

FIRE ASSESSMENT REPORT

FAR 3932 ISSUE 3

FIRE RESISTANCE OF SNAP FIRE SYSTEMS PTY LTD CAST-IN FIRE COLLARS WITH A VARIETY OF PIPE SIZES AND MATERIAL TYPES

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ASSESSMENT OBJECTIVE

This assessment report considers the fire resistance of SNAP cast-in collars with PVC, HDPE, PP-R and PE pipe penetrations in concrete floor slabs when tested in accordance with AS 1530.4:2014 with reference to AS 4072.1 – 2005.

CONCLUSION

It is considered that the SNAP Fire Systems cast-in collar pipe penetration systems given in Tables 3 to 8 for PVC, HDPE, PP-R and PE would achieve a fire resistance in terms of the Integrity and Insulation when tested in accordance with AS 1530.4:2014 with reference to AS 4072.1 – 2005.

It is also considered that the floor waste collar (identified by the suffix FWS) can be used in place of the stack cast-in collar identified by the suffix S of the same tested or assessed size for stack pipe assemblies without prejudicing the established fire resistance of the penetration in question.

It is further considered that the minor variations of the high (H) and low (L) profile collar tops and the exclusion or inclusion of the rubber ring identified by the suffix (RR) can be used in any combination without prejudicing the established fire resistance of the collar and penetration in question.

For a different thickness of floor slab with a lower FRL the penetration system FRL is lowered to match the slab FRL. Where the penetration system insulation rating is lower than the slab rating the penetration insulation takes precedence.

The following table gives the required thickness of concrete to achieve a required fire resistance level (FRL).

Note: The standard floor slab thickness used for the tests and assessments is 150 mm. Specific pipe penetrations require thicker floor slabs to maintain the insulation and integrity criteria these are noted on the specific tables above.

Concrete Slab FRL and Slab Thickness

FRL (minutes)	Thickness (mm)
120	120
180	150
240	180

As defined in Table 5.5.1 of AS 3600-2001.

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LIMITATION

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1. INTRODUCTION

This report gives BRANZ's assessment on the fire resistance of SNAP cast-in collars with PVC, HDPE, PP-R and PE pipe penetrations in concrete floor slabs when tested in accordance with AS 1530.4:2014 with reference to AS 4072.1 – 2005.

2. BACKGROUND

2.1 General

The following gives the collar designation coding used in this report.

Prefix

- H = High profile
- L = Low profile

Suffix

- S = Used for stack assemblies only
- RR = Rubber ring
- FWS = Use with floorwaste or shower

Where reference is made to "stack" assemblies this relates to the vertical pipe installation through a slab.
The suffix (SC) for the PVC pipes indicates the pipe is of sandwich core construction.

2.2 Summary of Background Test Data

Snap Fire Systems Pty Ltd have conducted a number of fire resistance tests of pipe penetrations and their cast in fire collars penetrating a floor slab. Table 1 gives the relevant test summary data for the test specimens relevant to this assessment.

* = Fitting in collar.

Table 1: Background Test Data

Test ID	Pipe ID	Pipe Material	Pipe ∅ (mm)	Collar Code	Description Penetration Type/ Slab Thickness around Penetration	Result (FRL)
FSP1144	A	PVC	315	FS3S-315A1	Stack / 250 mm	-/180/180
FSP1592	3	PVC (SC)	110	H150FWS	Floorwaste / 185 mm	-/240/240
	4	HDPE	110	L100FWS	Floorwaste / 185 mm	-/240/240
	5	HDPE	56	H50FWS	Floorwaste / 185 mm	-/240/240
FSP1577	1	HDPE	110	H100S*	Stack / 150 mm	-/240/240
	2	PVC (SC)	110	H100S	Stack / 150 mm	-/240/240
	3	PVC	69	H100FWS RR	Floorwaste / 185 mm	-/240/240
	4	PVC (SC)	110	H100FWS RR	Floorwaste / 185 mm	-/240/240
	5	PVC	43	H50S-RR*	Stack /150 mm	-/240/240
FSP1576	2	PVC	56	H50FWS	Floorwaste / 185 mm	-/240/240
	3	PVC	82	H100FWS	Floorwaste / 185 mm	-/240/240
	5	PVC	43	H50FWS	Floorwaste / 185 mm	-/240/240

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Test ID	Pipe ID	Pipe Material	Pipe ∅ (mm)	Collar Code	Description Penetration Type/ Slab Thickness around Penetration	Result (FRL)
FSP1575	1	PVC	110	H100S-RR	Stack / 150 mm	-/240/240
	2	PVC	82	H100S-RR	Stack / 150 mm	-/240/240
	3	PVC	69	L65S	Stack / 150 mm	-/240/240
	4	PVC	56	H50S-RR	Stack / 150 mm	-/240/240
	5	PVC	43	L40S	Stack / 150 mm	-/240/240
FSP1564	4	PVC	56	H50FWS	Floorwaste / 185 mm	-/240/240
FSP1359	1	PPR	110	(H/L)100FWS	Stack / 150 mm	-/240/240
	2	PPR	160	SNAP Metal 160	Stack / 150 mm	-/240/180
	3	PPR	50	(H/L)100FWS	Stack / 150 mm	-/240/180
	4	PPR	125	SNAP Metal 125	Stack / 150 mm	-/240/180
	5	PPR	20	(H/L)50FWS	Stack / 150 mm	-/240/240
	6	PPR	50	(H/L)50FWS	Stack / 150 mm	-/240/240
FSP1367a	1	PE	110	(H/L)100FWS	Stack / 150 mm	-/240/180
	2	PE	160	SNAP Metal 160	Stack / 150 mm	-/240/120
	2/1	PE	160		Stack / 175 mm	-/240/180
	3	PE	50	(H/L)100FWS	Stack / 150 mm	-/240/240
	4	PE	125	SNAP Metal 125	Stack / 150 mm	-/240/120
	4/1	PE	125		Stack / 175 mm	-/240/240
	5	PE	20	(H/L)50FWS	Stack / 150 mm	-/240/240
	6	PE	50	(H/L)50FWS	Stack / 150 mm	-/240/240
FP4837	5	PVC (SC)	110	H100S	Stack / 150 mm	-/240/240
	6	PVC (SC)	110	L100FWS	Floorwaste / 185 mm	-/240/240
	7	PVC (SC)	110	H100FWS	Stack / 150 mm	-/240/240
FP4640	5	PVC	56	H100FWS	Floorwaste / 185 mm	-/240/240
	6	HDPE	56	H50S	Stack / 150 mm	-/240/240

In BRANZ assessment report FAR 3528 it was considered that the SNAP H150FWS cast in collar would maintain the integrity and insulation criteria of AS 1530.4-2005 for the times stated below.

Table 2: BRANZ Assessment FAR 3528 Results

Report No/Note	Pipe Description	Floor Thickness	Assessed Performance
FP 4428	160 mm uPVC DWV with elbow socket fitted into the body of the collar	170 mm	-/240/240
	160 mm uPVC DWV See Note	170 mm 150 mm	-/240/240 -/180/180
FSP 1132	160 mm HDPE PE80	150 mm	-/180/180
FSP 1359	160 mm PPR 80 Fazer composite SDR 7.4	150 mm	-/240/180
FSP 1367	160 mm PE SDR 7.4	150 mm	-/240/120

Note: Installation of the pipe as per the specimen in FP 4428 with extra fire resistance sealant filling the annular space between the collar and the pipe at the unexposed face.

In CSIRO assessment report FCO-2598 it was assessed that a nominal 40 mm HDPE pipe with H50FWS cast in collar with a floorwaste type installation would achieve an FRL of - /180/180.

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3. DISCUSSION

3.1 AS 1530.4-1997 and AS 1530.4-2005 vs 2014

In the supporting test evidence referenced in Section 2.2 the fire collars were tested in accordance with AS 1530.4-1997 and AS 1530.4-2005. A review of the 1997, 2005 and 2014 version of AS 1530.4 has been undertaken with respect to the testing of fire collars. Based on the review between versions of the test standard it is considered had the tests referenced in Section 2.2 been undertaken in accordance with AS 1530.4:2014 a similar fire resistance performance would be expected.

3.2 Snap Cast-in Collars Description and Method of Operation

The range of SNAP cast-in collars has a variety of minor variations to the design of the collar. These include the following.

- H = High profile. The high profile refers to the moulded polypropylene top fitted to the collar body. This is used where the pipe is not fitted prior to pouring the concrete slab. The plastic top is trimmed off afterwards level with the slab surface.
- L = Low profile. The low profile top refers to the moulded polypropylene top that has a hole sized for the pipe it is used for. A section of pipe must be fitted prior to pouring the concrete slab.
- S = Stack assembly only. The moulded plastic cast in collars include three equally spaced springs with thermal triggers to assist with closure of the penetration. The collars used for floor waste applications are identified with the suffix FWS include stainless steel grade 304 springs. Collars used for stack applications identified with the suffix (S) have galvanised steel springs.
- RR = Rubber ring. The rubber ring is an option used where it is necessary to reduce water ingress through the penetration during construction.
- The L65S, L80S, L100S and H100S collars are essentially the same collar except for the high profile top used on the H100S. Similarly the L40S and L50S is the same as the H50S except for the high profile top section.
  The L65FWS, L80FWS, L100FWS and H100FWS are also essentially the same collar except for the top low profile section with the smaller clearance hole for smaller diameter pipes. Similarly the L40FWS and L50FWS is the same as the H50FWS except for the high profile top section.

The cast in collars includes a polypropylene moulded body with a single layer of Intumesh intumescent and a layer of stainless steel mesh measuring 0.15 mm thick with 30 squares per inch sandwiched between the intumescent sleeve and the body of the collar. The height and thickness of the intumescent within the collar varies depending on the collar specification.

On exposure to fire the intumescent material activates to close off the fire exposed end of the pipe as it burns back from the exposed face of the slab. The stainless steel mesh forms a lattice that helps to bind the activated intumescent within the collar and helps to prevent the intumescent from being consumed and falling away from the penetration prematurely.

The collars are assisted by the springs to fold the intumescent into the penetration upon activation of the spring thermal link.

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Where the high profile collars were used for the pipe penetrations detailed in the above reports, the gap between the pipe and the floor slab at the unexposed face was sealed with a bead of fire rated sealant or cement mortar.

It is considered that the test results on the SNAP cast in collars indicate that the minor variations of the High and Low profile collars and the inclusion or exclusion of the rubber ring, described above, have no discernible impact on the test result. Accordingly any combination of these configurations may be used without affecting the FRL of the tested and assessed specimens.

3.3 Assessment

3.3.1 AS 4072.1-2005 Prerequisite Test Data

AS 4072.1-2005 Section 4 sets out the prerequisite test data required for assessing the variations to the tested specimen. Where assessing plastic pipes other than PVC it is a requirement that the nominal 40 mm, 50 mm, 65 mm, 80 mm and 100 mm PVC pipe sizes have been tested in the collar assembly under consideration and have achieved the desired FRL. For the plastic pipe under consideration the maximum and minimum pipe size where the diameter Ø is (40 mm ≤ Ø ≤ 120 mm) must also be tested and have achieved the desired FRL. The intermediate pipe sizes can then be assessed. The test and assessment results shown in section 1.2 of this report give the required prerequisite test data for completing the assessment of PVC, HDPE, PP-R and PE pipes through a concrete slab.

3.3.2 Method

The significant factor in initially sealing the pipe is considered to be the ability of the intumescent material to fully seal the cross sectional area of the pipe. The spring assist collars force the intumescent and stainless mesh to close around the softening plastic pipe material thereby ensuring that the penetration is closed quickly. For the purposes of assessment for the performance of the cast-in collars with a variety of pipe materials and installation methods all of the collars have been tested with PVC pipes in floor waste installations. Further two test specimens consisting of 100 mm and 50 mm PVC pipes with a fitting located within the collar have been tested. For pipes other than PVC the cast-in collars have been tested at the extremes, 40 mm and 100 mm nominal diameters or tested at the relevant sizes above 100 mm.

3.4 Floorwaste and Shower (FWS) Collars with PVC Pipes

The most onerous pipe penetration configuration for fire resistance testing is the floor waste system where the pipe terminates at the unexposed face with a grate located over the pipe end. The method used to close the penetration needs to be quick acting to ensure the thermocouple located on the centre of the grate does not exceed the 180K temperature rise criterion. The H 100 FWS and H/L 50 FWS floor waste collars have been tested on floor waste installations with PVC pipes without failure maintaining the integrity and insulation criteria for 240 minutes. See Table 1 for details.

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In FSP1577 specimen No 4 was a floorwaste installation with an H/L100FWS cast in collar and a 100 mm PVC (SC) pipe. The fitting was located in the collar. The assembly maintained the integrity and insulation criteria for 240 minutes. In FSP1564 specimen No 4 was a floorwaste installation with an H/L50FWS cast in collar and a nominal 50 mm PVC pipe. The fitting was located in the collar. The assembly maintained the integrity and insulation criteria for 240 minutes.

In FAR 3528 it was assessed that the H150FWS cast-in collar with a 150 mm PVC pipe and fitting located in the collar would maintain the fire resistance of the system for 240 minutes. It is therefore considered that the same collar would maintain the established fire resistance when sealing a 100 mm PVC stack assembly with a fitting located in the collar. The nominal 100 mm PVC pipe floorwaste assembly with a fitting in the H/L100FWS collar and the H150FWS collar have been tested with a floorwaste system for 240 minutes. As both collars are similar in construction it is considered that the H150FWS with a floorwaste and fitting in collar assembly would not prejudice the fire resistance of the system before 240 minutes.

PVC pipes 100 mm and above are usually manufactured as sandwich core (SC) construction. Experience has shown that the sandwich core construction pipes are harder to close than solid construction. It is therefore considered that the nominal 100 mm PVC solid core pipe would achieve no less a result than the sandwich core pipe.

Table 3 gives the tested and assessed results for the floorwaste cast in collars suffix (FWS). The highlighted cells indicate a previously tested or assessed specimen.

Table 3: Floorwaste and Shower (FWS) Collars with PVC Pipes

Pipe Material	∅	Collar Code	Stack	Stack with Fitting	Floorwaste & Shower	Floorwaste with Fitting
PVC (SC)	100	H150FWS	-/240/240	-/240/240	-/240/240	-/240/240
PVC (SC)	100	H/L100FWS	-/240/240	-/240/240	-/240/240	-/240/240
PVC*	100	H/L100FWS	-/240/240	-/240/240	-/240/240	-/240/240
PVC	80	H/L80FWS	-/240/240	-/240/240	-/240/240	-/240/240
	65	H/L65FWS	-/240/240	-/240/240	-/240/240	-/240/240
	50fw	H/L100FWS	-/240/240	-/240/240	-/240/240	-/240/240
	50	H/L50FWS	-/240/240	-/240/240	-/240/240	-/240/240
	40	H/L40FWS	-/240/240	-/240/240	-/240/240	n/a

Note: All Floorwaste and Shower assemblies including with fitting in collar must be through 185 mm thick floor slab or 150 mm slab with 35 mm thick topping.

PVC* = Solid core PVC pipe.

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3.5 Stack Only (S Range) Collars with PVC Pipes

As per the argument in 3.3.1 and 3.3.2 Table 4 below gives the tested and assessed results for PVC pipes and the S range of fire collars. The highlighted cells indicate the tested results.

Table 4: Stack Only (S Range) Collars with PVC Pipes

Pipe Material	∅	Collar Code	Stack	Stack with Fitting
PVC	315	315C	-180/180**	n/a
	160	H150FWS	-/180/180 -/240/240*	n/a
PVC (SC)	100	H/L100S	-/240/240	-/240/240
PVC	100	H/L100S	-/240/240	-/240/240
	90	H/L100S	-/240/240	-/240/240
	80	H/L80S	-/240/240	-/240/240
	65	H100S or L65S	-/240/240	-/240/240
	50	H/L50S	-/240/240	-/240/240
	40	H50S or L40S	-/240/240	-/240/240

Slab thickness minimum 150 mm.
* = Slab thickness must be minimum 170 mm thick.

** = Slab thickness must be minimum 250 mm thick.

3.6 Floorwaste and Shower (FWS) Collars with HDPE Pipes

As per the argument in 3.3.1 and 3.3.2 Table 5 below gives the tested and assessed results for HDPE pipes and the FWS range of fire collars. The highlighted cells indicate the tested results.

Table 5: Floorwaste and Shower (FWS) Collars with HDPE Pipes

Pipe Material	∅	Collar Code	Stack	Stack with Fitting	Floorwaste & Shower
HDPE	100	H/L100FWS	-/240/240	n/a	-/240/240
HDPE (Silent)	100	H/L100FWS	-/240/240	n/a	-/240/240
HDPE	90	H100FWS	-/240/240	n/a	-/240/240
	75	H100FWS	-/240/240	n/a	-/240/240
	63	H100FWS	-/240/240	n/a	-/240/240
	56	H50FWS	-/240/240	n/a	-/240/240
	50	H50FWS	-/180/180	n/a	-/180/180
	40	H50FWS	-/180/180	n/a	-/180/180

Note: All Floorwaste and Shower assemblies including with fitting in collar must be through 185 mm thick floor slab or 150 mm slab with 35 mm thick topping.
The HDPE (Silent) pipe is a standard pipe with a very smooth internal wall to reduce friction and is essentially the same as the standard HDPE pipe penetration testing purposes.

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3.7 Stack Only (S Range) Collars with HDPE Pipes

As per the argument in 3.3.1 and 3.3.2 Table 6 below gives the tested and assessed results for HDPE pipes and the S range of fire collars. The highlighted cells indicate the tested results.

Table 6: Stack Only (S Range) Collars with HDPE Pipes

Pipe Material	∅	Collar Code	Stack	Stack with Fitting	Floorwaste & Shower
HDPE	160	H150FWS	-/180/180*	n/a	n/a
	100	H/L100S	-/240/240	n/a	n/a
HDPE (Silent)	100	H/L100S	-/240/240	n/a	n/a
HDPE	90	H100S	-/240/240	n/a	n/a
	75	H100S	-/240/240	n/a	n/a
	63	H100S	-/240/240	n/a	n/a
	56	H50S	-/240/240	n/a	n/a

Slab thickness minimum 150 mm.
* = Slab thickness must be minimum 180 mm thick.

3.8 Floorwaste and Shower (FWS) Collars with PP-R SDR 7.4 Pipes

As per the argument in 3.3.1 and 3.3.2 Table 7 below gives the tested and assessed results for PP-R SDR 7.4 pipes and the FWS range of fire collars. The highlighted cells indicate the tested results.

The 50 mm diameter and 20 mm diameter pipe sizes have been tested in the same collar H50FWS and achieved integrity and insulation of 240 minutes. It is considered that the intermediate pipe sizes would achieve the same result given the assessed pipes fall between the 20 mm and 50 mm pipe sizes in the same collar.

The 50 mm diameter and 110 mm diameter pipe sizes have been tested in the same collar H100FWS and achieved integrity of 240 minutes and insulation of 180 minutes for the smaller pipe size. It is considered that the intermediate pipe sizes would achieve the same integrity 240 minutes and no less insulation than the smaller pipe size tested of 180 minutes.

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Table 7: Floorwaste and Shower (FWS) Collars with PP-R SDR 7.4 Pipes

Pipe Material	∅	Collar Code	Stack	Stack with Fitting	Floorwaste & Shower
PP-R SDR 7.4	160	H150FWS	-/240/180*	n/a	n/a
	125	125C	-/240/180*	n/a	n/a
	110	H100FWS	-/240/240	n/a	n/a
	90	H100FWS	-/240/180	n/a	n/a
	75	H100FWS	-/240/180	n/a	n/a
	63	H100FWS	-/240/180	n/a	n/a
	50	H100FWS	-/240/180	n/a	n/a
	50	H50FWS	-/240/240	n/a	n/a
	40	H50FWS	-/240/240	n/a	n/a
	32	H50FWS	-/240/240	n/a	n/a
	25	H50FWS	-/240/240	n/a	n/a
	20	H50FWS	-/240/240	n/a	n/a

Slab Thickness minimum 150 mm.
* = Slab thickness must be minimum 175 mm thick.

3.9 Floorwaste and Shower (FWS) Collars with PE Pipes

As per the argument in 3.3.1 and 3.3.2 Table 8 below gives the tested and assessed results for PE SDR 7.4 and SDR 11 pipes and the FWS range of fire collars for pipes sizes in the range 160 mm diameter to 50 mm diameter. The highlighted cells indicate the tested results.

The 50 mm diameter and 20 mm diameter pipe sizes have been tested in the same collar H50FWS and achieved integrity and insulation of 240 minutes. It is considered that the intermediate pipe sizes would achieve the same result given the assessed pipes fall between the 20 mm and 50 mm pipe sizes in the same collar.

The 50 mm diameter and 110 mm diameter pipe sizes have been tested in the same collar H100FWS and achieved integrity of 240 minutes and insulation of 180 minutes for the smaller pipe size. It is considered that the intermediate pipe sizes would achieve the same integrity 240 minutes and no less insulation than the smaller pipe size tested of 180 minutes.

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Table 8: Floorwaste and Shower (FWS) Collars with PE SDR 7.4 & SDR 11 Pipes

Pipe Material	∅	Collar Code	Stack	Stack with Fitting	Floorwaste & Shower
PE SDR 11	160	H150FWS	-/240/120 -/240/180*	n/a	n/a
	125	125C	-/240/120 -/240/240*	n/a	n/a
	110	H100FWS	-/240/180	n/a	n/a
PE SDR 7.4	90	H100FWS	-/240/180	n/a	n/a
	75	H100FWS	-/240/180	n/a	n/a
	63	H100FWS	-/240/180	n/a	n/a
	50	H100FWS	-/240/240	n/a	n/a
	50	H50FWS	-/240/240	n/a	n/a
	40	H50FWS	-/240/240	n/a	n/a
	32	H50FWS	-/240/240	n/a	n/a
	25	H50FWS	-/240/240	n/a	n/a
	20	H50FWS	-/240/240	n/a	n/a

Slab Thickness minimum 150 mm.
* = Slab thickness must be minimum 175 mm thick.

3.10 Concrete Thickness

Tables 3 – 8 above give the tested and assessed integrity and insulation for the penetration through a floor slab also given is the minimum thickness for the slab for the specific penetration. Consideration must be placed on the thickness of the floor slab. Table 5.5.1 of AS 3600-2001, Concrete Structures, gives the required thickness of concrete to achieve a required fire resistance level (FRL). Where the insulation for the penetration in question is less than the slab as specified in the above standard the lower insulation takes precedence.

4.CONCLUSION

It is considered that the SNAP Fire Systems cast-in collar pipe penetration systems given in Tables 3 to 8 for PVC, HDPE, PP-R and PE would achieve a fire resistance in terms of the Integrity and Insulation when tested in accordance with AS 1530.4:2014 with reference to AS 4072.1 – 2005.

It is also considered that the floor waste collar (identified by the suffix FWS) can be used in place of the stack cast-in collar identified by the suffix S of the same tested or assessed size for stack pipe assemblies without prejudicing the established fire resistance of the penetration in question.

It is further considered that the minor variations of the high (H) and low (L) profile collar tops and the exclusion or inclusion of the rubber ring identified by the suffix (RR) can be used in any combination without prejudicing the established fire resistance of the collar and penetration in question.

For a different thickness of floor slab with a lower FRL the penetration system FRL is lowered to match the slab FRL. Where the penetration system insulation rating is lower than the slab rating the penetration insulation takes precedence.

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Table 9 gives the required thickness of concrete to achieve a required fire resistance level (FRL).

Note: The standard floor slab thickness used for the tests and assessments is 150 mm. Specific pipe penetrations require thicker floor slabs to maintain the insulation and integrity criteria these are noted on the specific tables above.

Table 9: Concrete Slab FRL and Slab Thickness

FRL (minutes)	Thickness (mm)
120	120
180	150
240	180

As defined in Table 5.5.1 of AS 3600-2001.

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