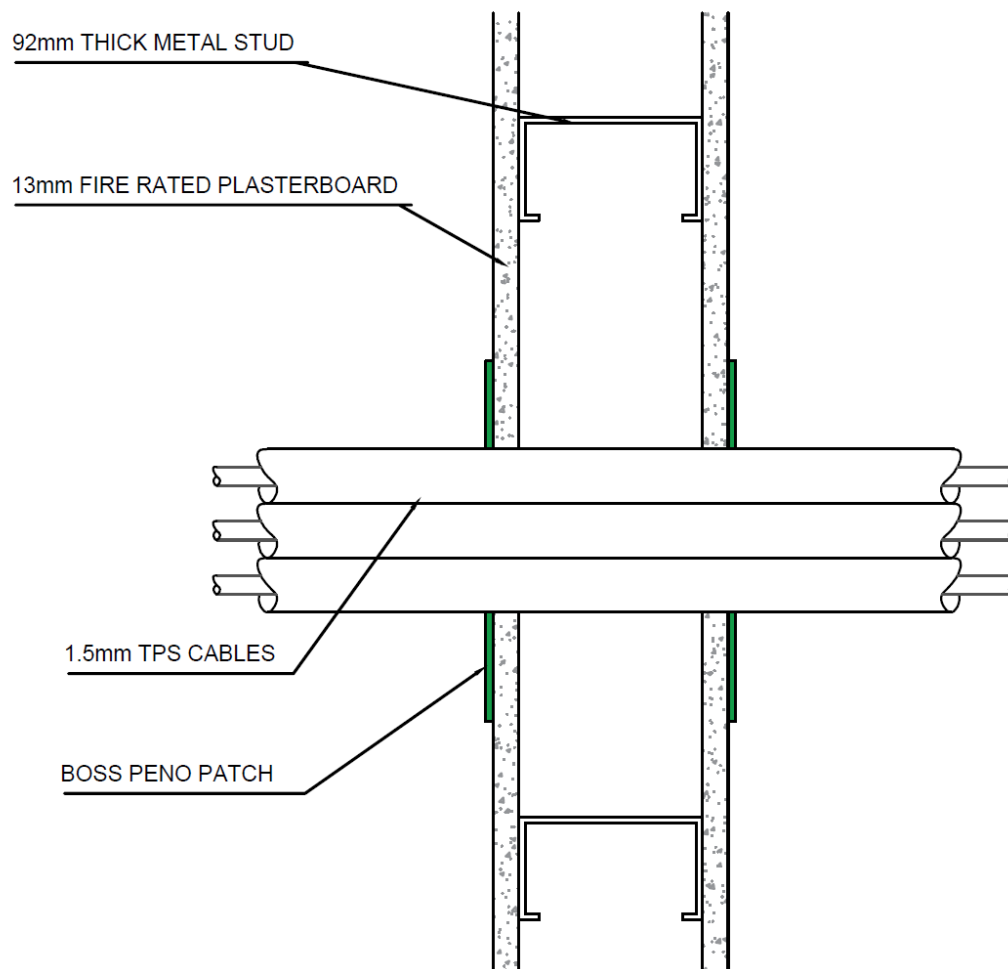


Figure A1.13: Vertical Cross section (Specimen 11)



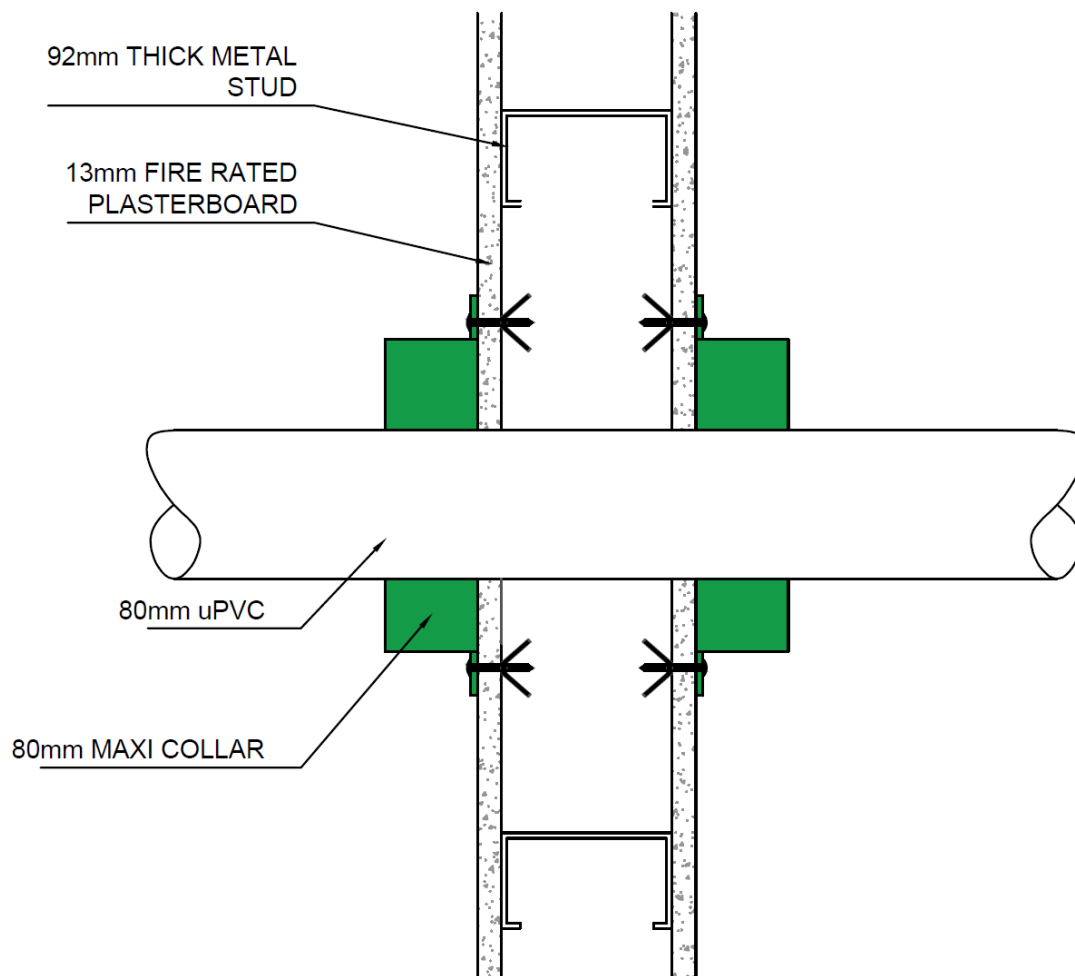


Figure A1.14: Vertical Cross section (Specimen 12)

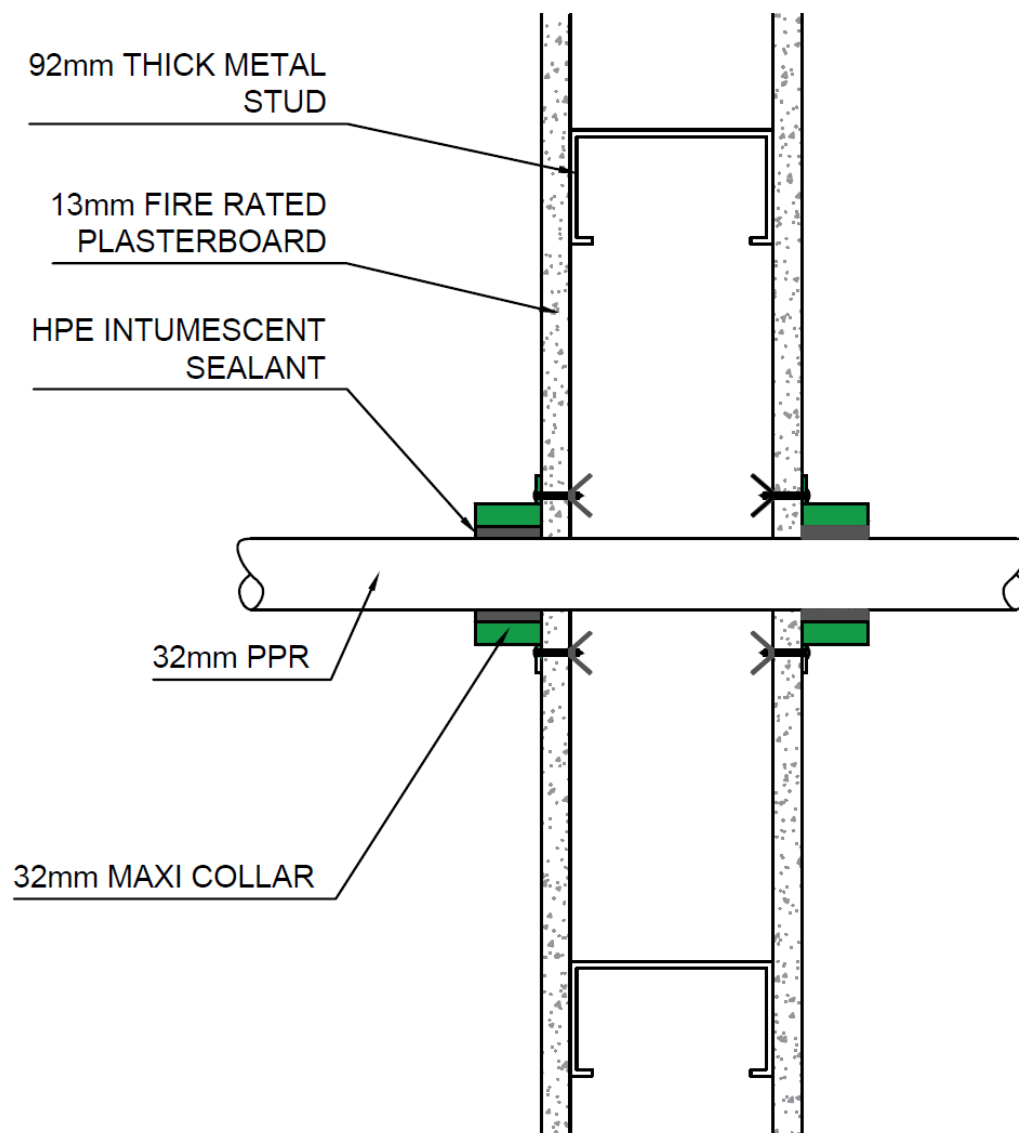


Figure A1.15: Vertical Cross-Section 13

## APPENDIX 2 TEST OBSERVATIONS

The following include observations of the significant behaviour of the specimen.

Time		Observation
min	sec	
Specimen 1		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
08	44	Fluid was dripping from the end of the pipe
12	49	Smoke venting from the end of the pipe
14	50	Smoke venting from the end of the pipe had stopped
18	09	Smoke emissions from pipe end restarted
20	00	Smoke venting from the end of the pipe had completed stopped
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
40	00	Smoke venting from the end of the pipe had restarted
45	45	<b>TC 011 located on the pipe, 25mm away from the collar recorded a temperature of 192°C.</b> <b>Failure of insulation in accordance with AS 1530.4-2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 011 exceeded the initial temperature by more than 180°C.</b>
53	29	The expanded intumescent was coming out from the collar
60	00	The specimen had continued to maintain integrity in accordance with AS 1530.4-2014
61	00	Test stopped at the request of the sponsor.
Specimen 2		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
03	28	Smoke venting from the end of the pipe
06	50	The sealant had sucked into the wall system. Smoke emissions appeared from the sealant.
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
61	00	Test stopped at the request of the sponsor.
Specimen 3		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
04	30	Smoke venting from the end of the pipe
06	50	The sealant had sucked into the wall system. Smoke emissions appeared from the sealant.
25	52	Smoke venting appeared from the end of the pipe.
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
47	55	<b>TC 021 located on the pipe, 25mm away from the collar recorded a temperature of 192°C.</b> <b>Failure of insulation in accordance with AS 1530.4-2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 021 exceeded the initial temperature by more than 180°C.</b>
54	30	Deformation appeared on the pipe near the wall
60	00	The specimen had continued to maintain integrity in accordance with AS 1530.4-2014

Time		Observation
min	sec	
61	00	Test stopped at the request of the sponsor.
<b>Specimen 4</b>		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
03	28	Smoke venting from the end of the pipe
08	18	Smoke venting from the end of the pipe had stopped
26	10	Smoke venting appeared from the end of both pipes.
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
38	40	Slight deformation appeared on the pipe near the wall
41	30	<b>TC 031 located on the pipe, 25mm away from the collar recorded a temperature of 192°C.</b> <b>Failure of insulation in accordance with AS 1530.4-2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 031 exceeded the initial temperature by more than 180°C.</b>
60	00	The specimen had continued to maintain integrity in accordance with AS 1530.4-2014
61	00	Test stopped at the request of the sponsor.
<b>Specimen 5</b>		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
61	00	Test stopped at the request of the sponsor.
<b>Specimen 6</b>		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
01	52	Smoke venting from the end of the pipe
07	50	Smoke venting had stopped
25	00	Smoke emission appeared from the end of the pipe and the collar
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
32	15	Yellow smoke was venting from the end of the pipe
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
61	00	Test stopped at the request of the sponsor.
<b>Specimen 7</b>		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
02	34	Smoke venting from the end of the pipe
02	50	Expanded intumescent was blown off from the end of the pipe
07	50	Smoke venting had stopped
14	30	Smoke emissions from the collar
28	25	Small volume of smoke venting from the end of the pipe had restarted
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014

Time		Observation
min	sec	
39	00	Discolouration appeared on the wall above the collar
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
61	00	Test stopped at the request of the sponsor.
<b>Specimen 8</b>		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
06	25	Smoke venting from the end of the pipe
07	50	Smoke venting had stopped
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
32	50	Smoke venting from the end of the pipe had restarted
42	28	Fluid was dripping from the end of the pipe
51	00	Discolouration appeared on the wall above the collar
52	50	Deformation appeared on the pipe near the wall.
54	50	<b>TC 103 located on the pipe, at the mid-height of the collar recorded a temperature of 191°C.</b> <b>Failure of insulation in accordance with AS 1530.4-2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 021 exceeded the initial temperature by more than 180°C.</b>
56	40	The pipe had detached from the collar.
60	00	The specimen had continued to maintain integrity in accordance with AS 1530.4-2014
61	00	Test stopped at the request of the sponsor.
<b>Specimen 9</b>		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
04	30	Smoke venting from the end of the pipe.
16	00	Fluid was dripping from the end of the pipe.
19	00	Smoke venting from the end of the pipe had stopped.
19	40	Deformation appeared on the pipe near the wall. Sealant had expanded out from the wall.
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
61	00	Test stopped at the request of the sponsor.
<b>Specimen 10</b>		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
01	30	Smoke emission appeared from the interface between the pipe and the penetration patch.
13	00	The sealant had expanded out from the core hole
15	15	Smoke emissions from the interface between cables and the wall.
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
31	25	<b>TC 047 located on the pipe, 25mm away from the collar recorded a temperature of 192°C.</b>

Time		Observation
min	sec	
		<b>Failure of insulation in accordance with AS 1530.4-2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 047 exceeded the initial temperature by more than 180°C.</b>
60	00	The specimen had continued to maintain integrity in accordance with AS 1530.4-2014
61	00	Test stopped at the request of the sponsor.
<b>Specimen 11</b>		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
13	00	The sealant had expanded out from the core hole.
21	00	Smoke emissions appeared from the collar
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
61	00	Test stopped at the request of the sponsor.
<b>Specimen 12</b>		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
02	34	Smoke venting from the end of the pipe
02	50	Expanded intumescent was blown off from the end of the pipe
07	50	Smoke venting had stopped
21	20	Small volume of smoke venting from the end of the pipe had restarted
24	45	The volume of smoke venting from the end of the pipe had increased
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
61	00	Test stopped at the request of the sponsor.
<b>Specimen 13</b>		
00	00	Fire resistance test commenced and the average initial temperature was approximately 11°C.
02	34	Smoke venting from the end of the pipe
07	50	Smoke venting had stopped
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
50	00	The sealant in the control joint had expanded
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
61	00	Test stopped at the request of the sponsor.

## APPENDIX 3 DIRECT FIELD OF APPLICATION

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### A 3.1 GENERAL

AS1530.4- 2014 indicates that the results of the fire test contained in the test report are directly applicable without reference to the testing authority to similar constructions where one or more of the changes have been made:

### A 3.2 SEPARATING ELEMENTS

Results obtained for sealing systems in various types of masonry and concrete construction may be applied as follows:

- a) For elements manufactured from similar types of concrete or masonry, the results of the prototype test may be applied to materials of density within  $\pm 15\%$  of the tested specimen. For greater variations, the opinion of a registered testing authority shall be obtained.
- b) Test results obtained in conjunction with hollow concrete blocks may be used in a solid concrete element of the same overall thickness. The reverse does not apply.
- c) Results obtained from framed wall systems may be applied to the performance of a system in concrete, masonry or solid gypsum blocks of greater or equal thickness to that of the tested prototype. The reverse does not apply.
- d) Results obtained from framed wall systems may be applied to similar walls having studs of the same material with sizes greater than the tested prototype.
- e) Results obtained from a prototype test may be applied to framed wall systems of similar construction but having thicker facings of the same material applied to the studs.

### A 3.3 PLASTIC PIPE

#### A 3.3.1 General

In addition to the requirements of AS 1530.4-2014 Clause 10.12.2, test results may be directly applied to masonry and concrete elements thicker than the tested prototype when installed in accordance with AS 1530.4-2014 Figure 10.12.5.1

Results obtained from a particular test shall not be applied to plastics pipes of different diameters, wall thicknesses or material types

Results obtained from tests on penetrations through vertical separating elements shall not be used to assess performance in horizontal elements, and vice versa.

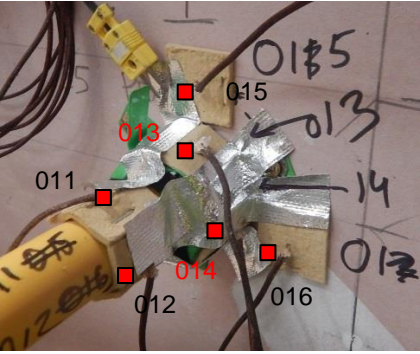
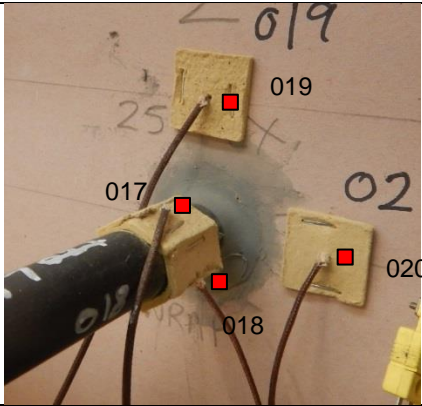
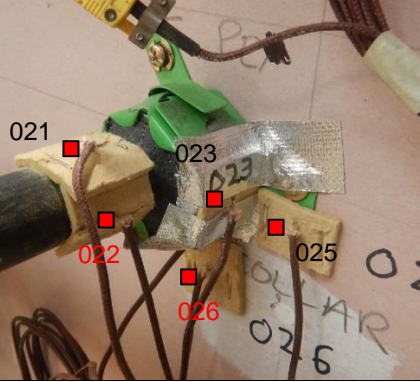
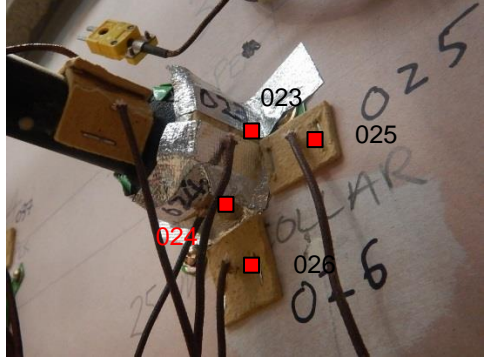
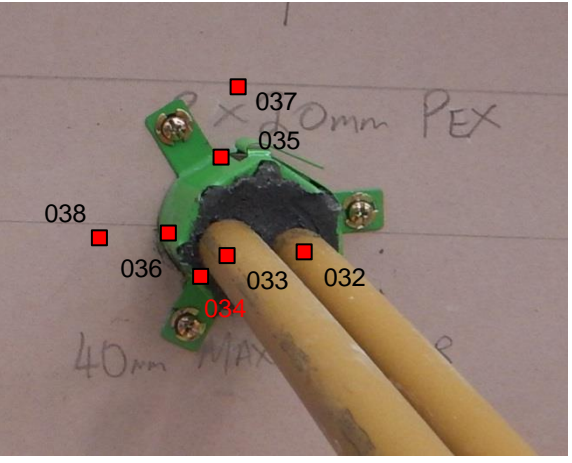
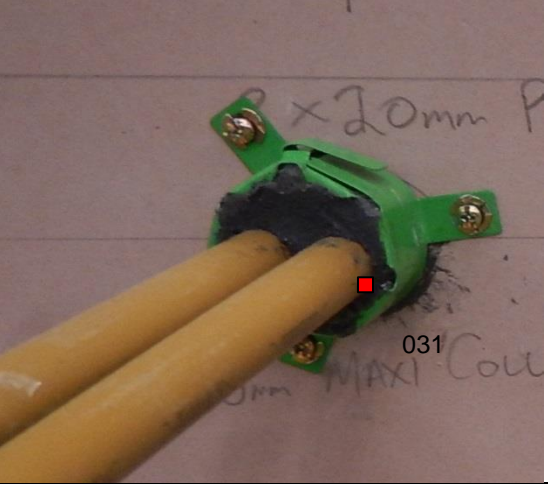
As penetration seals for plastics pipes are depend for activation upon exposure to fire conditions, they shall always be installed with the same orientation and fire exposure as was established in the fire resistance test.

#### A 3.3.2 Services not perpendicular to the fire separation

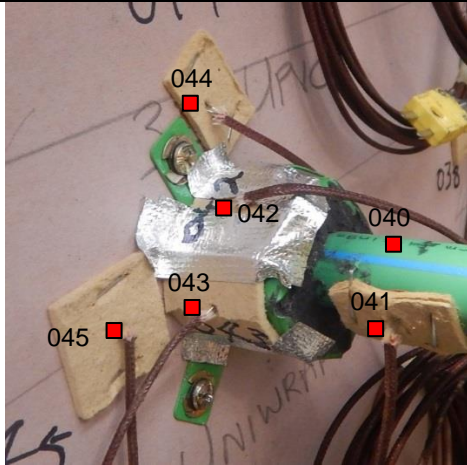
Penetrations not perpendicular to the plane of the element are acceptable, provided the fire-stopping system has similar exposure and dimensions to the tested prototype.



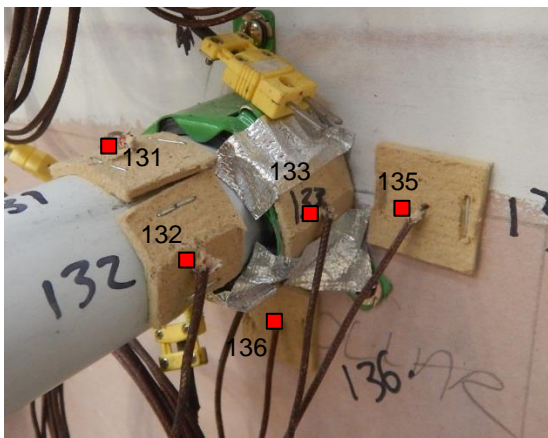
## APPENDIX 4 INSTRUMENTATION POSITIONS

	
Specimen 1	Specimen 2
	
Specimen 3	Specimen 3
	
Specimen 4	Specimen 4

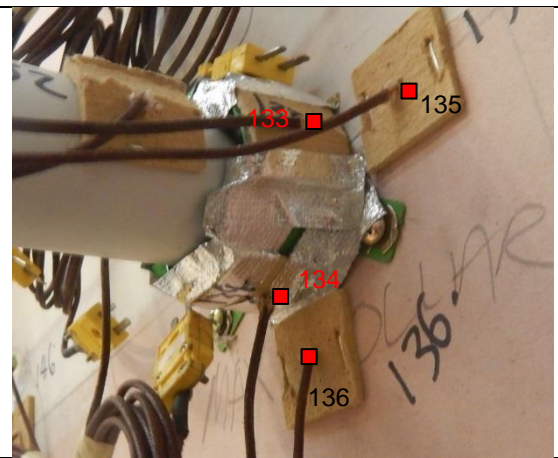




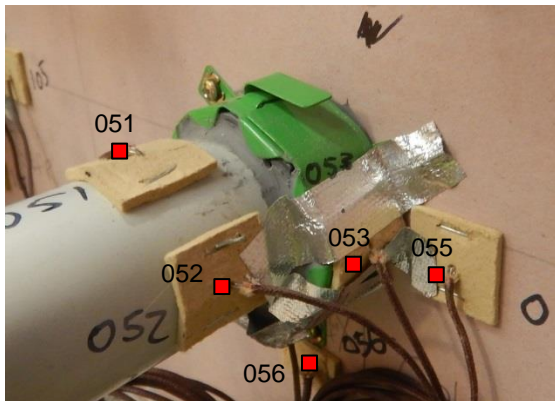
Specimen 5



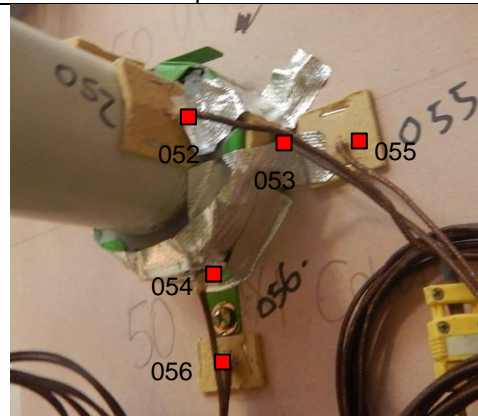
Specimen 6



Specimen 6



Specimen 7



Specimen 7

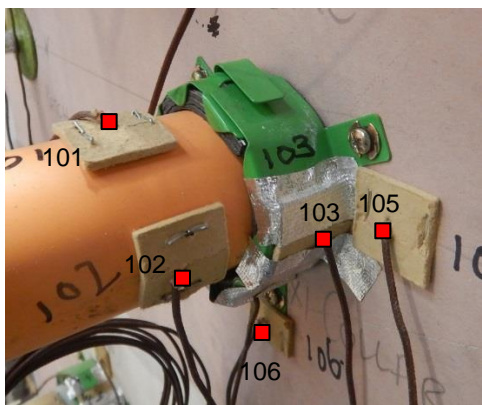
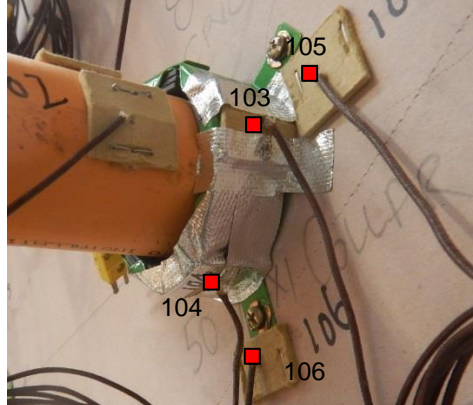
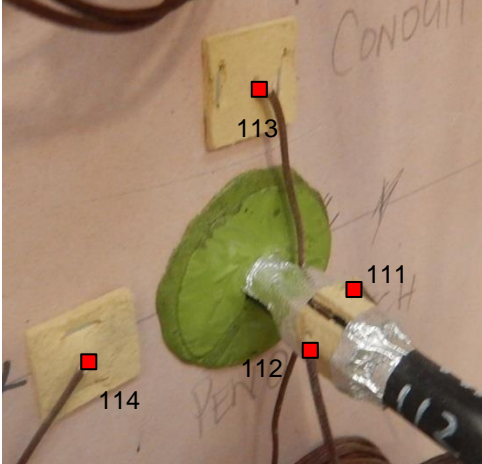
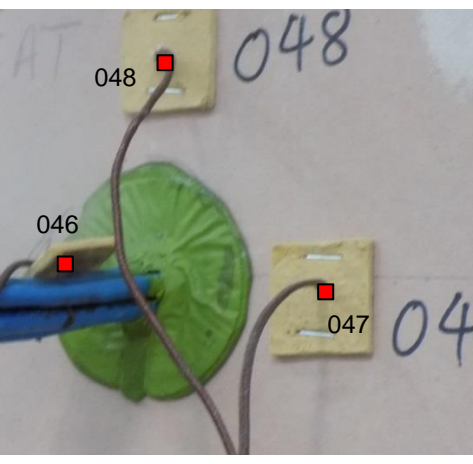
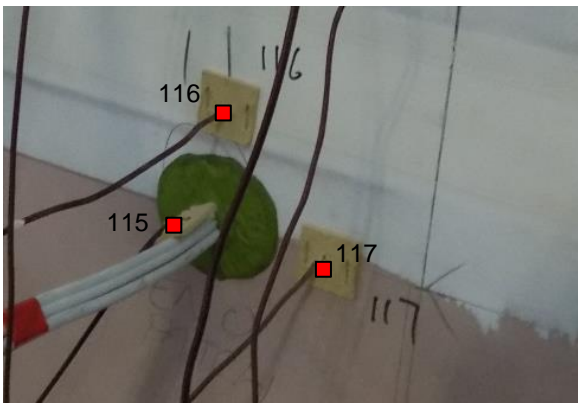
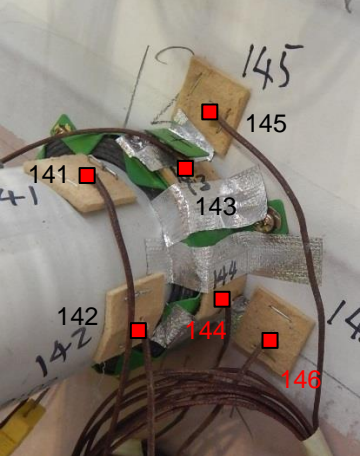
	
<p>Specimen 8</p>	<p>Specimen 8</p>
	
<p>Specimen 9</p>	<p>Specimen 10</p>
	
<p>Specimen 11</p>	<p>Specimen 12</p>





Figure A4.1: Unexposed surface thermocouple locations

**Table A4.1: Thermocouple Locations**

Service	T/C No.	Description
1	011	On the top side of the pipe, 25mm away from the collar
	012	On the east side of the pipe, 25mm away from the collar
	013	On the top side of the collar at mid-height
	014	On the east side of the collar at mid-height
	015	On the plasterboard, 25mm away from the top side of the collar
	016	On the plasterboard, 25mm away from the east side of the collar
2	017	On the top side of the pipe, 25mm away from the plasterboard
	018	On the east side of the pipe, 25mm away from the plasterboard
	019	On the plasterboard, 25mm away from the mastic at the top side of the collar
	020	On the plasterboard, 25mm away from the mastic at the east side of the collar
3	021	On the top side of the pipe, 25mm away from the collar
	022	On the east side of the pipe, 25mm away from the collar
	023	On the east side of the collar at mid-height
	024	On the bottom side of the collar at mid-height
	025	On the plasterboard, 25mm away from the east side of the collar
	026	On the plasterboard, 25mm away from the bottom side of the collar
4	031	On the east side pipe, 25mm away from the collar
	032	On the east side pipe, 25mm away from the collar
	033	On the west side pipe, 25mm away from the collar
	034	On the west side pipe, 25mm away from the collar
	035	On the top side of the collar at mid-height
	036	On the west side of the collar at mid-height
	037	On the wall, 25mm away from the top side of the collar
	038	On the wall, 25mm away from the east side of the collar
5	040	On the top side of the pipe, 25mm away from the collar
	041	On the west side of the pipe, 25mm away from the collar
	042	On the top side of the collar, at mid-height
	043	On the west side of the pipe, at mid-height
	044	On the wall, 25mm away from the top side of the collar
	045	On the wall, 25mm away from the west side of the collar
6	131	On the top side of the pipe, 25mm away from the collar
	132	On the east side of the pipe, 25mm away from the collar
	133	On the east side of the collar, at mid-height
	134	On the bottom side of the collar, at mid-height
	135	On the wall, 25mm away from the east side of the collar
	136	On the wall, 25mm away from the bottom side of the collar
7	051	On the top side of the pipe, 25mm away from the collar
	052	On the east side of the pipe, 25mm away from the collar
	053	On the east side of the collar, at mid-height
	054	On the bottom side of the collar, at mid-height
	055	On the wall, 25mm away from the east side of the collar
	056	On the wall, 25mm away from the bottom side of the collar
8	101	On the top side of the pipe, 25mm away from the collar
	102	On the east side of the pipe, 25mm away from the collar
	103	On the east side of the collar, at mid-height
	104	On the bottom side of the collar, at mid-height
	105	On the wall, 25mm away from the east side of the collar

Service	T/C No.	Description
	106	On the wall, 25mm away from the bottom side of the collar
9	111	On the top side of the pipe, 25mm away from the PenoPatch
	112	On the west side of the pipe, 25mm away from the PenoPatch
	113	On the wall, 25mm away from the top side of the PenoPatch
	114	On the wall, 25mm away from the west side of the PenoPatch
10	047	On the top side of the bundle of cables, 25mm away from the PenoPatch
	048	On the wall, 25mm away from the PenoPatch at the top side of the cable
	049	On the wall, 25mm away from the PenoPatch at the east side of the cable
11	115	On the top side of the bundle of cable, 25mm from the PenoPatch
	116	On the wall, 25mm away from the top edge of the PenoPatch
	117	On the wall, 25mm away from the east edge of the PenoPatch
12	141	On the top side of the pipe, 25mm away from the collar
	142	On the east side of the pipe, 25mm away from the collar
	143	On the top side of the collar, at mid-height
	144	On the east side of the collar, at mid-height
	145	On the wall, 25mm away from the top side of the collar
	146	On the wall, 25mm away from the east side of the collar
13	121	On the top side of the pipe, 25mm away from the collar
	122	On the east side of the pipe, 25mm away from the collar
	123	On the east side of the collar, at mid-height
	124	On the bottom side of the collar, at mid-height
	125	On the wall, 25mm away from the east side of the collar
	126	On the wall, 25mm away from the bottom side of the collar
East edge detail	151	On the mastic, 300mm away above the centre of the joint
	152	On the mastic, at the centre of the joint
	153	On the mastic, 300 away from below the centre of the joint
	154	On the wall system, 25mm away from the control joint on the top section of the wall beside TC 151.
	155	On the wall system, 25mm away from the control joint on the bottom section of the wall beside TC 153.
Top edge detail	156	On the mastic on west side, 300mm away from the centre of the joint
	157	On the mastic, at the centre of the joint
	158	On the mastic on east side, 300mm away from the centre of the joint
	159	On the wall system, 25mm away from the control joint on the west section of the wall beside TC 156
	160	On the wall system, 25mm away from the control joint on the centre section of the wall besides TC 157
	201	On the wall system, 25mm away from the control joint on the east section of the wall besides TC 158
West edge detail	202	On the mastic, 300mm away above the centre of the joint
	203	On the mastic, at the centre of the joint
	204	On the mastic, 300 away from below the centre of the joint
	205	On the wall system, 25mm away from the control joint on the top section of the wall beside TC 202
	206	On the wall system, 25mm away from the control joint on the bottom section of the wall beside TC 204.
	207	On the mastic on west side, 300mm away from the centre of the joint
	208	On the mastic, at the centre of the joint

Service	T/C No.	Description
Bottom edge detail	209	On the mastic on east side, 300mm away from the centre of the joint
	210	On the wall system, 25mm away from the control joint on the west section of the wall beside TC 207
	211	On the wall system, 25mm away from the control joint on the centre section of the wall besides TC 208
	212	On the wall system, 25mm away from the control joint on the east section of the wall besides TC 209

## APPENDIX 5 TEST DATA

### A 5.1 FURNACE TEMPERATURE

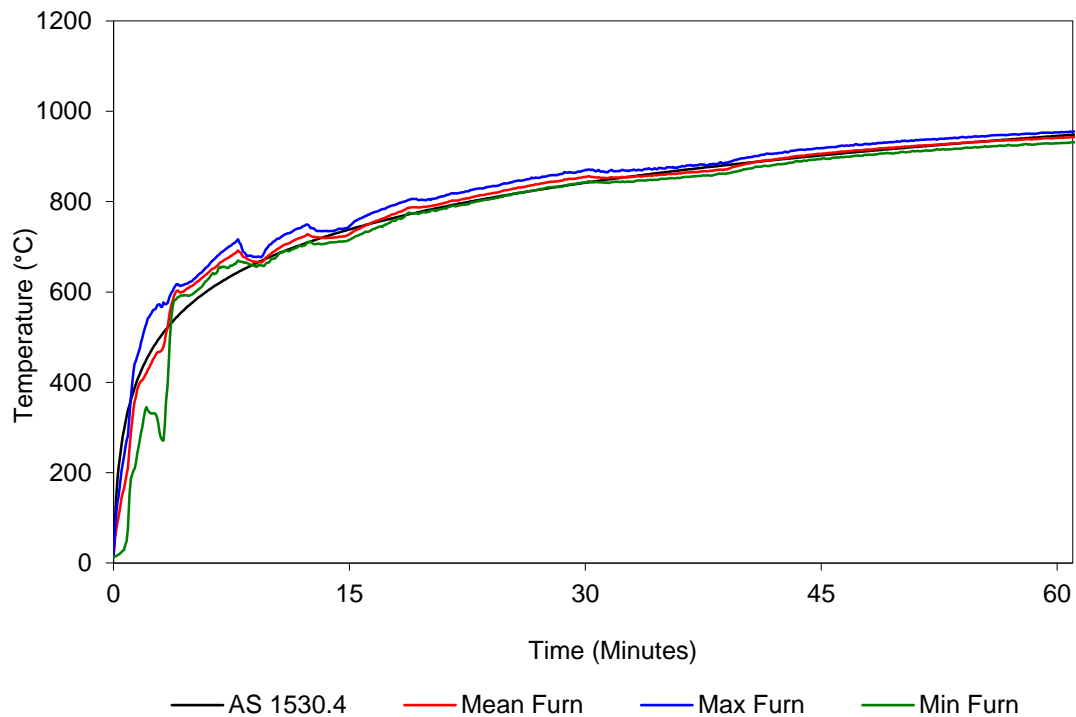


Figure A5.1: Furnace Temperatures vs. Time

### A 5.2 FURNACE PRESSURE

The pressure was measured 120mm above the centre of the lowest penetration service.  
The pressure in table below have been adjusted to reflect pressure at the lowest service

Table A5.1: Pressure

Time (minutes)	Pressure (Pa) Avg.
5-10	16
10-15	16
15-20	16
20-25	17
25-30	16
30-35	16
35-40	16
40-45	15
45-50	15
50-55	15
55-60	16

### A 5.3 SPECIMEN TEMPERATURES

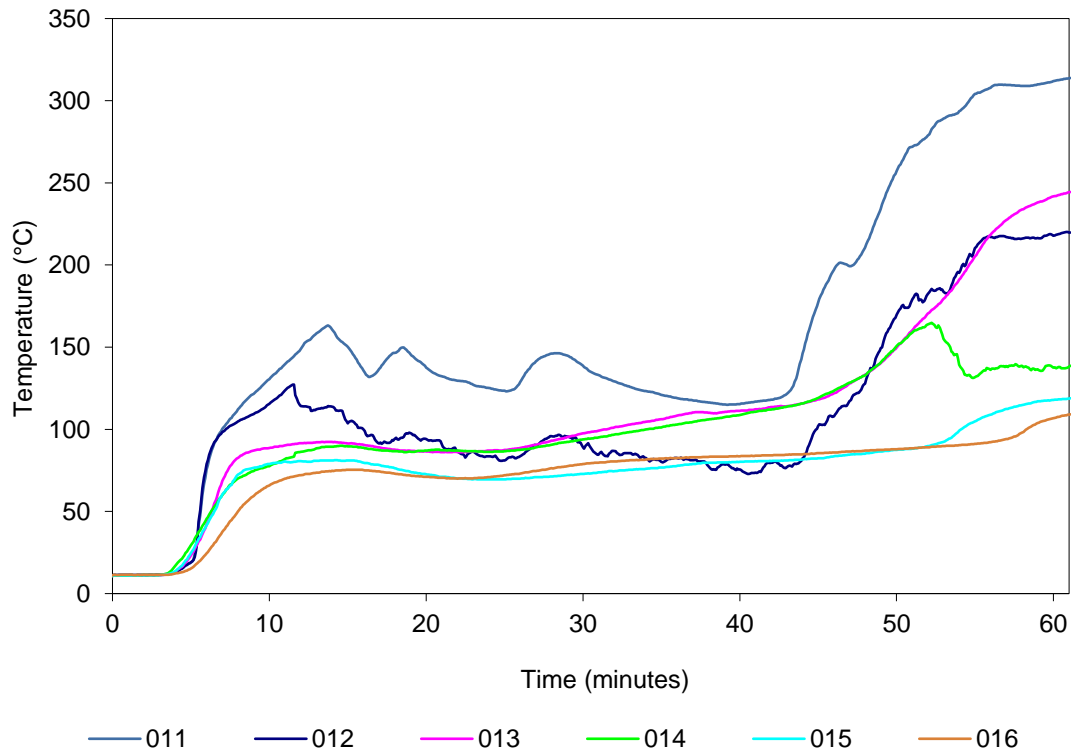


Figure A5.2: Service 1 Temperature. Temperatures vs. time

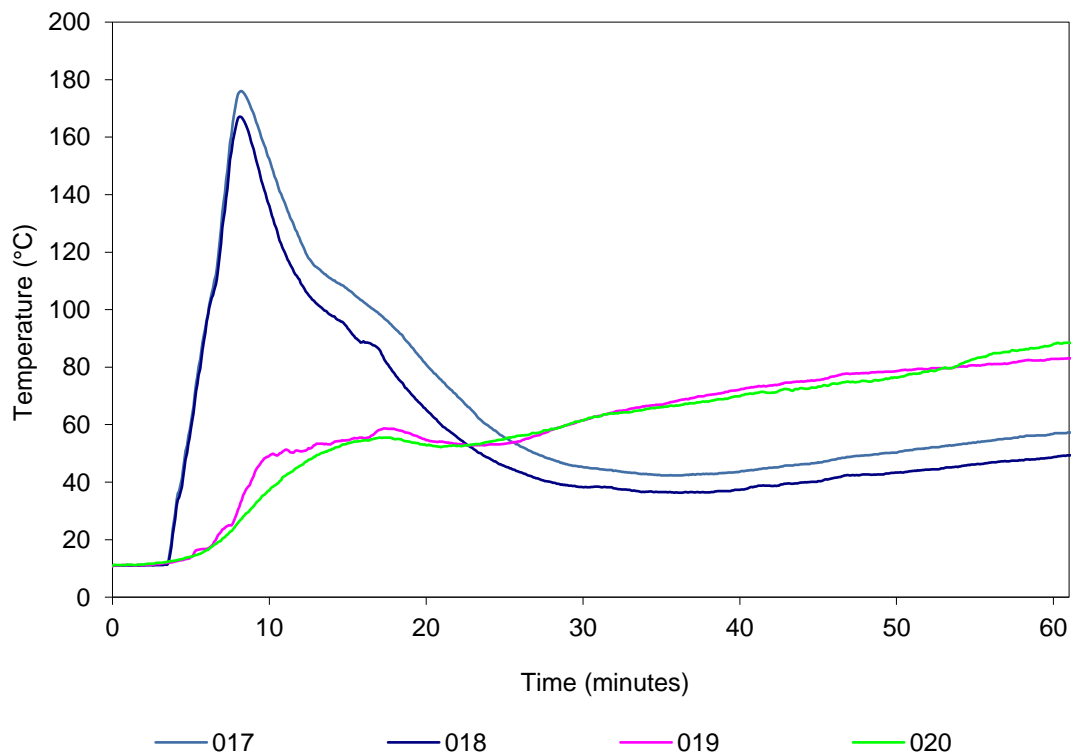
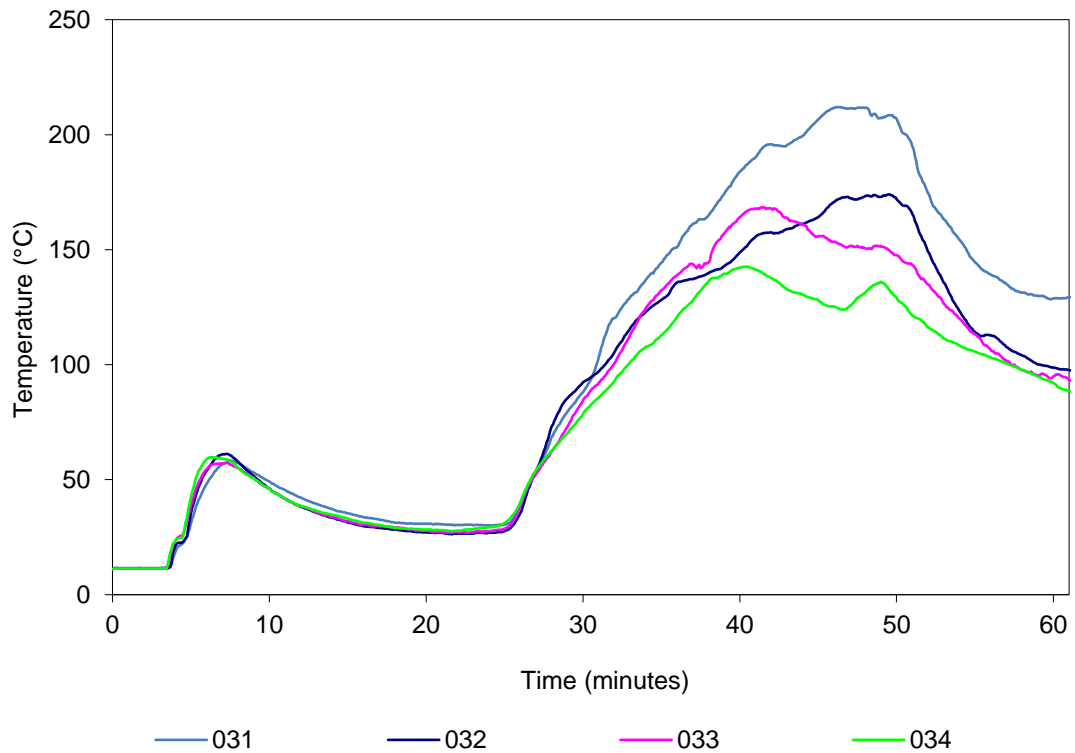
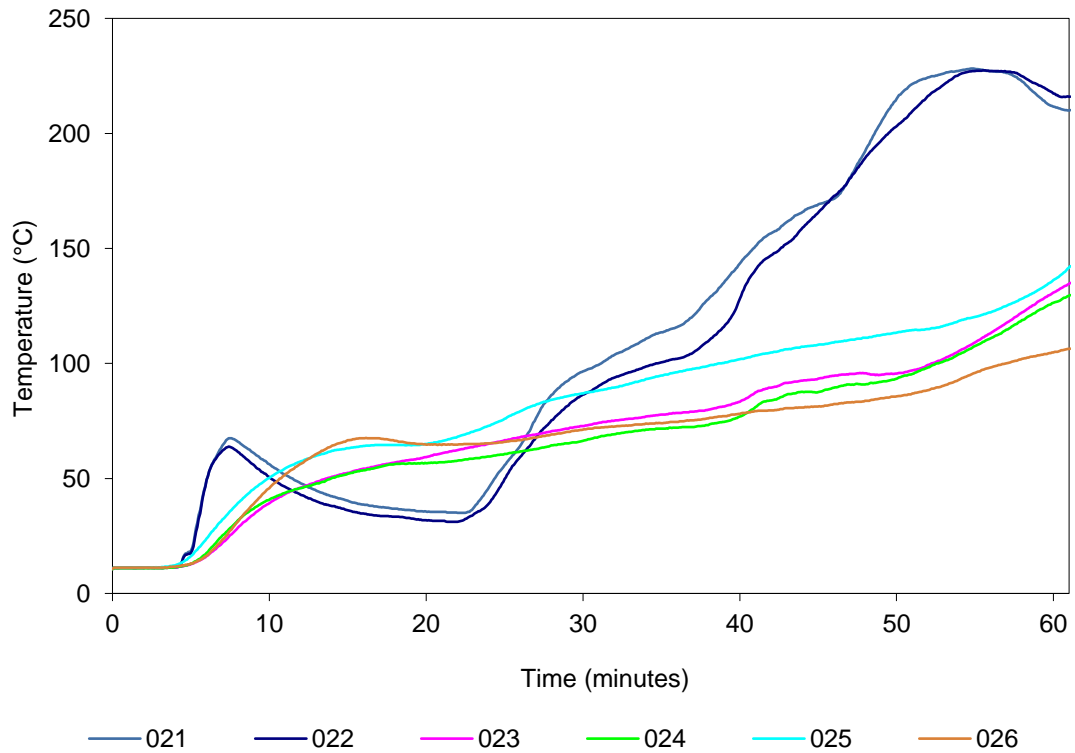
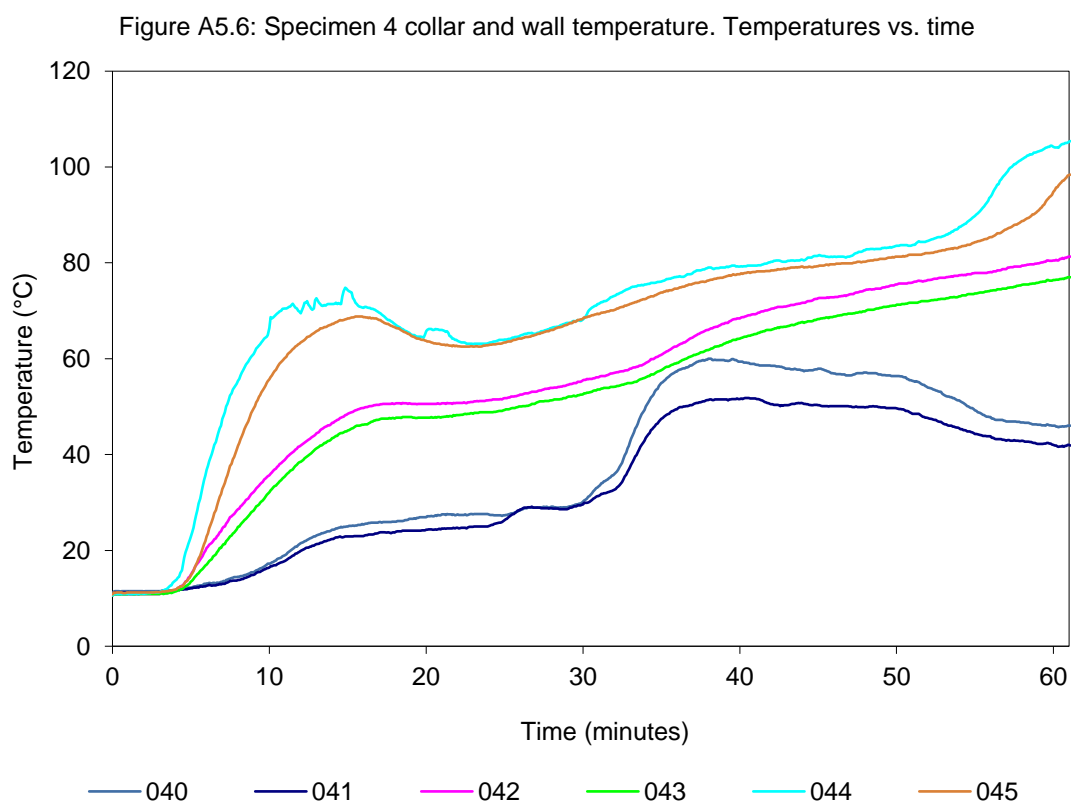
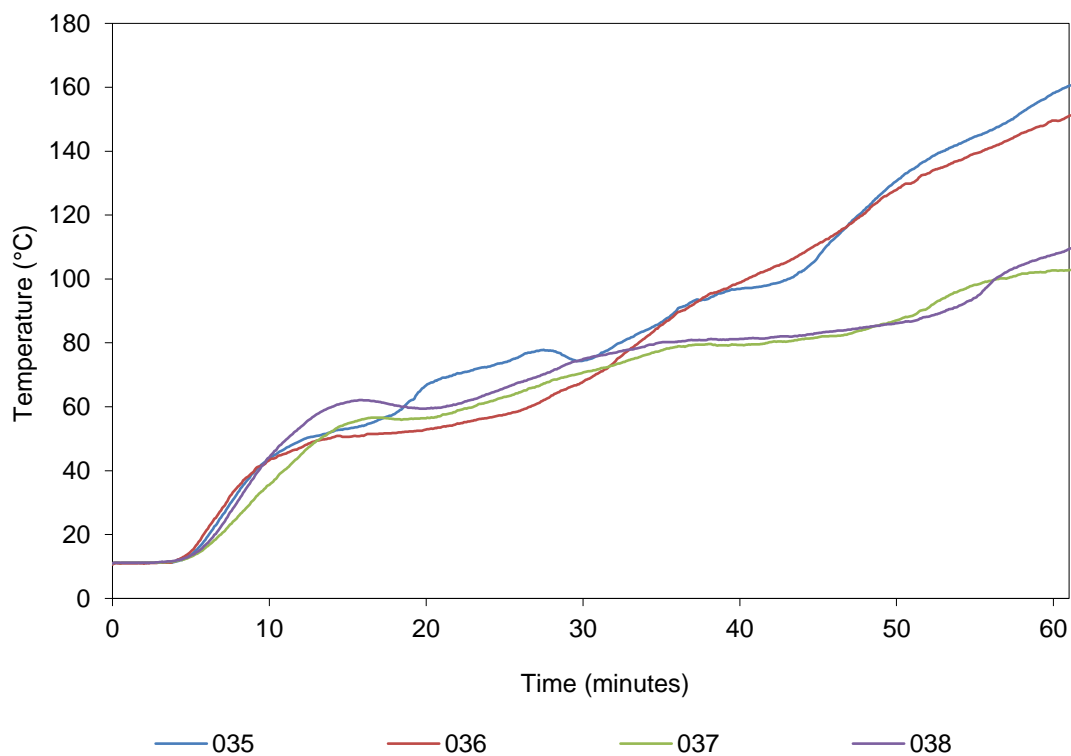
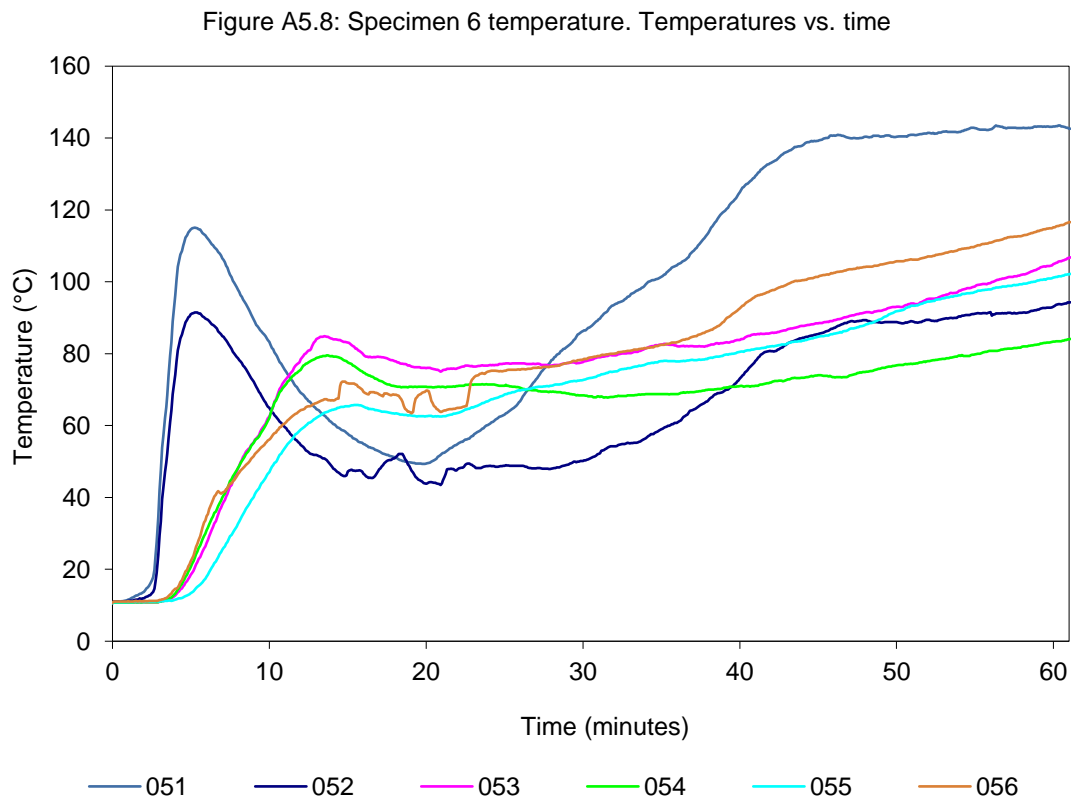
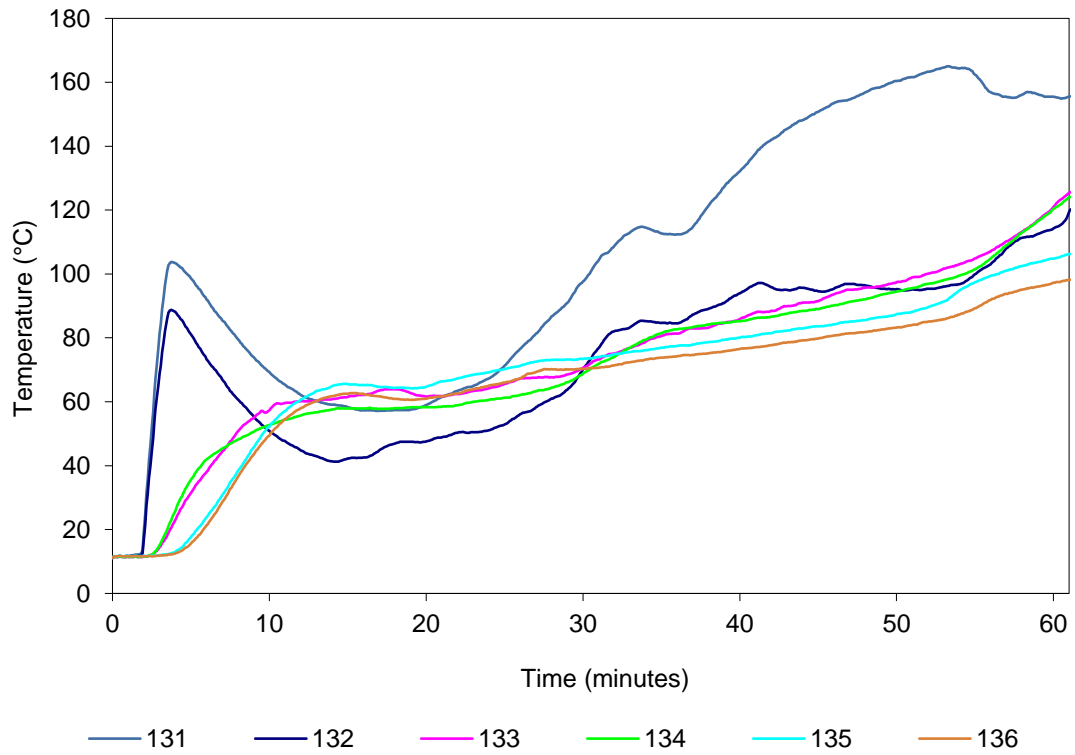


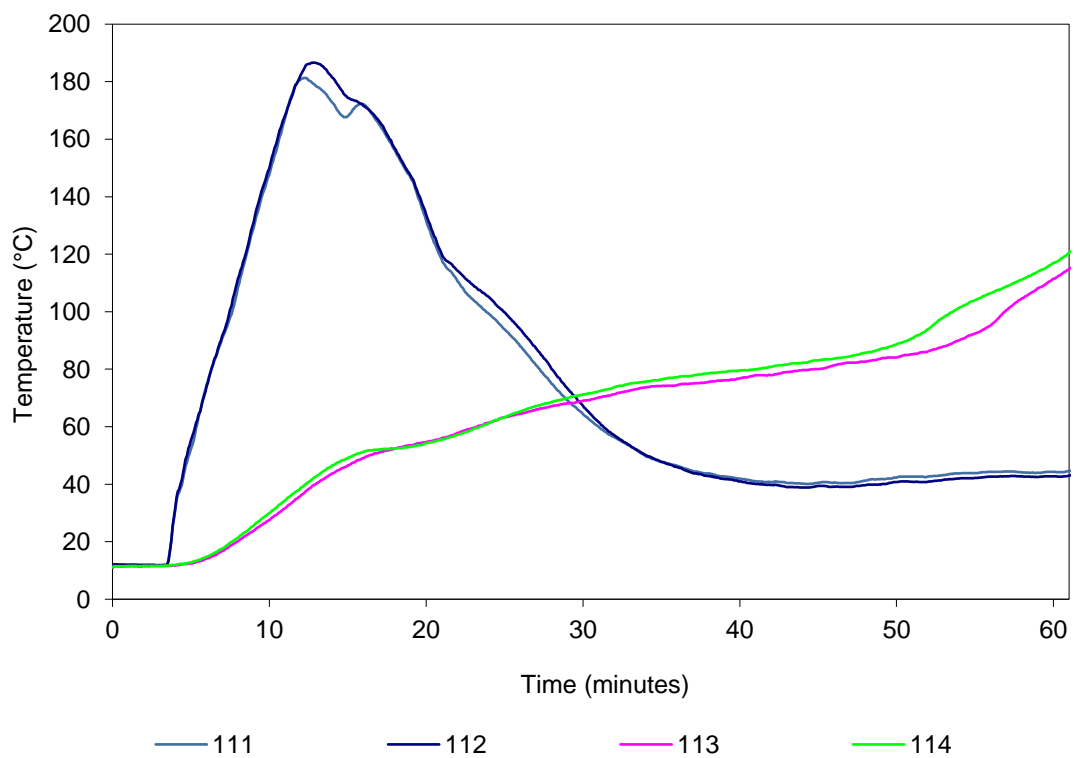
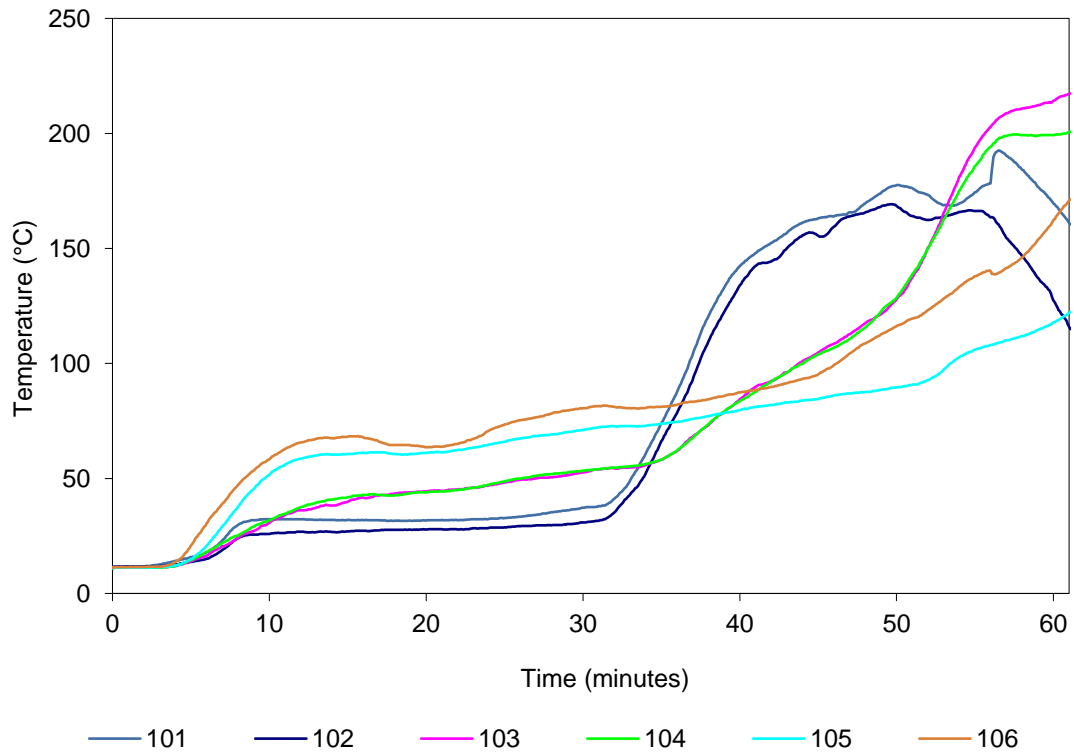
Figure A5.3: Specimen 2 Temperature. Temperatures vs. Time

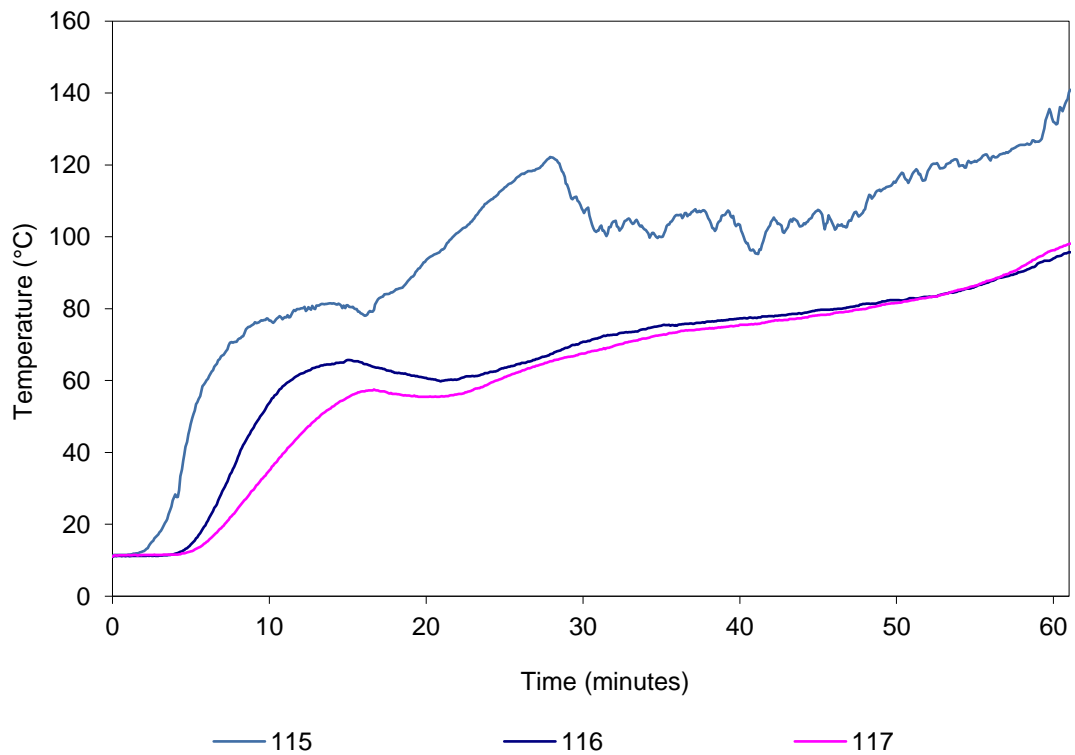
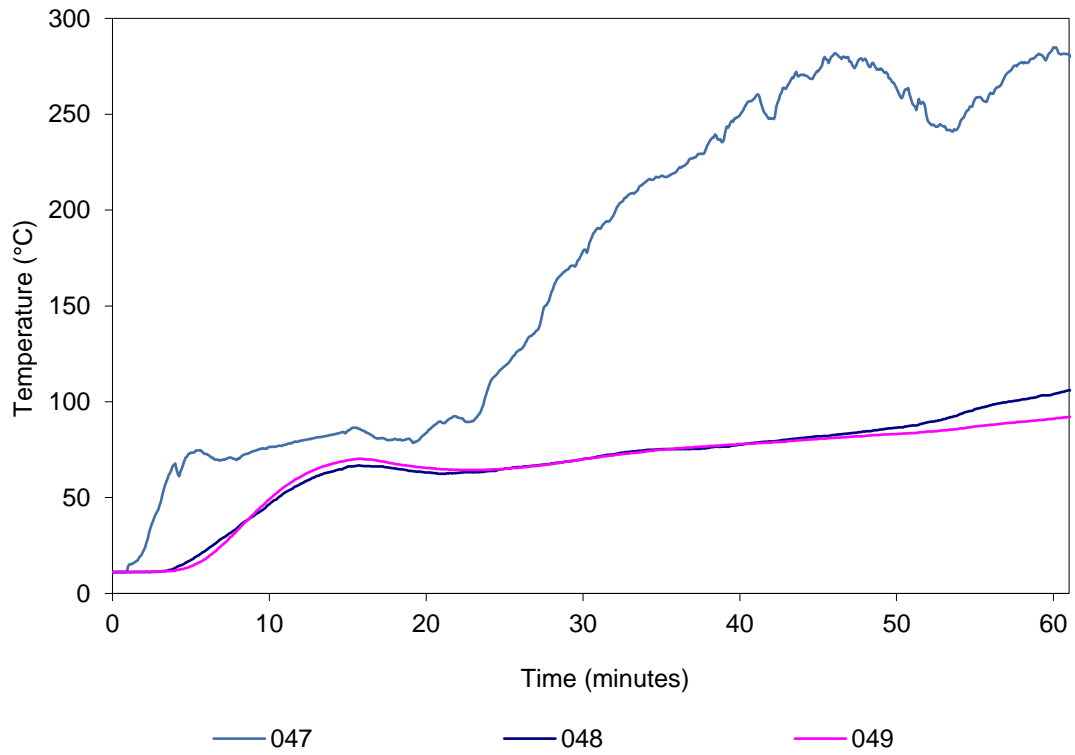












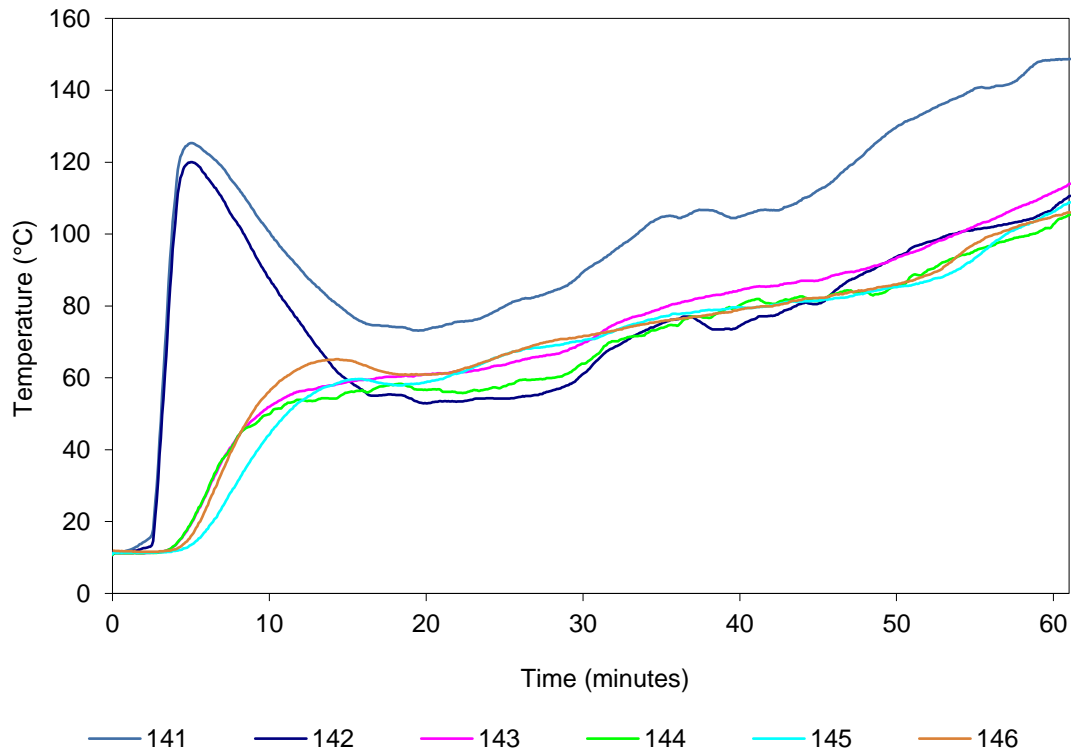


Figure A5.14: Specimen 12 temperature. Temperatures vs. time

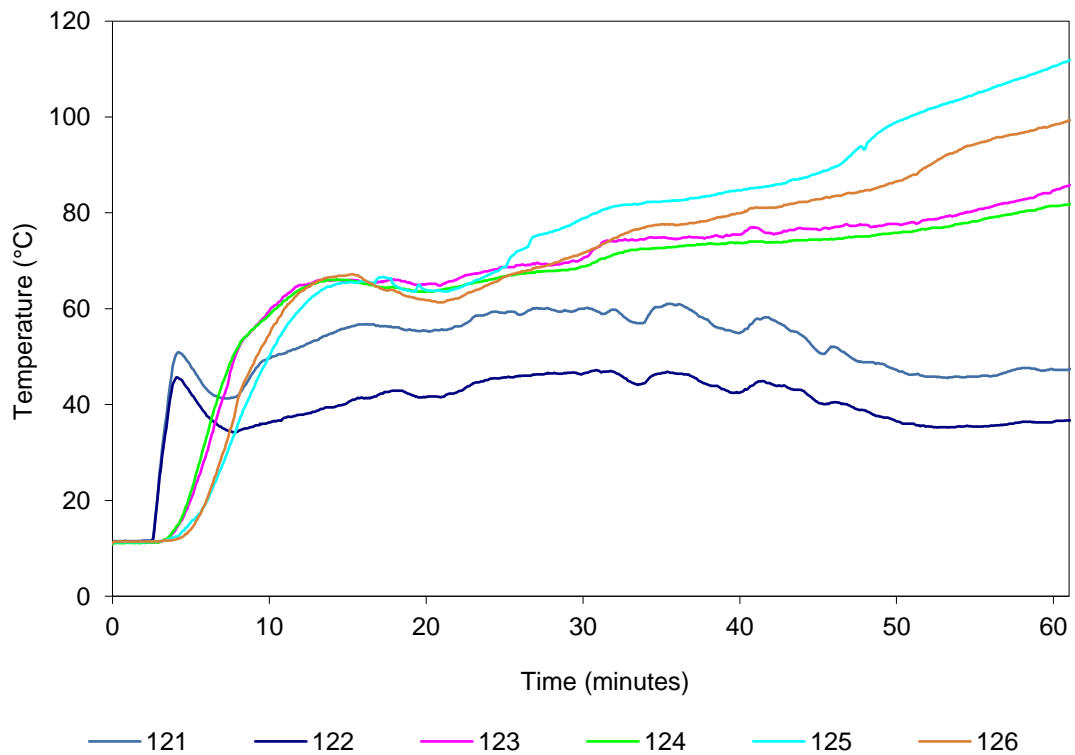


Figure A5.15: Specimen 13 temperature. Temperatures vs. time

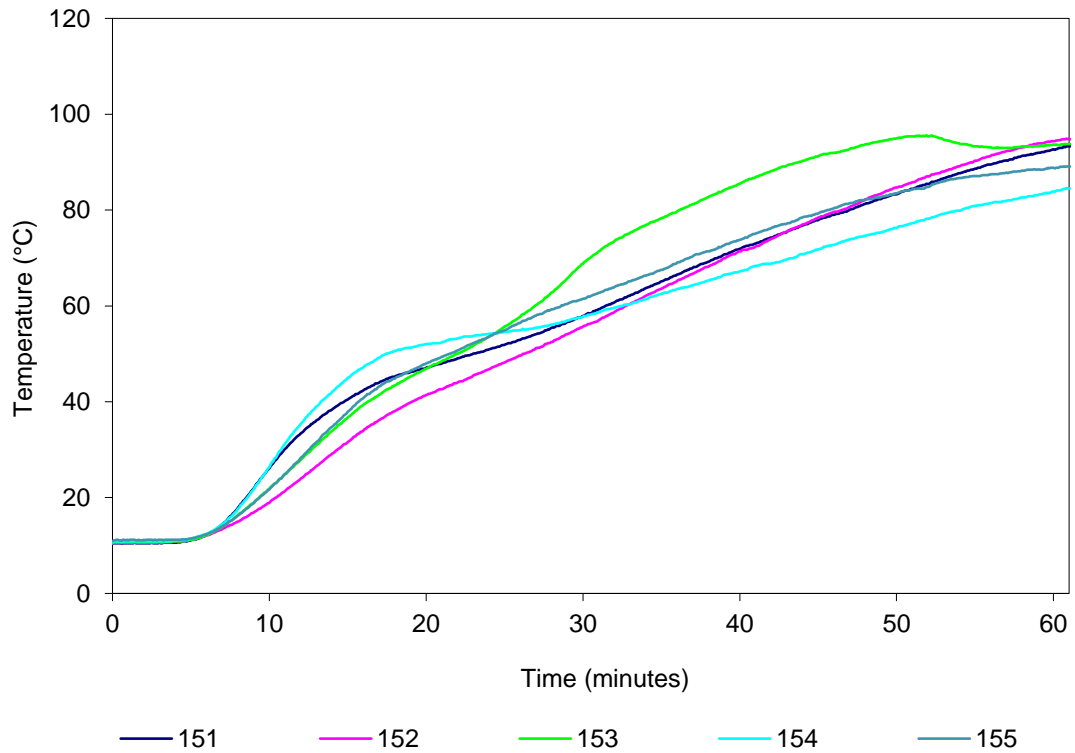


Figure A5.16: Wall system east edge detail temperature. Temperatures vs. time

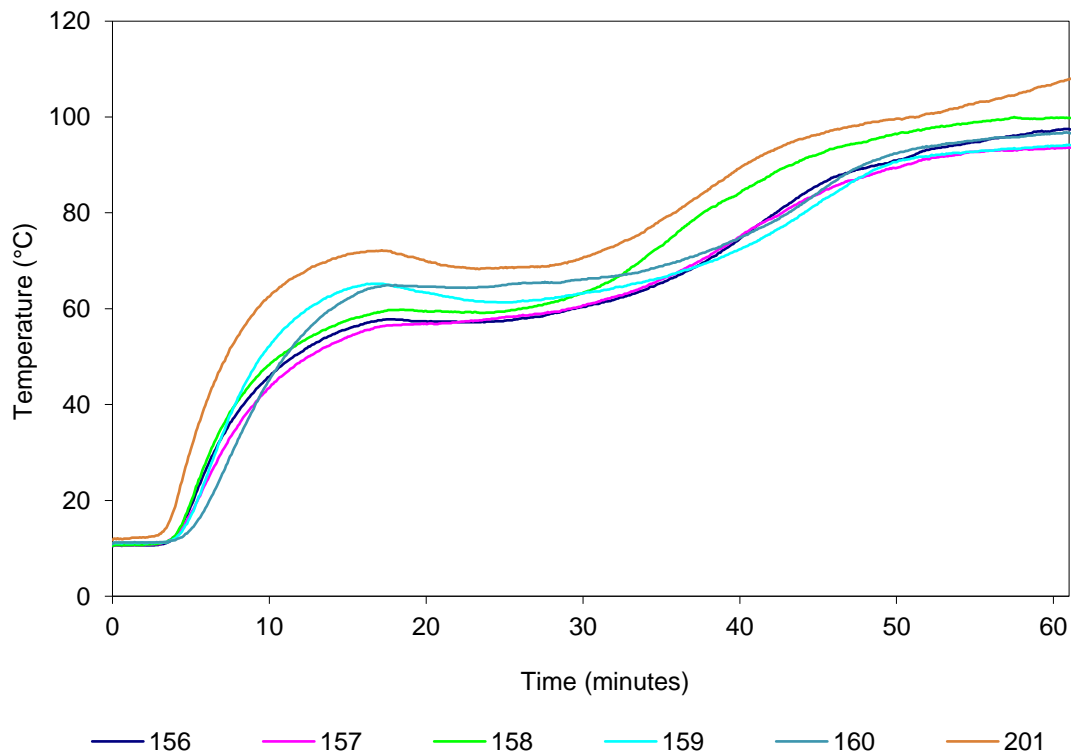


Figure A5.17: Wall system top edge detail temperature. Temperatures vs. time

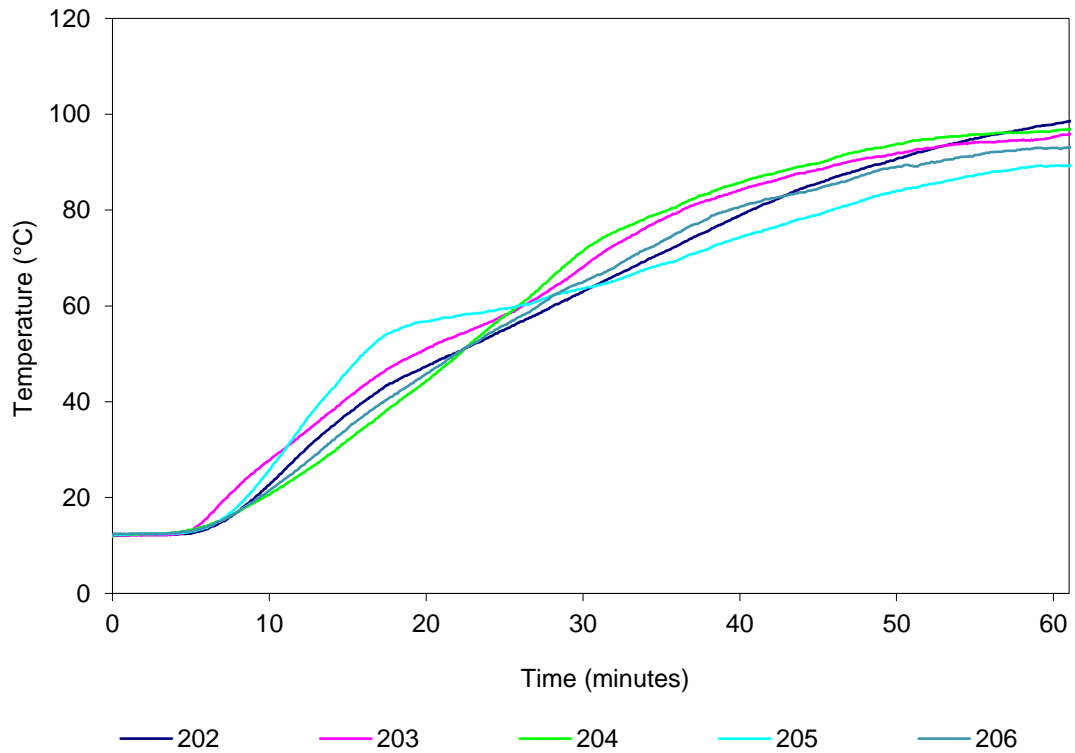


Figure A5.18: Wall system west edge detail temperature. Temperatures vs. time

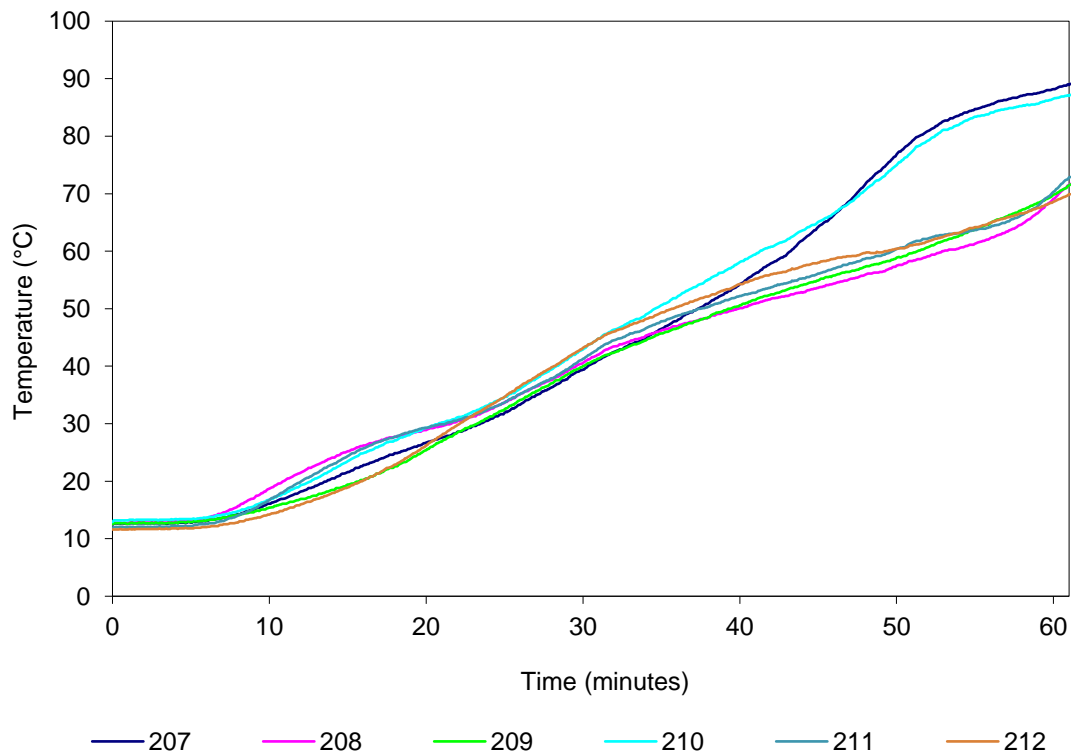


Figure A5.19: Wall system bottom edge detail temperature. Temperatures vs. time



**Table A5.2: Test Specimen Temperatures**

Service	T/C No.	Description <sup>2</sup>	Temp (°C) at t (minutes)					Limit <sup>1</sup> (Mins)
			t=0	t=15	t=30	t=45	t=60	
1	011	On the pipe	11	147	137	179	312	45
	012	On the pipe	11	105	91	103	219	53
	013	On the collar	11	92	98	118	243	54
	014	On the collar	11	90	94	119	138	-
	015	On the wall system	11	81	73	82	118	-
	016	On the wall system	11	75	79	85	108	-
2	017	On the pipe	11	106	45	47	57	-
	018	On the pipe	11	92	38	40	49	-
	019	On the wall system	11	55	62	76	83	-
	020	On the wall system	11	54	62	73	88	-
3	021	On the pipe	11	40	97	169	211	47
	022	On the pipe	11	36	87	166	216	48
	023	On the collar	11	53	73	94	132	-
	024	On the collar	11	52	67	88	127	-
	025	On the wall system	11	63	87	108	138	-
	026	On the wall system	11	67	72	81	105	-
4	031	On the pipe	11	35	91	207	129	41
	032	On the pipe	11	31	93	165	98	-
	033	On the pipe	11	32	86	156	96	-
	034	On the pipe	11	33	81	128	90	-
	035	On the collar	11	53	75	108	159	-
	036	On the collar	11	51	69	111	150	-
	037	On the wall system	11	55	71	82	103	-
	038	On the wall system	11	62	75	83	108	-
5	040	On the pipe	11	25	31	58	46	-
	041	On the pipe	11	23	30	50	42	-
	042	On the collar	11	49	56	73	81	-
	043	On the collar	11	45	53	68	77	-
	044	On the wall system	11	74	69	82	104	-
	045	On the wall system	11	69	69	79	96	-
6	131	On the pipe	11	58	99	151	155	-
	132	On the pipe	11	43	72	95	115	-
	133	On the collar	11	62	71	92	123	-
	134	On the collar	11	58	70	89	121	-
	135	On the wall system	11	65	74	84	105	-
	136	On the wall system	11	63	70	80	98	-
7	051	On the pipe	11	57	87	139	144	-
	052	On the pipe	11	48	51	86	94	-
	053	On the collar	11	82	78	89	106	-
	054	On the collar	11	77	68	74	84	-
	055	On the wall system	11	66	73	85	102	-
	056	On the wall system	11	72	79	102	116	-
8	101	On the pipe	11	32	38	163	167	56
	102	On the pipe	11	27	31	155	123	-
	103	On the collar	11	41	53	105	216	54
	104	On the collar	11	42	54	104	200	55
	105	On the wall system	11	61	71	85	119	-
	106	On the wall system	11	68	81	96	165	-
9	111	On the pipe	11	174	66	39	43	-
	112	On the pipe	11	47	69	80	112	-
	113	On the wall system	11	50	71	83	118	-
	114	On the wall system	11	80	108	107	133	-
10	047	On the bundle of cables	11	86	178	273	282	31
	048	On the wall system	11	66	70	82	105	-
	049	On the wall system	11	70	70	81	92	-

11	115	On the bundle of cables	11	80	108	107	133	-
	116	On the wall system	11	66	71	80	95	-
	117	On the wall system	11	56	68	78	97	-
12	141	On the pipe	11	77	90	112	149	-
	142	On the pipe	11	59	62	81	109	-
	143	On the collar	11	59	70	87	112	-
	144	On the collar	11	56	64	82	104	-
	145	On the wall system	11	60	71	82	107	-
	146	On the wall system	11	65	72	82	105	-
13	121	On the pipe	11	56	60	51	47	-
	122	On the pipe	11	41	47	40	37	-
	123	On the collar	11	66	71	76	85	-
	124	On the collar	11	66	69	74	81	-
	125	On the wall system	11	66	79	88	111	-
	126	On the wall system	11	67	72	83	99	-
East edge detail	151	On the mastic of the control joint	10	41	58	78	93	-
	152	On the mastic of the control joint	10	32	56	79	95	-
	153	On the mastic of the control joint	11	37	70	91	94	-
	154	On the wall system	11	46	58	72	84	-
	155	On the wall system	11	39	62	79	89	-
Top edge detail	156	On the mastic of the control joint	10	56	61	86	97	-
	157	On the mastic of the control joint	11	54	61	84	94	-
	158	On the mastic of the control joint	11	58	64	92	100	-
	159	On the wall system	11	64	63	82	94	-
	160	On the wall system	11	63	66	84	97	-
	201	On the wall system	12	72	71	96	107	-
West edge detail	202	On the mastic of the control joint	12	38	63	86	98	-
	203	On the mastic of the control joint	12	42	69	89	96	-
	204	On the mastic of the control joint	12	33	72	90	97	-
	205	On the wall system	12	47	64	79	89	-
	206	On the wall system	12	35	65	85	93	-
Bottom edge detail	207	On the mastic of the control joint	12	22	40	64	89	-
	208	On the mastic of the control joint	13	26	41	54	70	-
	209	On the mastic of the control joint	13	20	40	55	70	-
	210	On the wall system	13	24	44	65	87	-
	211	On the wall system	12	25	42	56	71	-
	212	On the wall system	12	19	44	58	69	-

- Notes**
- <sup>1</sup> Limit time is the time to the nearest whole minute, rounded down to the nearest minute, at which the temperature recorded by the thermocouple does not rise by more than 180K above the initial temperature.
  - <sup>2</sup> Refer to Appendix 4 for locations of thermocouples as only a generic description is included in the table.
  - # Thermocouple failure.
  - ‘-’ Under Limit column indicates the temperature limit was not exceeded during the test period or up until the time of integrity failure if a failure occurred.

## APPENDIX 6      PHOTOGRAPHS

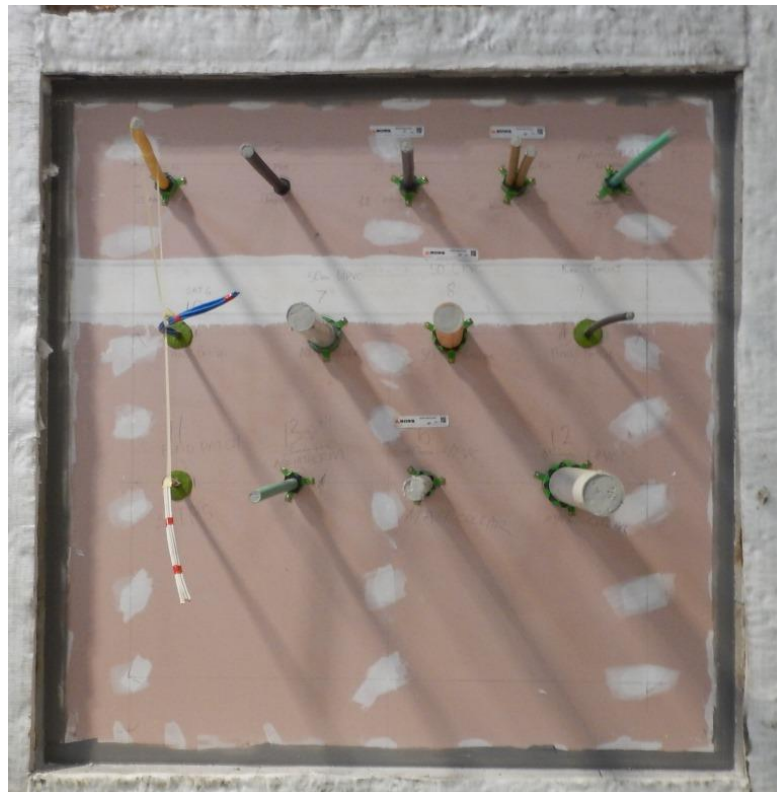
West



East

Figure A6.1: Unexposed face of specimen before commencement of the test

East



West

Figure A6.2: Exposed face of specimen before commencement of the test





Figure A6.3: Unexposed face of specimen at the end of the test.

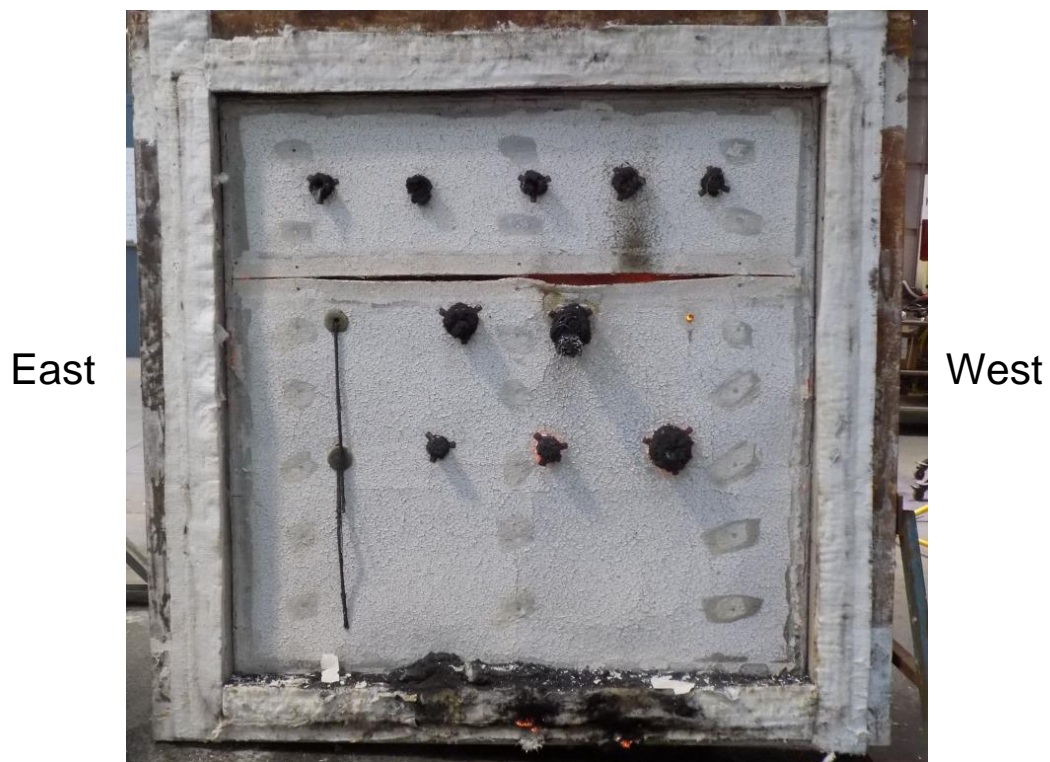


Figure A6.4: Exposed face of specimen at the end of the test.