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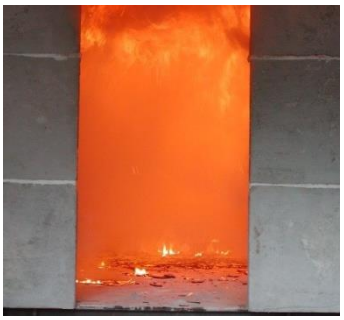

FIRE TEST REPORT

FP 5663

FIRE RESISTANCE OF PIPE PENETRATIONS IN A 60 MINUTE PLASTERBOARD WALL

CLIENT
Snap Fire Systems Pty Ltd
Building A
1343 Wynnum Road
Tingalpa, 4173 QLD
Australia

This Laboratory is accredited by International Accreditation New Zealand (IANZ). The tests reported herein have been performed in accordance with the laboratory's scope of accreditation.

TEST SUMMARY

Objective

To determine the fire resistance of pipe penetration sealing systems in accordance with AS 1530.4-2005 *Fire Resistance tests of elements of building construction: Section 10 Service Penetrations and Control Joints,* with reference to AS 4072.1-2005

Test sponsor

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

Description of test specimen

The test wall consisted of 16 mm thick Fyrestop plasterboard secured over 64 mm deep steel studs. The overall dimensions of the wall measured 2,200 x 1,000 mm.

The wall was fitted with 10 pipe penetration collars which were placed over pre-drilled holes. The pipes ranged in diameter from 20 mm to 110 mm OD and the materials included Pex-Al-Pex, PVC and HDPE. All pipes were fitted with Snap pipe collars comprising a galvanised steel sleeve with an intumescent wrap inserted in the annular space between the pipe and the sleeve to both the exposed and unexposed faces of the wall.

Date of test

28th July 2015

Test results

The fire resistance in minutes, in accordance with AS 1530.4-2005, of 10 pipe penetrations and their sealing systems in a plasterboard wall, was as follows:

Specimen No.	Collar	Pipe	Size (Nom, mm)	Integrity, min	Insulation, min	FRL
1	32Gas	Gas Pex	20	91NF	86	-/90/60
2	32R	PVC U*	25	91NF	73	-/90/60
3	32R	Electrical Conduit	25	91NF	63	-/90/60
4	50R	PVC U	40	91NF	61	-/90/60
5	50R	HDPE	40	91NF	68	-/90/60
6	50R	PVC U	50	91NF	75	-/90/60
7	63R	PVC U	65	91NF	73	-/90/60
8	65-80R	PVC U	80	91NF	76	-/90/60
9	110R	PVC U	100	91NF	66	-/90/60
10	110R	HDPE	110	91NF	62	-/90/60

* AS/NZS 1477: 2006. PVC pipes and fittings for pressure applications.
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 recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions."

"This report details methods of construction, the test conditions and results obtained when the specific element of construction described herein was tested following the procedure outlined in this standard. Any significant variations 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 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."

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.

NATA

IANZ

TO WHOM IT MAY CONCERN

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(ii) accepts, for its own purposes, endorsed* certificates or reports issued by organisations accredited by other signatories on the same basis as it accepts endorsed* certificates or reports issued by its own accredited organisations,

(iii) recommends and promotes the acceptance by users in its economy of endorsed* certificates and reports,

* *The word "endorsed" means a certificate or report bearing an Arrangement signatory's accreditation symbol (or mark) preferably combined with the ILAC-MRA Mark.*

Signed:

Jennifer Evans
NATA CEO

Date: 24 March 2014

Dr Llewellyn Richards
IANZ CEO

Date: 24th March 2014

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IANZ Approved Signatory

DOCUMENT REVISION STATUS

ISSUE NO.	DATE ISSUED	DESCRIPTION
1	19 March 2016	Initial Issue

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 tests of elements of construction", Section 10 Service penetrations and control joints*, 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;

a) If flaming on the unexposed surface of the specimen is sustained for longer than 10 seconds; or

b) 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.

2. DESCRIPTION OF TEST SPECIMEN

2.1 General

The vertical separating element consisted of a steel framed wall nominally 2,200 mm high x 1,000 mm wide. One layer of 16 mm thick Firestop plasterboard was installed on the exposed and unexposed face of the wall. The framing consisted of nominal 64 mm x 0.5 mm base metal thickness (BMT) steel studs at nominally 510 mm centres with nogs at intervals of firstly 400 mm, then 325 mm centres from the top of the wall. The framing was screwed together with 6g x 12 mm pan head TEK screws. The plasterboard was screwed fixed to the steel frame with wallboard screws measuring 6g x 32 mm.

There were a total of 10 pipe specimens, all the pipe specimens passed through the wall perpendicular to the face. All dimensions are nominal unless stated otherwise.

A drawing of the layout is included in this report as Figure 7. All pipes protruded a minimum of 430 mm into the furnace and at least 2,040 mm from the unexposed face. All pipes were plugged with kaowool on the exposed face and were open on the unexposed face.

2.2 Penetration details

2.2.1 Pipe support spacing

All pipes were supported at nominal distances from the wall of 800 and 1,800 mm with pipe clamps which were in turn attached to a steel frame.

2.2.2 Pipe specification

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

Table 1: Specimen pipe details

Speci-men no.	Hole in wall size (mm)	Nominal size of pipe	Diameter (actual) x wall thickness (mm)	Pipe Material	Pipe (Unex/Ex)
1	21.5	20	20.2 x 2.6	Gas Pex	Open/capped
2	37	25	33.5 x 2.0	PVC U*	Open/capped
3	25	25	24.8 x 1.8	Electrical Conduit	Open/capped
4	44	40	43.0 x 2.3	PVC U	Open/capped
5	43.5	40	40.3 x 3.3	HDPE	Open/capped
6	61	50	56.1 x 2.4	PVC U	Open/capped
7	70.5	65	69.3 x 3.2	PVC U	Open/capped
8	84.5	80	82.9 x 3.4	PVC U	Open/capped
9	113	100	110.8 x 3.5	PVC U	Open/capped
10	113	110	110.2 x 5	HDPE	Open/capped

* AS/NZS 1477: 2006. PVC pipes and fittings for pressure applications.

2.2.3 Penetration seal details

The pipe collar details are presented in Table 2 and photographs of the collars in Figure 1 to Figure 6. The collars were fixed to each side of the plasterboard wall with hollow wall anchors designated as HWA4SL by Powers Fasteners and washers measured as 15 x 1.2 x 5.5 mm diameter hole.

Table 2: Pipe collars and intumescent

Specimen no.	Pipe Size (Nom mm)	Product Code	Intumescent Material (# x width x thickness)
1	20	Gas32	2 x (60 x 4)
2	25	32R	2 x (25 x 4)
3	25	32R	2 x (25 x 4)
4	40	50R	2 x (60 x 4)
5	40	50R	2 x (60 x 4)
6	50	50R	2 x (60 x 4)
7	65	63R	2 x (60 x 4)
8	80	65-80R	2 x (60 x 4)
9	100	110R	3 x (60 x 4)
10	110	110R	3 x (60 x 4)

Figure 1: Specimen 1 collar for gas pipe, Gas32

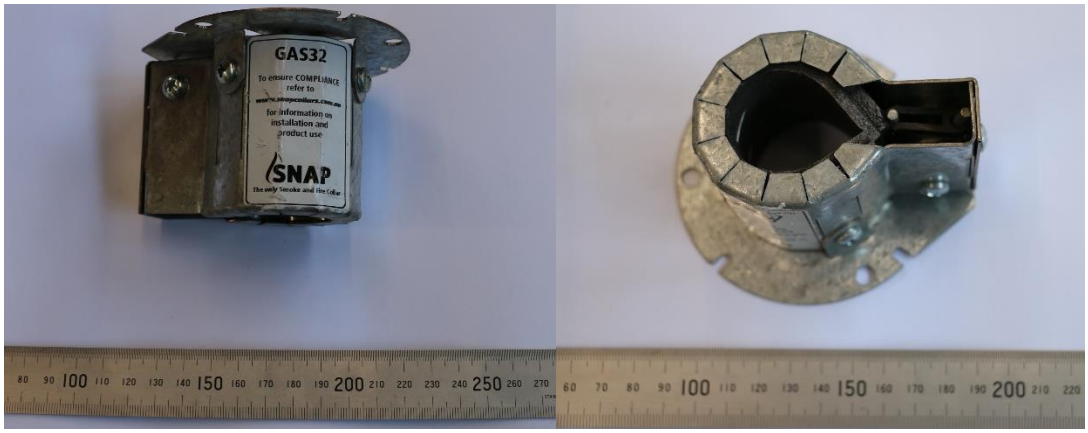


Figure 2: Specimen 2 and 3 collars, 32R

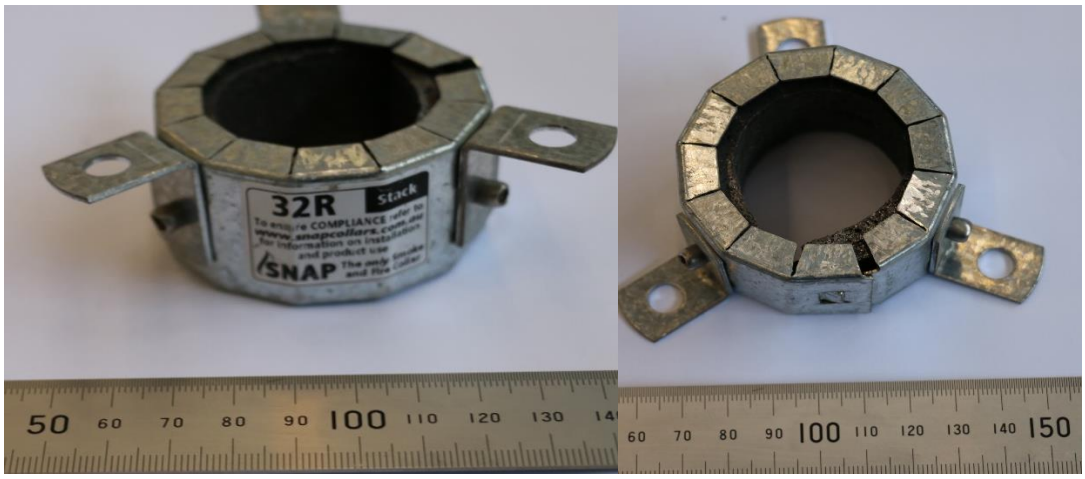


Figure 3: Specimens 4 to 6 collars, 50R

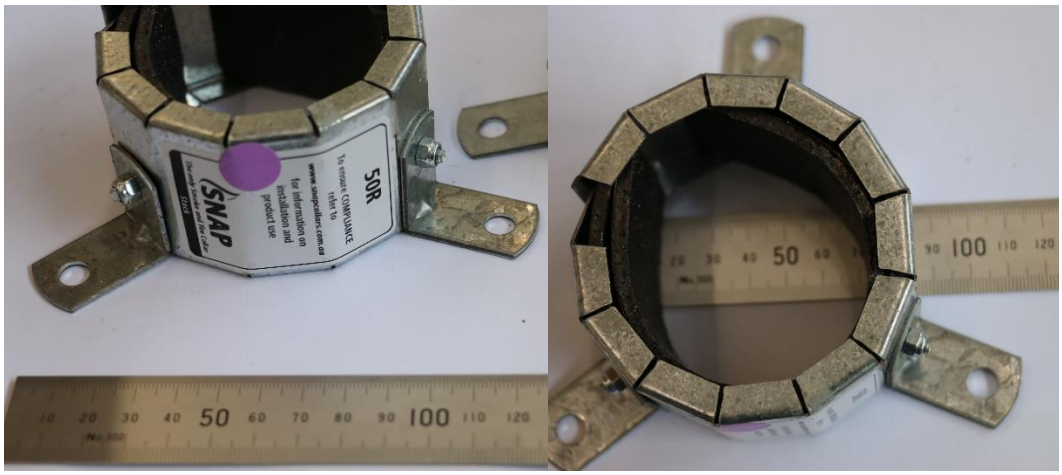


Figure 4: Specimen 7 collar, 63R

Figure 5: Specimen 8 collar, 65-80R

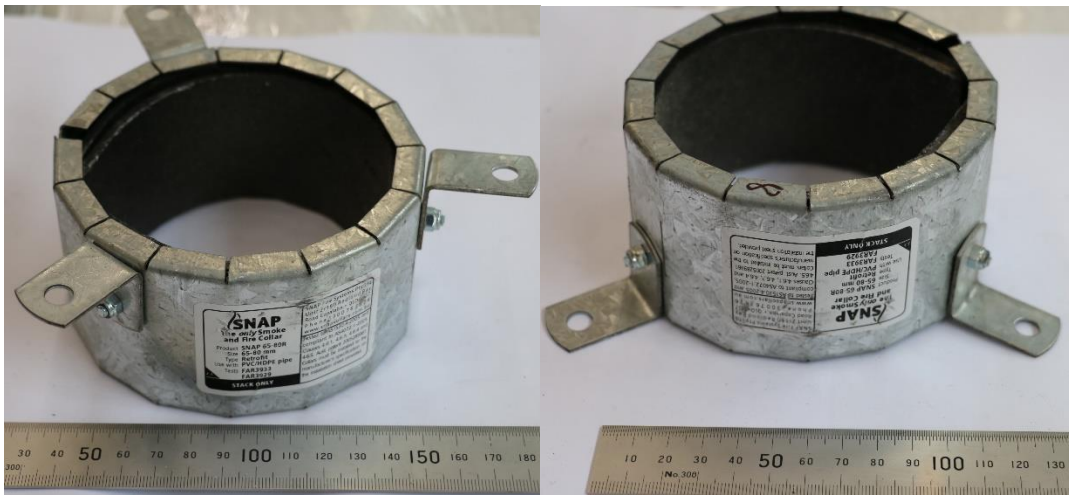
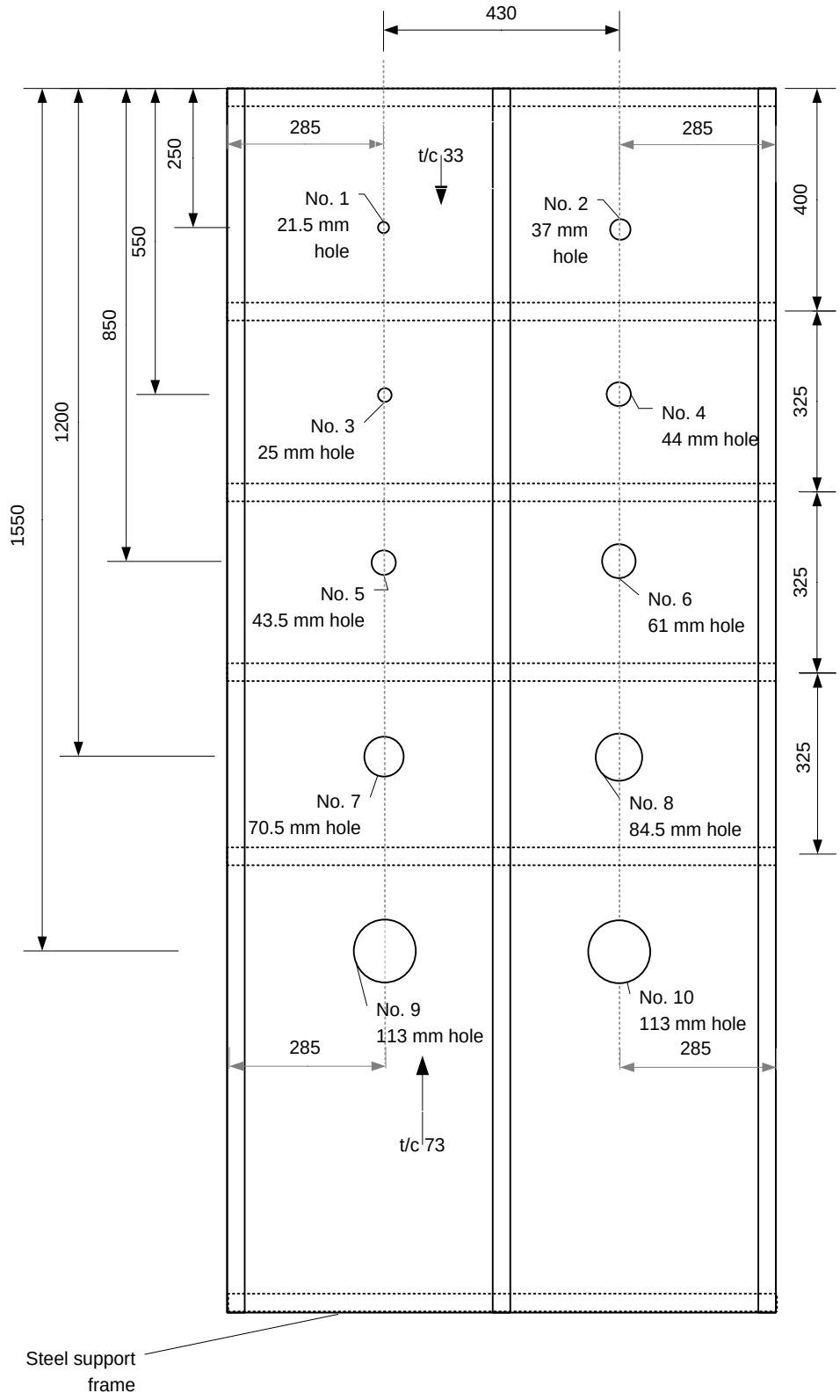


Figure 6: Specimens 9 and 10 collar, 110R

Figure 7: Test specimen showing location of penetrations



3. TEST CONDITIONS AND RESULTS

3.1 General

The specimen was tested on the 28 July 2015 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 13°C.

The wall containing the specimens was placed against the vertical pilot furnace and the temperature and pressure conditions were controlled to the limits defined in AS 1530.4-2005.

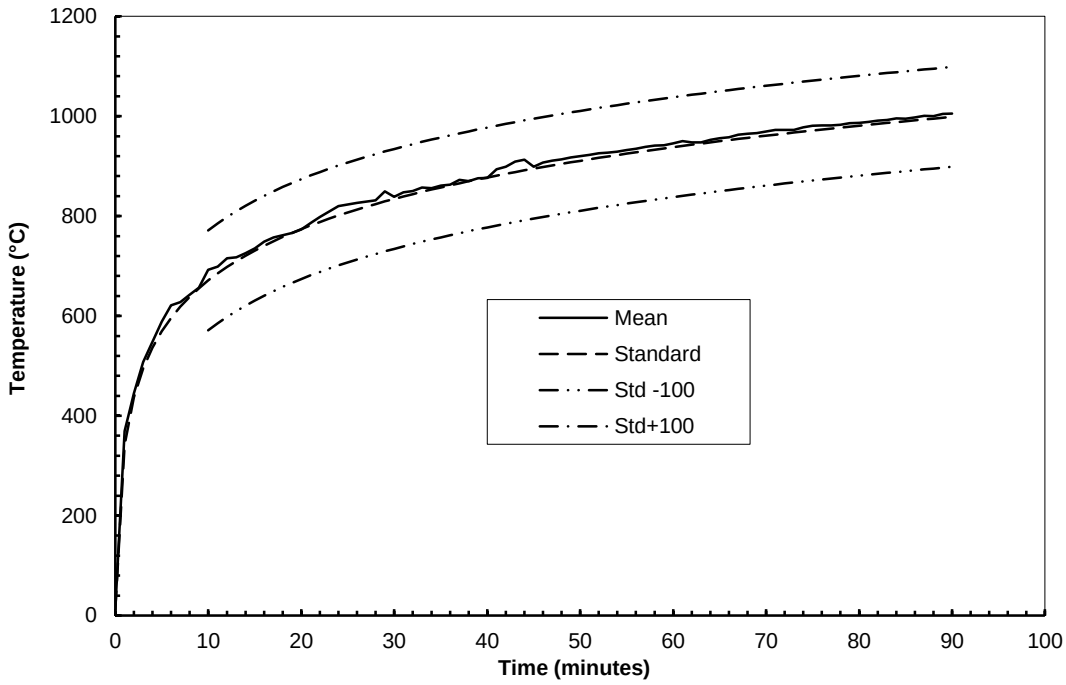
3.2 Furnace temperature measurement

Temperature measurement within the furnace was made using four mineral insulated metal sheathed (MIMS) chromel-alumel thermocouples uniformly distributed in a vertical plane approximately 100 mm from the exposed face of the specimen.

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

Figure 8 shows the furnace temperature curve and the permitted upper and lower limits in accordance with AS 1530.4: 2005.

Figure 8: Furnace temperature

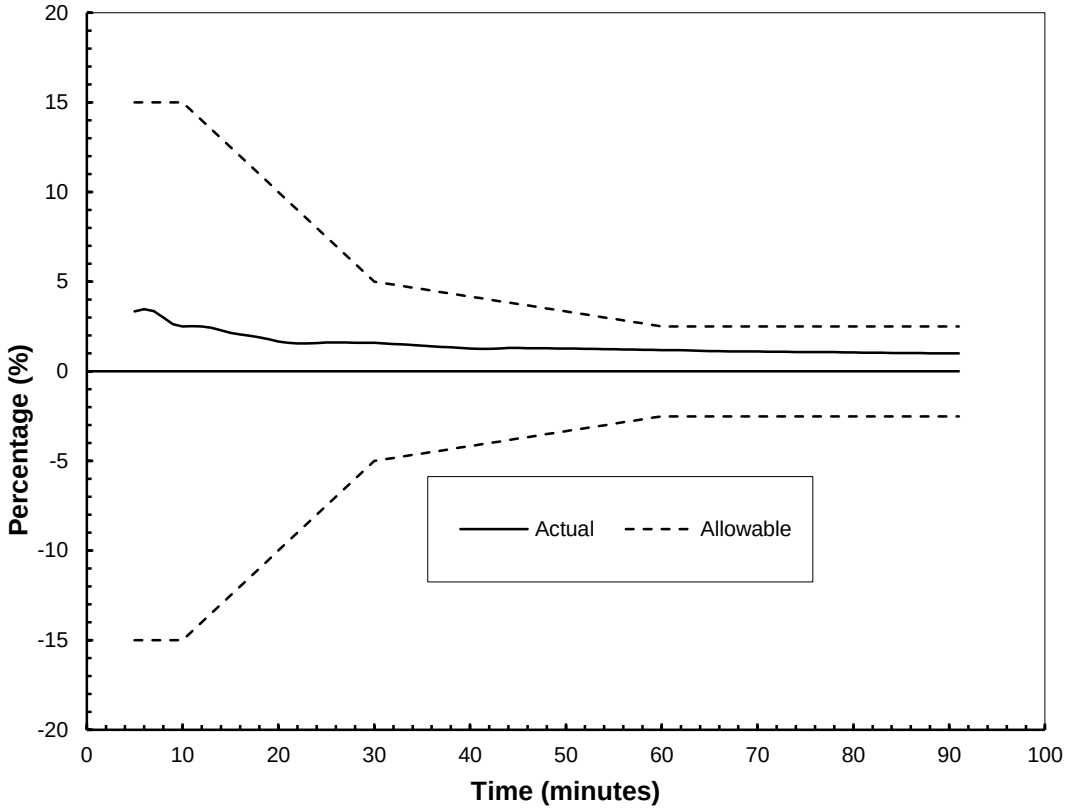


3.3 Furnace control

The percentage deviation of the area of the furnace mean temperature from the standard temperature/time curve complied with the test standard for the duration of the test.

Figure 9 shows the percentage deviation of the mean furnace temperature from the Standard curve.

Figure 9: Accuracy of furnace control

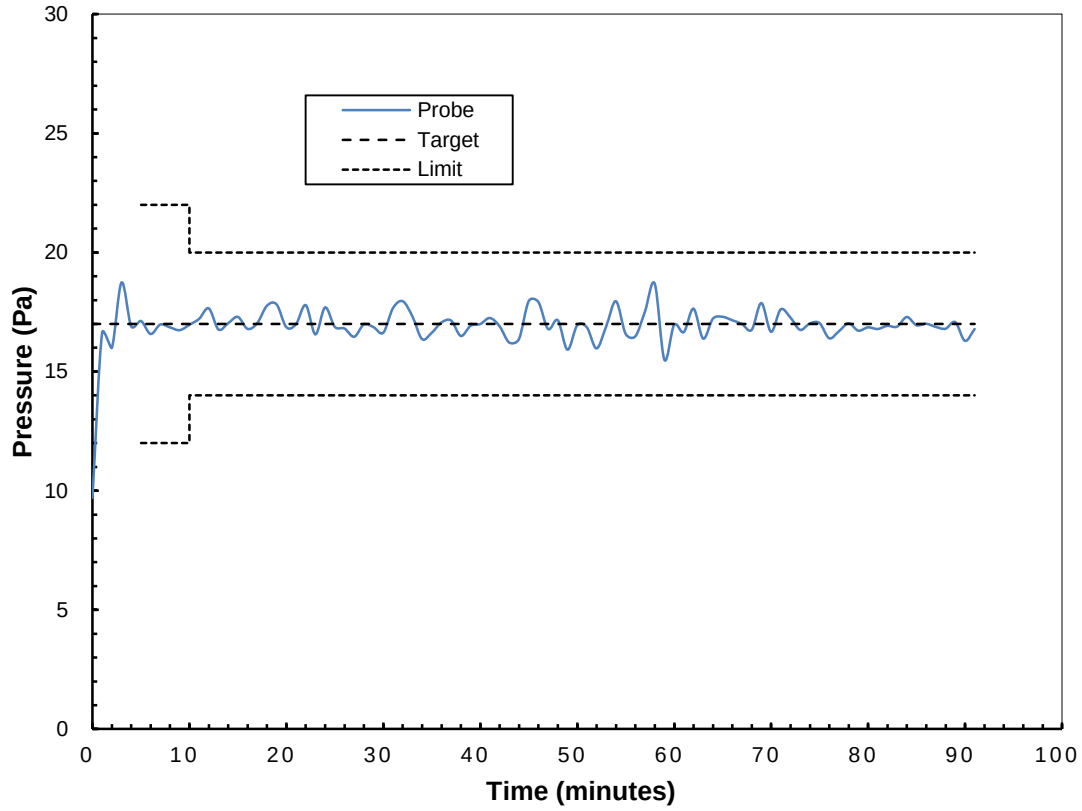


3.4 Pressure measurement

The furnace pressure was controlled to be 15 Pa at the mid height of the lowest penetration at 650 mm, as defined in the test standard. The differential pressure was monitored using a micromanometer connected to a computer controlled data acquisition system which recorded the pressure at 15 second intervals.

Figure 10 shows the pressure measured at the 900 mm probe during the test, where the target pressure was 17 Pa.

Figure 10: Furnace pressure



The furnace pressure complied with the test standard for the entirety of the test.

3.5 Specimen temperature measurement

The temperature on the unexposed face of the penetrations were measured with chromel-alumel thermocouples attached to the specimens. The arrangement consisted of thermocouples placed as specified in clause 10.5 of the test standard AS 1530.4-2005.

For each specimen, thermocouples were placed on the unexposed surface of the plasterboard element at 25 mm from the collar, on the collar and on the pipes at a distance 25 mm from the collar. These three locations were in pairs with thermocouples fitted to the top and side of the penetrations, making a total of six thermocouples per penetration.

Two additional thermocouples were placed on the unexposed surface of the wall clear of any of the penetrations.

Figure 11 to Figure 21 show the temperature rise for each specimen.

The temperature rise on the unexposed side of the wall is shown in Figure 22 where the positions of thermocouples 33 and 73 are shown in Figure 7.

Figure 11: Specimen 1 temperature rise

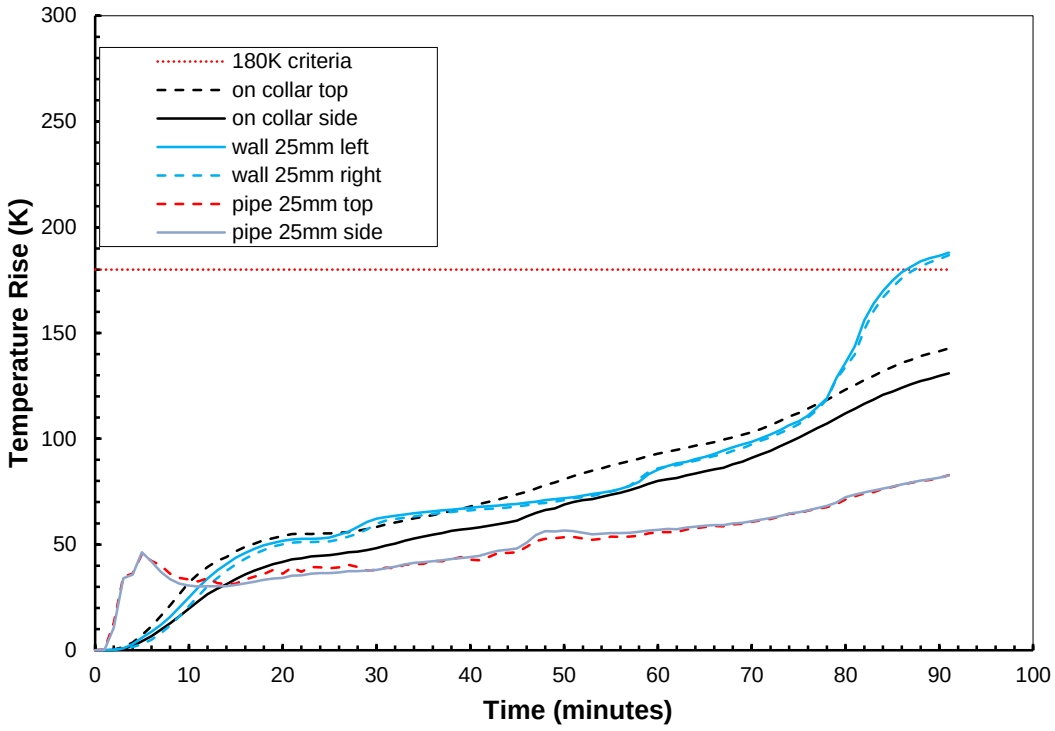


Figure 12: Specimen 2 temperature rise

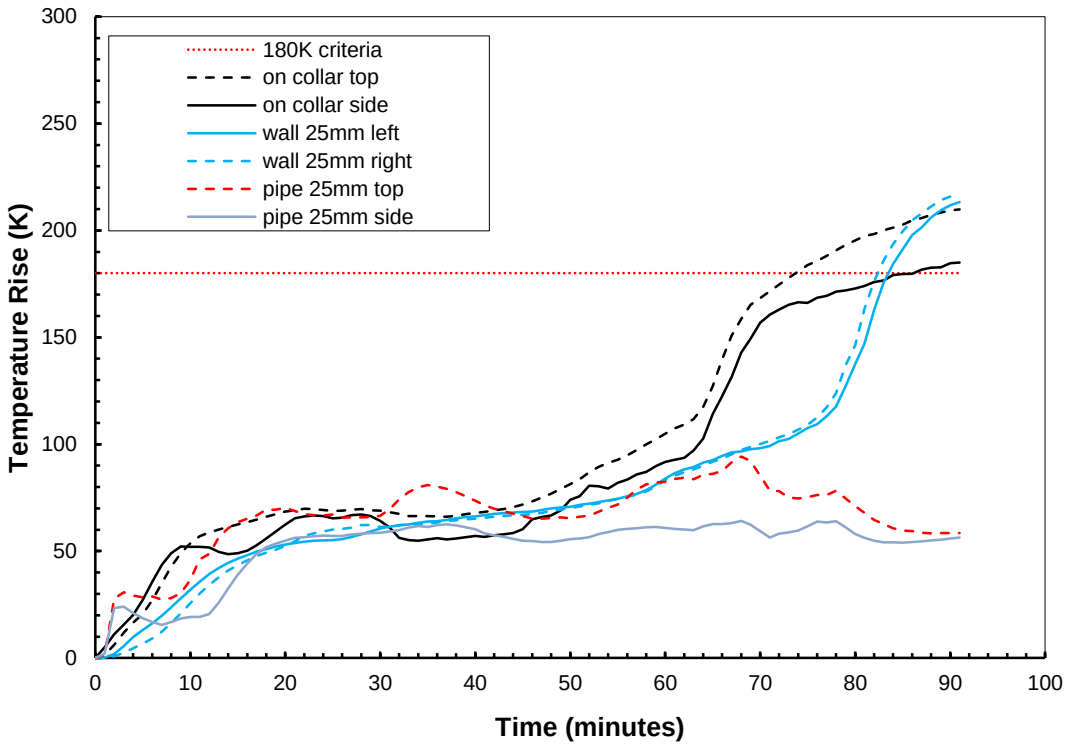


Figure 13: Specimen 3 temperature rise

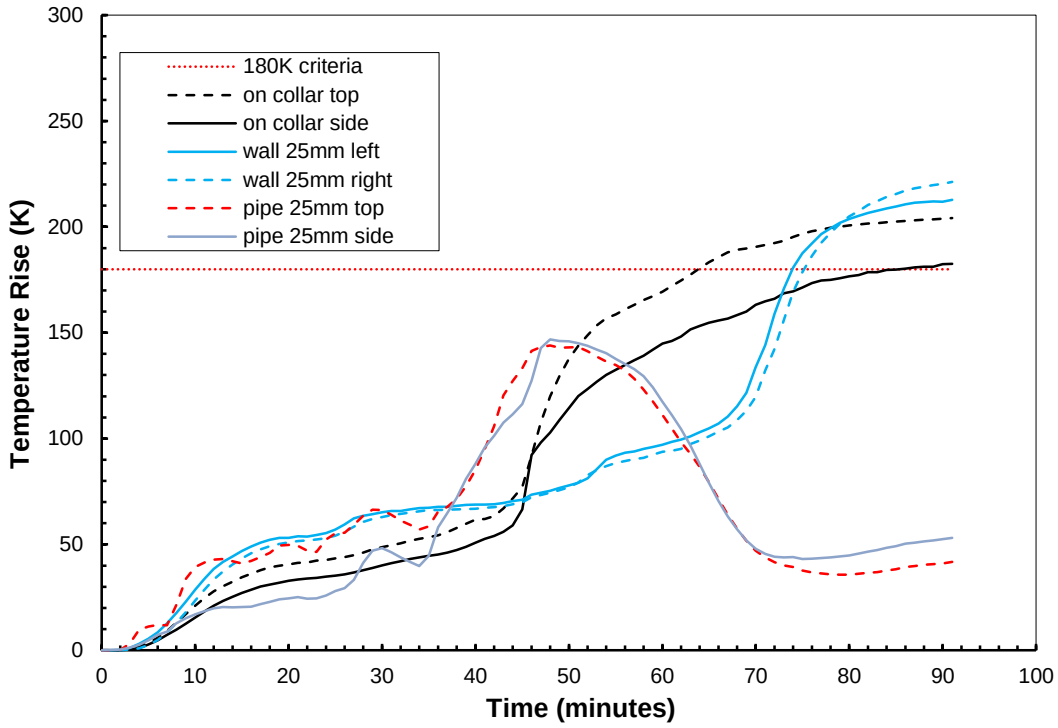


Figure 14: Specimen 4 temperature rise

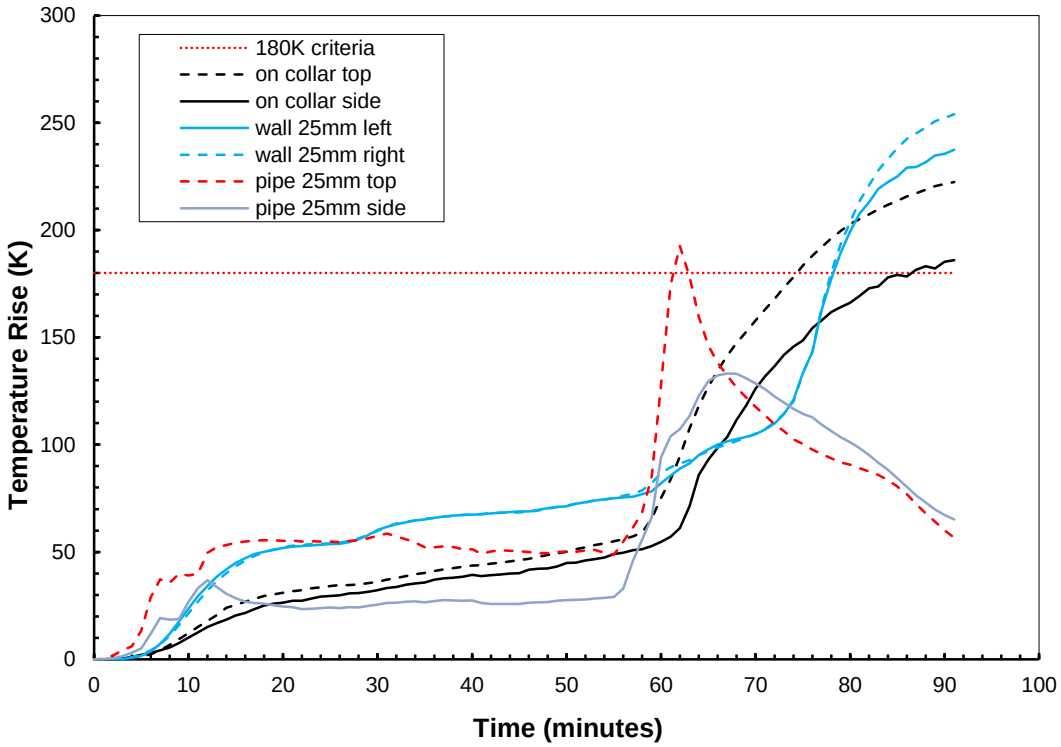


Figure 15: Specimen 5 temperature rise

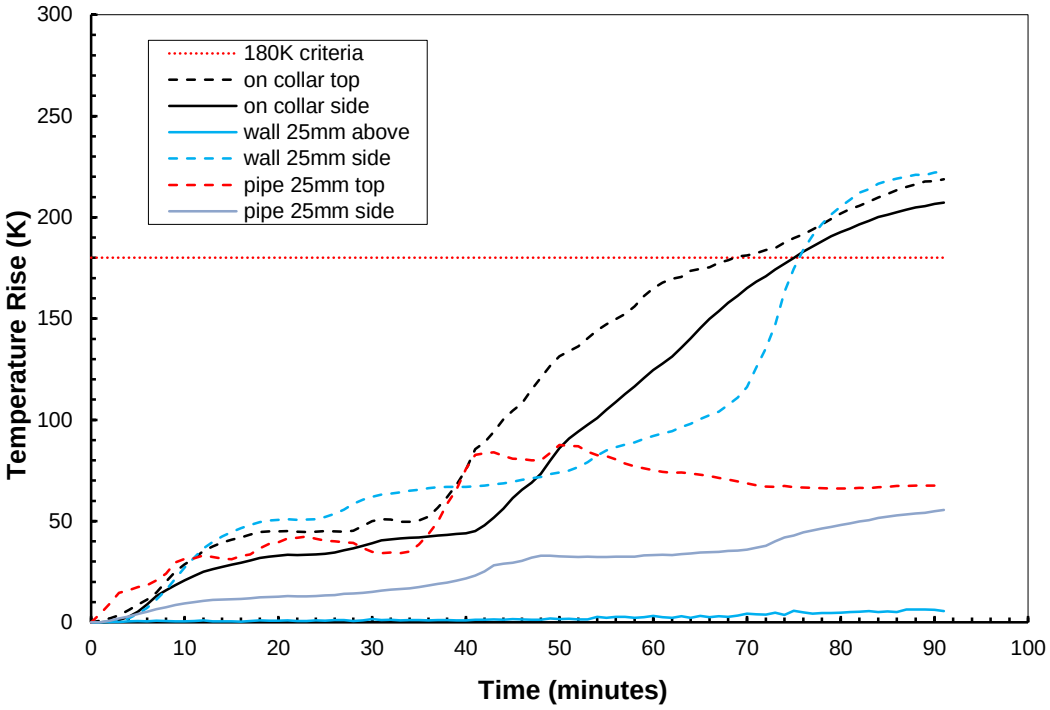


Figure 16: Specimen 6 temperature rise

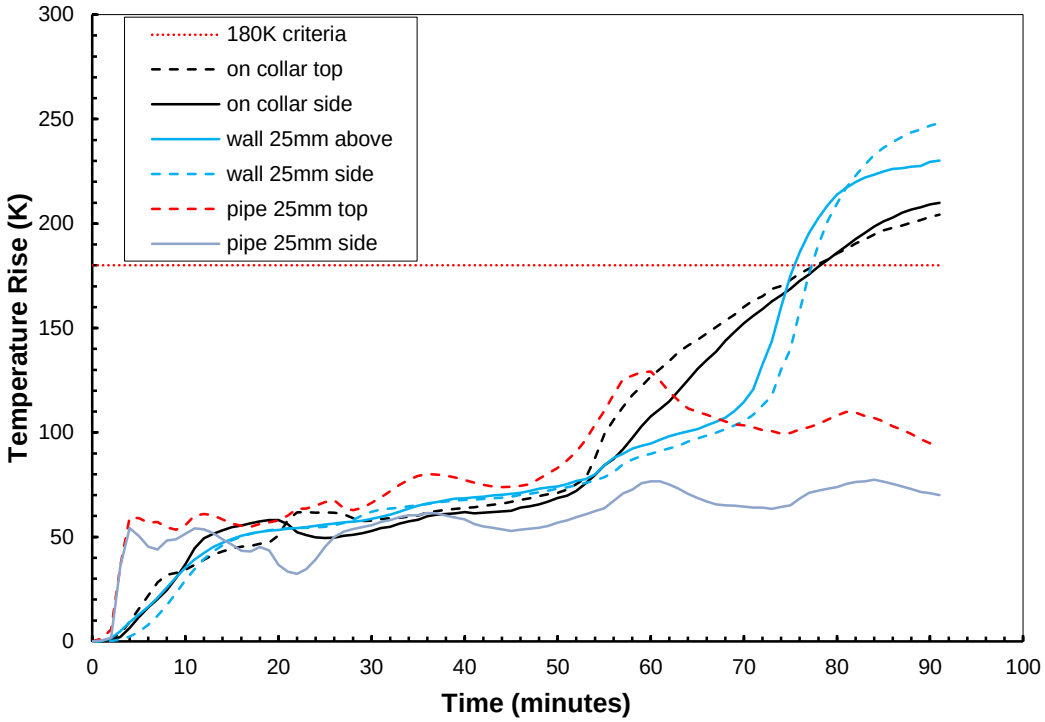


Figure 17: Specimen 7 temperature rise

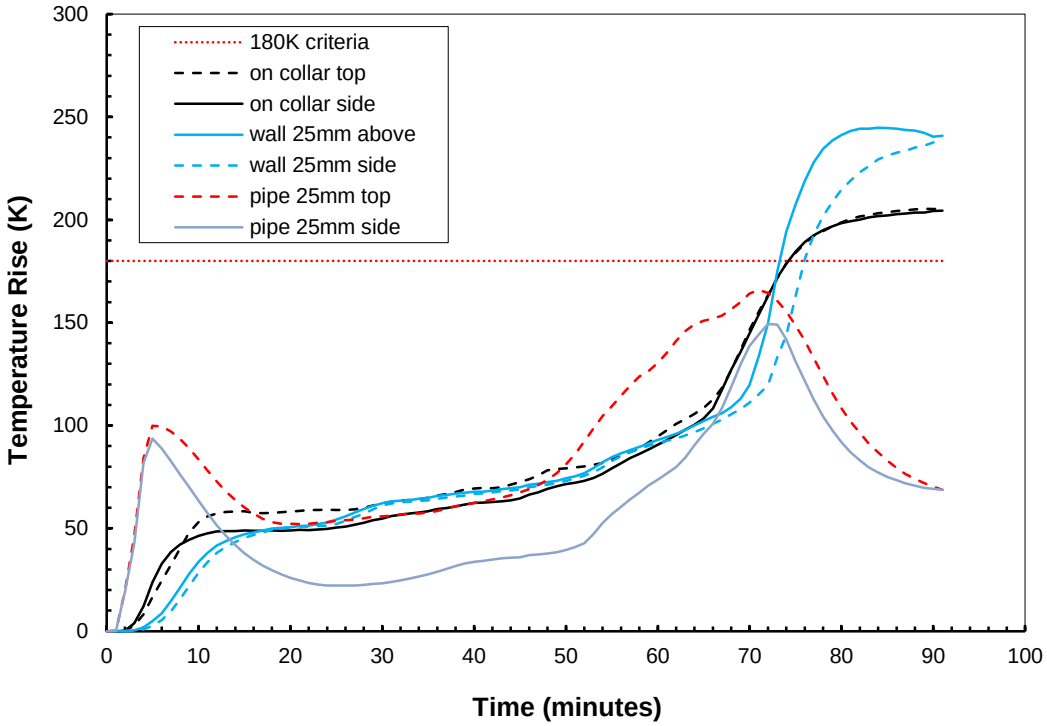


Figure 18: Specimen 8 temperature rise

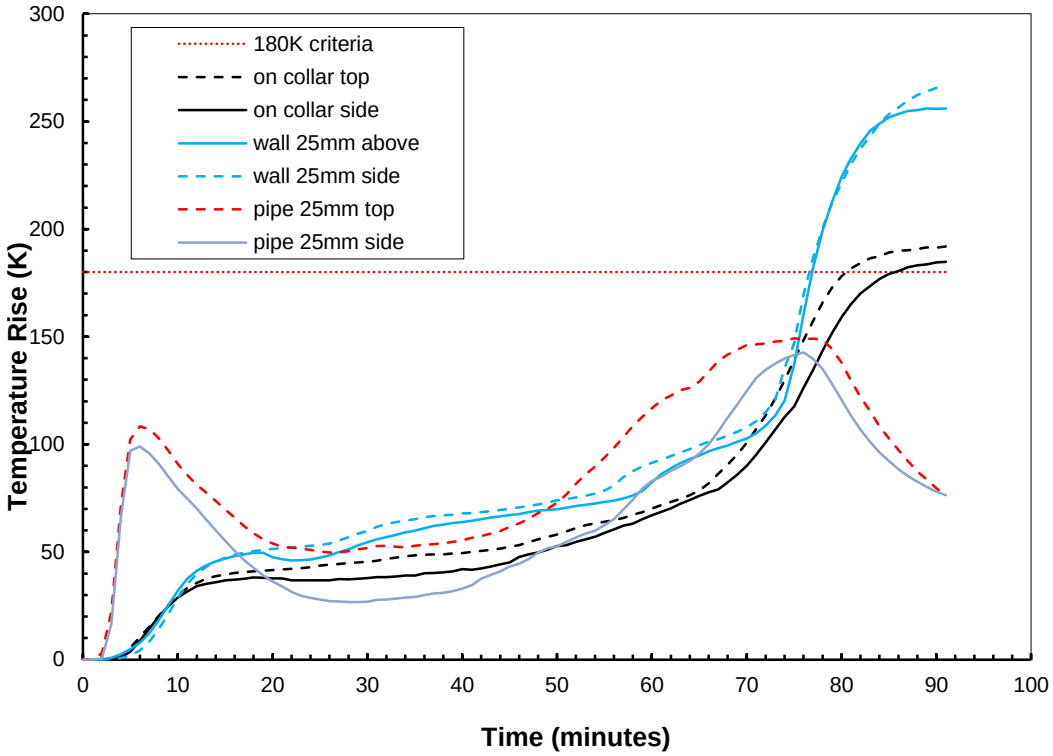


Figure 19: Specimen 9 temperature rise

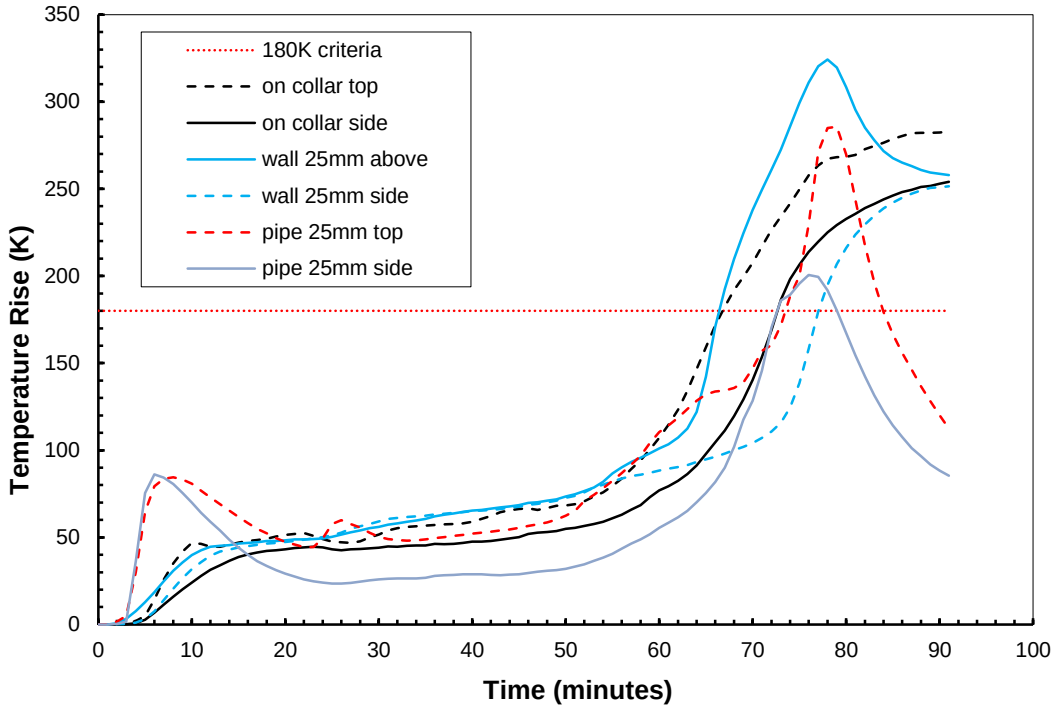


Figure 20: Specimen 10 temperature rise

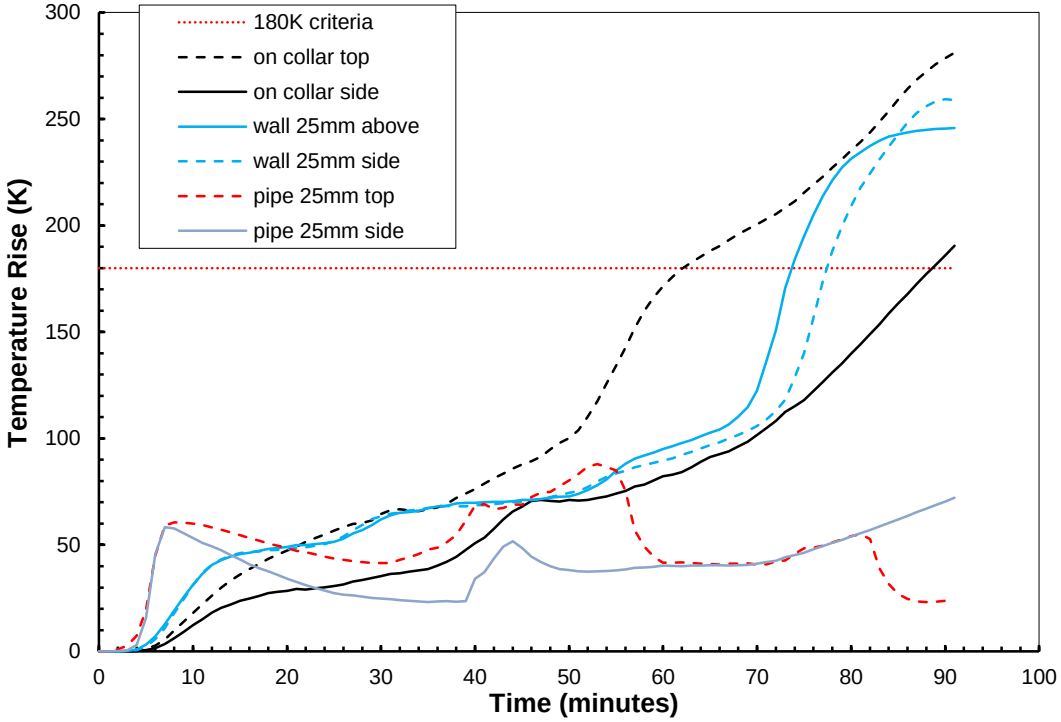


Figure 21: Maximum temperature rises on all 10 specimens

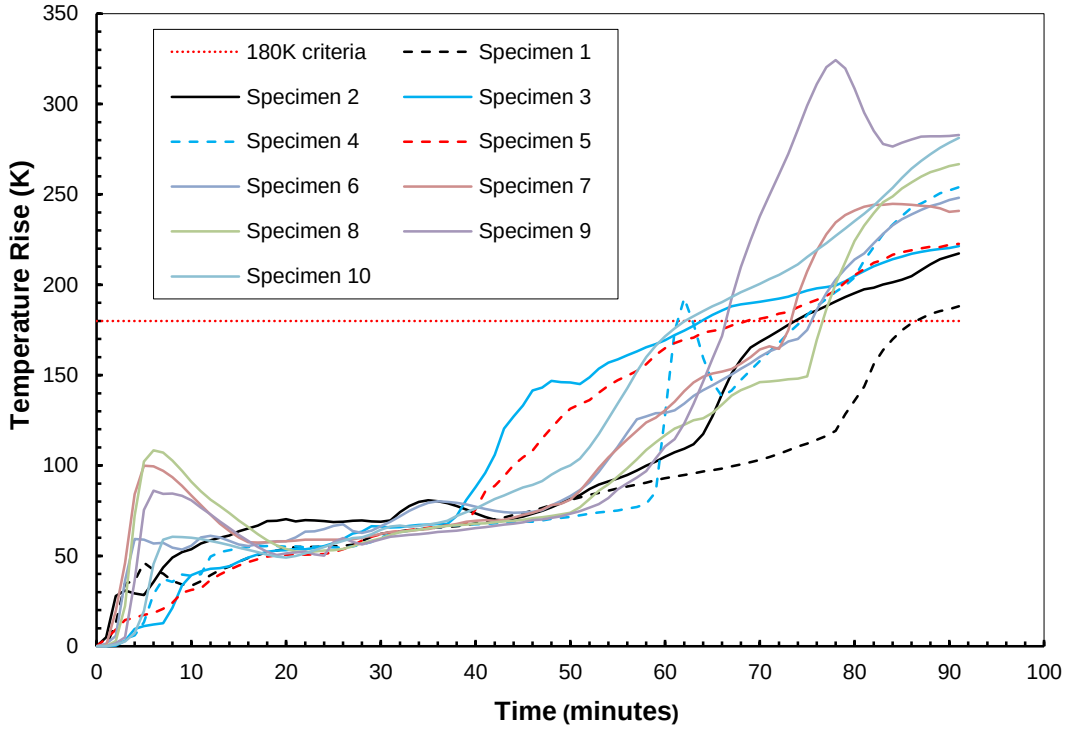
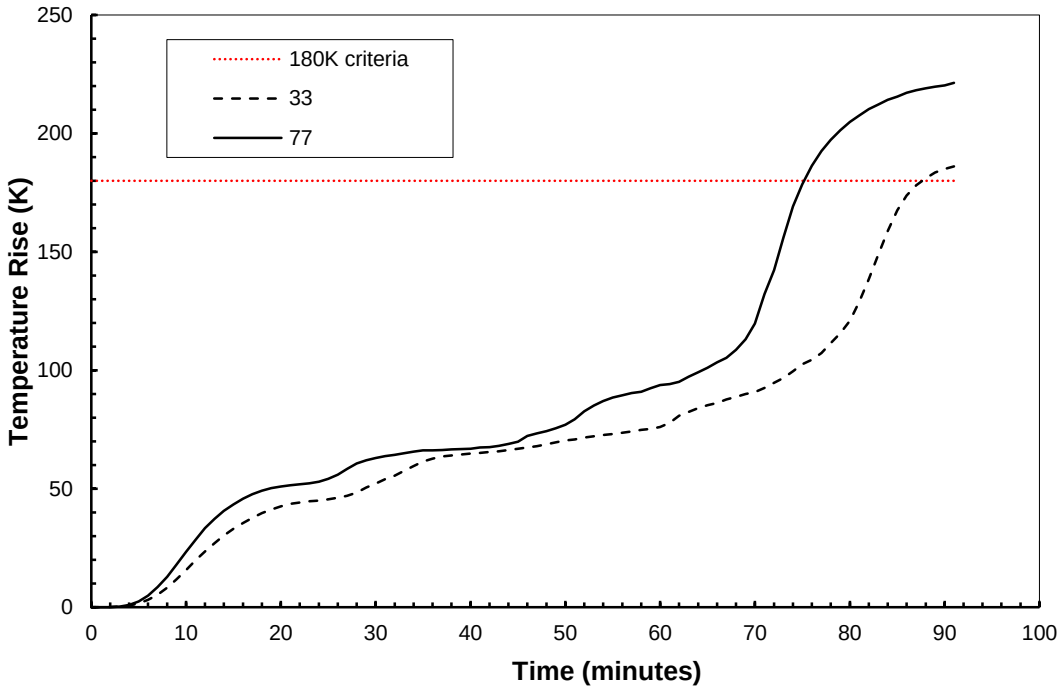


Figure 22: Unexposed surface temperature rise



3.6 Specimen insulation

Table 3: Specimen Insulation failures

Specimen No.	Time (minutes) until which failure occurred (T>180K)	Location of Insulation Failure
1	86	On wall 25 mm from collar
2	73	On collar
3	63	On collar
4	61	On pipe wall 25 mm from collar
5	68	On collar
6	75	On wall 25 mm from collar
7	73	On wall 25 mm from collar
8	76	On wall 25 mm from collar
9	66	On wall 25 mm from collar, and on collar
10	62	On collar

3.7 Observations

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

U = Observations from the unexposed face. E = Observations from the exposed face.

Table 4: Observations

Time mm:ss	Test face	Observation
1:29	U	Smoke was being emitted from the ends of the pipes of penetrations No.1, 2 and 7.
1:55	U	A significant volume of smoke was being emitted from the end of the pipe of penetration No. 7.
2:16	U	Smoke was being emitted from the collars on penetrations No. 2 and 5.
2:20	U	Smoke was being emitted from the end of the pipe of penetration No.6.
2:36	U	Smoke was being emitted from the end of the pipe of penetration No.8.
3:30	U	A significant volume of smoke was being emitted from the ends of the pipes of penetrations No. 8 and 9.

Time mm:ss	Test face	Observation
4:15	U	Smoke was being emitted from the end of the pipe of penetration No.10.
5:00	U	Smoke has stopped being emitted from the end of the pipes of penetrations No.1, 2 and 6. There was a significantly reduced volume smoke emitted from the end of the pipe of penetrations No. 8 and 9. A significant volume of smoke was being emitted from the end of the pipe of penetration No.10.
7:00	U	The majority of pipes have closed off. There was a small volume of smoke being emitted from the ends of the pipes of penetration No. 8, 9 and 10. Where the pipes exit the wall of penetrations No. 6, 8 and 9 the pipe were sagging slightly.
8:00	U	There was a small volume of steam being emitted from around the collars of penetrations No. 2, 5 and 9 where they were attached to the wall.
10:30	U	Smoke has stopped being emitted from the end of the pipes of penetrations No.1 through 9, and a significantly reduced volume of smoke was being emitted from the end of the pipe of penetration No.10.
20:00	U	A small volume of smoke was being emitted from the collars on penetrations No. 2, 5 and 9.
24:00	U	Smoke was being emitted from the pipes of penetration No. 2, 6, 7 and 9. The pipe of penetration No. 2 was further sagging where it exits the collar.
27:00	U	Smoke and steam were being emitted from the ends of the pipes of penetrations No. 2, 5, 6, 7, 8 and 9.
29:00	U	Pipes were sagging over a length of approximately 300 mm outwards from the collars on penetrations No. 2, 6, 8 and 9.
35:00	U	Smoke was being emitted from the ends of the pipes of penetrations No. 2, 3, 6, 7, 8 and 9.
37:41	U	A significant volume of smoke was pulsating from the collar around the pipe of penetration No. 10.
40:00	U	There was a small volume of smoke being emitted from the end of the pipes of penetrations No. 2, 3, 7, 8, 9 and 10. The pipe of penetration No. 3 was sagging where it exited the wall.
40:50	U	Smoke was being emitted from between the collar and pipe of penetration No. 10.
44:00	U	Smoke has stopped being emitted from the end of the pipes of penetrations No. 1, 4 and 10. Smoke was being emitted from the ends of the pipes of penetrations No. 3, 7, 8 and 9. A small volume of smoke was being emitted from the ends of the pipes of penetrations No. 2 and 6.

Time mm:ss	Test face	Observation
45:00	U	Where the pipe of penetration No. 3 exits the collar the pipe had largely collapsed within collar. Smoke was still being emitted from the end of the pipe.
46:50	U	The pipe of penetration No. 3 was pulling away from the wall. The thermocouples on the pipe were approximately 50 mm from the end of the collar.
53:00	U	Smoke was being emitted from the end of the pipes of penetration No. 2, 3, 5, 6, 7, 8, 9 and 10. Smoke was being emitted from between the pipe and collar of penetration No. 6, 9 and 10.
55:50	U	The thermocouple on the top of the pipe of penetration No. 10 had detached from the pipe. The pipe was starting to collapse just past the collar with intumescent expanding into the void. The smoke being emitted from the end of the pipes of penetrations No. 6, 7 8 and 9 had turned yellow in color.
56:30	U	A reduced volume of smoke was being emitted from the ends of the pipes of penetrations No. 1, 2, 3, 4 and 10.
59:00	U	The pipe of penetration No. 10 has melted back about 50 mm from the collar and the intumescent had sealed the hole.
60:00	U	The pipes of penetrations No. 5, 6, 9 and 10 were starting to sag where they exited the collar and smoke/steam was being emitted from between the pipe and collar.
68:00	U	A significant volume of yellowish smoke was continuing to be emitted from the ends of the pipes of penetrations No. 7, 8 and 9. The pipe of penetration No. 9 had softened and the intumescent was oozing out of the collar.
71:00	U	At the wall the pipe of penetration No. 9 had largely collapsed and intumescent from the unexposed face collar was expanding outward. The pipes of penetrations No. 4 and 8 had largely collapsed where they exited the wall and the pipe of penetration No. 7 was sagging downward.
72:30	U	Intumescent was starting to fall away from the collar of penetration No. 9 as it pushed the pipe away from the collar. There was also a corresponding reduction in the volume of smoke being emitted from the end of the pipe.
74:00	U	A red glow was visible in the center of the intumescent of penetration No. 9.
74:50	U	A cotton pad was applied over the red glow of penetration No. 9. Minor discoloration of the pad had occurred, but no Integrity failure occurred. The paper facing around the lower penetrations on the left hand side of the wall was starting to discolour.

Time mm:ss	Test face	Observation
77:00	U	Smoke was being emitted from the ends of the pipes of penetrations No. 2, 4, 6, and 8. A small volume of smoke was being emitted from the end of the pipe of penetrations No. 3. The pipe on penetration No. 4 had sagged and was almost dropping off.
79:00	U	There was a small volume of smoke being emitted from the ends of the pipes of penetrations No. 4, 6 and 8. The intumescent of penetration No. 9 continued to expand and the red glow was no longer visible in the middle of the opening.
80:43	U	Smoke was being emitted from the ends of the pipe of penetration No. 4. The pipe on penetration No. 8 had sagged at the collar and the intumescent had closed off the pipe.
89:20	U	A cotton pad was applied to penetration No. 9. No discolouration of the pad no Integrity failure occurred.
91:00		Test stopped.

3.7.1 Integrity

Integrity failures were recorded as follows:

Table 5: Specimen Integrity failures

Specimen No.	Time (minutes) which Integrity failure occurred
1	91 NF
2	91 NF
3	91 NF
4	91 NF
5	91 NF
6	91 NF
7	91 NF
8	91 NF
9	91 NF
10	91 NF

4. CONCLUSION

The fire resistance in minutes, in accordance with AS 1530.4-2005, of the 10 pipe penetrations and their sealing systems in a plasterboard wall was as follows:

Specimen No.	Collar	Pipe	Size (Nom, mm)	Integrity, min	Insulation, min	FRL
1	32Gas	Gas Pex	20	91NF	86	-/90/60
2	32R	PVC U*	25	91NF	73	-/90/60
3	32R	Electrical Conduit	25	91NF	63	-/90/60
4	50R	PVC U	40	91NF	61	-/90/60
5	50R	HDPE	40	91NF	68	-/90/60
6	50R	PVC U	50	91NF	75	-/90/60
7	63R	PVC U	65	91NF	73	-/90/60
8	65-80R	PVC U	80	91NF	76	-/90/60
9	110R	PVC U	100	91NF	66	-/90/60
10	110R	HDPE	110	91NF	62	-/90/60

* AS/NZS 1477: 2006. PVC pipes and fittings for pressure applications.
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 recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions."

"This report details methods of construction, the test conditions and results obtained when the specific element of construction described herein was tested following the procedure outlined in this standard. Any significant variations 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 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."

5. PERMISSIBLE VARIATIONS

In accordance with AS 1530.4:2005 clause 10.11, the permissible variations that are relevant to the tested penetration systems reported in FP 5663 are as follows.

10.11 PERMISSIBLE VARIATIONS TO THE TESTED SPECIMEN

10.11.1 General

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.

10.11.2 Separating elements

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

(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.

10.11.5 Plastic pipes

10.11.5.1 *General*

In addition to the requirements of clause 10.11.2, test results may be directly applied to the masonry and concrete elements thicker than the tested prototype when installed in accordance with Figure 10.11.5

10.11.5.2 *Services not perpendicular to the fire separation*

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

PHOTOS

Photo 1: Pre-test unexposed face

Photo 2: Pre-test exposed face

Photo 3: Penetration 1, left to right, unexposed, exposed and unexposed post test

Photo 4: Penetration 2, left to right, unexposed, exposed and unexposed post test

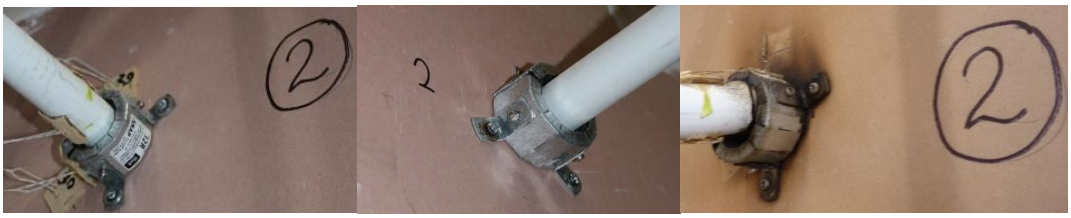


Photo 5: Penetration 3, left to right, unexposed, exposed and unexposed post test

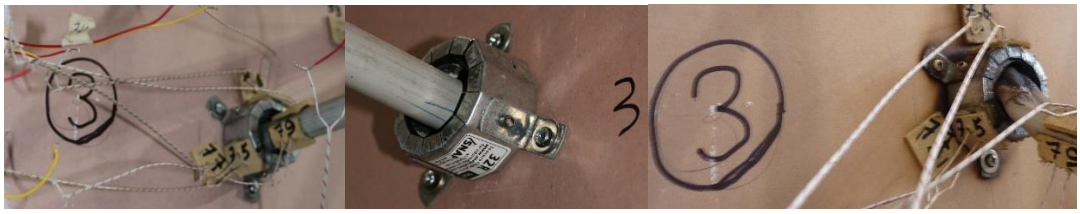


Photo 6: Penetration 4, left to right, unexposed, exposed and unexposed post test

Photo 7: Penetration 5, left to right, unexposed, exposed and unexposed post test

Photo 8: Penetration 6, left to right, unexposed, exposed and unexposed post test

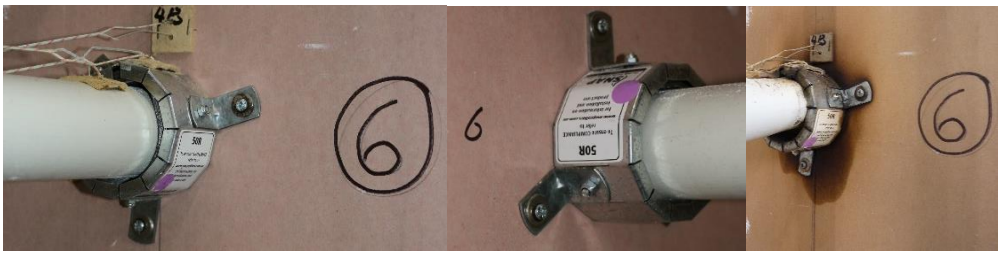


Photo 9: Penetration 7, left to right, unexposed, exposed and unexposed post test

Photo 10: Penetration 8, left to right, unexposed, exposed and unexposed post test

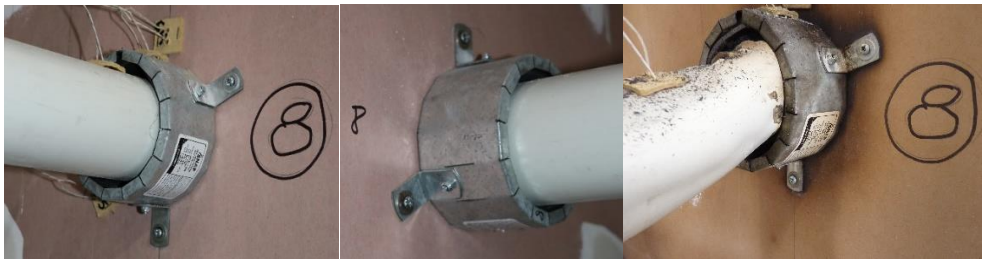


Photo 11: Penetration 9, left to right, unexposed, exposed and unexposed post test

Photo 12: Penetration 10, left to right, unexposed, exposed and unexposed post test

Photo 13: Exposed face after test