



FIRE TECHNICAL OPINION

FC10453-001-TO

FIRE RESISTANCE OF 3M TUCK-IN WRAP STRIP PENETRATION SEALS FOR PVC U PIPES

CLIENT

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ASSESSMENT OBJECTIVE

To assess the fire resistance in accordance with AS 1530.4:2014 for compliance with AS 4072.1-2005 of 3M Tuck-In Wrap Strip penetration seals installed in fire rated walls and floors to achieve an Integrity and Insulation of at least up to 180 minutes subject to the pipe diameter and number of Tuck-In Wrap Strips.

CONCLUSION

It is considered that 3M™ Tuck-In wrap penetration seals for PVC U pipes when installed in fire rated walls and floors would achieve the FRL given in Table 1 and Table 2 if they had been tested in accordance with AS 1530.4:2014 for compliance with AS 4072.1-2005.

The walls may be either masonry walls at least 120 mm thick or plasterboard lined walls at least 100 mm thick with at least two layers of 12.5 mm thick fire rated plasterboard and at least 50 mm deep steel studs. The concrete floors are 74 mm to 150 mm thick.

LIMITATION

This report is subject to the accuracy and completeness of the information supplied.

BRANZ reserves the right to amend or withdraw this assessment if information becomes available which indicates the stated fire performance may not be achieved.

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The results reported here relate only to the item/s described in this report.



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1. INTRODUCTION

This report gives BRANZ's assessment of 3M™ Tuck-In wrap penetration seals for PVC-U pipes when installed in fire rated walls and floors in accordance with AS 1530.4:2014 for compliance with AS 4072.1-2005. The walls may be either masonry walls at least 100 mm thick or plasterboard lined walls with at least two layers of 12.5 mm thick fire rated plasterboard and at least 50 mm deep steel studs with a total thickness of greater than 100 mm. The concrete floors are at least 74 mm thick.

2. BACKGROUND

In Exova Warringtonfire fire resistance test report WF Report No. 320202, eighteen penetration systems using 3M™ Fire Barrier Tuck-In Wrap Strips were reported as having been tested in a steel stud plasterboard wall in accordance with BSEN 1366-3: 2009. The wall consisted of nominal 50 mm deep steel studs lined with two layers of 12.5 mm thick fire rated gypsum plasterboard. The cavity of the wall system was packed with 50 mm thick 100 kg/m³ mineral fibre insulation. The insulation material was removed from the core for a distance of 100 mm around each aperture. The overall thickness of the wall was nominally 100 mm.

The specimen configuration and result expressed as a Fire Resistance Level (FRL) is given in Table 1.

In Efectis Nederland fire resistance test report 2001-Efectis-R93991b, sixty penetration systems were tested in an AAC floor slab in accordance with BSEN 1366-3: 2009. Sixteen were installed directly into the 150 mm concrete slab with 3M™ Fire Barrier Tuck-In Wrap Strips and PVC U pipes.

The specimen configuration and result expressed as a Fire Resistance Level (FRL) is given in Table 2 for the 180 minute column.

3. DISCUSSION

3.1 BSEN 1366-3: 2009 vs AS 1530.4:2014

3.1.1 General

Test standards BSEN 1366-3: 2009 and AS 1530.4:2014 are both based on the same ISO fire resistance time/temperature curve. There are some differences in terms of furnace conditions and specimen configurations. The significant difference in relation to the penetrations tested in fire resistance tests WF Report No. 320202 and 2001-Efectis-R93991b are discussed below.

3.1.2 Furnace conditions

BSEN 1366-3 refers to BSEN 1363-1 general requirements which defines the test conditions. BSEN 1363-1 specifies plate thermometers to be used to measure and control the furnace temperature. AS 1530.4 specifies 3 mm MIMS thermocouples but also allows for the use of plate thermometers as an alternative. Therefore it is considered that the furnace test conditions would also comply with the requirements of AS 1530.4.



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The pressure in the fire resistance test was set to achieve a minimum of 10 Pa to the underside of the lowest penetration system in accordance with BSEN 1366-3. This is similar to what is specified to comply with AS 1530.4 where multiple penetrations are tested in a vertical element. Therefore it is considered the pressure conditions would also meet the requirements of AS 1530.4.

3.1.3 Failure criteria

The Integrity criteria for penetration systems is similar in both test standards and therefore would expect a similar Integrity performance had the test been undertaken in accordance with AS 1530.4.

The Insulation criteria for penetration systems is similar between test standards with a maximum temperature rise limit of 180 K and placement of thermocouples 25 mm away from features in the test specimen. It is expected a similar Insulation performance would have been achieved if the test had been undertaken in accordance with AS 1530.4.

3.2 3M™ Fire Barrier Tuck-In Wrap Strips

Tuck-In strips are used in penetrations on specimens A1-A6, C1-C8 and D1-D8 as shown in Figure 1 and Figure 2, and as listed in Table 1 and Table 2.

The wrap strips are 64 mm wide x 5 mm thick with a length to suit the pipe diameter.

3.3 3M™ Fire Barrier Tuck-In Wrap Strips protecting PVC pipes in walls

3.3.1 AS 1530.4:2014 Permissible variations

Section 10.12.2 of AS 1530.4:2014 permits variations to the wall construction as follows:

- *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.*
- *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.*
- *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.*

3.3.2 Plasterboard walls

Various pipes were installed in the plasterboard wall. On each pipe 3M™ Fire Barrier Tuck-In Wrap Strips were applied on each face and installed as described below.

The number of 3M™ Fire Barrier Tuck-In Wrap Strips with the pipe diameter and wall thickness is given in Table 1.

The annular space between the 3M™ Fire Barrier Tuck-In Wrap Strips and aperture is infilled with 3M™ Fire Barrier Sealant IC 15WB+, applied to each face. Additionally, a bead of 3M™ Fire Barrier Sealant IC 15WB+ is applied around the 3M™ Fire Barrier Tuck-In Wrap Strips to pipe junction, on each face of the wall.



In Exova Warringtonfire fire resistance test report WF Report No. 320202 the penetrations were tested in a wall consisting of nominally 50 mm thick steel studs, lined with two layers of 12.5 mm fire rated plasterboard with the cavity filled with 50 mm thick 100 kg/m³ mineral fibre. The insulation material was removed from the core for a distance of 100 mm around each aperture. It is considered that a similar result would be expected if the pipe penetrations were installed into a similar fire rated plasterboard walls of 100 mm thickness or greater with no insulation.

3.3.3 Concrete walls

In accordance with AS 1530.4:2014 the results obtained from Exova Warringtonfire fire resistance test report WF Report No. 320202 may be used for concrete wall of 120 mm thickness or greater to be in agreement with AS 3600 for the Insulation values for walls to give an FRL of -/120/120 for the penetration.

3.3.4 Concrete wall one sided installation

Where access is only possible from one side of a concrete wall, the 3MTM Fire Barrier Tuck-In Wrap Strips may be installed from one side only as shown in Figure 3. The amount of intumescent is no less than that when installed from both sides, therefore it is considered that installing from one side would not be detrimental to the FRL of the wall.

3.4 Installation in different thickness concrete floors.

The number of 3MTM Fire Barrier Tuck-In Wrap Strips in the floor, with the pipe diameter and wall thickness is given in Table 2. Figure 2 shows full slabs and profile steel decking. For profiled steel decking the thickness, and corresponding FRL, is taken as the minimum thickness through which the penetration passes.

The wraps are fitted closely to the pipe and recessed 10 mm from the top of the slab.

The annular space between the pipe and aperture is filled with 10 mm deep 3MTM Fire Barrier Water Tight Sealant 3000 WT finished flush with the top of the slab. The annular space in the tested specimens was from 9 to 21 mm wide.

The proposed floor slab varies from 74 mm thick to 150 mm thick, with an FRL of -/30/30 to -/180/180 specified for the penetration.

In Efectis Nederland fire resistance test report 2001-Efectis-R93991b it was demonstrated that a 110 mm diameter x 6.6 mm wall thickness PVC-U pipe with two 3MTM Fire Barrier Tuck-In Wrap Strips and a 21 mm annular gap could achieve an FRL of -/180/180. Refer to Table 2 specimen D6.

In accordance with AS 3600, Table 5.5.1, a standard 150 mm thick concrete floor slab would achieve 180 minutes insulation which is commensurate with the result achieved by the specimen in fire resistance test 2001-Efetcis-R93991b. AS 3600 also gives the FRL for insulation for various thicknesses of concrete as shown in Table 3.

These are used as the basis of the FRL for the 3MTM Fire Barrier Tuck-In Wrap Strips. Whilst the minimum thickness is 60 mm for an FRL of -/30/30, the 3MTM Tuck-In wrap strip width is



64 mm, and a minimum of 10 mm recess from the top of the slab to accommodate 10 mm depth of 3M™ 3000WT, the minimum concrete thickness shall not be less than 74 mm.

The wrap demonstrated its ability to provide an FRL of at least -/180/180. This shows that the two layers of intumescent material can close off the 110 mm x 6.6 mm pipe and remain in place for 180 minutes. Reducing the thickness of the floor is not expected to be detrimental to the intumescent reacting. The intumescent material is closer to the furnace heating conditions than in a 150 mm thick slab, as tested in fire resistance test 2001-Efectis-R93991b, therefore would be expected to close as quickly thereby limiting the temperature rise on the unexposed face of the pipe to less than 180K. The intumescent essentially remains within the thickness of the concrete slab and the number and thickness of 3M™ Fire Barrier Tuck-In Wrap Strips is the same as tested therefore would be expected to maintain Integrity and Insulation for at least the times listed in Table 2.

The thickness of the pipe wall can determine the effectiveness of the pipe penetration seal with greater wall thicknesses being more difficult to close than smaller thicknesses. The PVC-U pipe wall thickness was 6.6 mm, therefore the result can apply to a wall thickness of 6.6 mm or less.

4. CONCLUSION

It is considered that 3M™ Tuck-In wrap penetration seals for PVC U pipes when installed in fire rated walls and floors would achieve the FRL given in Table 1 and Table 2 if they had been tested in accordance with AS 1530.4:2014 for compliance with AS 4072.1-2005.

The walls may be either masonry walls at least 120 mm thick or plasterboard lined walls at least 100 mm thick with at least two layers of 12.5 mm thick fire rated plasterboard and at least 50 mm deep steel studs. The concrete floors are 74 mm to 150 mm thick.



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Figure 1: Tuck-In wrap in concrete and plasterboard walls

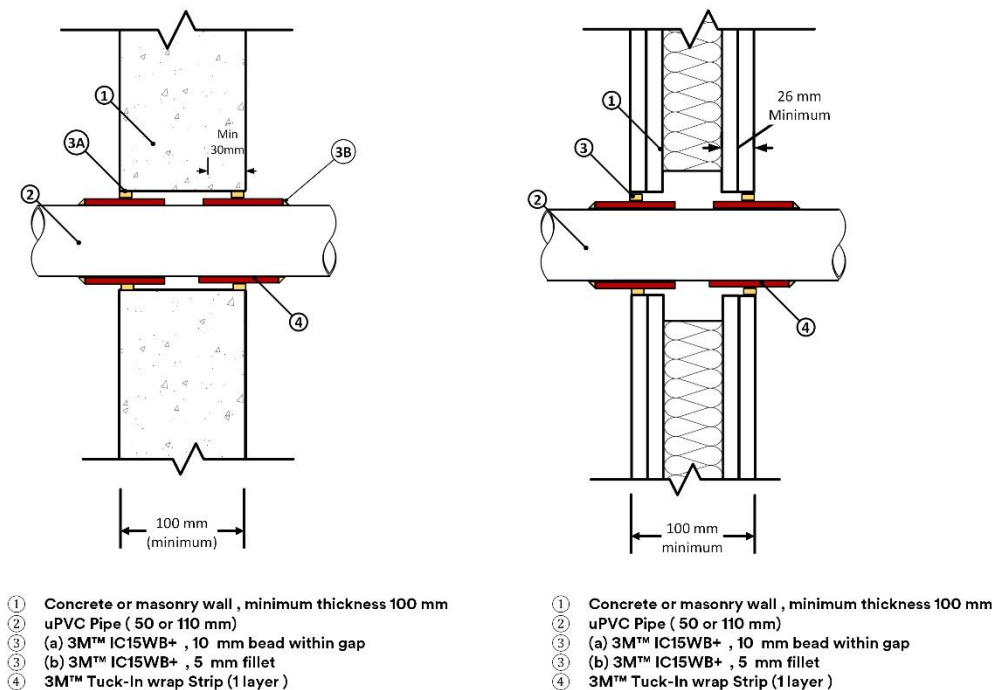
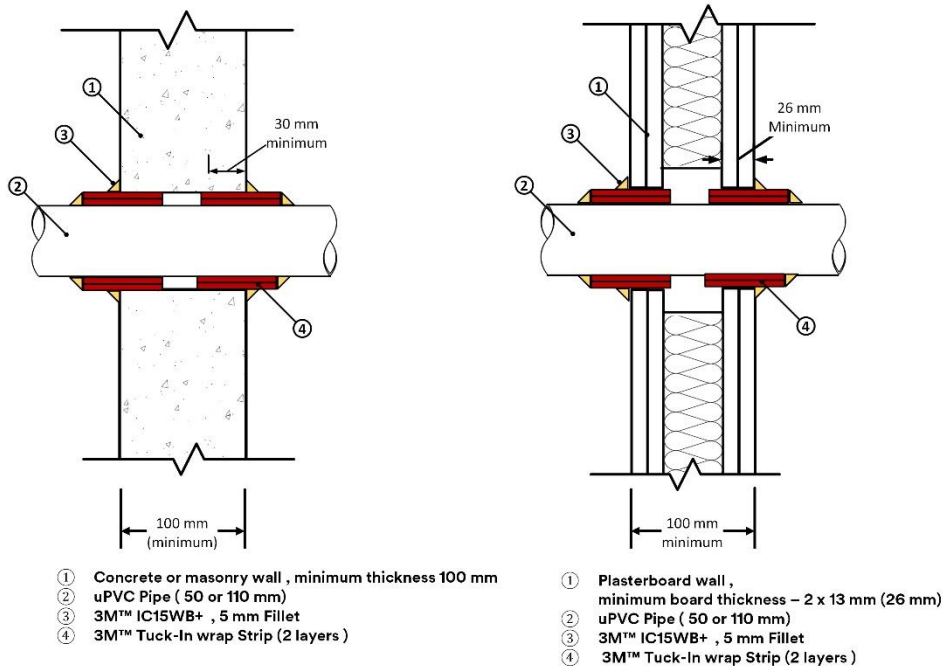
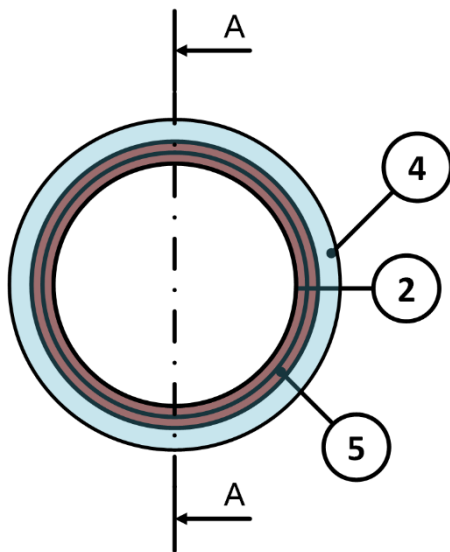
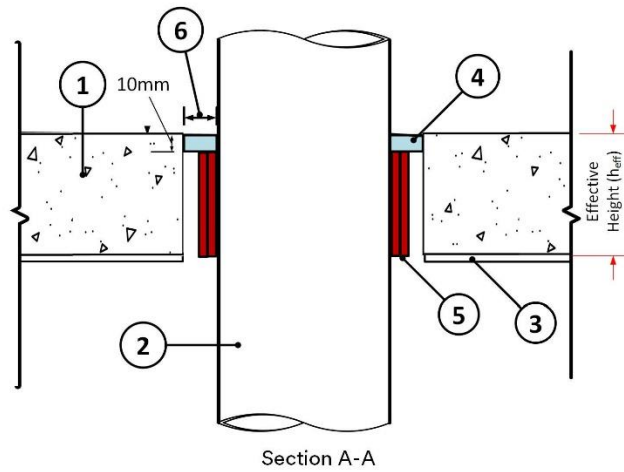
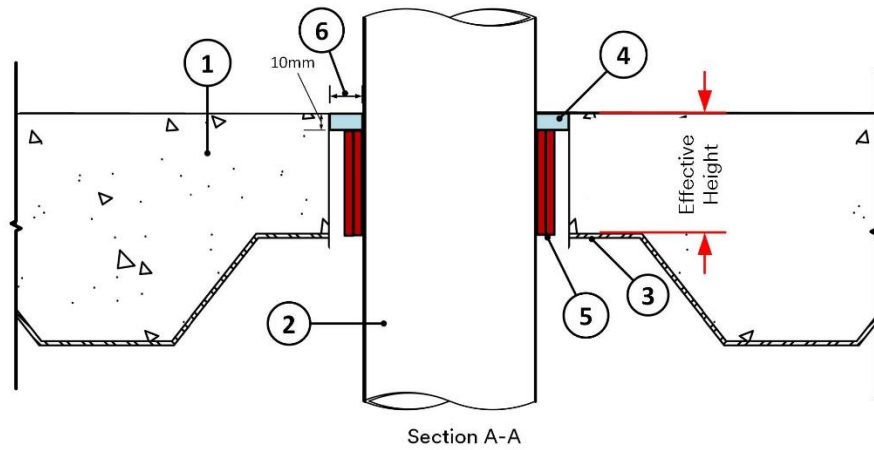


Figure 2: Tuck-In wrap in concrete floors



- | |
|--|
| ① Concrete Floor Slab |
| ② uPVC Pipe |
| ③ Optional Steel Deck or Form |
| ④ 3M™ 3000 WT, 10 mm depth |
| ⑤ 3M™ Tuck-In wrap Strip |
| ⑥ Annular Gap – distance between pipe and concrete |

Table 1: PVC-U FRL summary in a 100 mm thick plasterboard or 120 mm thick concrete wall system

Penetration number	Pipe diameter and wall thickness	No. of Wraps	FRL
A1	PVC-U 50 x 1.8 mm	1	-/120/120
A2	PVC-U 50 x 3.7 mm	1	-/120/120
A3	PVC-U 110 x 3.2 mm	2	-/120/120
A4	PVC-U 110 x 5.3 mm	2	-/120/120
A5	PVC-U 110 x 3.2 mm	1	-/120/90
A6	PVC-U 110 x 5.3 mm	1	-/60/60

Table 2: PVC-U FRL summary in concrete floor slab

Number	Pipe Size	Annular Gap (mm)	Number of Wrap Strips	Fire Resistance (min) for Minimum Slab Effective Thickness (mm)				
				150	120	100	80	74
C1	160 x 9.5 mm	21	2	180	120	90	60	30
C2	114 x 5 mm	19	2	180	120	90	60	30
C3	160 x 3.2 mm	21	2	180	120	90	60	30
C4	114 x 5 mm	19	1	180	120	90	60	30
C5	114 x 6 mm	19	2	180	120	90	60	30
C6	114 x 5 mm	9	1	180	120	90	60	30
C7	50 x 2.4 mm	21	1	180	120	90	60	30
C8	50 x 2.4 mm	11	1	180	120	90	60	30
D1	114 x 4.5 mm	9	2	180	120	90	60	30
D2	160 x 3.2 mm	11	2	180	120	90	60	30
D3	114 x 6 mm	9	2	180	120	90	60	30
D4	160 x 6.5 mm	11	2	180	120	90	60	30
D5	110 x 6.6 mm	11	1	120	120	90	60	30
D6	110 x 6.6 mm	21	2	180	120	90	60	30
D7	50 x 3.7 mm	21	1	180	120	90	60	30
D8	50 x 3.7 mm	11	1	180	120	90	60	30

The FRL, derived from the table above is expressed as -/180/180, -/120/120, etc.



Table 3: AS 3600 FRL for a given thickness of concrete slab

FRL for Insulation (mm)	Effective Thickness
30	60
60	80
90	100
120	120
180	150
240	175



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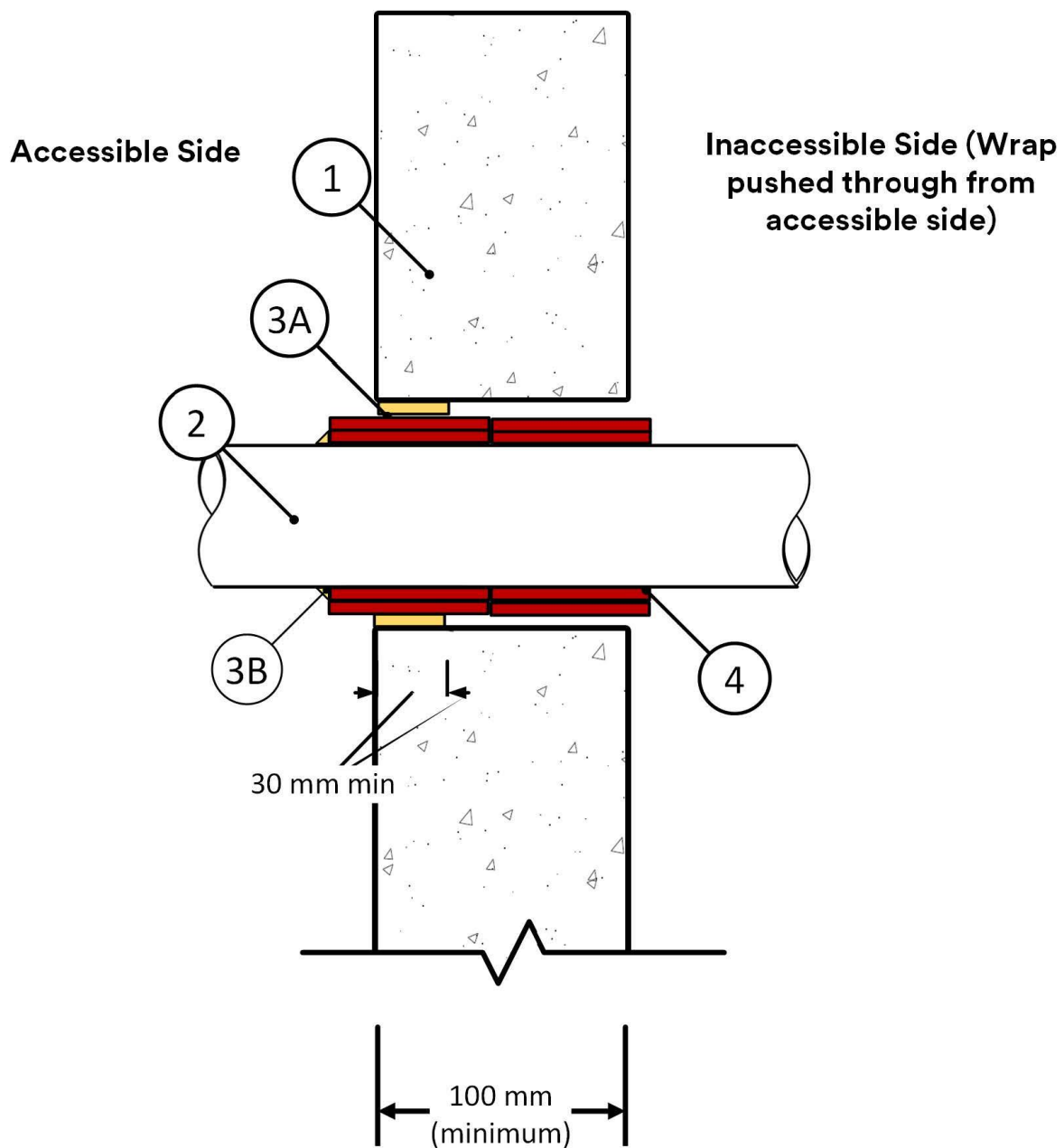
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Figure 3: Tuck-In wrap one sided application



- ① Concrete or masonry wall , minimum thickness 100 mm
- ② Solid Core uPVC Pipe (50 or 110 mm)
- ③ (a) 3M™ IC15WB+ , 30 mm depth bead within gap
- ③ (b) 3M™ IC15WB+ , 5 mm fillet
- ④ 3M™ Tuck-In wrap Strip (2 layer)

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Technical Opinion Summary



This is to certify that the specimen described below has been examined by BRANZ on behalf of the sponsor.

Sponsor

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North Ryde,
NSW, 2113
Australia

Reference BRANZ Reports FC10453-001-TO

Referenced Standard AS1530.4:2014 and AS 4072.1-2005

Specimen Name: 3M TUCK-IN WRAP STRIP penetration seals for PVC U pipes

Specimen Description: Intumescent material formed into strips 64 mm wide x 5 mm thick with a length to suit the pipe diameter. The strips are wrapped around the pipe in layers as required for the pipe.

The walls may be either masonry walls at least 120 mm thick or plasterboard lined walls at least 100 mm thick with at least two layers of 12.5 mm thick fire rated plasterboard and at least 50 mm deep steel studs. The concrete floors are 74 mm to 150 mm thick.

Orientation: Exposure from either side for walls or the underside of floor slabs.

The assessed results were as follows:

Table 1 and Table 2 give the FRL for walls and floors respectively.

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Reviewed by

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A3	PVC-U 110 x 3.2 mm	2	-/120/120
A4	PVC-U 110 x 5.3 mm	2	-/120/120
A5	PVC-U 110 x 3.2 mm	1	-/120/90
A6	PVC-U 110 x 5.3 mm	1	-/60/60

Table 2: PVC-U FRL summary in concrete floor slab

Number	Pipe Size	Annular Gap (mm)	Number of Wrap Strips	Fire Resistance (min) for Minimum Slab Effective Thickness (mm)				
				150	120	100	80	74
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D2	160 x 3.2 mm	11	2	180	120	90	60	30
D3	114 x 6 mm	9	2	180	120	90	60	30
D4	160 x 6.5 mm	11	2	180	120	90	60	30
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