BRANZ
1222 Moonshine Road
Judgeford RD1
Porirua 5381
New Zealand
T +64 4 237 1170
F +64 4 237 1171
branz@branz.co.nz
www.branz.co.nz

FIRE TEST REPORT

FP 4874 ISSUE 2

FIRE RESISTANCE OF PIPE PENETRATIONS IN A STEEL FRAMED PLASTERBOARD WALL

REFERENCED STANDARDS
AS1530.4 – 2005
AS4072.1 – 2005
CLIENT
Snap Fire Systems
Unit 2-160 Redland Bay Rd,
Capalaba,
4157 QLD
Australia

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

International Accreditation New Zealand (IANZ) has a Mutual Recognition Agreement (MRA) with the National Association of Testing Authorities, Australia (NATA). Users of test reports are recommended to accept test reports in the name of either accrediting body.

TEST SUMMARY

Objective

To determine the fire resistance of nine pipe penetrations and their respective seals through a nominal 128 mm thick plasterboard wall when tested in accordance with AS 1530.4 – 2005 with reference to AS 4072.1 – 2005.

Test sponsor

Snap Fire Systems
Unit 2-160 Redland Bay Rd,
Capalaba,
4157 QLD
Australia

Description of test specimen

The test specimen was a steel framed plasterboard wall consisting of a 64 mm x 0.55 mm thick steel stud with 2 x layers of 16 mm thick Boral Firestop at each face. The wall was placed against a 2,200 mm high x 1,000 mm wide furnace opening. Nine penetrations passed through the nominal 128 mm thick plasterboard wall. The pipes were fitted with retro-fit collars at each face of the wall. Two of the specimens included a 90° elbow fitting with the fitting inserted in the body of the retro-fit collar.

Date of test

29 May 2012

Test results

No.	Collar Designation	Pipe Designation	FRL
1	110R (Retro-fit)	100 PVC-U SC DWV (With Elbow socket in collar)	-/180/120
4	63R (Retro-fit)	50 PVC-U DWV	-/180/120
5	50R (Retro-fit)	40 PVC-U DWV (With Elbow socket in collar)	-/180/180
6	50R (Retro-fit)	40 PVC-U DWV	-/180/120
7	110R (Retro-fit)	100 PVC-U SC DWV	-/180/180
8	110R (Retro-fit)	110 mm x 4.3 mm PE100 SDR 26	-/180/120
9	65-80R (Retro-fit)	80 PVC-U DWV	-/180/120
10	84R (Retro-fit)	65 PVC-U DWV	-/180/120
11	50R (Retro-fit)	40 mm x 3 mm PE80 S12.5	-/180/180

NF = No failure for the duration of the test.

The test standard requires the following statements to be included:

"*The results of these fire tests may be used to directly assess fire hazard, but it should be recognised that a single test method will not provide a full assessment of fire hazard under all fire conditions.*"

LIMITATION

The results reported here relate only to the item/s tested.

TERMS AND CONDITIONS

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

CONTENTS

FIGURES

TABLES

SIGNATORIES

Author

R. W. Causer
Fire Testing Engineer
IANZ Approved Signatory

Reviewer

P. Bano – Chapman
Senior Fire Safety Engineer

DOCUMENT REVISION STATUS

ISSUE No.	DATE ISSUED	DESCRIPTION
1	30 October 2012	Initial Issue
2	30 October 2012	Re issued to include reference to AS 4072.1 – 2005

1. TEST PROCEDURE

The test was conducted in accordance with AS 1530.4-2005, Methods for fire tests on building materials, components and structures, Part 4: Fire–Resistance test of elements of construction, with reference to AS 4072.1 – 2005 Service penetrations and control joints, Section 3.1 Fire Resistance Testing.

In accordance with the test standard the fire resistance of the specimen is the time, expressed in minutes, to failure under one or more of the following criteria.

1.1 Integrity

Failure shall be deemed to occur when cracks, fissures or other openings develop through which flames or hot gases can pass. Failure occurs;

- If a gap, crack or fissure develops, which exceeds 6 mm x 150 mm and, allows unobstructed vision into the interior of the furnace from any viewing angle, or a 25 mm gap gauge can be passed through the specimen so that the gauge projects into the furnace; or
- If flaming on the unexposed surface of the specimen is sustained for longer than 10 seconds; or
- When flames and/or hot gases cause flaming or glowing of the cotton fibre pad.

1.2 Insulation

Failure shall be deemed to occur when any of the relevant thermocouples attached to the unexposed face of the test specimen rises more than 180K above the initial temperature.

Temperatures recorded from thermocouples that become embedded in softening material or covered by intumescent material shall be disregarded.

2. DESCRIPTION OF THE TEST SPECIMEN

2.1 General

The test specimens consisted of nine pipe penetrations in a nominal 128 mm thick steel framed plasterboard wall. All the pipes consisted of either PVC-U DWV or HDPE DWV plastic pipe.

All of the pipes were fitted with retro-fit collars. All the through pipes protruded a minimum of 500 mm into the furnace and at least 2,000 mm to the unexposed face except for pipe No's 1 and 5 which had a 90°elbow fitting on the exposed face with the elbow socket inserted into the retro-fit collar. All pipes were capped on the exposed end and were open on the unexposed end. The pipes were secured in place using pipe clamps supported by a steel framework at 800 mm and 1,800 mm from the face of the wall.

The wall framing consisted of 64 mm x 0.55 base metal thickness (BMT) galvanised steel studs. The plasterboard lining consisted of two layers of 16 mm thick Boral Firestop at each face. The density of the plasterboard at the time of the fire resistance test was calculated to be 13.15 kg/m^2. The moisture content of the plasterboard at the time of the test was calculated to be 0.65%.

A drawing of the layout including the location of the steel studs is included in this report as Figure 6.

2.2 Pipe Specification

Table 1 lists the nominal and measured pipe dimensions and pipe designation details.

DWV = Drain Waste Vent

The nominal 100 mm PVC-U pipes were of sandwich core construction.

Table 1: Pipe specification

Pipe No	Nominal Ø/ Material/Type	(mm) OD	(mm) Wall	Details recorded on pipe
1 - 7	100 PVC-U/S DWV	110.0	3.3	Biplex 100 PVC-U SC DWV SH SN6
4	50 PVC-U DWV	56.0	2.5	Keyplas 50 PVC-U DWV SH
5 & 6	40 PVC-U DWV	43.0	2.2	Keyplas 40 PVC-U DWV SH
8	100 HDPE DWV	109.6	4.5	Mueller Pipelines Coestilen PE100 DN 110Ø x 4.3 SDR 26 SN4
9	80 PVCU DWV	82.3	3.1	Vinidex Quality Long Life Recyclable 80PVCU DWV
10	65 PVCU DWV	69.0	3.0	Vinidex Quality Long Life Recyclable 65PVCU DWV

Pipe No	Nominal Ø/ Material/Type	(mm)		Details recorded on pipe
		OD	Wall	
11	40 HDPE DWV	40.4	3.4	Coestilen PE80 40Ø x 3 S12.5

2.3 Collar Designation and Materials of Manufacture Details

Table 2 lists the average measured dimensions of the intumescent used in each collar type with number of layers and location of stainless steel mesh. The client advised that the intumescent was named INTUMESH.

The type 63R, 65-80R, 84R and 110R retro-fit collar bodies were fabricated from 0.95 mm thick galvanised steel. The type 50R retro-fit collar was fabricated from 0.7 mm thick stainless steel. All the retro-fit collars were secured to the plasterboard wall with three equally spaced brackets around the perimeter of the collar body. Pipe specimens 1, 4 – 8 and 11 were secured to the wall with expanding hollow wall anchors designation 438. The brackets were fabricated from 2 mm thick galvanised steel and consisted of a 20 mm wide angle bracket with leg lengths measuring 33 mm and 30 mm. An expanding wall anchor passed through an 8 mm Ø hole through the longer leg length, the bracket was screw fixed to the body of the collar with a self tapping screw.

The exposed and unexposed collars of pipe specimen No. 9 were secured to the wall with M6 threaded rod through the brackets of the respective collars passing through the cavity thereby sandwiching the wall between the collars.

Figures 1 – 5 show detailed construction drawings for each collar type. Where difference between the drawing and the report text exists the text takes precedence.

Table 2: Collar intumescent details

Collar Designation	Pipe No.	Intumescent Details (Average measured dimensions)				
		Width (mm)	Thickness (mm)	No of Layers	Length (mm)	Steel Mesh and Location
50 R	5, 6, 11	44	4.0	2	L1: 217 L2: 207	I layer sandwiched between intumescent layers
63 R	4	43	4	2	L1: 267 L2: 240	I layer sandwiched between intumescent layers
84 R	10	56	4.0	2	L1: 290 L2: 270	I layer sandwiched between intumescent layers
65-80 R	9	56	4.0	2	L1: 300 L2: 324	I layer sandwiched between intumescent layers
110 R	1, 7, 8	58	3.1	3	L1: 380 L2: 400 L3: 415	1 layer either side of middle intumescent layer

The stainless steel mesh wire measured 0.15 mm thick with 30 squares per inch.

2.4 Collar Drawings

Figure 1: 50 R Retro-fit collar installed to specimen No's. 5, 6 & 11

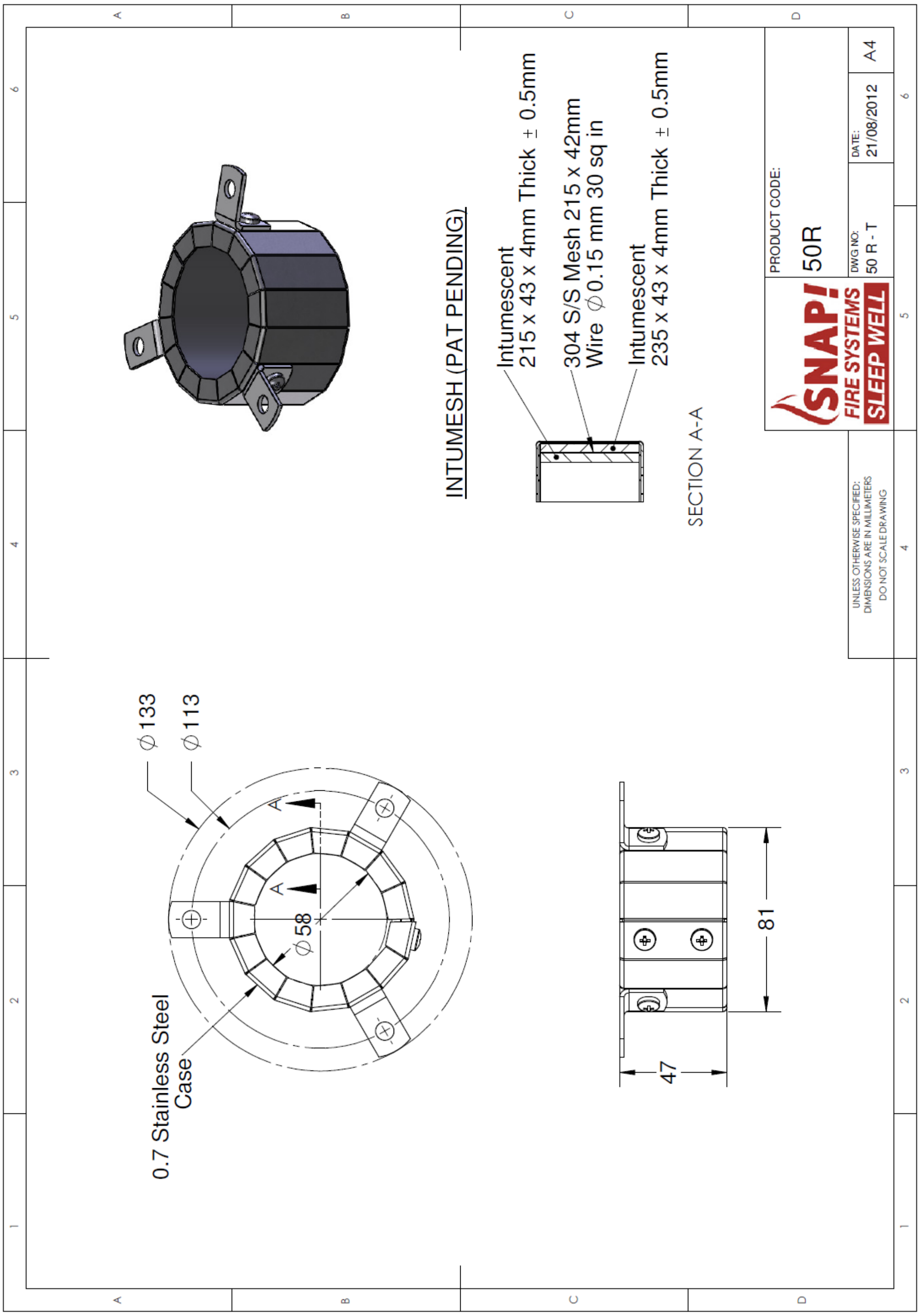


Figure 2: 63 R Retro-fit collar installed to specimen No 4

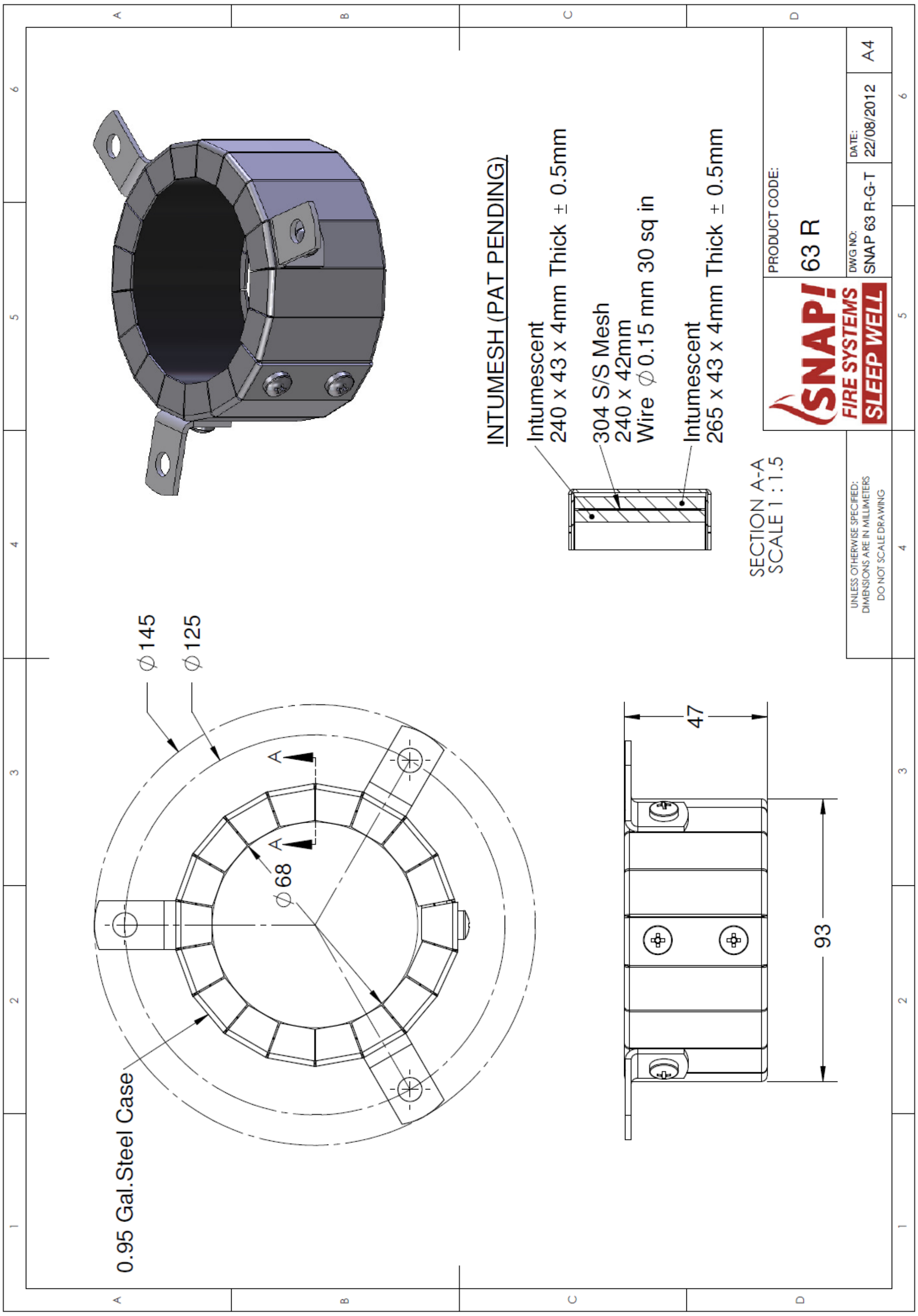


Figure 3: 84 R Retro-fit collar installed to specimen 10

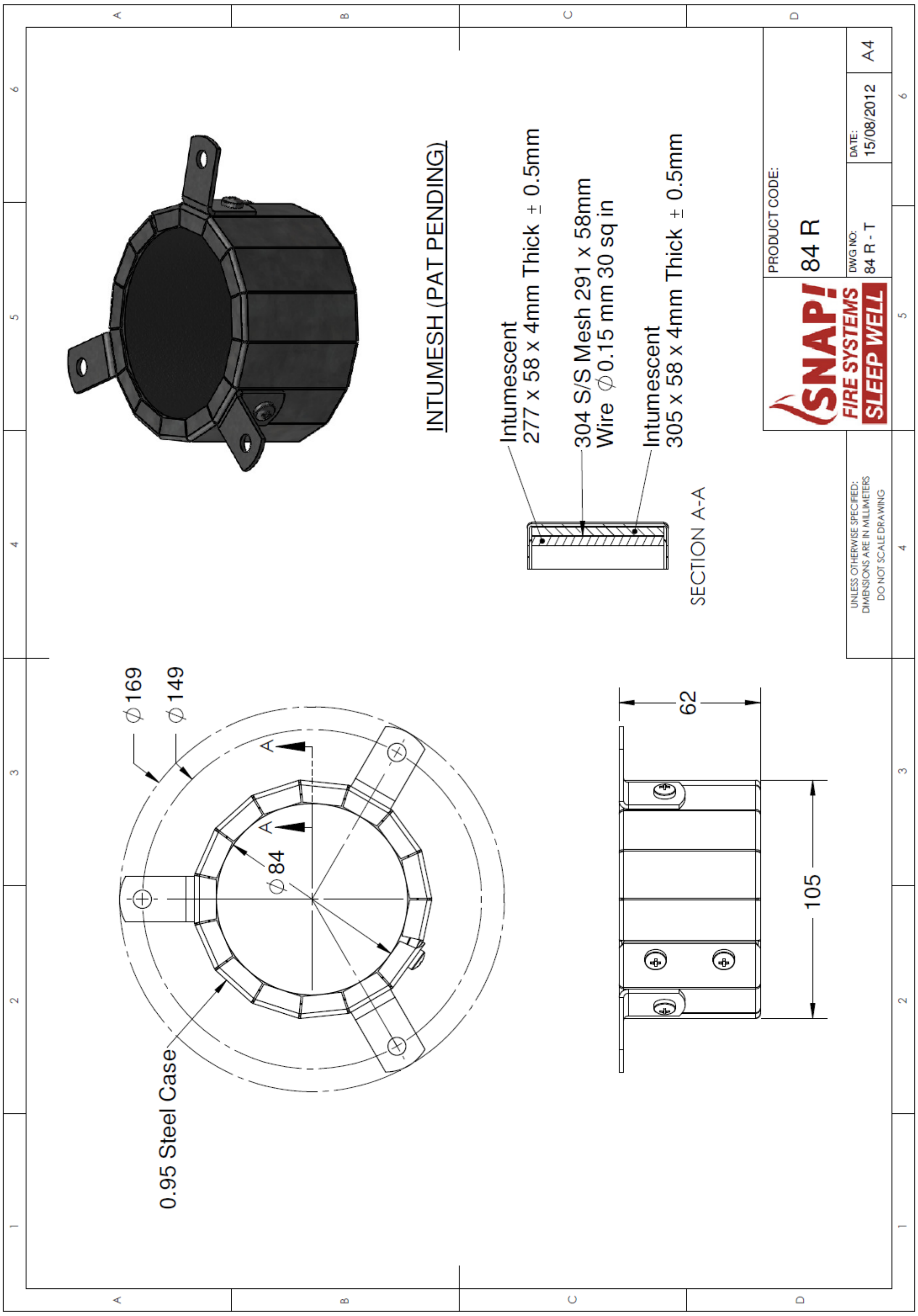


Figure 4: 65 – 80 R Retro-fit collar installed to specimen 9

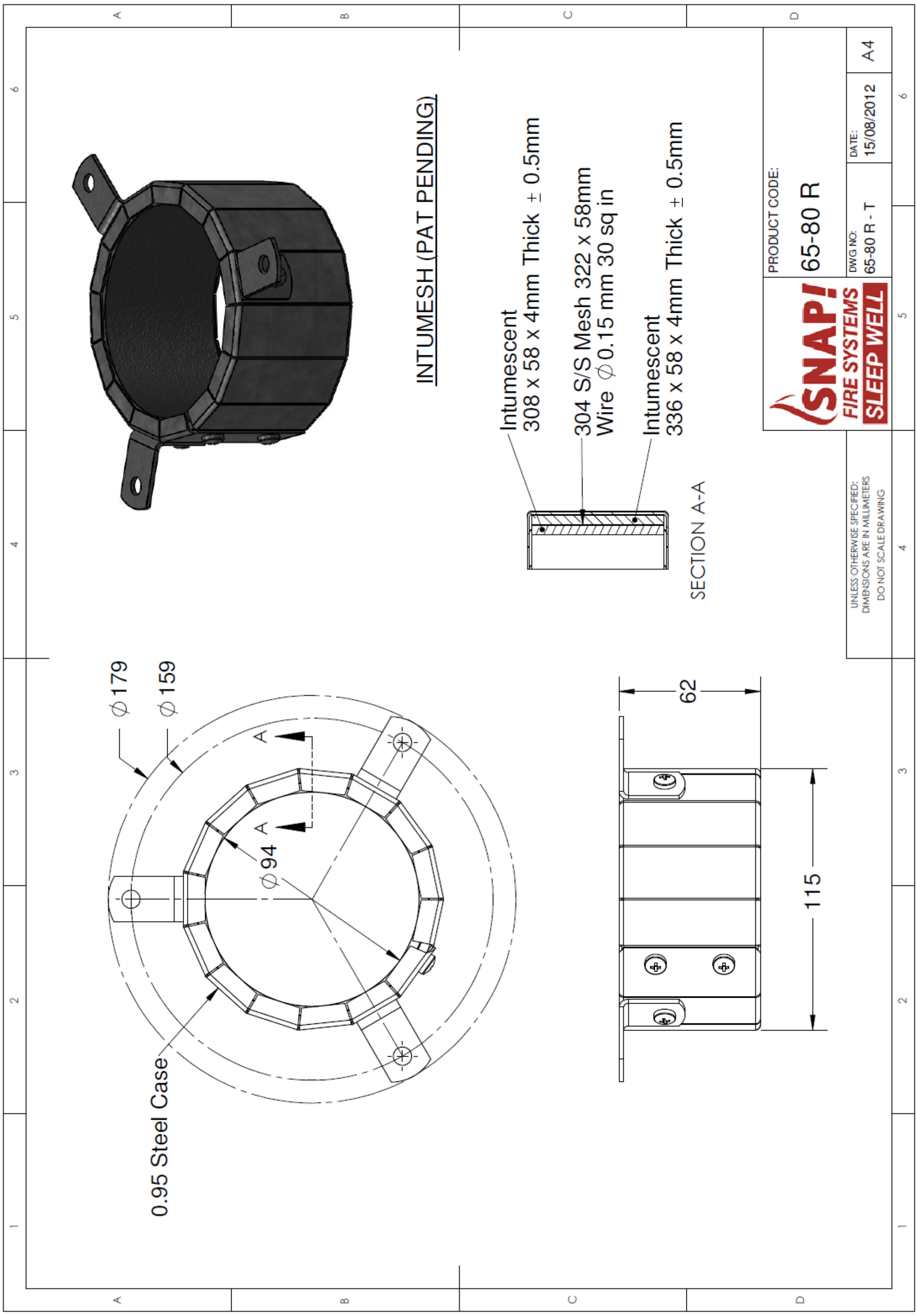
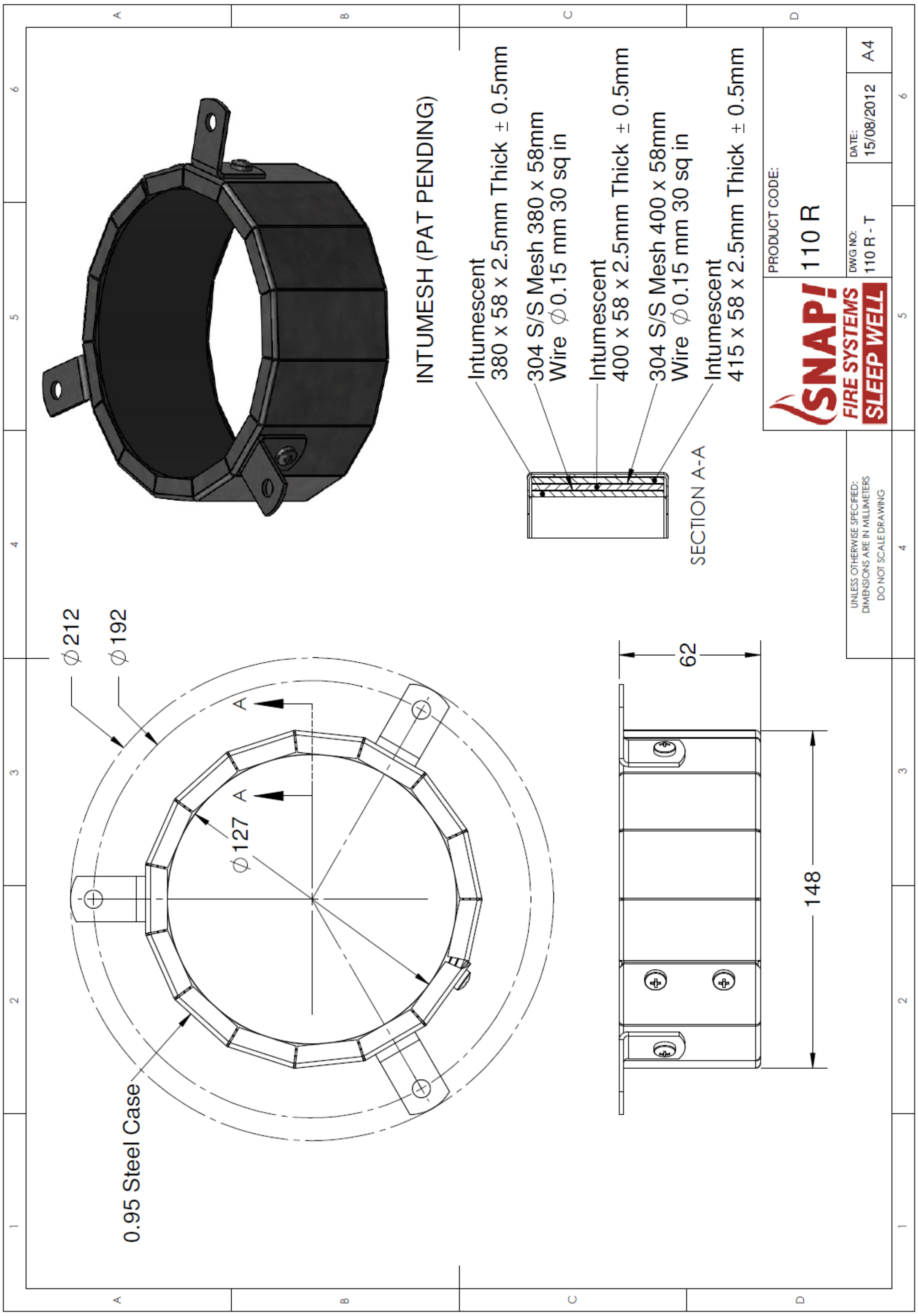


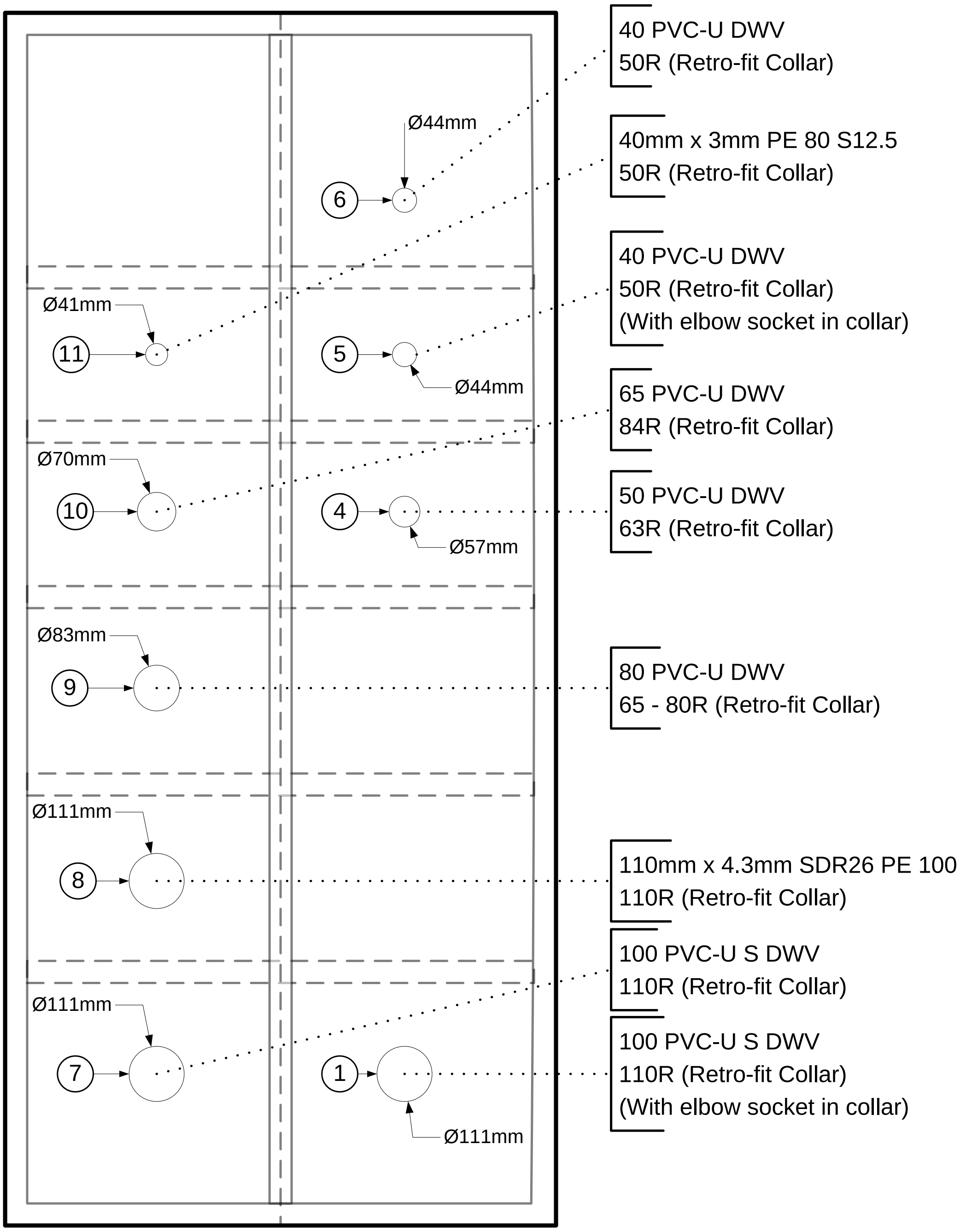
Figure 5: 110 R Retro-fit collar installed to specimen No’s. 1, 7 & 8



2.5 Test Specimen Layout

Figure 6 shows the plasterboard wall and general layout of the test specimens. The dotted lines indicate the location of the steel framing. Figures 7 to 15 show cross sectional views for individual test specimens.

Figure 6: Test Specimen Layout



Steel frame: 64mm x 0.55 mm BMT
Lining: 2 x layers of Boral 16mm thick Firsetop

Figure 7: Specimen 1. 100 mm Ø PVCU with 90° elbow in 110 R Retro-fit collar

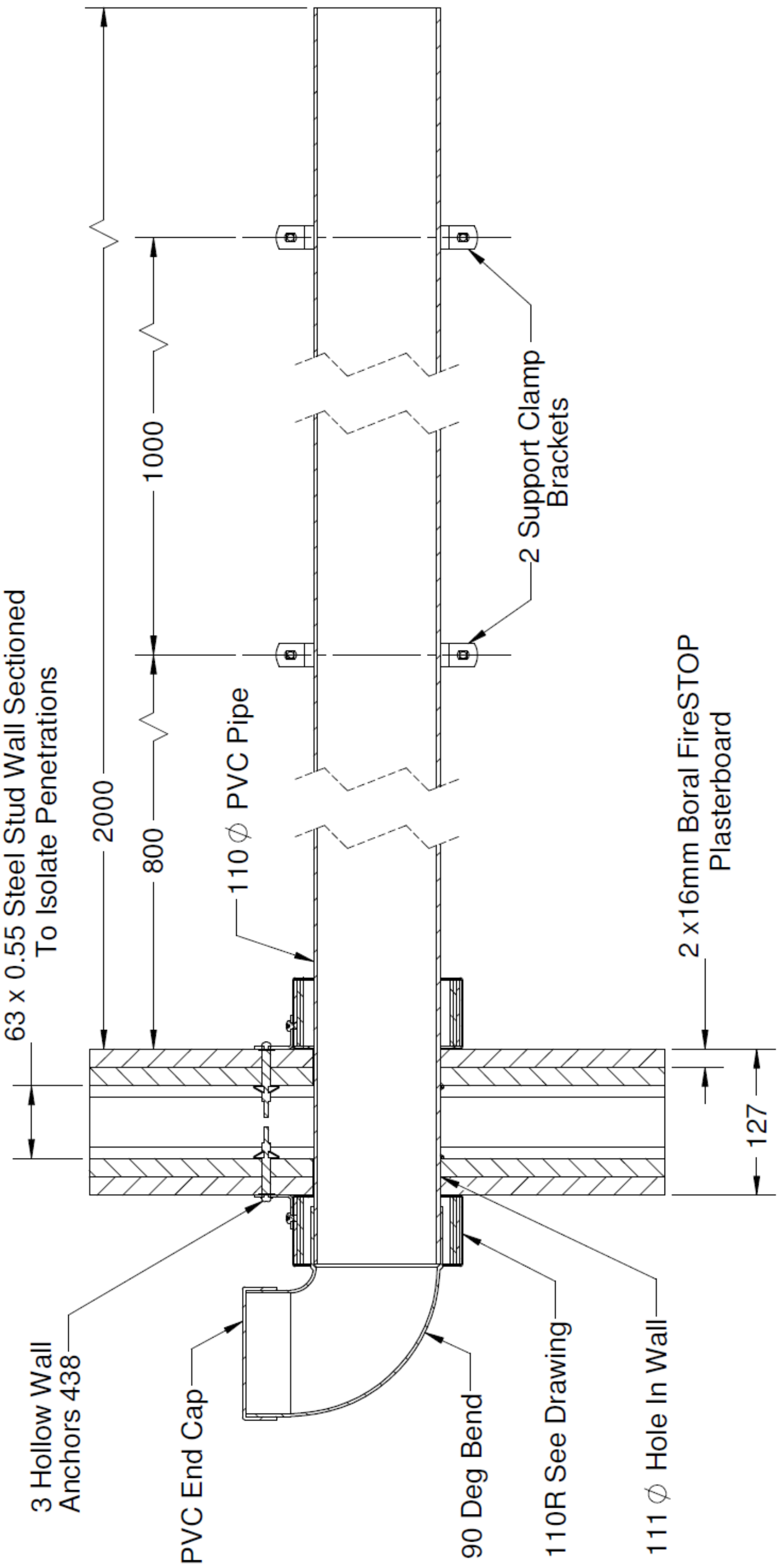


Figure 8: Specimen 4. 50 mm PVCU with 63 R Retro-fit collar

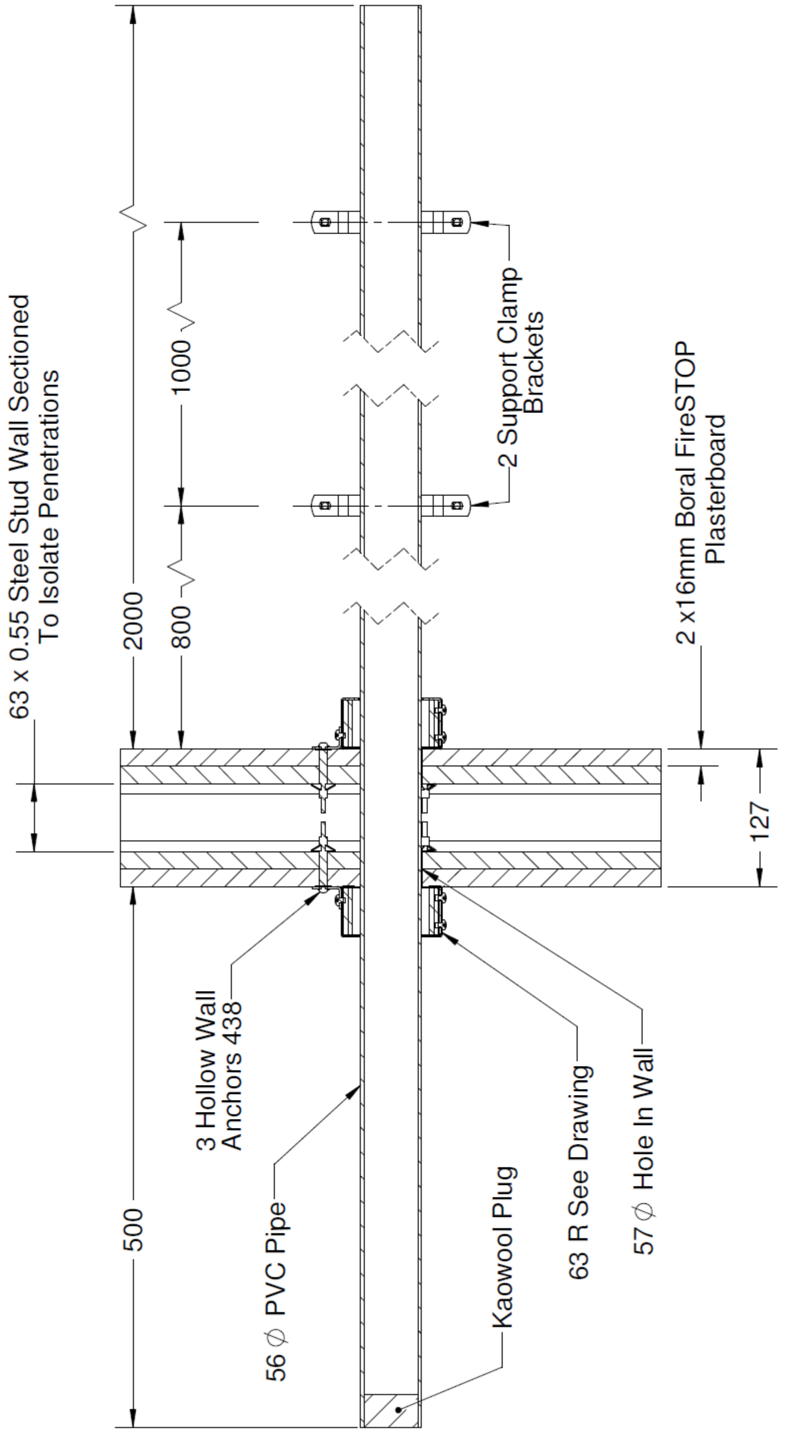


Figure 9: Specimen 5. 40 mm Ø PVCU with 90° elbow in 50 R Retro-fit collar

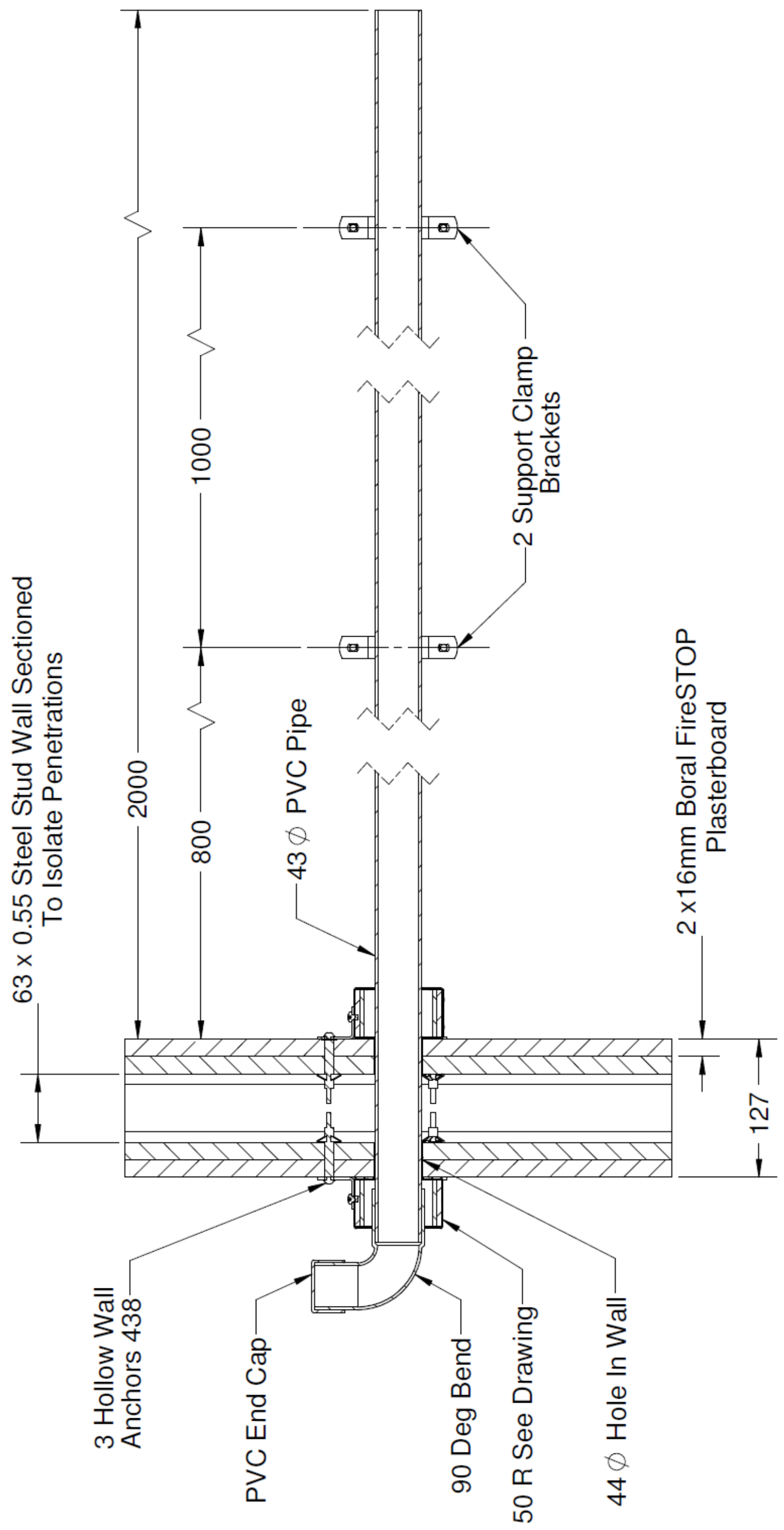


Figure 10: Specimen 6. 40 mm PVCU with 50 R Retro-fit collar

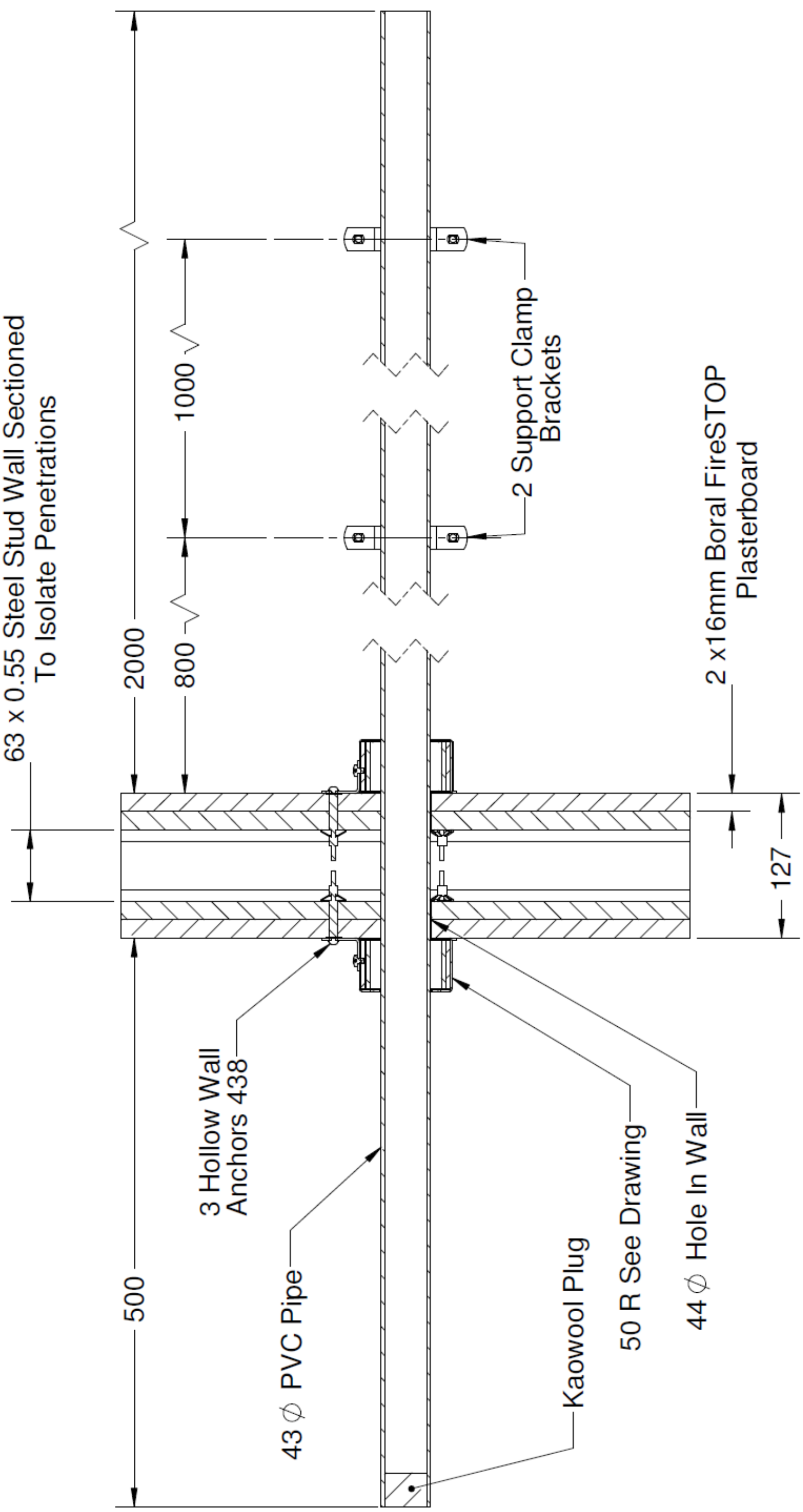


Figure 11: Specimen 7. 100 mm Ø PVCU with 110 R Retro-fit collar

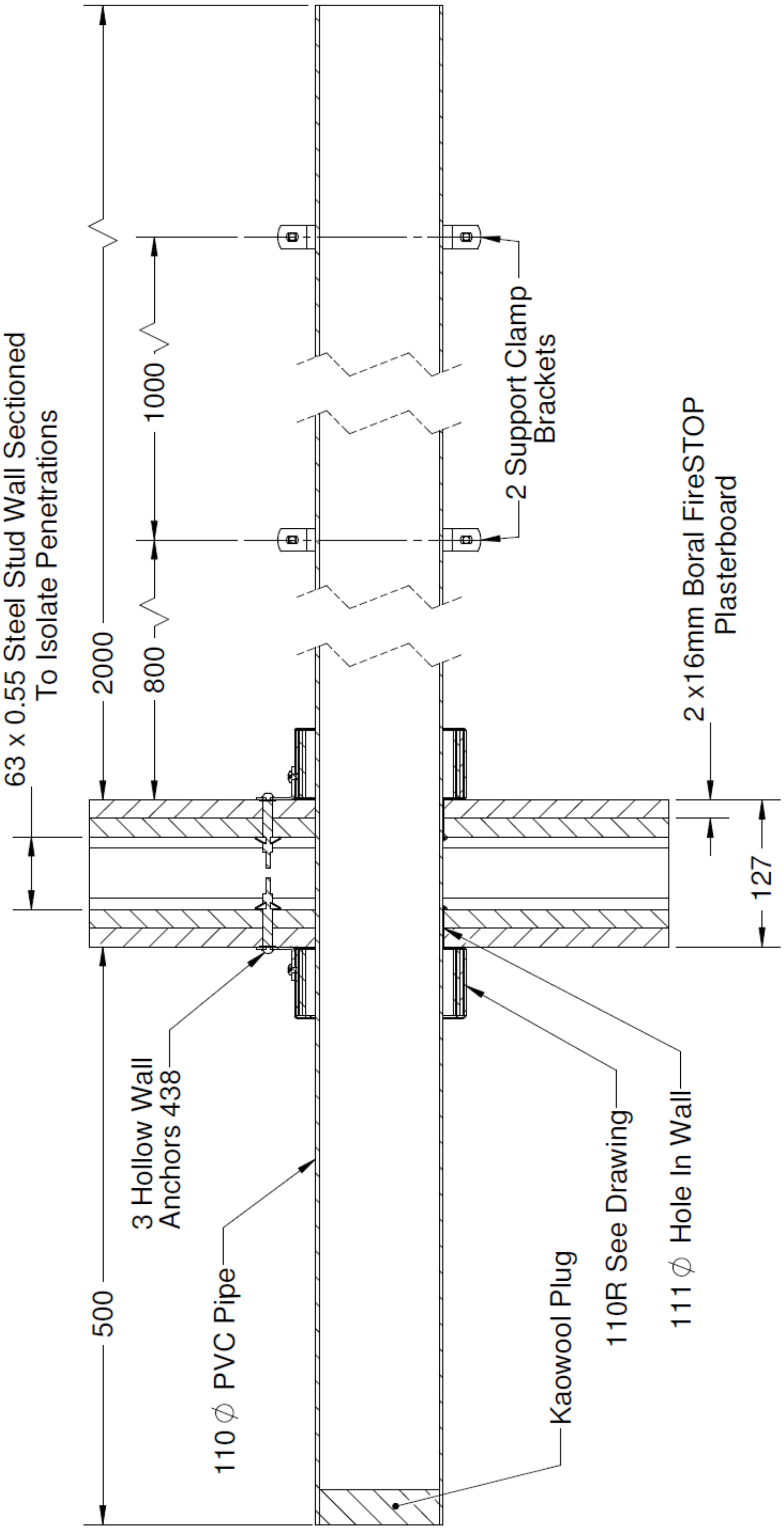


Figure 12: Specimen 8. 100 mm Ø HDPE with 110 R Retro-fit collar

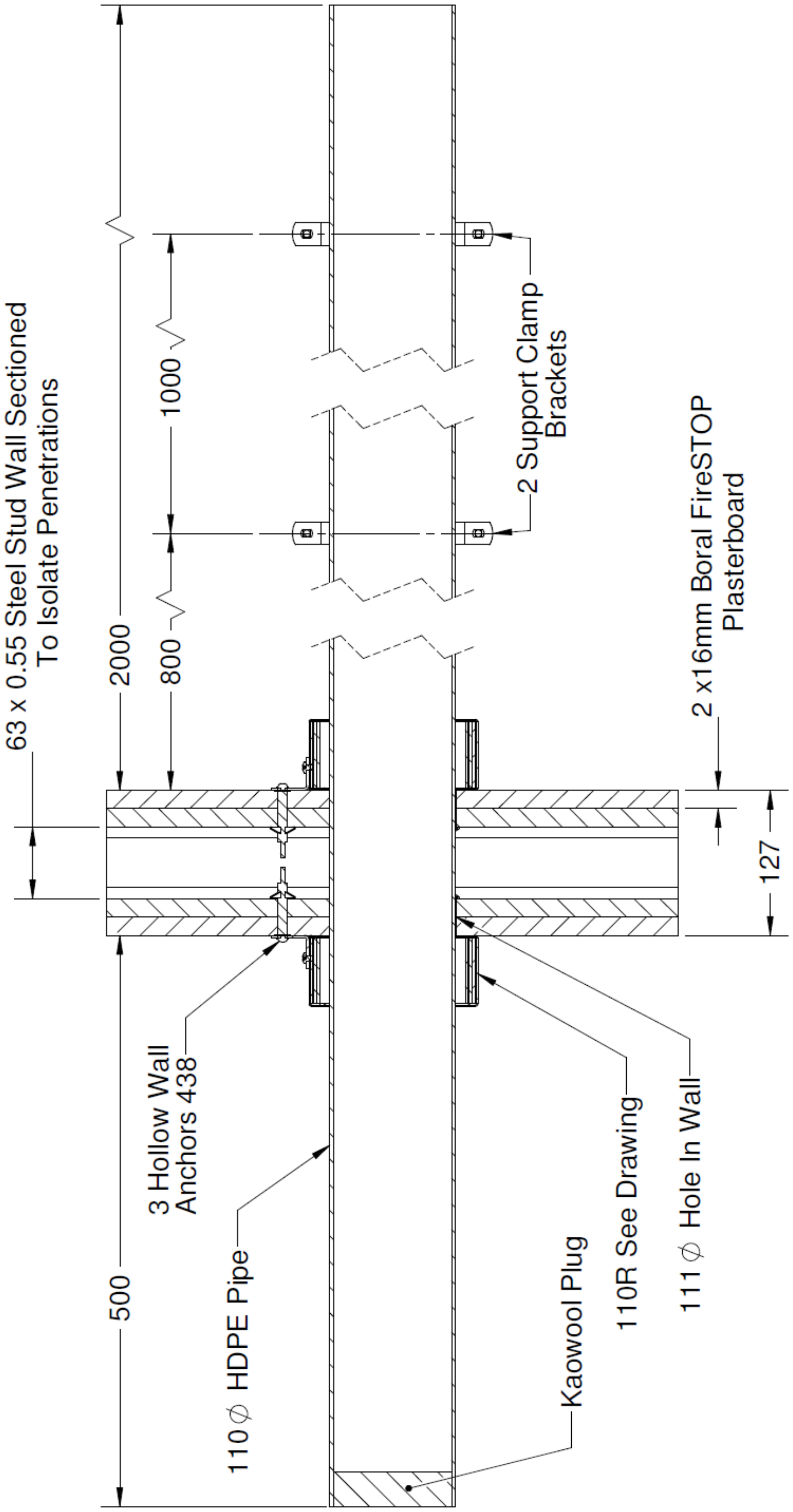


Figure 13: Specimen 9. 80 mm Ø PVCU with 65 - 80 R Retro-fit collar

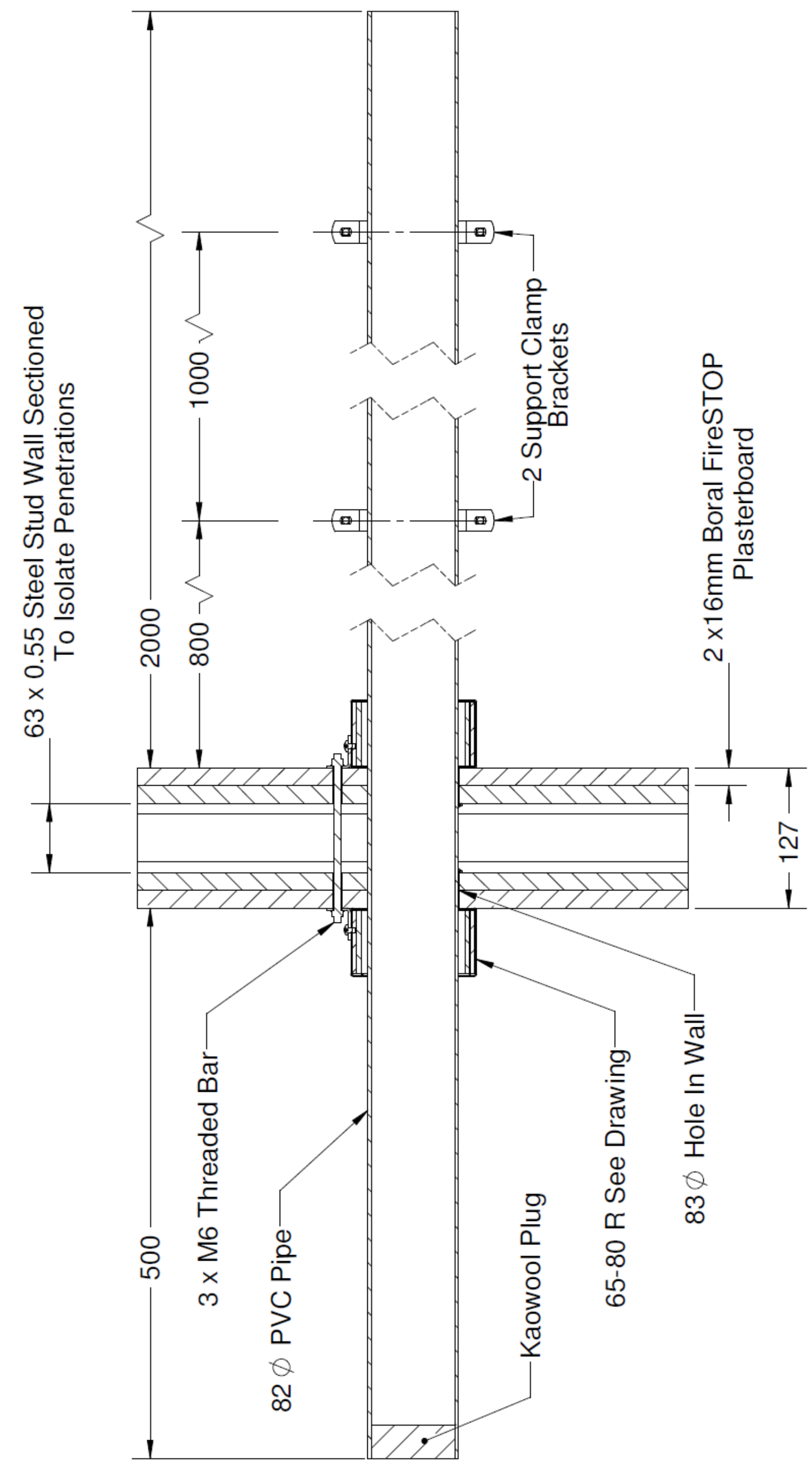


Figure 14: Specimen 10. 65 mm Ø PVCU with 84 R Retro-fit collar

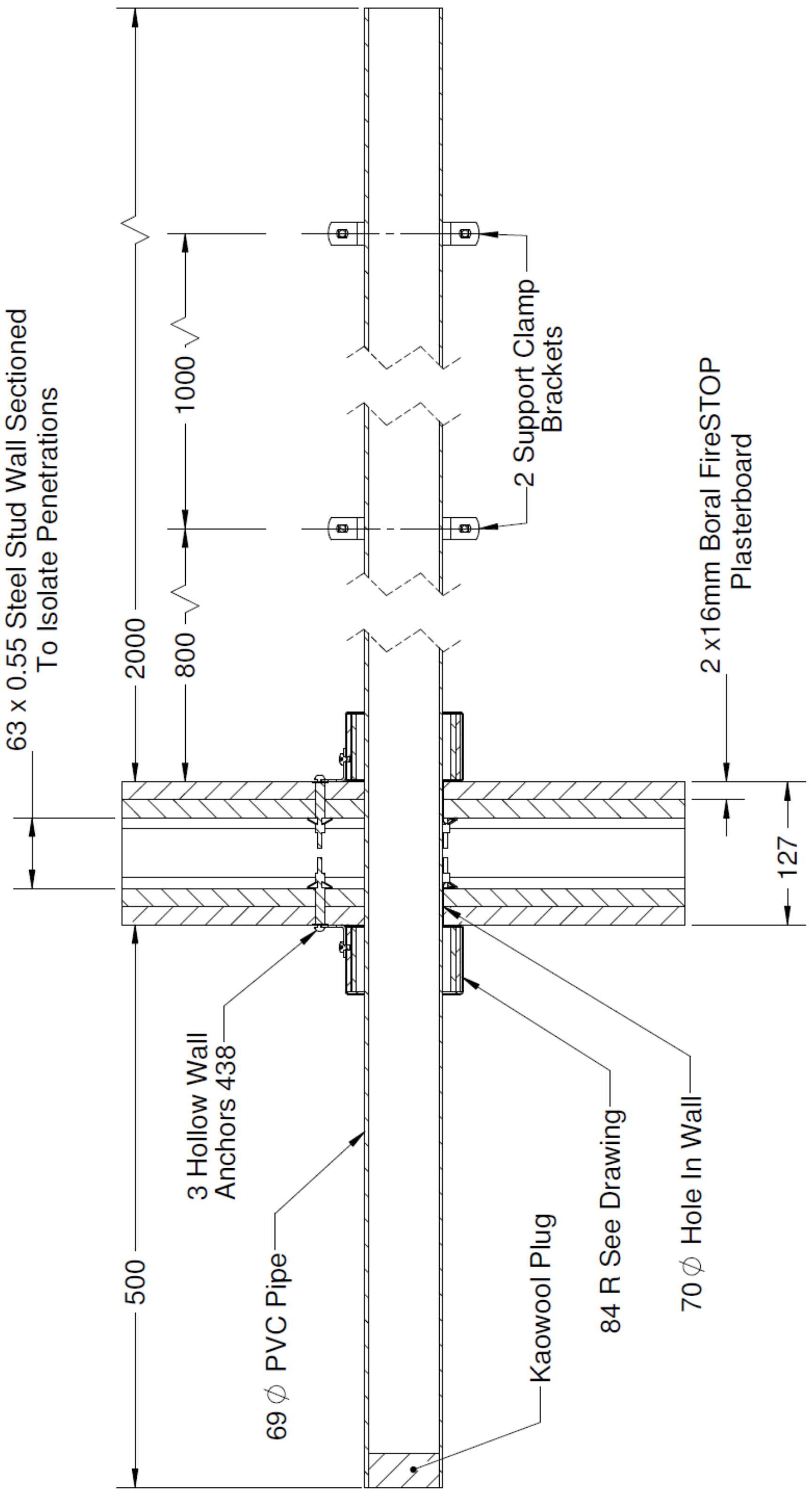
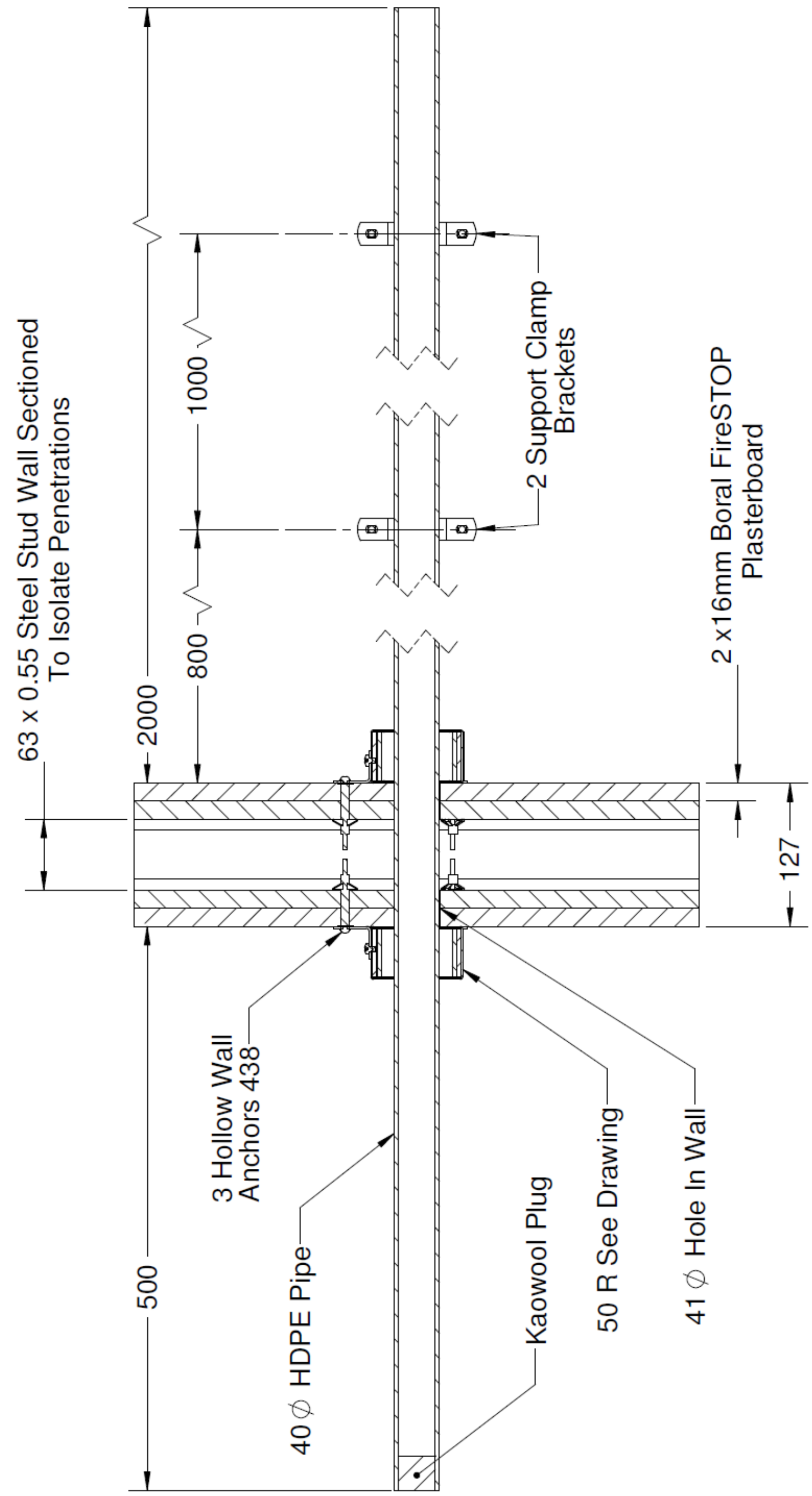


Figure 15: Specimen 11. 40 mm Ø HDPE with 50 R Retro-fit collar



3. TEST CONDITIONS AND RESULTS

3.1 General

The specimen was tested on the 29 May 2012 at BRANZ laboratories, Judgeford, New Zealand, in the presence of a representative of the client. The ambient temperature at the beginning of the test was 11°C.

The concrete slab containing the specimens was placed against the vertical 2,200 mm x 1,000 mm furnace aperture and the temperature and pressure conditions were controlled to the limits defined in AS 1530.4-2005.

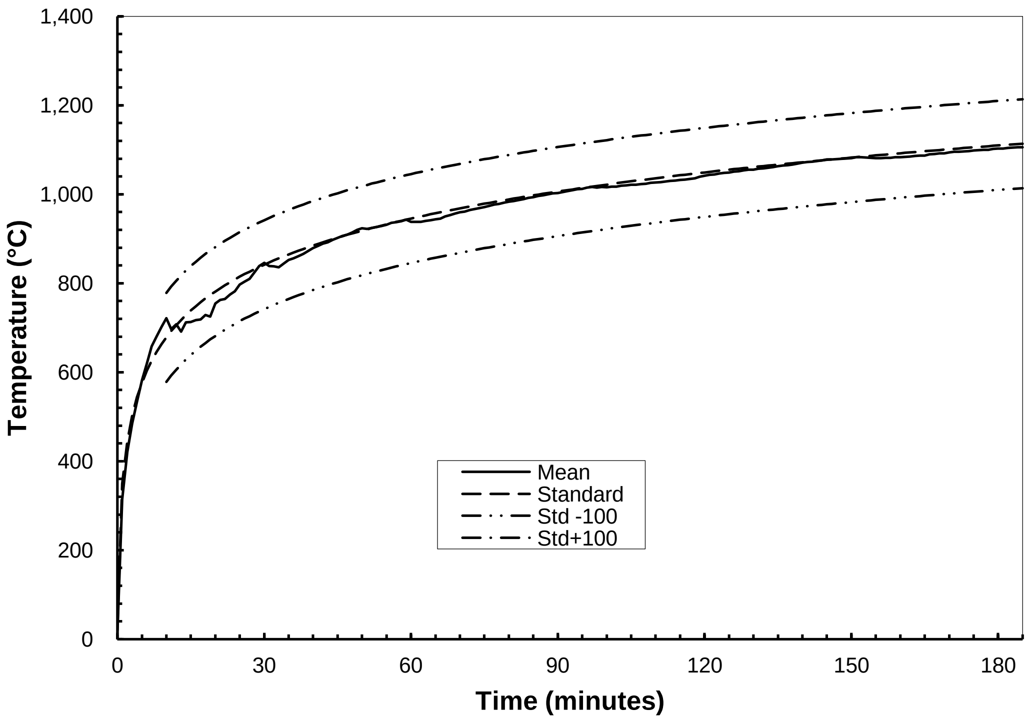
3.2 Furnace Temperature Measurement

The temperature measurement within the furnace was made using twelve mineral insulated metal sheathed (MIMS) chromel-alumel thermocouples distributed uniformly in a vertical plane approximately 100 mm from the exposed face of the separating element. In summary the furnace conditions complied with the test standard.

The furnace thermocouples were connected to a computer controlled data acquisition system which recorded the temperatures at 15 second intervals.

Figure 16 shows the furnace temperature curve and the permitted upper and lower limits in accordance with AS 1530.4: 2005.

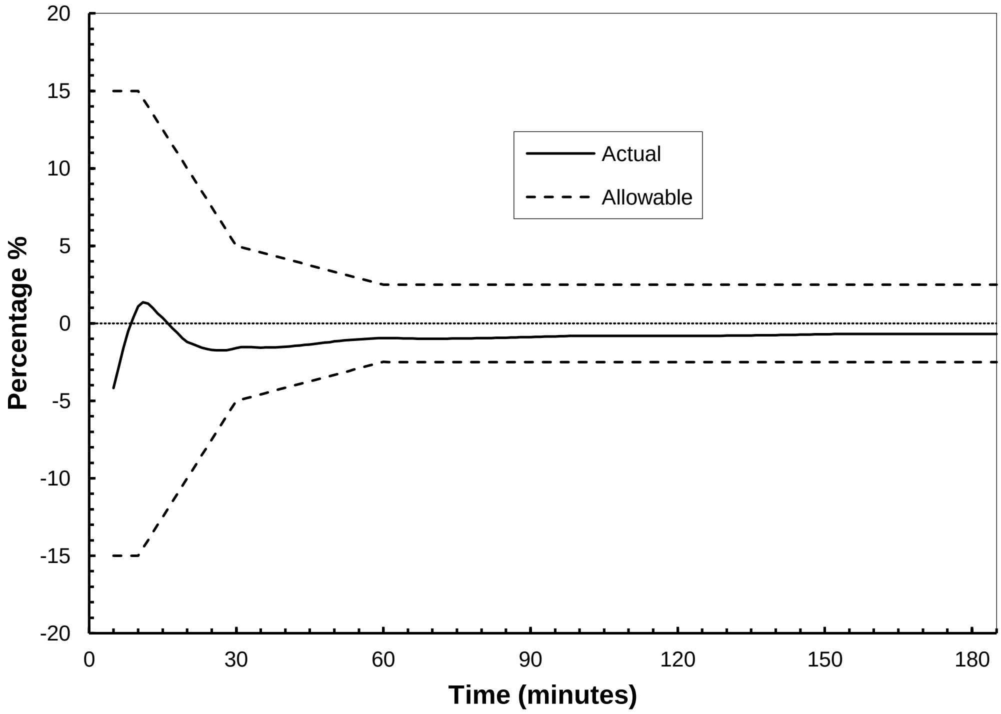
Figure 16: Furnace Temperature



3.3 Furnace Control

The percentage deviation of the furnace mean temperature from the standard time temperature curve is shown in Figure 17 and was within the standard requirements.

Figure 17: Percentage Deviation of the Mean Furnace Temperature from the Standard Curve



3.4 Pressure Measurements

The differential pressure was controlled to be not less than 15 Pa at the centre of the lowest pipe penetration. The differential pressure was monitored using a micromanometer connected to a computer controlled data acquisition system which recorded the pressure at 15 second intervals.

The furnace pressure was monitored and controlled during the test so that the calculated pressure at the probe does not deviate as follows:

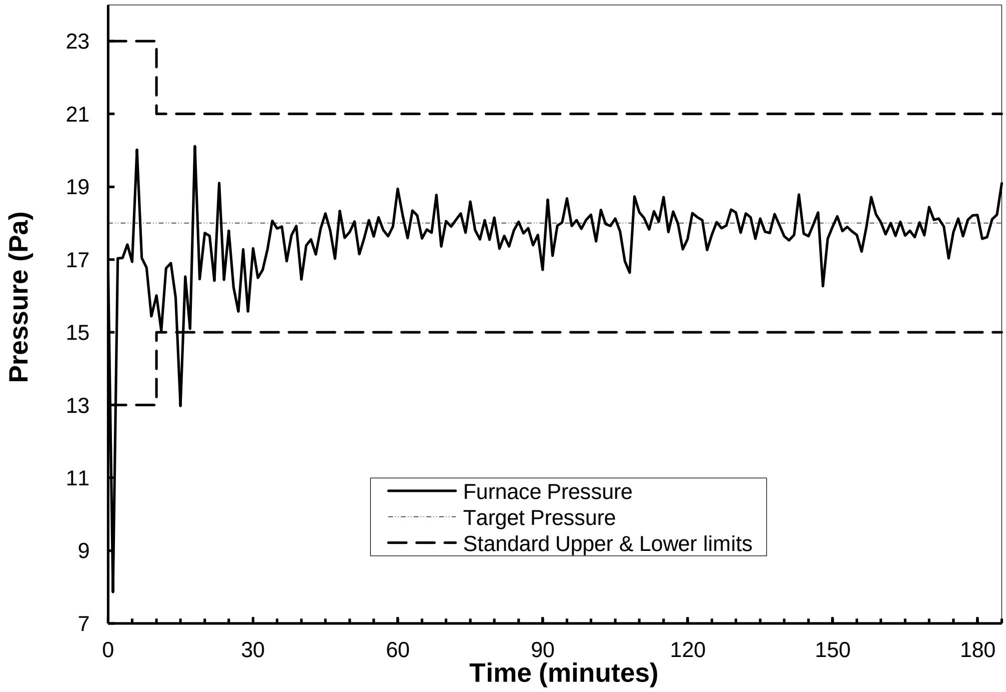
for $5 < t < 10$ minutes - ± 5 Pa

for $t \geq 10$ minutes - ± 3 Pa.

The pressure sensor was located 400 mm above the centre of specimen 1 and 7.

A minor pressure deviation outside of the lower limits occurred on a single occasion, this minor variation is not considered to have impacted on the test result.

Figure 18: Furnace Pressure



3.5 Specimen Temperature Measurement

To monitor heat conduction through the sealing systems, fifty four chromel-alumel thermocouples were attached to the specimens. The arrangement consisted of thermocouples placed as specified in clause 10.5 of the test standard AS 1530.4-2005.

Thermocouples were placed on the unexposed surface of the wall 25 mm from the collar, on the collars and on the pipes at 25 mm from the collar. Two additional thermocouples were placed on the unexposed surface of the wall clear of any of the penetrations.

All the thermocouples described above were connected to a computer controlled data acquisition system which recorded the temperatures at 15 second intervals.

3.6 Specimen Insulation

Specimen 1:	The temperature rise exceeded 180K on the top of the collar after 162 minutes.
Specimen 4:	The temperature rise exceeded 180K on the top of the pipe after 123 minutes.
Specimen 5:	The temperature rise did not exceed the 180K criterion for the duration of the test. The maximum temperature recorded was 148K rise at the top of the collar after 185 minutes.

Specimen 6:	The temperature rise exceeded 180K on the top of the pipe after 168 minutes.
Specimen 7:	The temperature rise did not exceed the 180K criterion for the duration of the test. The maximum temperature recorded was 173K rise at the top of the collar after 185 minutes.
Specimen 8:	The temperature rise exceeded 180K on the top of the collar after 140 minutes
Specimen 9:	The temperature rise exceeded 180K on the top of the collar after 167 minutes.
Specimen 10:	The temperature rise exceeded 180K on the top of the collar after 176 minutes.
Specimen 11:	The temperature rise did not exceed the 180K criterion for the duration of the test. The maximum temperature recorded was 84K rise at the top of the collar after 185 minutes.

Figures 19 - 27 show the temperature rise of the pipe, collar and wall for each test specimen.

Figure 28 shows the temperature rise measured by the thermocouples placed on the wall clear of all penetrations.

Figure 19: Specimen 1 Temperature Rise

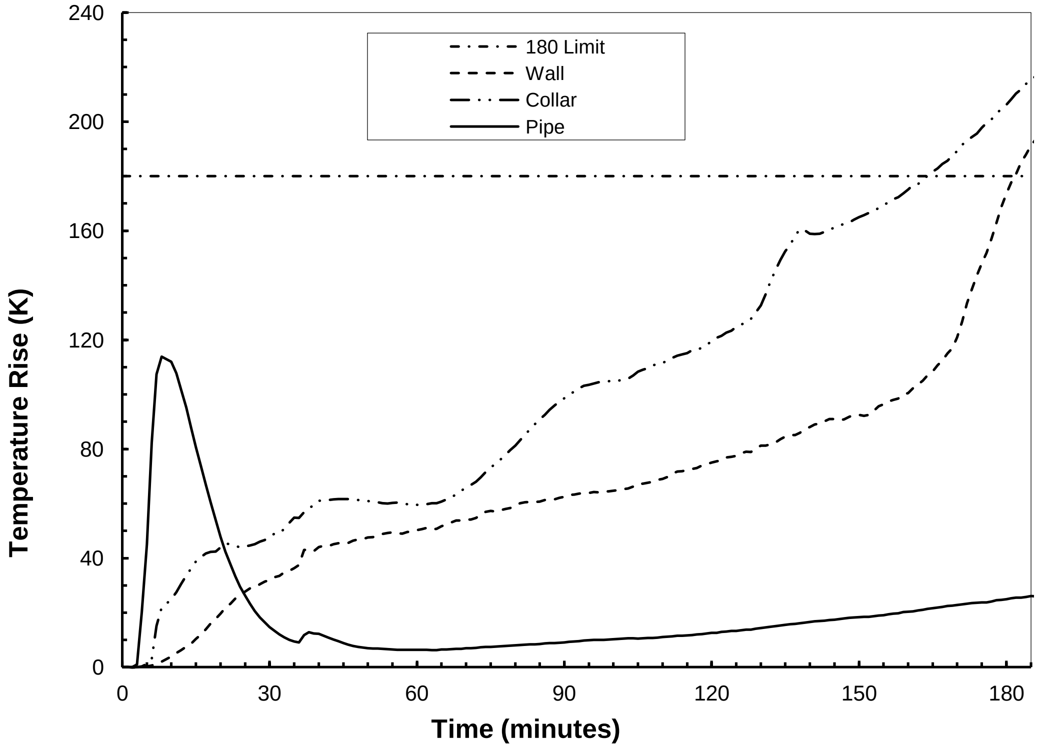


Figure 20: Specimen 4 Temperature Rise

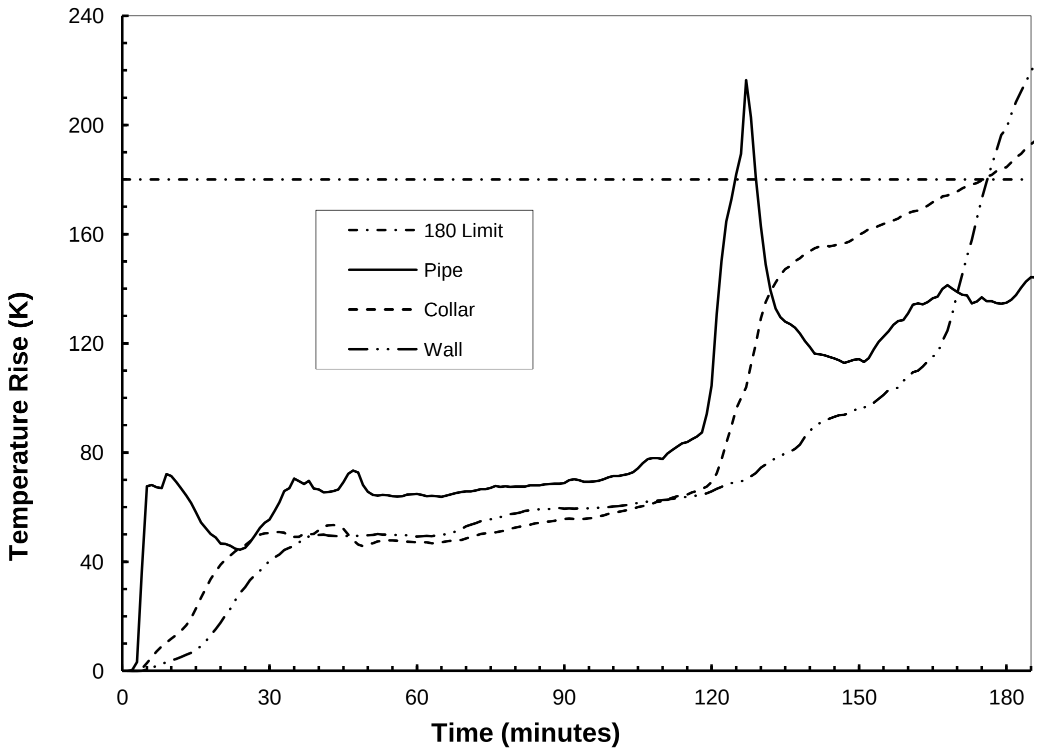


Figure 21: Specimen 5 Temperature Rise

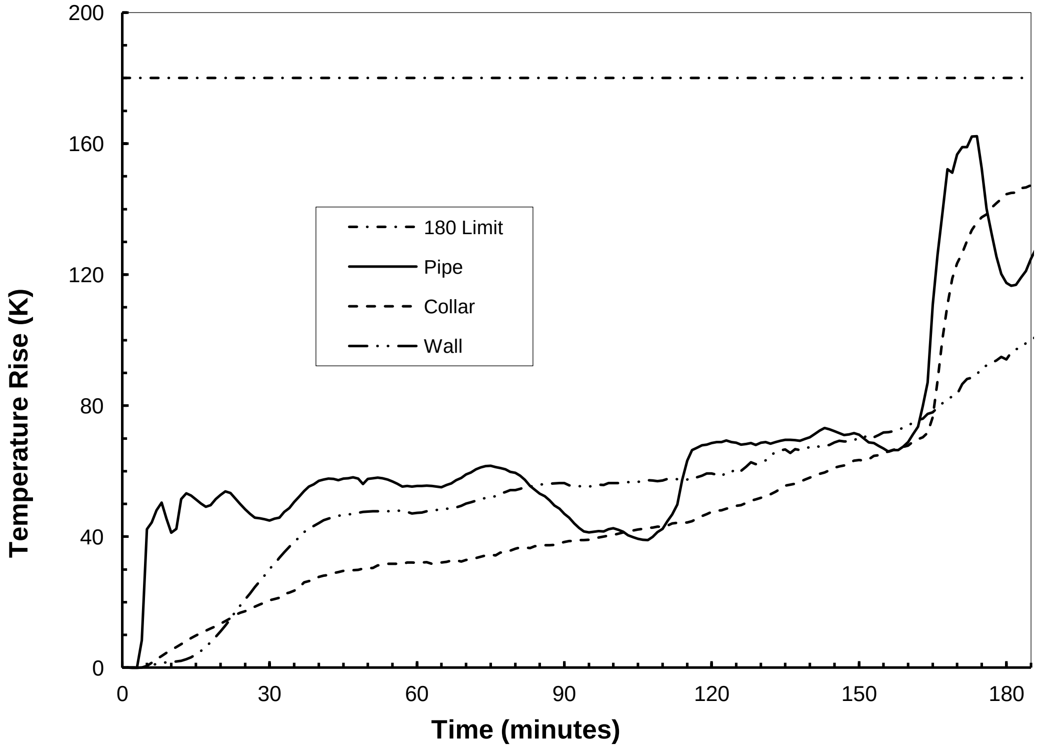


Figure 22: Specimen 6 Temperature Rise

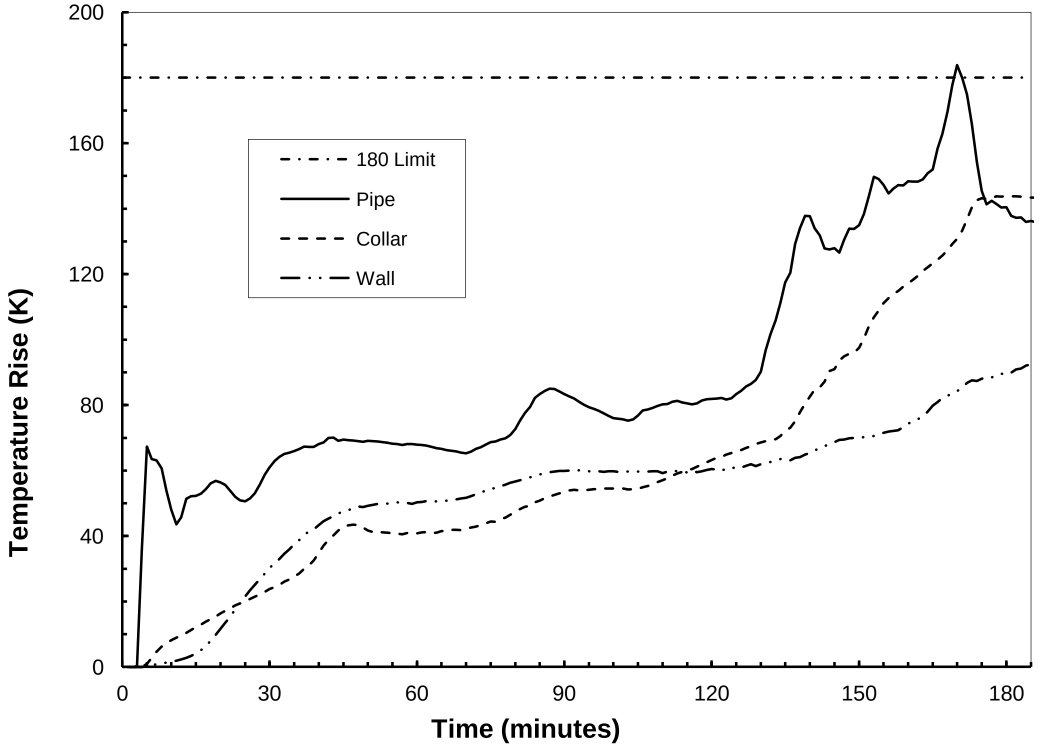


Figure 23: Specimen 7 Temperature Rise

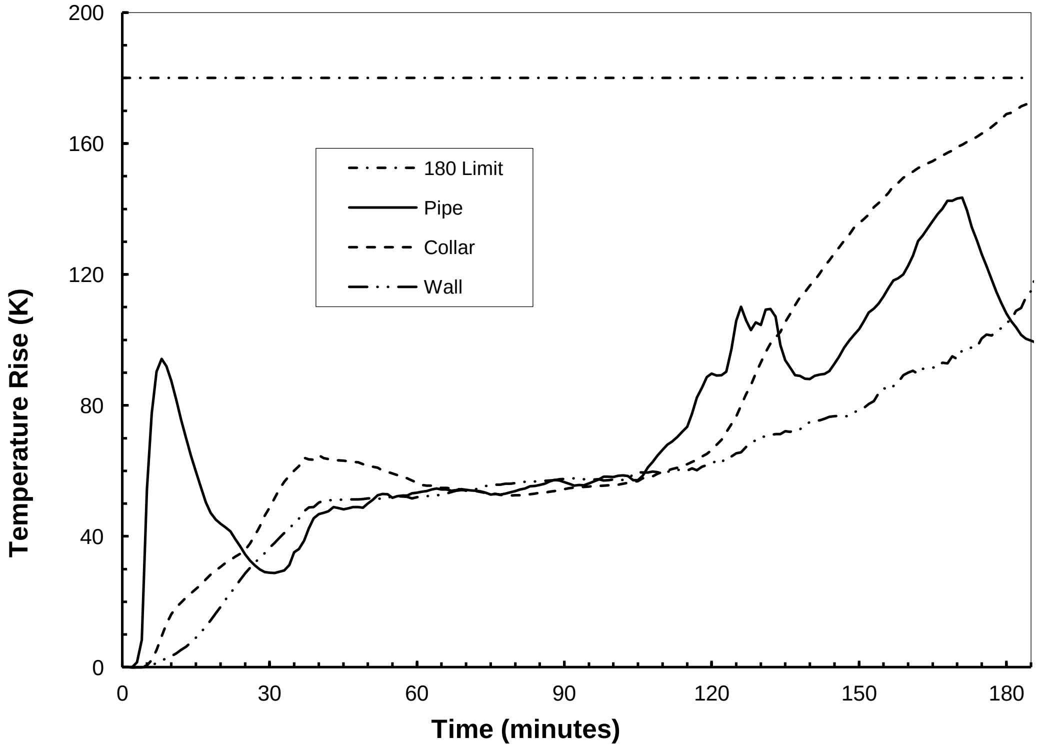


Figure 24: Specimen 8 Temperature Rise

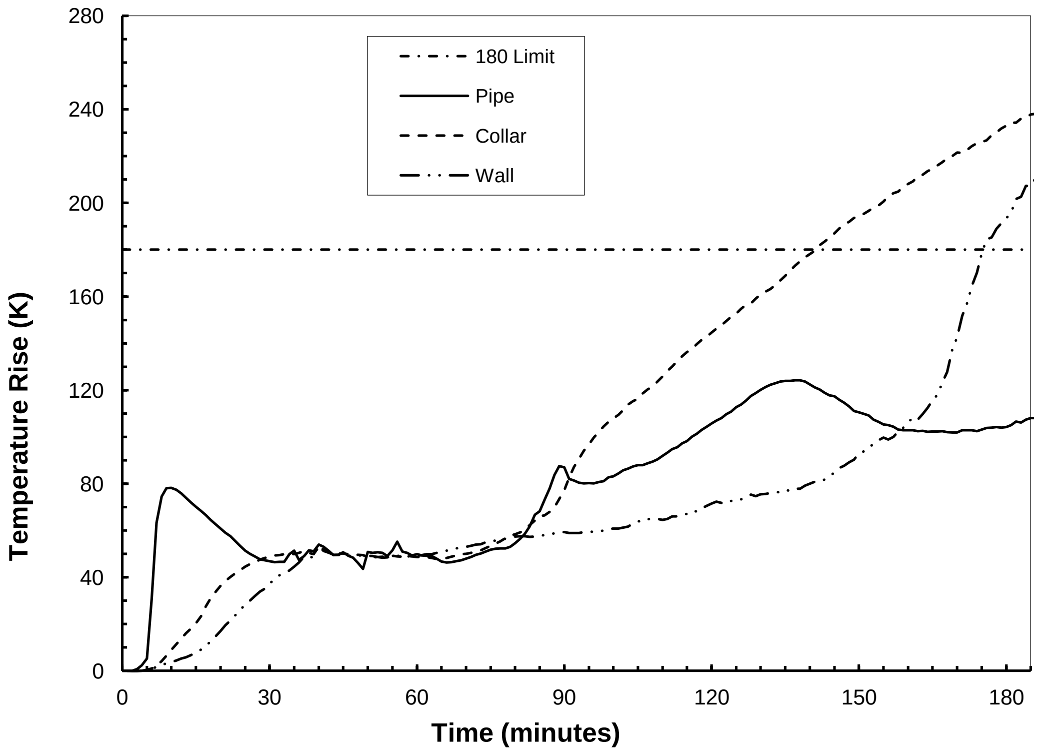


Figure 25: Specimen 9 Temperature Rise

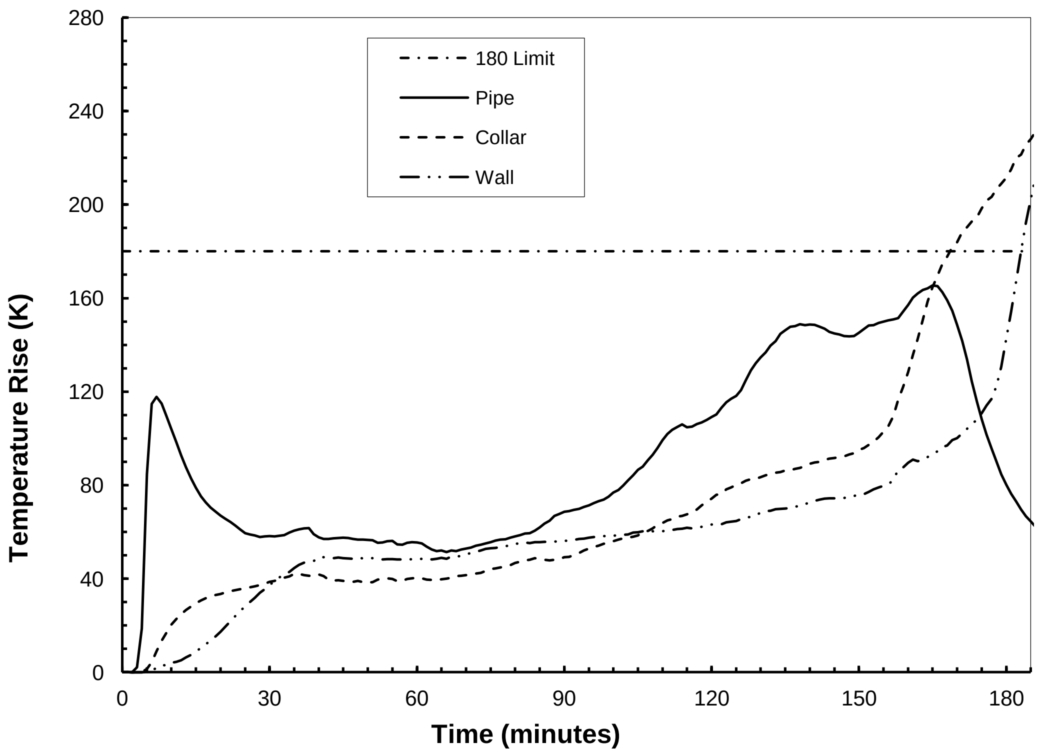


Figure 26: Specimen 10 Temperature Rise

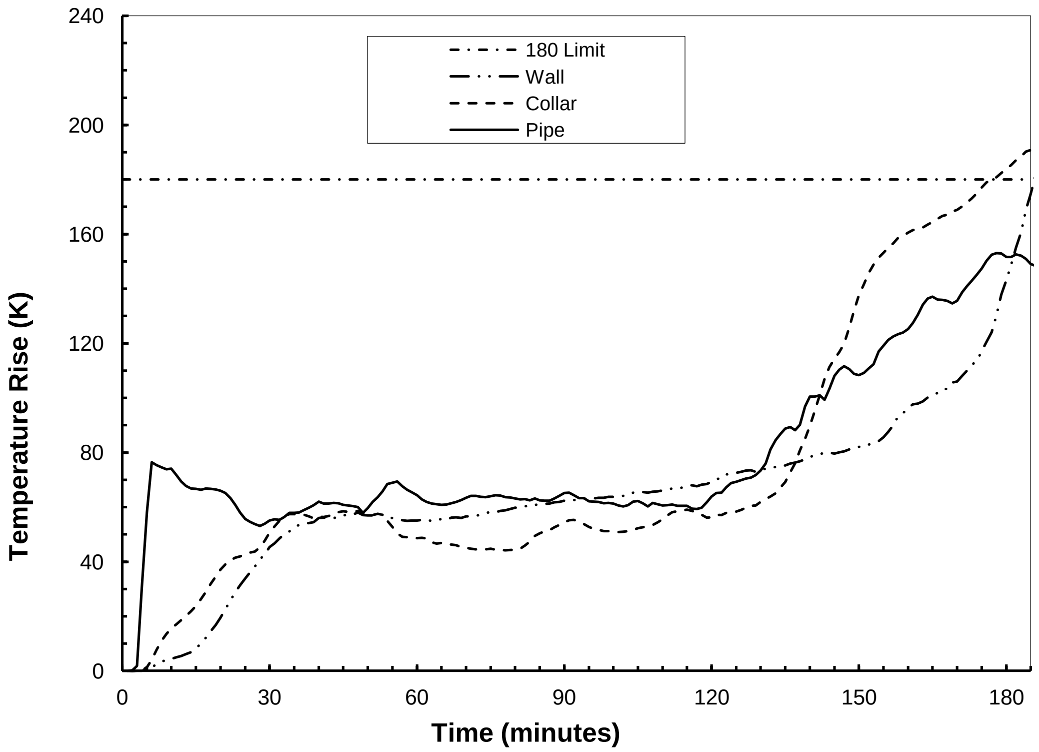


Figure 27: Specimen 11 Temperature Rise

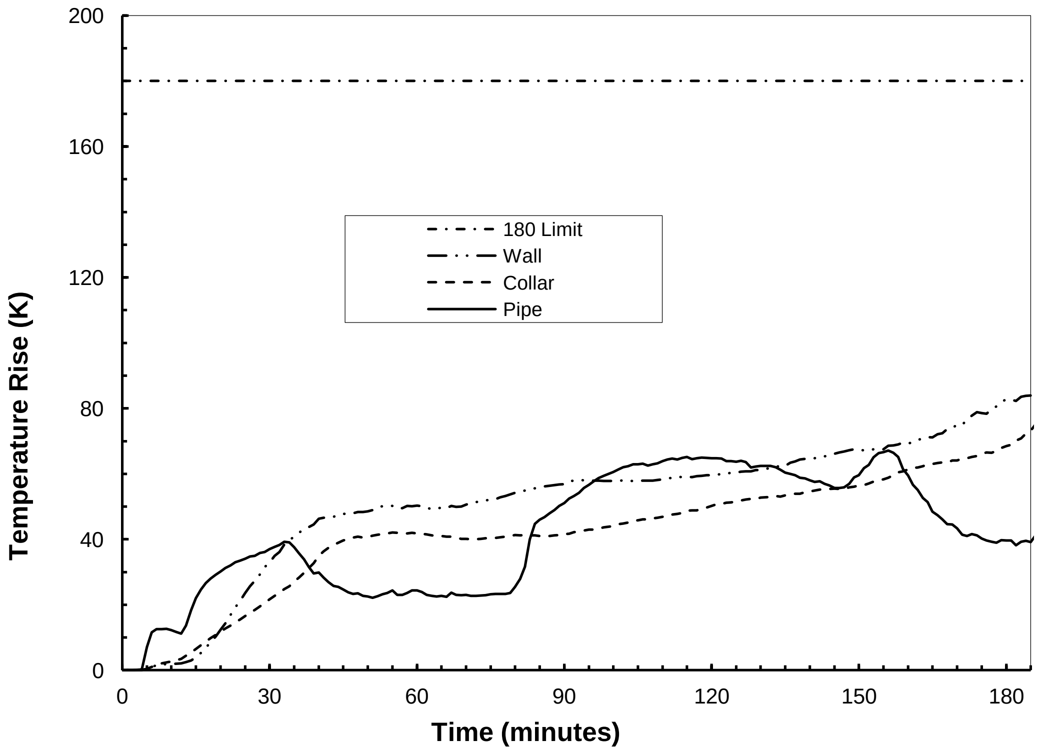
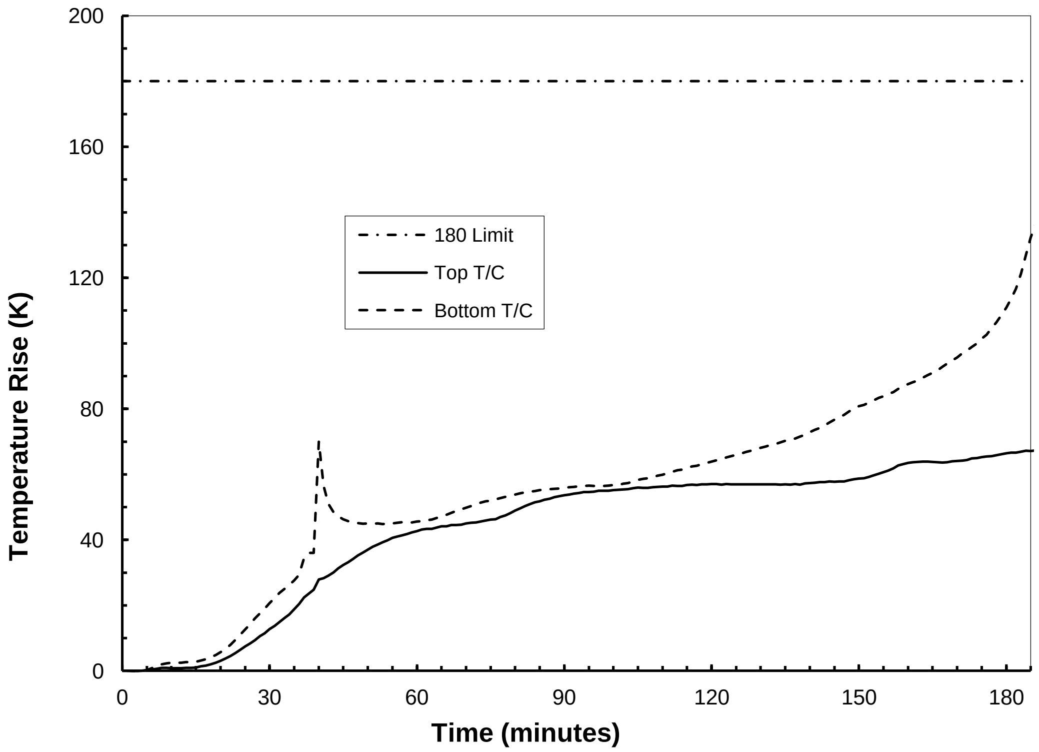


Figure 28: Temperature Rise of the Wall Clear of the Penetrations



3.7 Integrity Observations

Observations related to the integrity performance of the specimens were at the times stated in minutes and seconds.

Table 3: Integrity Observations

Time Min:sec	**Pipe (#)**	**Description**
0:37	8	Smoke was issuing from between the pipe and the collar.
1:54	1, 4, 7, 8 10	Smoke was issuing from the end of pipe No 1 and from between the pipe and the collar of pipe No's 3, 4, 7, 8 & 10.
2:27	9	Smoke was issuing in a steady stream from the end of the pipe.
3:07	5, 7	Smoke was issuing from the end of pipe No 5. Particles were issuing from the end of pipe No 7.
4:04	1, 4, 5, 8 - 11	The smoke issuing from the end of pipe No's 4 & 5 had almost ceased. A steady stream of smoke was issuing from the end of pipe No's 1 & 8. There was a reduction in the volume of smoke issuing from the end of pipe No's 9 & 10. A small volume of smoke was issuing from the end of pipe No 11.

Time Min:sec	**Pipe (#)**	**Description**
5:11	1	Pipe No 1 had softened and had started to sag between the collar and the first clamp, and between the 1st and 2nd pipe clamps. The pipe collapsed within the collar and then continued to sag eventually pulling out of the collar and wall completely. The intumescent within the exposed collar had activated and sealed off the penetration. It was not possible to see into the furnace at this location. The entire unexposed length of the pipe had softened and was hanging between clamps and was no longer attached or entered the wall.
7:06	4, 6, 7, 9	Pipe No 9 had started to sag between the collar and the 1st clamp. Pipe No's 4, 6 & 7 exhibited slight sagging between the collar and their respective 1st clamp.
30:20	7, 8, 10	Smoke was issuing from between the pipe and the collar.
55:32	4, 6 - 10	Smoke was issuing from between the pipe and the collar.
76:35	8	A steady stream of smoke was issuing from between the pipe and the collar.
85:42	8	There was a big increase in the volume of smoke issuing from between the pipe and the collar.
105:14	1	The intumescent from the unexposed collar was continuing to expand and had started to push out from the collar.
107:27	8	The intumescent of the unexposed collar was expanding and distorting the pipe.
109:46	6	Pipe No 6 had sagged where it passes through the unexposed collar at the top of the pipe exposing the intumescent within the collar.
112:56	4 - 7, 9 & 10	Smoke was issuing from the ends of the pipes
140:22	1 & 7	The intumescent from the exposed collar of pipe No 1 had expanded out past the unexposed collar face. Smoke was issuing from between the pipe and the collar of pipe No 7.
143:05	6	Smoke was issuing from the end of the pipe.
145:18	7 & 8	The intumescent in the unexposed collars had started to activate
151:19	7	Smoke and particulate matter was issuing from the end of the pipe

Time Min:sec	Pipe (#)	Description
154:08	8 - 10	The paper facing on the wall was charred where the top fastening of the collar was attached to the wall
154:58	7	The pipe had distorted further where it passed into the unexposed collar creating a flat top to the pipe at this location
157:20	4, 6, 9 & 10	Pipe No's 4 & 10 had distorted further where they passed into the unexposed collar, creating a flat top. Smoke was issuing from between the pipe and the collar of pipe No's 6 & 9, the unexposed collar was starting to intumesce.
185:00		Test Stopped

3.8 Specimen Integrity

None of the specimens failed the integrity criteria for the 185 minute duration of the test.

3.9 Test Result

The fire resistance in minutes, in accordance with AS 1530.4-2005 with reference to AS 4072.1–2005, of nine pipe penetrations and their sealing systems in a steel framed plasterboard wall, was as follows:

All the collars are Retro-fit type.

* = PVC-U pipe sandwich construction

NF = No failure for the duration of the test.

Table 4: Test Result

No.	Collar Designation	Pipe Designation	Integrity (Minutes)	Insulation (Minutes)	FRL
1	110R	100 PVC-U SC DWV* (With Elbow socket in collar)	185NF	162	-/180/120
4	63R	50 PVC-U DWV	185NF	123	-/180/120
5	50R	40 PVC-U DWV (With Elbow socket in collar)	185NF	185NF	-/180/180
6	50R	40 PVC-U DWV	185NF	168	-/180/120
7	110R	100 PVC-U SC DWV*	185NF	185NF	-/180/180
8	110R	110 mm x 4.3 mm PE100 SDR 26	185NF	140	-/180/120
9	65-80R	80 PVC-U DWV	185NF	167	-/180/120
10	84R	65 PVC-U DWV	185NF	176	-/180/120
11	50R	40 mm x 3 mm PE80 S12.5	185NF	185NF	-/180/180

"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 procedure outlined in this standard. any significant variation with respect to size, constructional details, loads, stresses, edge or end conditions, other than those allowed under the field or direct application in the relevant test method, is not covered by this report.

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."

4. PERMISSIBLE VARIATIONS

Taken from AS 1530.4 -2005 as applicable to this test specimen.

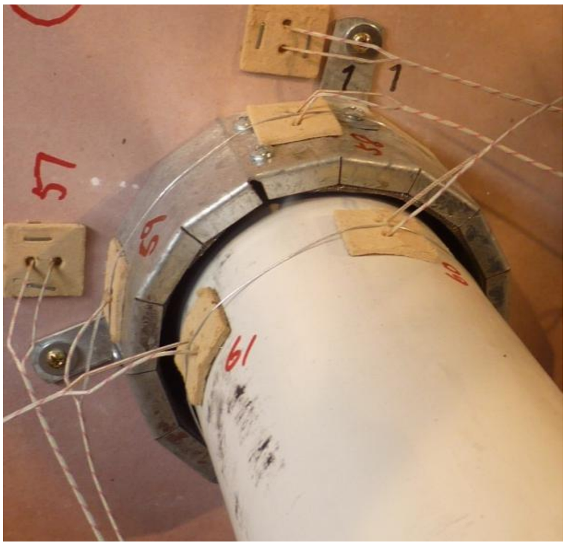
The results of the fire test contained in the test report are directly applicable without reference to the testing authority to similar constructions where one or more of the changes set out in Clauses 10.11.2 to 10.11.6 have been made.

1. Results obtained from framed wall systems may be applied as follows:
   a. The results of the prototype test may be applied to concrete, masonry or solid gypsum blocks greater or equal to 128 mm thick.
   b. The test results may be applied to similar wall systems having studs of the same material with sizes greater than 64 mm x 0.55 BMT.
   c. The test results may be applied to similar wall systems having facings thicker than 32 mm.
   d. 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.

5. SPECIMEN PHOTOGRAPHS

5.1 Specimen 1

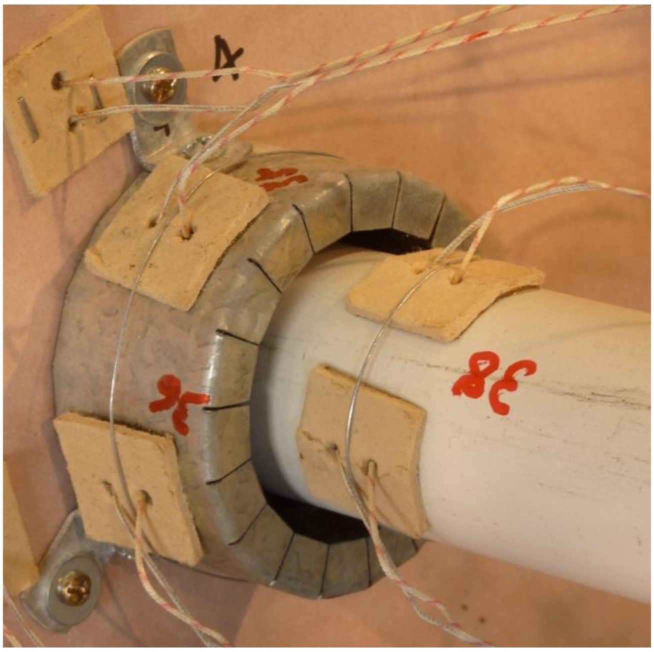
Unexposed Face



Exposed Face

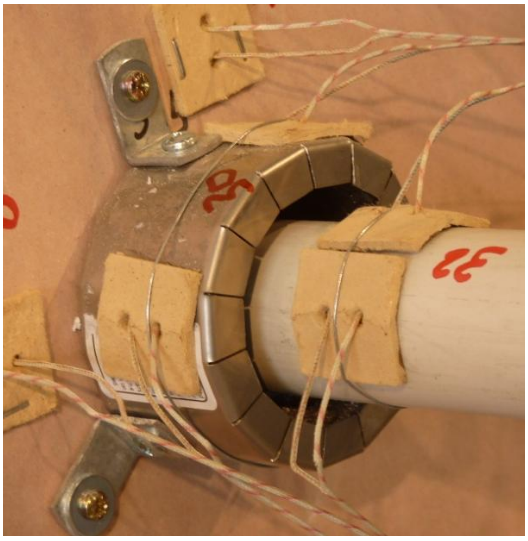
5.2 Specimen 4

Unexposed Face



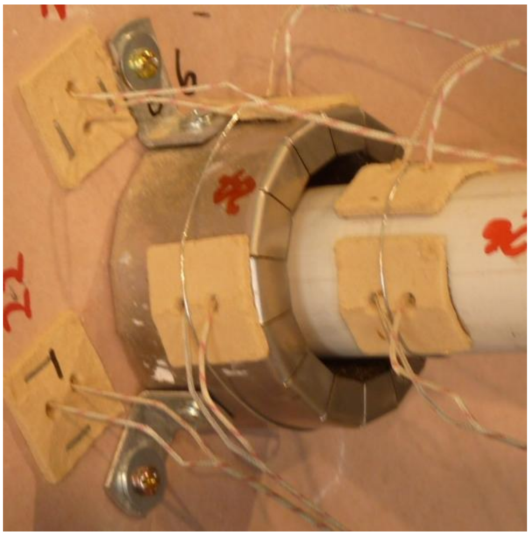
5.3 Specimen 5

Unexposed Face | Exposed Face



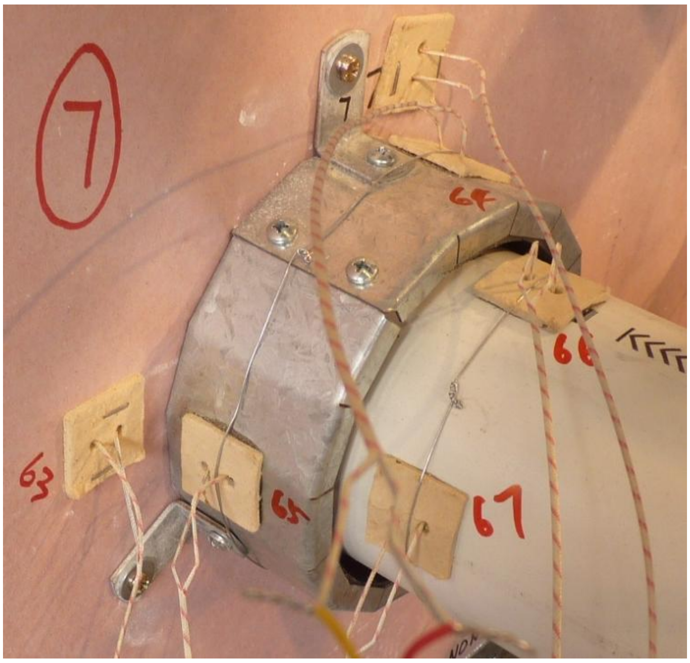
5.4 Specimen 6

Unexposed Face



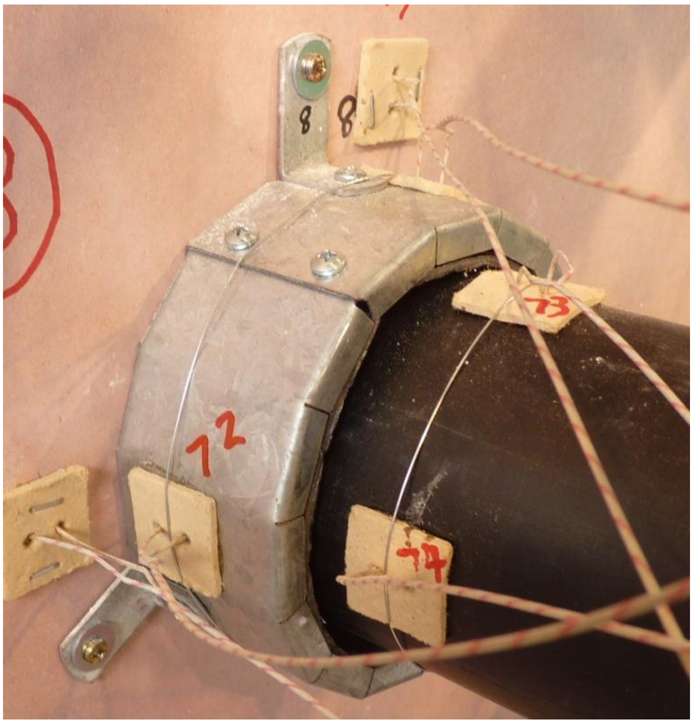
5.5 Specimen 7

Unexposed Face



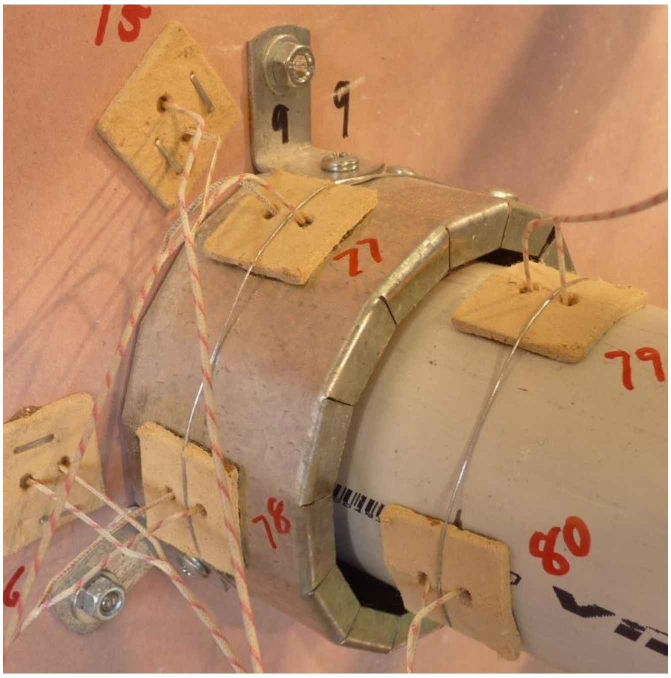
5.6 Specimen 8

Unexposed Face



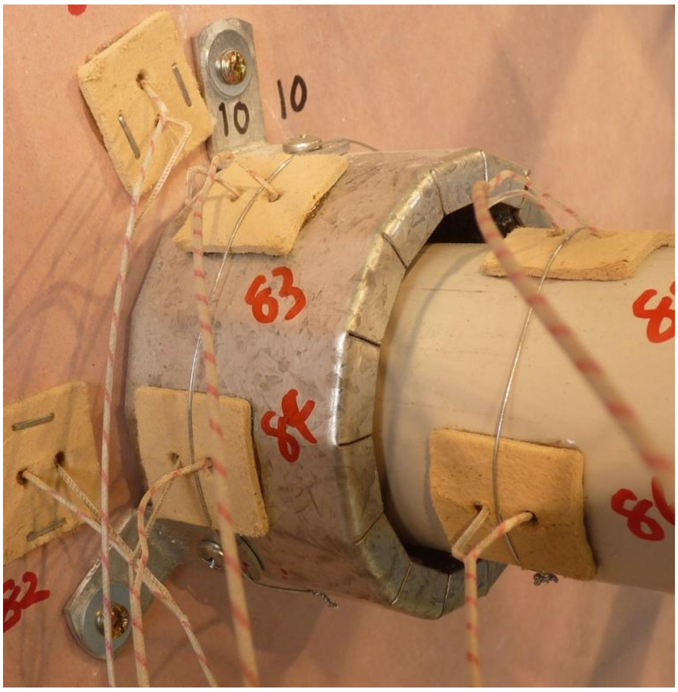
5.7 Specimen 9

Unexposed Face



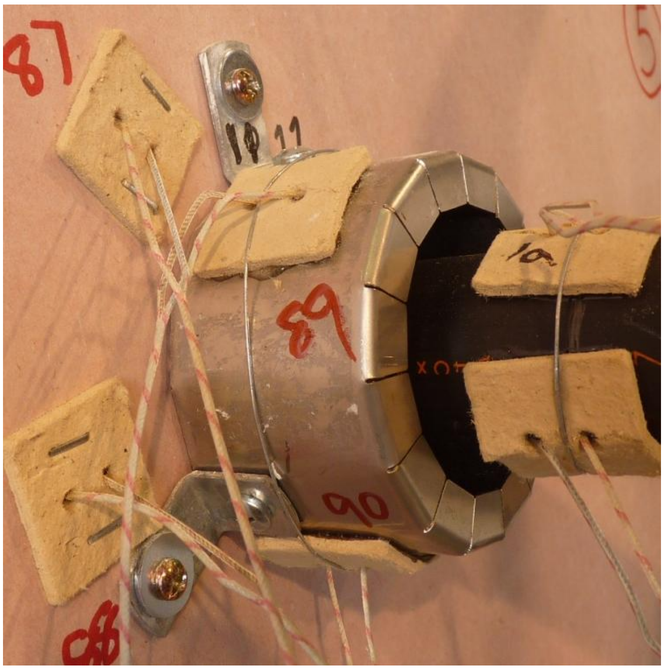
5.8 Specimen 10

Unexposed Face



5.9 Specimen 11

Unexposed Face



5.10 Exposed Face of Wall at End of the Test