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 4640 ISSUE 2

FIRE RESISTANCE OF PIPE PENETRATIONS IN A CONCRETE FLOOR SLAB

REFERENCED STANDARDS
AS 4072.1 - 2005
AS1530.4 – 2005
CLIENT
Snap Fire Systems
Unit 2-160 Redland Bay Rd,
Capalaba,
4157 QLD
Australia

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TEST SUMMARY

Test sponsor

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

Description of test specimen

The test specimen consisted of a reinforced concrete slab placed above a horizontal 2,200 mm x 1,000 mm pilot furnace to represent a structural concrete floor. Eight penetrations were cast in the nominal 150 mm thick concrete floor. All the pipes consisted of either PVCU "Drain, Waste & Vent (DWV) or HDPE DWV plastic pipe. Two specimens consisted of floor wastes with retro fit collars. Two specimens consisted of vertically orientated pipe assemblies with retro fit collars. Pipe assemblies orientated vertically are referred in this report as "stack" assemblies. A single specimen consisted of a floor waste with a 35 mm high screed plinth and cast in collar system. A single specimen consisted of a stack assembly and cast in collar. Two specimens consisted of stack assemblies with an elbow socket inserted into the body of the retro fit collar.

Date of test

18 October 2011

Test results

The fire resistance in minutes, in accordance with AS 1530.4-2005 with reference to AS 4072.1-2005, of eight pipe penetrations and their sealing systems in a 150 mm thick concrete slab, was as follows:

Pipe No	Specimen Description	Integrity (minutes)	Insulation (minutes)
2	100 nominal HDPE DWV Floor waste with "HP 100 R" retro fit collar	245	245
3	100 nominal PVCU DWV Stack with "110 R" retro fit collar	245	245
4	50 nominal PVCU DWV Stack with "63 R" retro fit collar	245	245
5	50 nominal PVCU DWV Floor waste with 35 mm high screed topping and "H 100 FWS" cast in collar	245	245
6	50 nominal HDPE DWV Stack with "H 50 S" cast in collar	245	245
7	50 nominal PVCU DWV Floor waste with "LP 50 R" retro fit collar	245	245
9	50 nominal PVCU DWV Stack with 90° Elbow socket inserted into a "63 R" retro fit collar	245	245
10	100 nominal PVCU DWV Stack with 90° Elbow socket inserted into a "110 R" retro fit collar	245	245

The test standard requires the following statement 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 BRANZ Service Agreement for this work.

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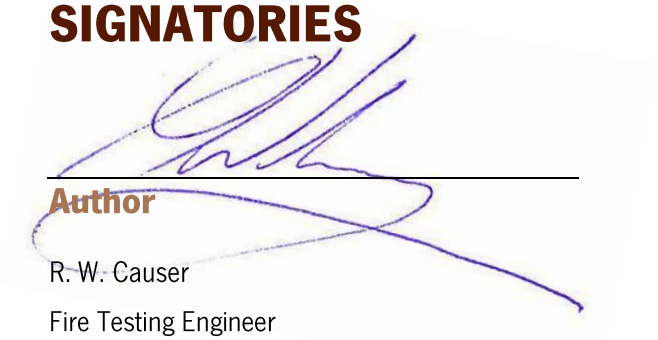
SIGNATORIES

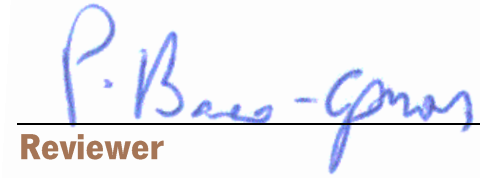


Author

R. W. Causer

Fire Testing Engineer

IANZ Approved Signatory



Reviewer

P. Bano-Chapman

Senior Fire Testing Engineer

DOCUMENT REVISION STATUS

DATE ISSUED	ISSUE NO.	DESCRIPTION
29 November 2011	FP 4640	Initial Issue
2 November 2012	FP 4640 Issue 2	Re Issued to include reference to AS 4072.1 - 2005

1 TEST PROCEDURE

The test was conducted on the 18 October 2011 at BRANZ laboratories, Judgeford, New Zealand, in the presence of a representative of the client.

The test was conducted in accordance with AS 1530.4-2005 *Fire Resistance tests of elements of building 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, before 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.

2 DESCRIPTION OF THE TEST SPECIMEN

2.1 General

The test specimens consisted of eight pipe penetrations in a 150 mm thick reinforced concrete slab representing a structural concrete floor. All the pipes consisted of either PVCU DWV or HDPE DWV plastic pipe.

Two specimens consisted of floor wastes with retro fit collars. Two specimens consisted of stack assemblies with retro fit collars. A single specimen consisted of a floor waste with a 35 mm high screed topping and cast in collar system. A single specimen consisted of a stack assembly and cast–in collar. Two specimens consisted of stack assemblies with an elbow socket inserted into the body of the retro fit collar.

All the through stack pipes protruded a minimum of 500 mm into the furnace and at least 2,000 mm to the unexposed face except for specimens 9 & 10 which had 90°elbows on the exposed face with the elbow sockets inserted into the retro fit collars. The floor wastes had typical elbow trap fittings fitted on the exposed face with the exposed pipe suspended from a single masonry pipe anchor fitting. All pipes were capped on the exposed ends and were open on the unexposed ends. Apart from the cast in collar specimens the penetrations through the slab had a maximum of 1-2 mm clearance between the pipe and the penetration. For specimen 5 the screed raised plinth was applied around the pipe and grate after the grate had been installed.

The stack test specimens were secured in place using pipe clamps supported by a steel framework. The pipe clamp locations are detailed in 2.2.

Sika Firerate intumescent fire resistant joint sealant was applied to the following test specimens.

- Around the grate of specimens 2 & 7.
- Around the pipe on the unexposed face of specimens 3, 4, 9, & 10.

No Sealant was applied around the grate of specimen No 5 or the pipe of specimen No 6.

The density of the concrete at the time of the fire resistance test was calculated to be 2,313 kg/m^3. The moisture content of the concrete at the time of the test was calculated to be 4.3%.

A drawing of the layout is included in this report as Figure 7.

2.2 Pipe Support Spacing

The following pipe specimens were secured using pipe clips supported by a steel framework. Table 1 gives the measured distance of the pipe clip from the concrete slab.

Table 1: Pipe support spacing

Pipe Specimen	Pipe Clip Distance from Concrete Slab (mm)		
	1st	2nd	3rd
3	800	1450	1,800
4	780	1,360	1,770
6	880	1,800	
9	830	1,470	1,800
10	780	1,375	1,790

2.3 Pipe Specification

Table 2 lists the nominal and measured pipe dimensions and pipe designation details.

Table 2: Pipe specification

		Average Measured Size (mm)		
Pipe No's	Nominal Ø mm Material/Type	OD	Wall thickness	Details recorded on pipe
3 & 10	100 PVCU DWV	110.36	3.14	Iplex Novacor DN 100 PVCU DWV SC SN6 110831 16 PN AS/NZS 1260 LIC 20184
4 & 9	50 PVCU DWV	55.9	2.4	Iplex Novadrain 100. 50 PVCU DWV 100803 23 PN AS/NZS 1260 LIC 20184
5 & 7	50 PVCU DWV	56	2.4	Vinidex DWV 50 PVCU WMKA1010 AS/NZS1260 SL13
6	50 HDPE DWV	55.95	3.28	DN56 56 Ø x 3 PE80 S12.5
2	100 HDPE DWV	110.31	4.87	Geberit 110 x 4.3 SDR26 PE100 Series 12.5

2.4 Collar designation and intumescent details

Table 3 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. Figures 1 – 6 show detailed construction drawings for each collar type. Where difference between the drawing and the report text exists the text takes precedence.

Table 3: Collar intumescent details

Collar Designation	Specimen No.	Intumescent Details				
		Width (mm)	Thickness (mm)	No of Layers	Length (mm)	Steel Mesh and Location
LP 50 R	7	58	3.5	1	240	1 layer located between intumescent and body of collar
HP 100 R	2	85	4.2	1	412	1 layer located between intumescent and body of collar
110 R	3 & 10	58	2.7	3	L1: 380 L2: 400 L3: 415	1 layer either side of middle intumescent layer
SNAP 63 R	4 & 9	42	3	2	L1: 240 L2: 262	I layer sandwiched between intumescent layers
H 100 FWS	5	85	4.4	1	412	1 layer located between intumescent and body of collar
H 50 S	6	58.4	4.2	1	240	1 layer located between intumescent and body of collar

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

2.5 Collar Drawings

Figure 1: LP 50 R Retro Fit Collar installed to specimen No. 7

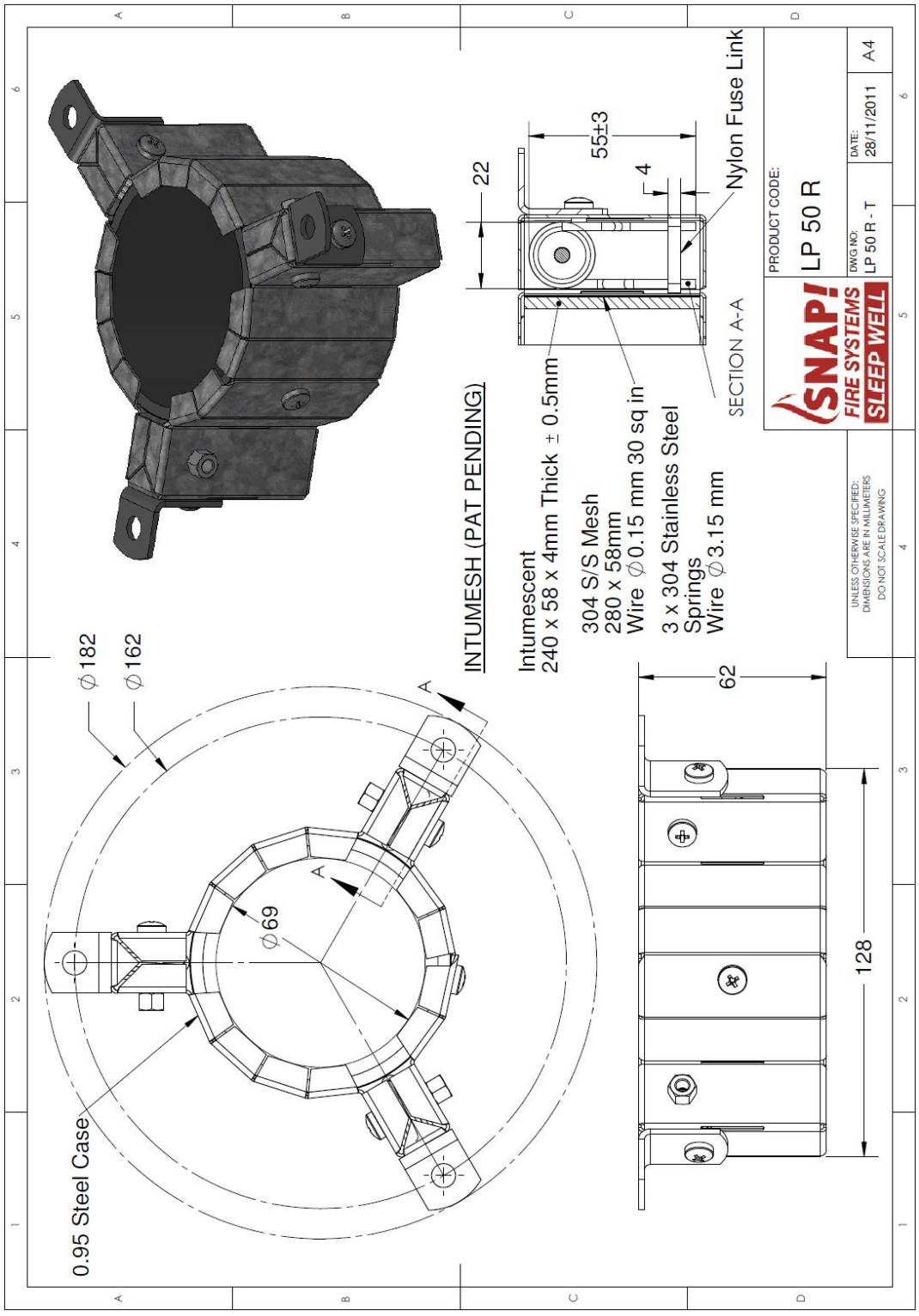


Figure 2: HP 100 R Retro Fit Collar installed to specimen No. 2

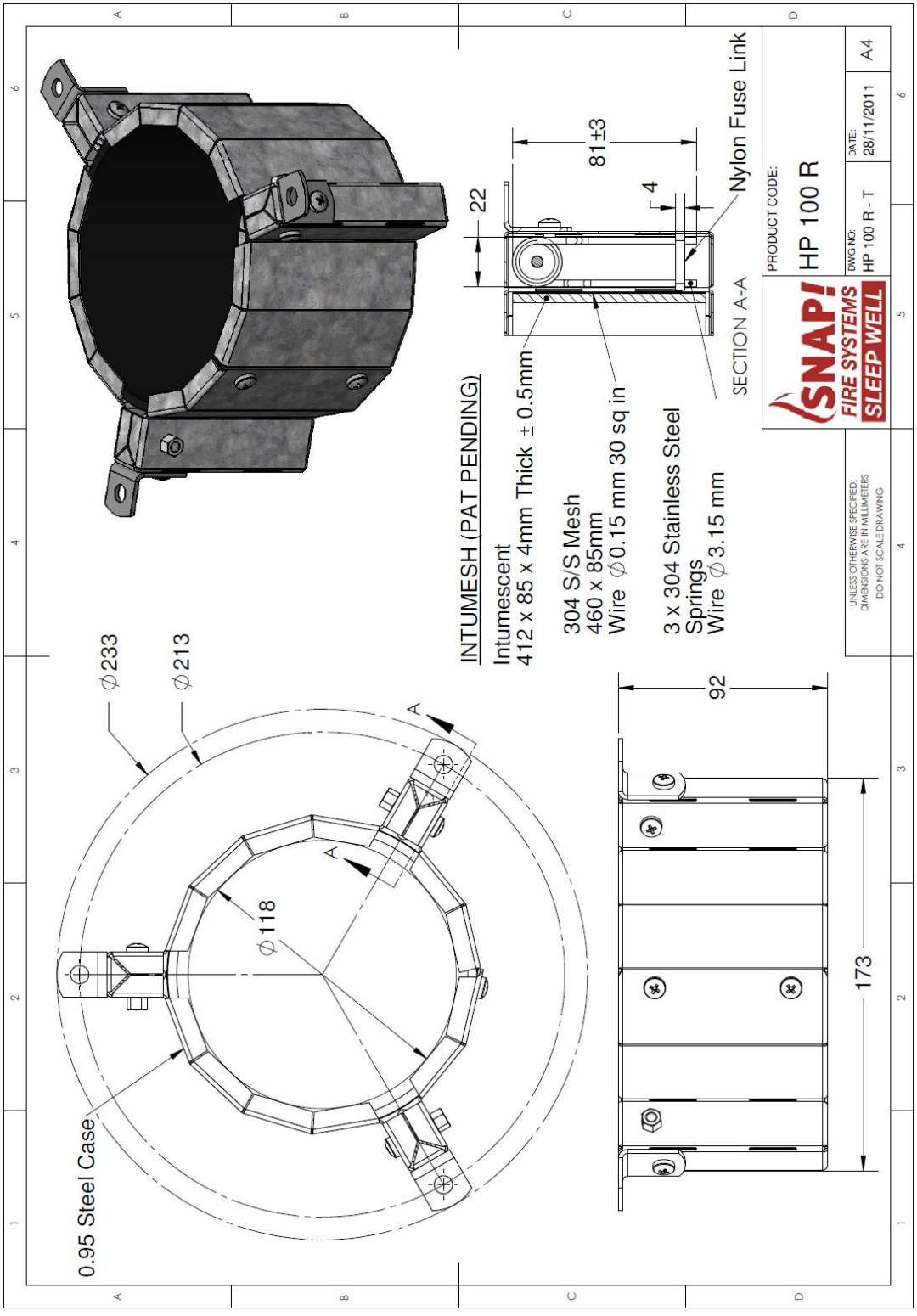


Figure 3: 110 R Retro Fit Collar installed to specimen No's 3 & 10

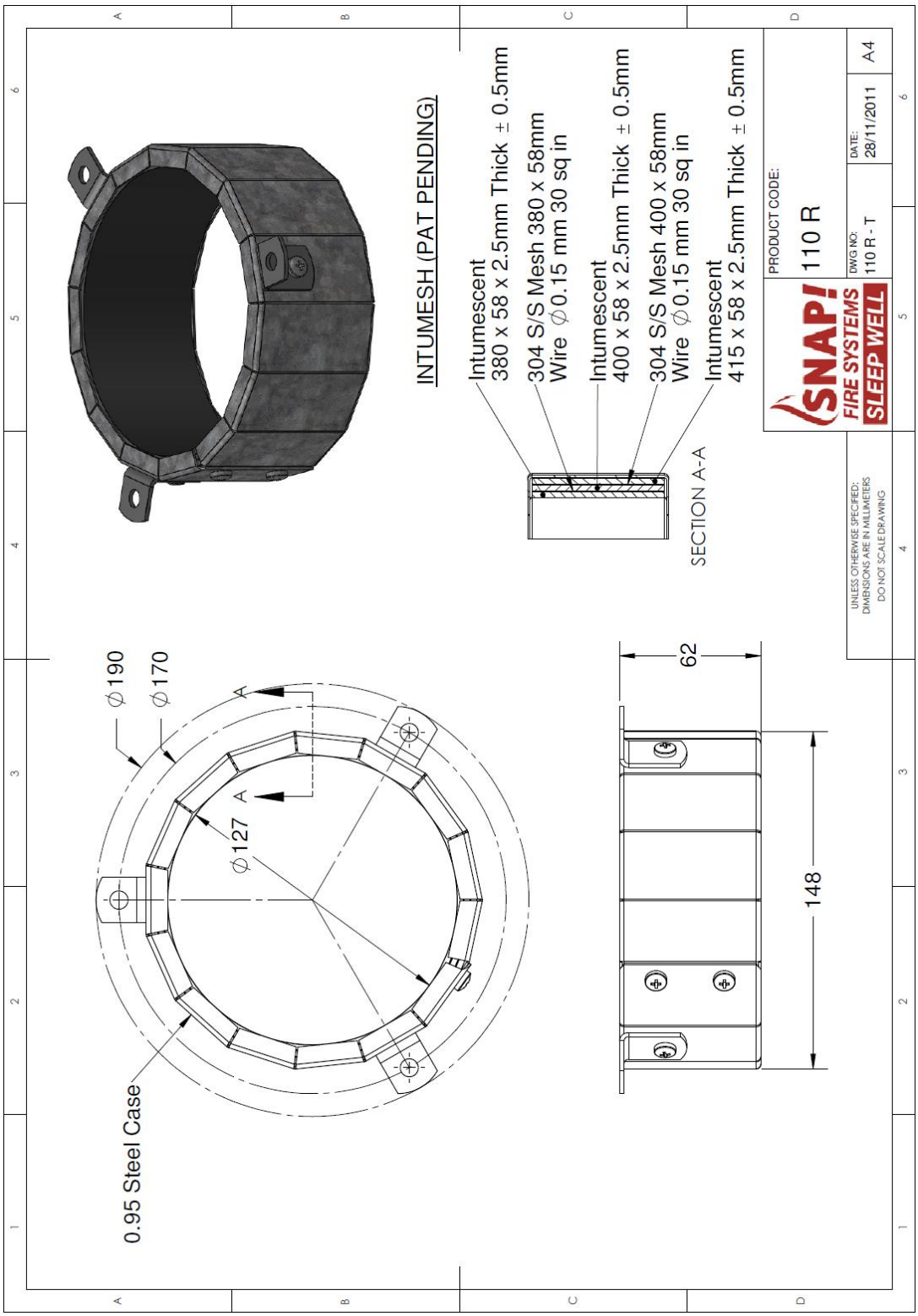


Figure 4: SNAP 63 R Retro Fit Collar installed to specimen No's. 4 & 9

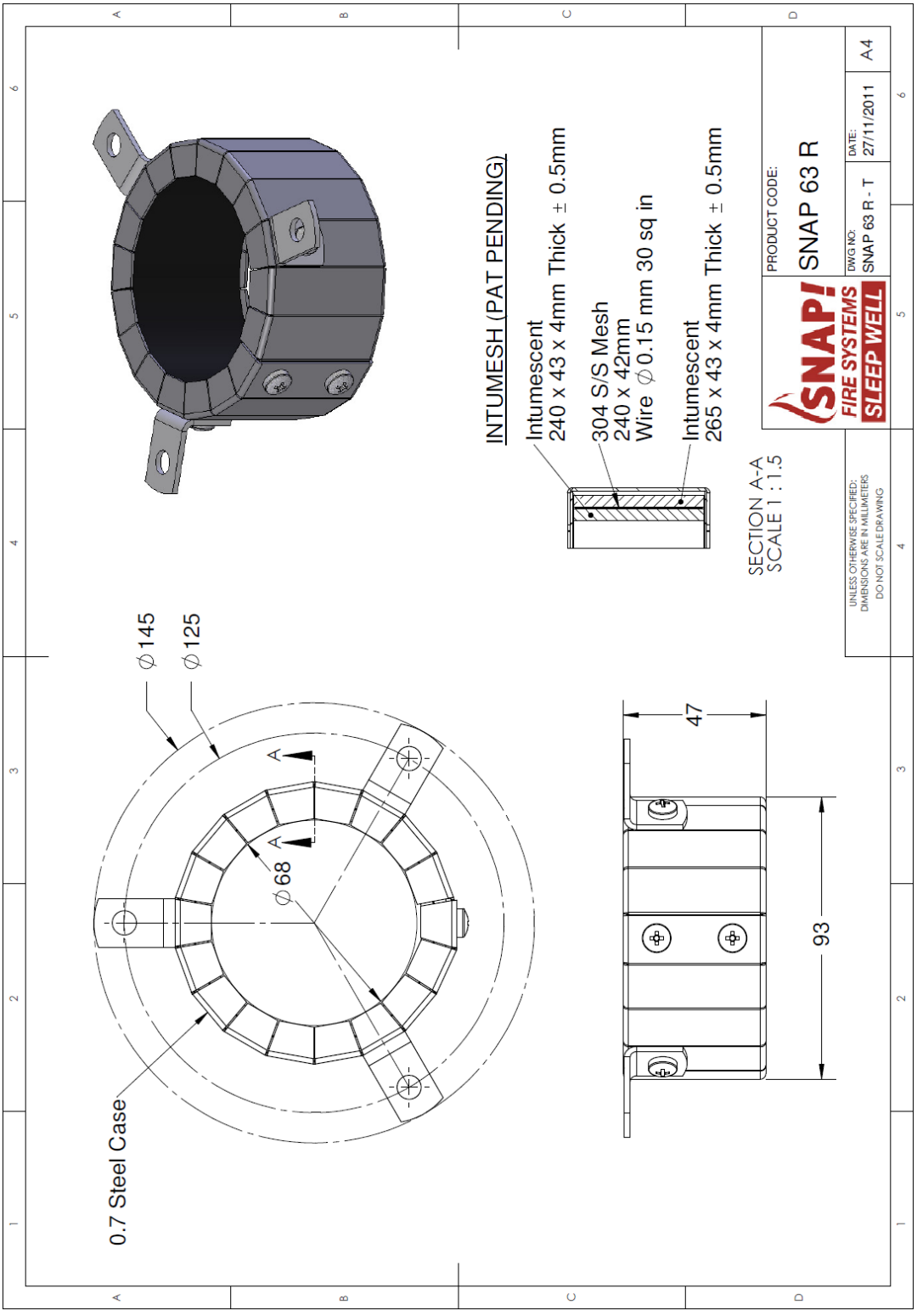


Figure 5: H 100 FWS Cast in Collar installed to specimen No. 5

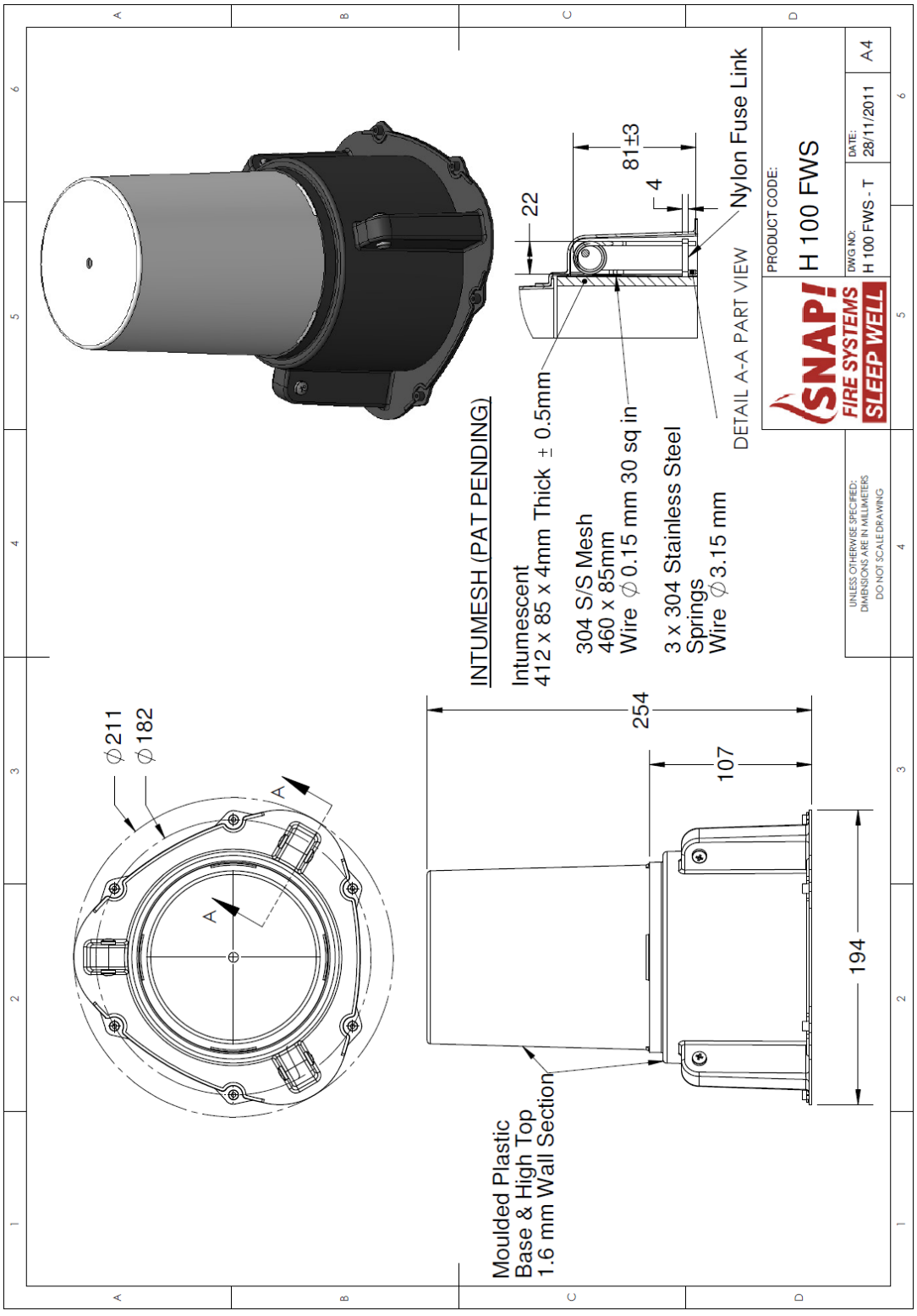
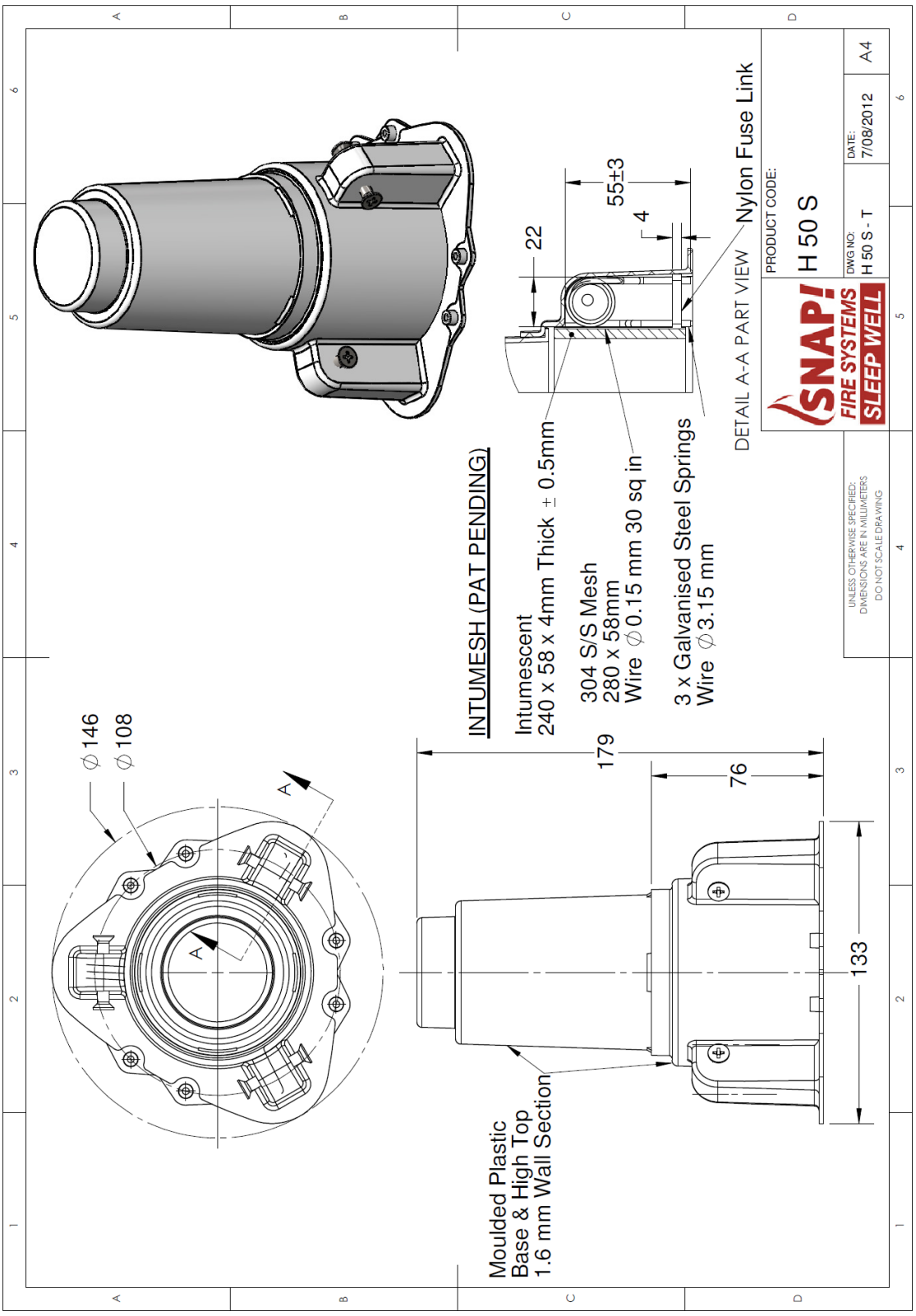


Figure 6: H 50 S Cast in Collar installed to specimen No. 6



2.6 Test Specimen Layout

Figure 7 shows the concrete slab and general test specimen layout Figure 8 - Figure 15 show cross sectional views for individual test specimens.

Figure 7: Test specimen layout

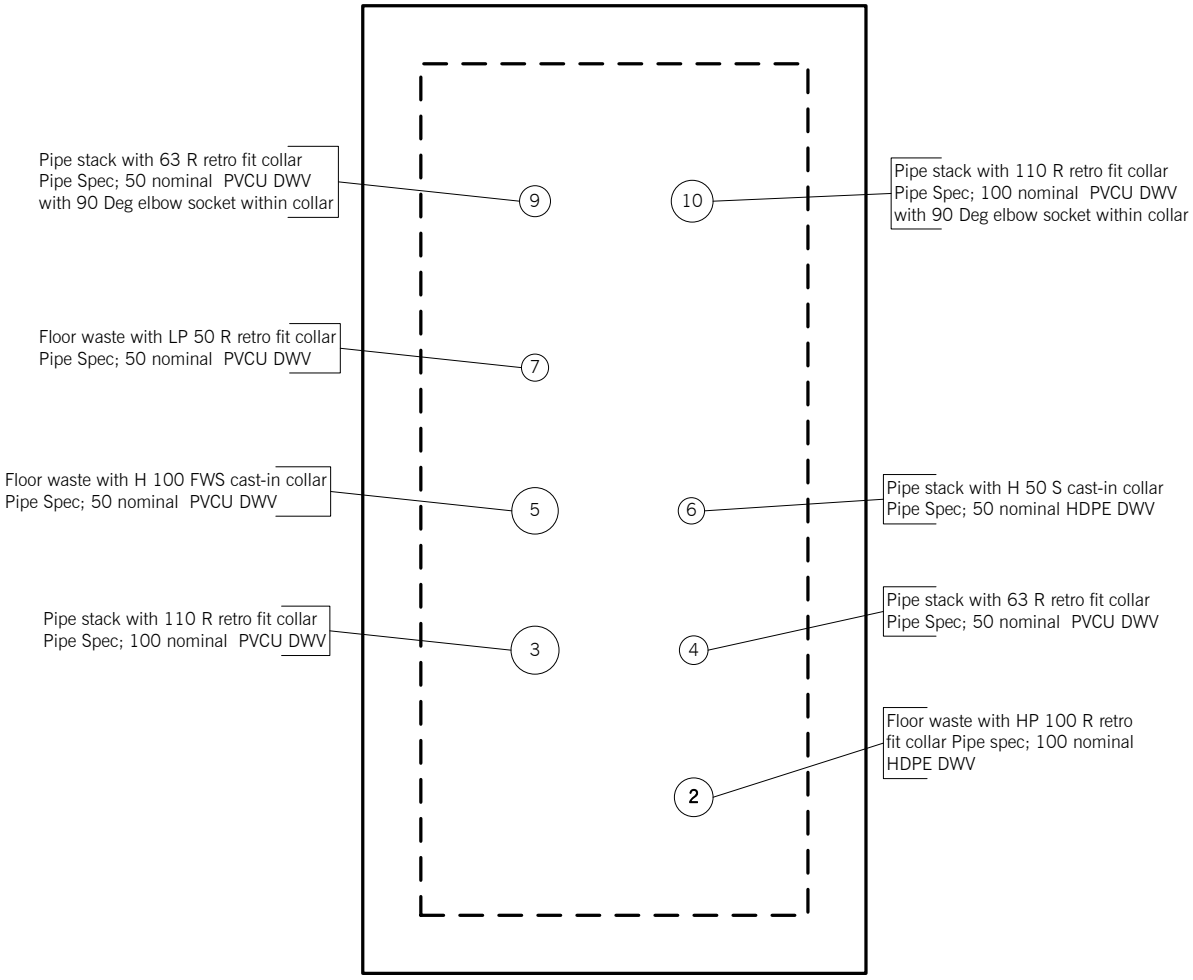


Figure 8: Specimen 2. Floor waste with HP 100 R Collar

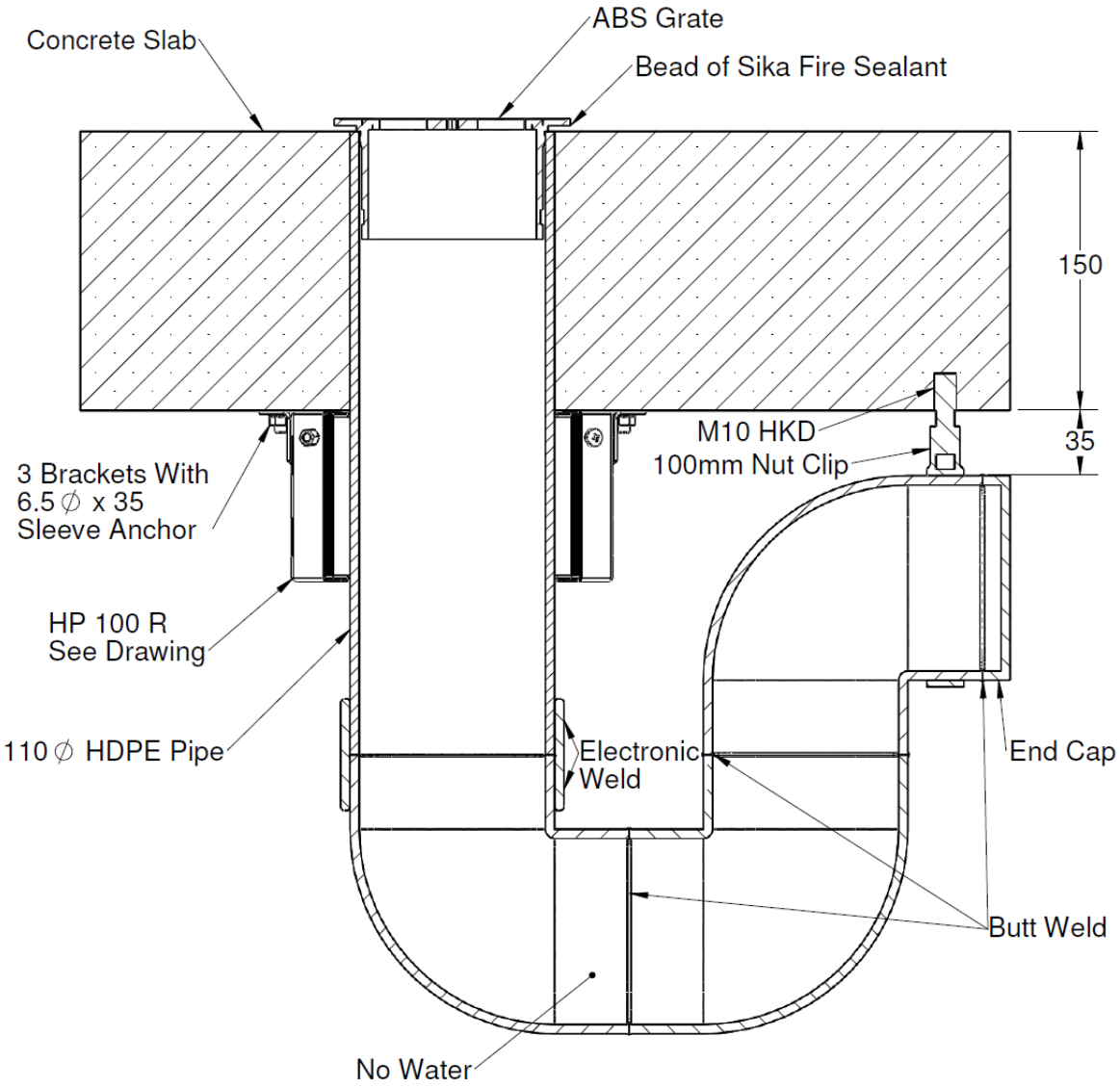


Figure 9: Specimen 3. Stack with 110 R Collar

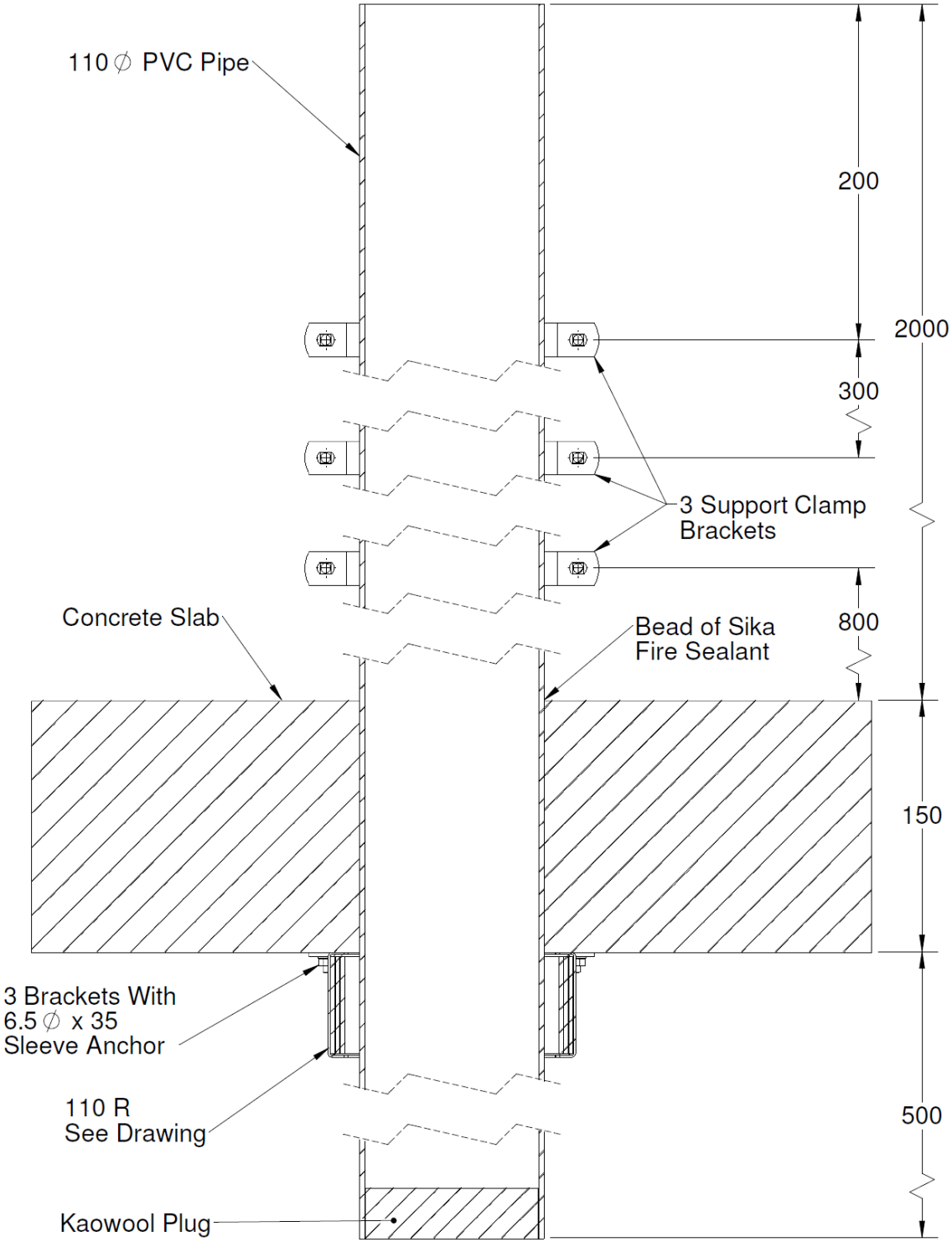


Figure 10: Specimen 4. Stack with 63 R Collar

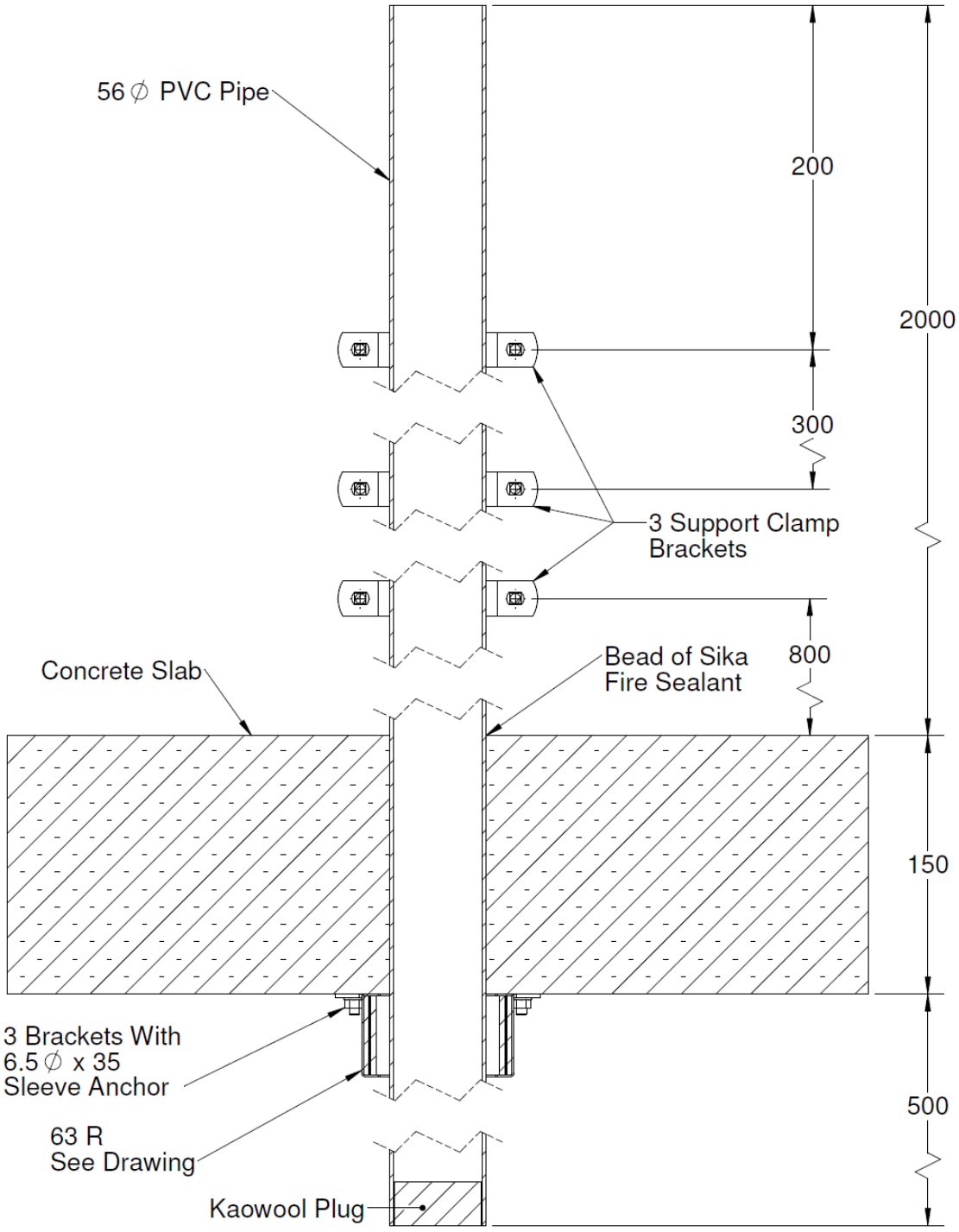


Figure 11: Specimen 5 Floor waste with raised plinth and H 100 FWS cast in collar

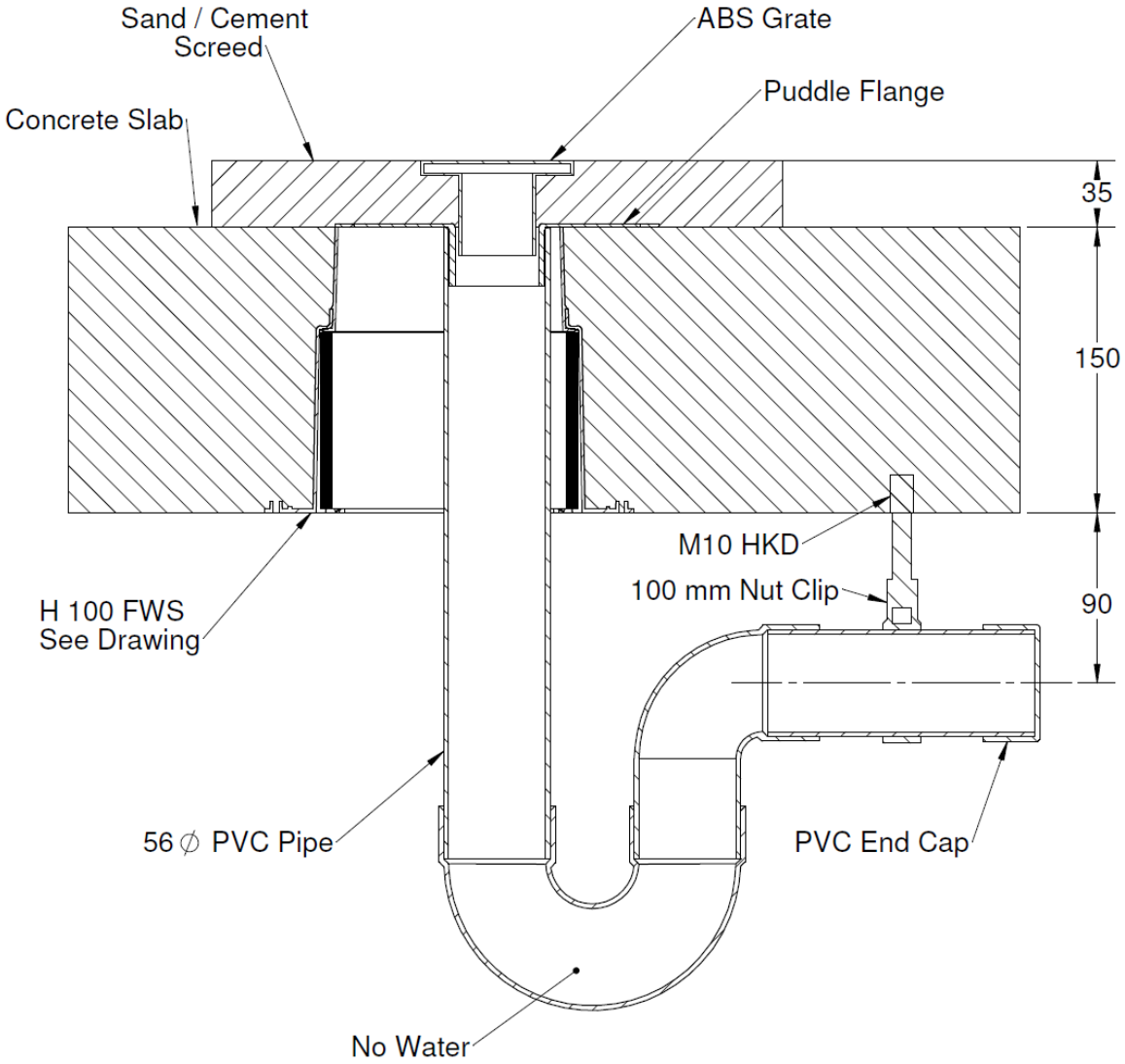


Figure 12: Specimen 6 Stack with H 50 S cast in collar

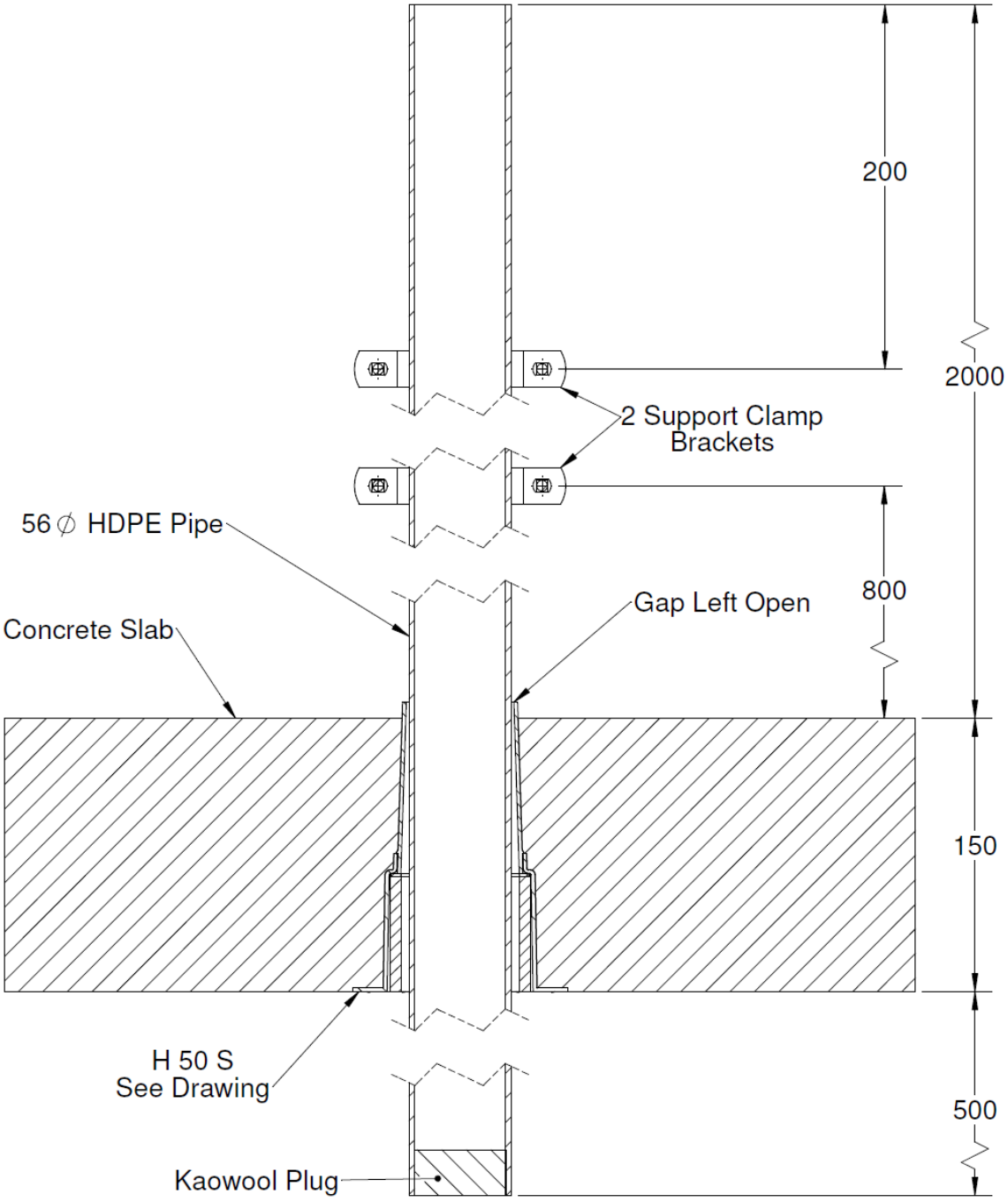


Figure 13: Specimen 7 Floor waste with LP 50 R collar

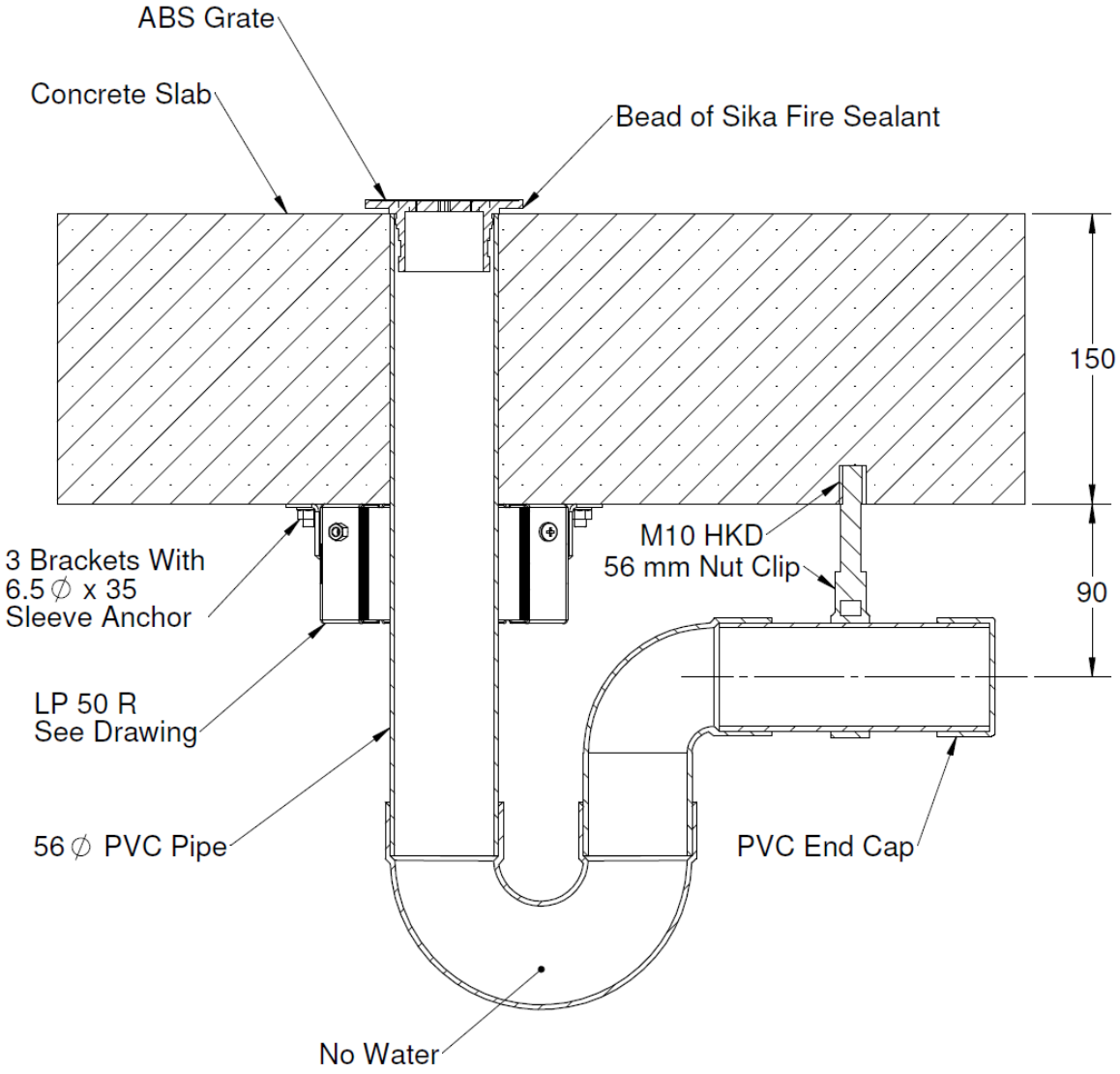


Figure 14: Specimen 9 Stack and 90° Elbow with 63 R collar

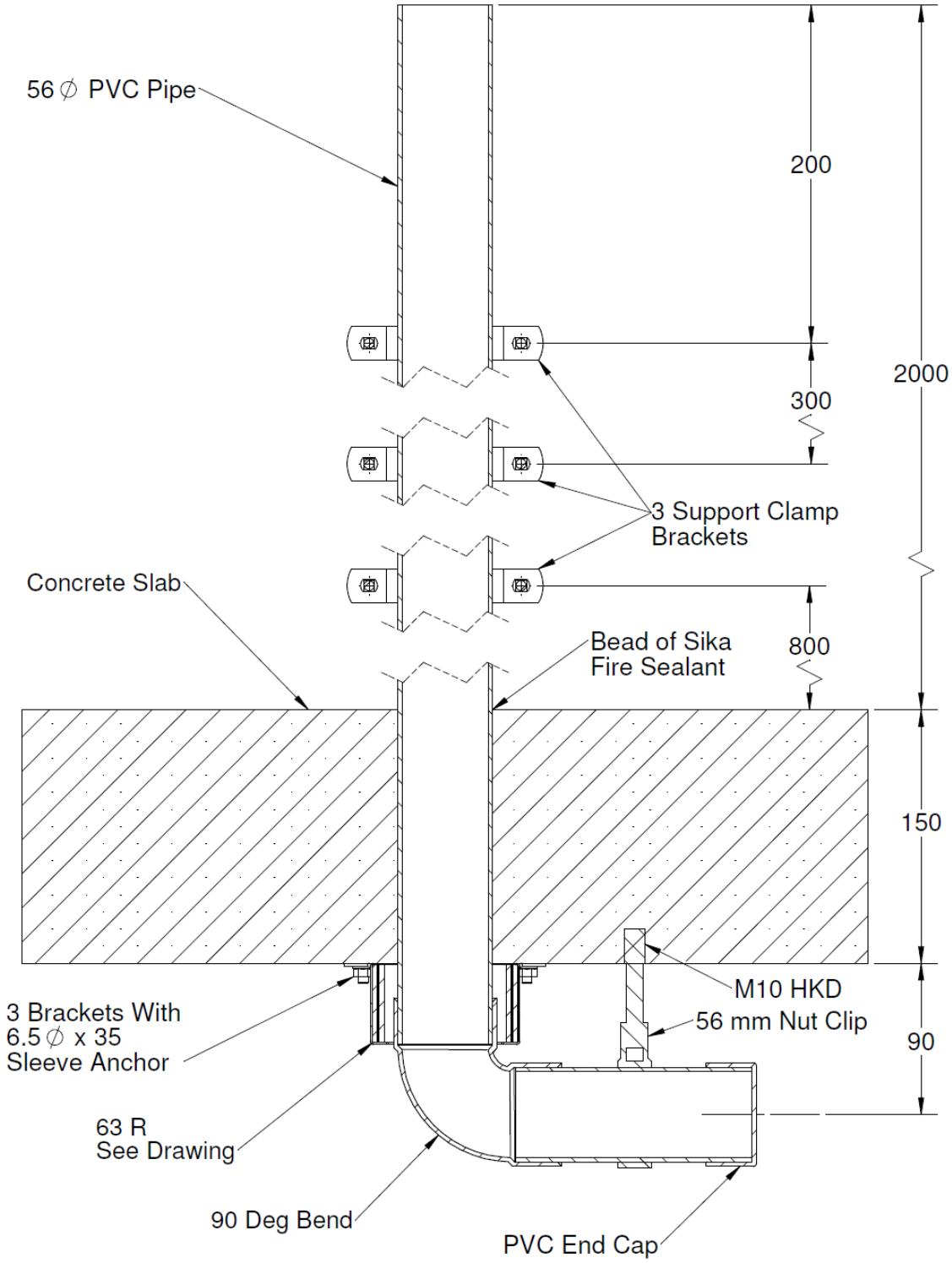
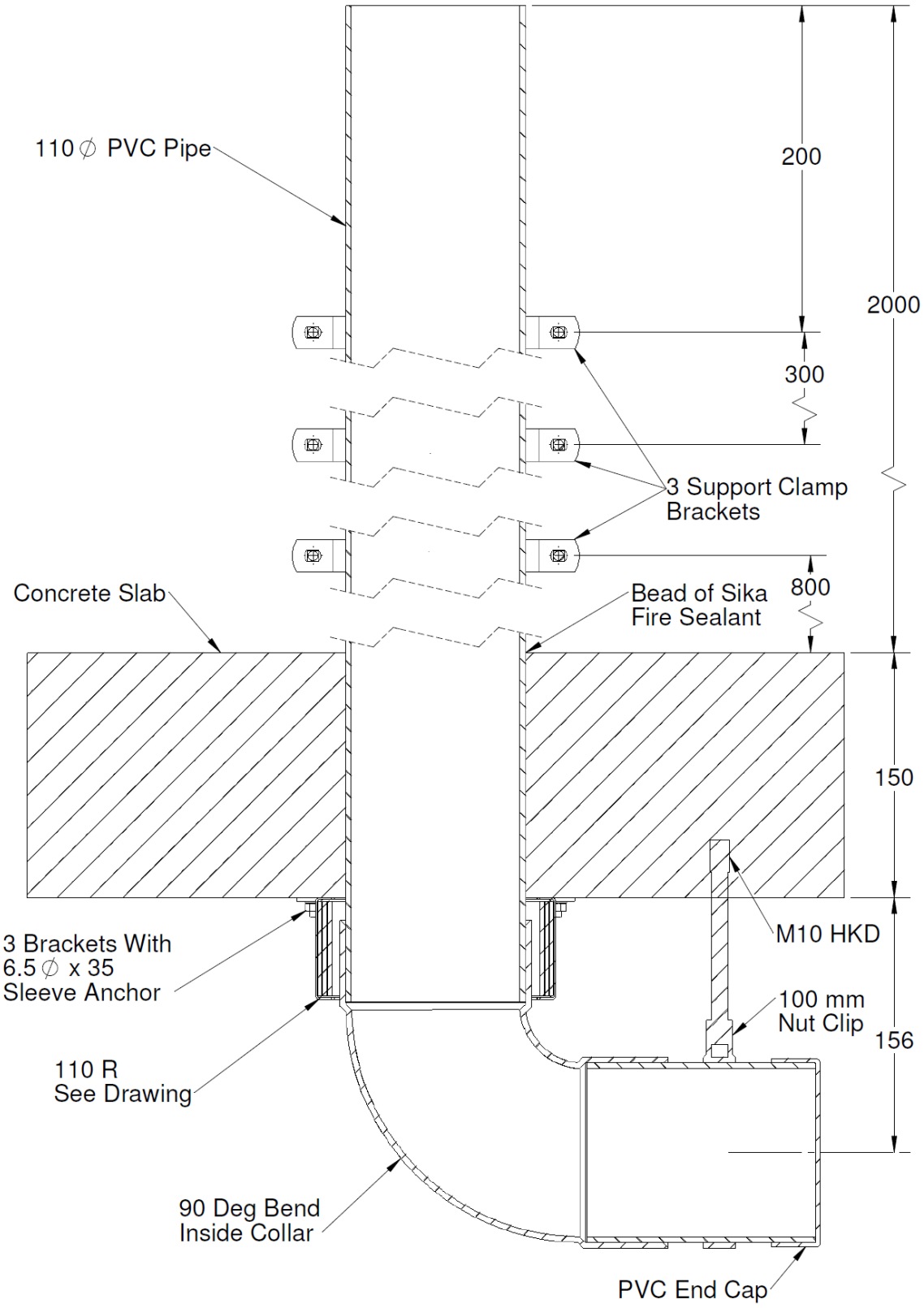


Figure 15: Specimen 10 Stack and 90° Elbow with 110 R collar



3 TEST CONDITIONS AND RESULTS

3.1 General

The specimen was tested on the 18 October 2011 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 14°C.

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

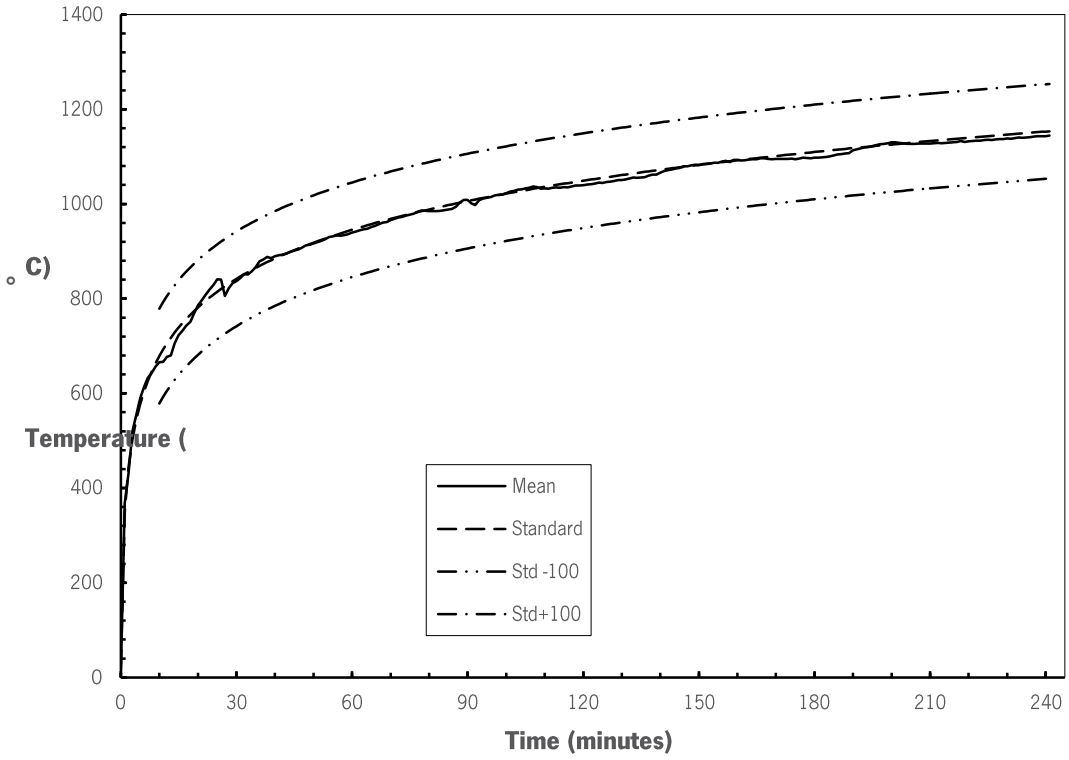
3.2 Furnace temperature measurement

The temperature measurement within the furnace was made using four 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.

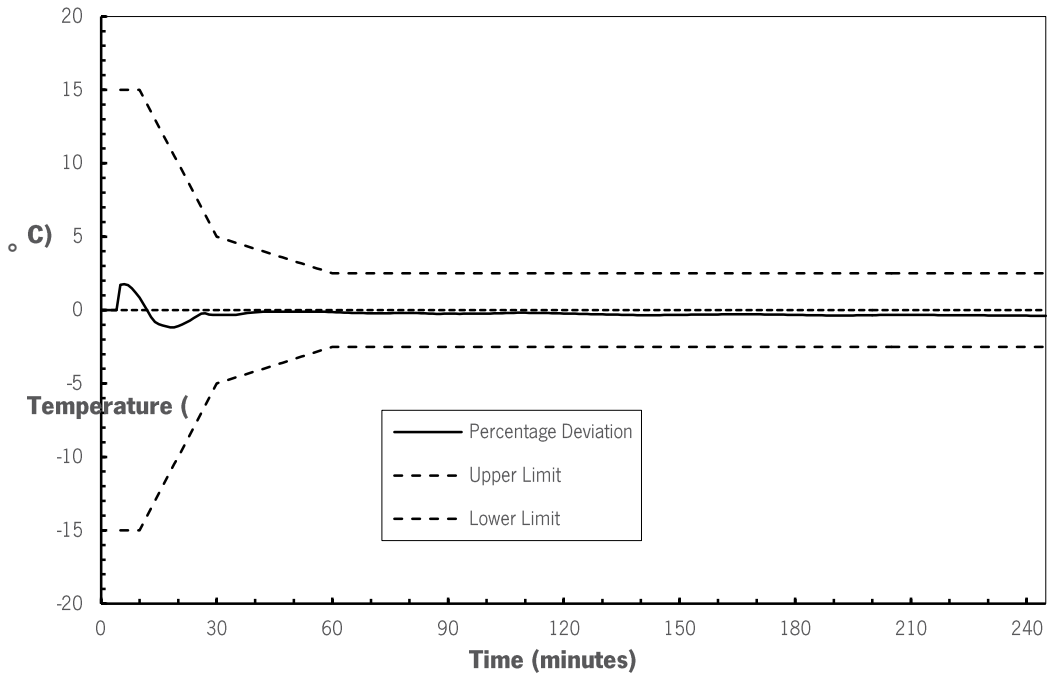
Figure 16: Furnace temperature



3.3 Furnace control

The furnace control complied with the standard for the duration of the test.

Figure 17: Percentage deviation of the furnace mean temperature from the standard curve



3.4 Pressure Measurements

The differential pressure was controlled to be not less than 20 Pa 100 mm below the underside of the concrete slab. The differential pressure was monitored using a micromanometer connected to a computer controlled data acquisition system which recorded the pressure at 15 second intervals.

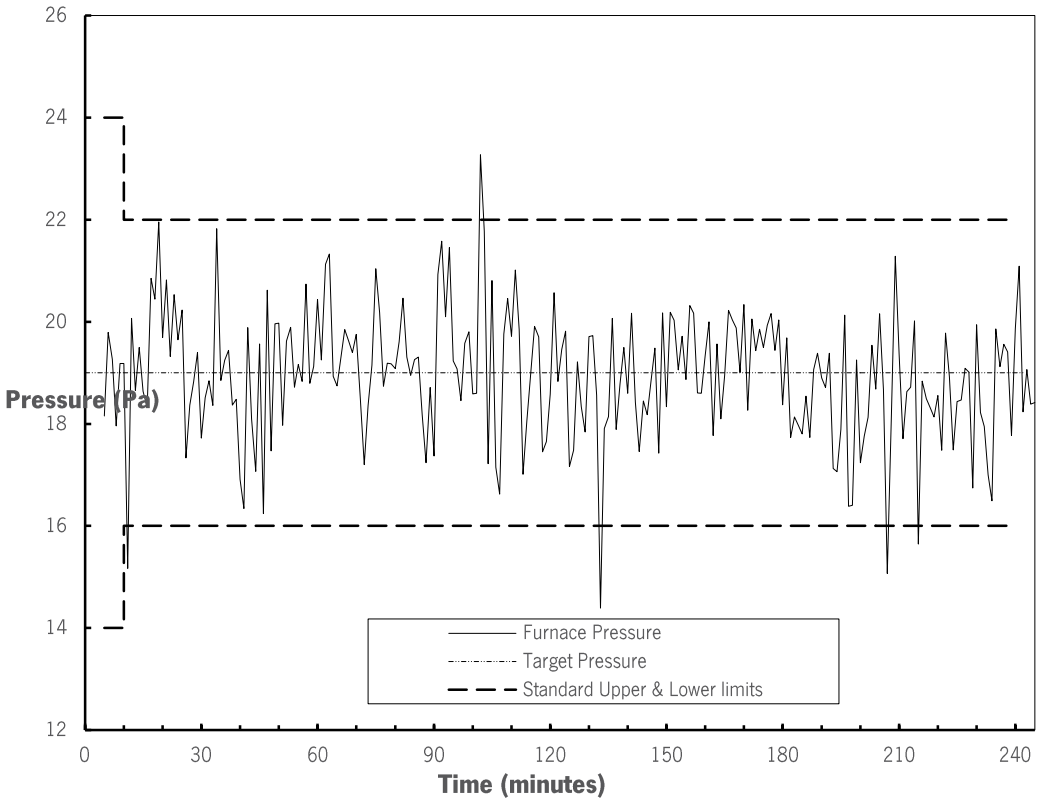
The furnace pressure was monitored and controlled during the test so that the calculated pressure at the probe does not deviate as follows:

- for $5 < t < 10$ minutes - ± 5 Pa
- for $t \geq 10$ minutes - ± 3 Pa.

The pressure sensor was located 720 mm above the sill.

Minor pressure deviations outside of the upper and lower limits occurred on four occasions, these minor variations are 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, 32 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 concrete slab at 25 mm from the penetrations, on the pipes at 25 mm from the slab and a single thermocouple was placed on the centre of each floor waste. Two additional thermocouples were placed on the unexposed surface of the slab 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.

Figure 19 shows the maximum temperature rise for each specimen.

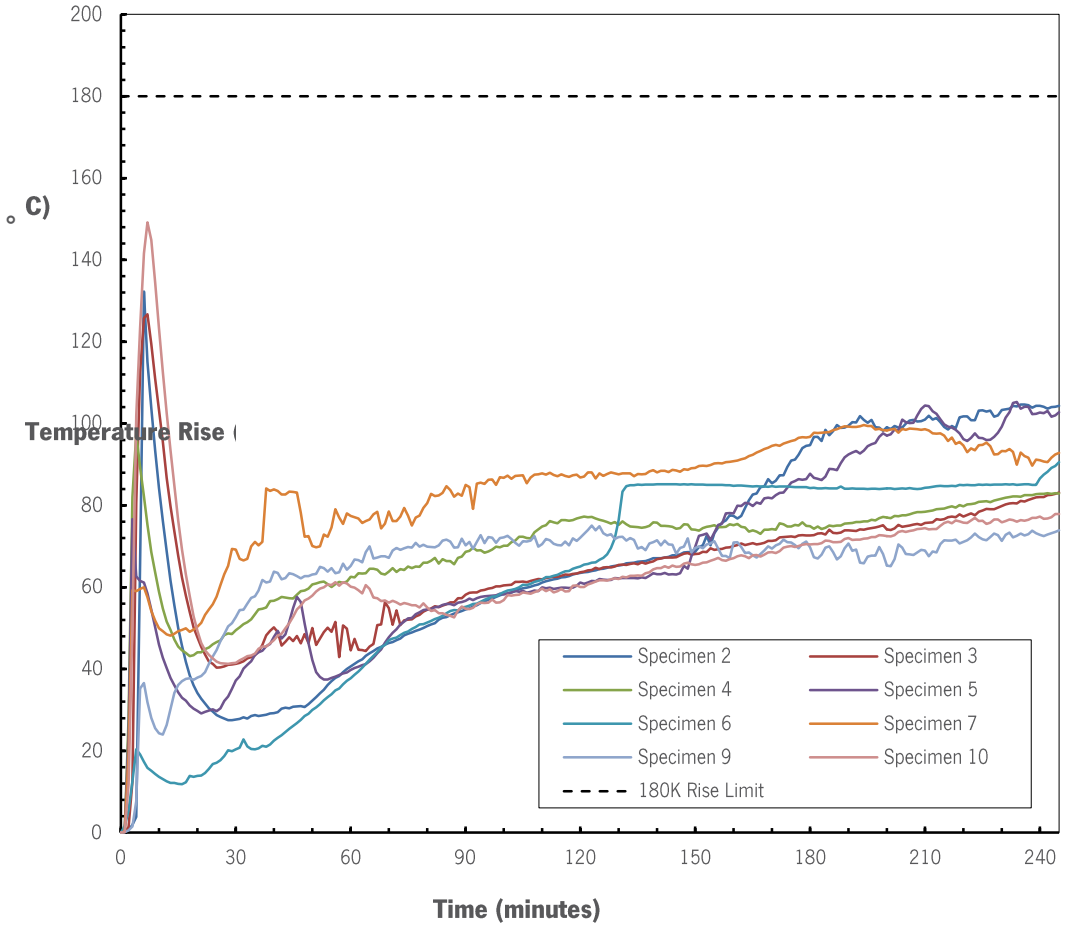
3.6 Specimen Insulation

None of the test specimens exceeded the insulation criteria before 245 minutes. Table 4 shows the maximum temperature rise achieved by each specimen and the location of the relevant thermocouple.

Table 4: Specimen maximum temperature

Pipe Specimen	Maximum Temperature and time	Thermocouple Location
2	132K @ 6 minutes	On the centre of the floor waste grate
3	127K @ 7 minutes	On the pipe 25 mm from the slab
4	98K @ 4 minutes	On the pipe 25 mm from the slab
5	105K @ 233 minutes	On the centre of the floor waste grate
6	91K @ 245 minutes	On the slab 25 mm from the pipe
7	100K @ 194 minutes	On the centre of the floor waste grate
9	75K @ 123 minutes	On the pipe 25 mm from the slab
10	149K @ 7 minutes	On the pipe 25 mm from the slab

Figure 19: Specimen maximum temperature rise.



3.7 Integrity 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.

The test was terminated after 245 minutes.

Table 5: Integrity observations

Time Min:sec	Specimen (#)	Description
0:20	6	Light smoke was being emitted from around the pipe.
1:45	5	Light smoke was being emitted through the floor grate.
2:12	7	Light smoke was being emitted through the floor grate.
2:50	5	Smoke emmision had reduced.
	6	Light smoke continued to be emitted from around the pipe.
	2	A light emission of smoke was emitted though the grate.
3:50	3, 9, 10	A large emission of smoke was issuing from the top of the pipes.
4:30	2	Smoke emission had increased through the grate.
	3, 9, 10	The smoke issuing from the top of the pipes had decreased substantially.
5:40	9	Smoke had stopped issuing from the top.
	2	The smoke issuing through the grate had decreased substantially.
6:10	2	Smoke had stopped issuing through the grate.
	5, 7	Smoke emission had reduced substantially.
	3, 10	Light smoke continued to be emitted from the top of the pipes.
7:30	5	Light smoke continued to be emitted through the grates.
	3, 10	Light smoke continued to be emitted from the top of the pipes.
9:00	5	The centre of the grate covers had sunken slightly.
	3	Light smoke was passing between the concrete and the pipe.
	10	The exterior of the pipe in the first approximately 500 mm above the concrete has been distorted by heat without any integrity failure.
27:00	10	The pipe had lifted out of the penetration by approximately 45 mm.
	7	The floor waste and grate had lifted out of the penetration by approximately. 40 mm.
	3	The pipe had lifted out of the penetration by approximately 20 mm.
	4	The pipe had lifted out of the penetration by approximately 10 mm.

Time Min:sec	Specimen (#)	Description
28:00	7	The floor waste had become physically loose in the concrete slab.
47:50	3	There was Increasing smoke emission from around the fitting.
180:00	2	The floor waste had lifted marginally above the concrete.
202:00	5	The smoke emission had thickened and changed colour slightly from white to yellow.
215:00	3	The pipe had lifted out of the penetration by approximately 35 mm.
	4	The pipe had lifted out of the penetration by approximately 25 mm.
	7	The floor waste had lifted out of the penetration by approximately 76 mm.
	9	The pipe had lifted out of the penetration by approximately 28 mm.
	10	The pipe had lifted out of the penetration by approximately 51 mm.
245:00		Test Stopped

3.8 Conclusion

The fire resistance in minutes, in accordance with AS 1530.4-2005 with reference to AS 4072.1– 2005, of eight pipe penetrations and their sealing systems in a concrete slab, was as follows:

NF = No failure for the duration of the test.

Pipe No	Specimen Description	Integrity (minutes)	Insulation (minutes)
2	100 nominal HDPE DWV Floor waste with “HP 100 R” retro fit collar	245	245
3	100 nominal PVCU DWV Stack with “110 R” retro fit collar	245	245
4	50 nominal PVCU DWV Stack with “63 R” retro fit collar	245	245
5	50 nominal PVCU DWV Floor waste with 35 mm high screed topping and “H 100 FWS” cast in collar	245	245
6	50 nominal HDPE DWV Stack with “H 50 S” cast in collar	245	245
7	50 nominal PVCU DWV Floor waste with “LP 50 R” retro fit collar	245	245
9	50 nominal PVCU DWV Stack with 90° Elbow socket inserted into a “63 R” retro fit collar	245	245
10	100 nominal PVCU DWV Stack with 90° Elbow socket inserted into a “110 R” retro fit collar	245	245

"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.

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

1. The results of the prototype test may be applied to concrete of density ±15% of the tested specimen.
2. Plastic pipes
    a. The test results may be directly applied to concrete elements thicker than the tested prototype.
    b. Penetrations not perpendicular to the plane of the element are acceptable provided that the fire-stopping system is used as reported here and the fire exposure is from below the slab.

5 SPECIMEN PHOTOGRAPHS

5.1 Test assembly at start of test unexposed face

5.2 Test assembly at end of test unexposed face

5.3 Specimen 2

Unexposed Face

Exposed Face

5.4 Specimen 3

Unexposed Face

Exposed Face

5.5 Specimen 4

Unexposed Face

Exposed Face

5.6 Specimen 5

Unexposed Face

Exposed Face

5.7 Specimen 6

Unexposed Face

Exposed Face

5.8 Specimen 7

Unexposed Face

Exposed Face

5.9 Specimen 9

Unexposed Face

Exposed Face

5.10 Specimen 10

Unexposed Face

Exposed Face

5.11 Exposed face at end of test