# Fire resistance of Ramset FRF700 protecting metal pipe penetrations when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005

## Assessment Report

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## Important disclaimer

# Contents

# 1 Introduction

This report is an assessment of fire resistance of Ramset FRF700 protecting metal pipe penetrations when tested in accordance with AS 1530.4-2014 and assessed in accordance with AS 4072.1-2005.

This report is prepared for meeting the evidence of suitability requirements of NCC Vol 1 Schedule 5 clause 2(c) as appropriate for FRL.

This report reviews and confirms the extent to which the reference fire resistance tests listed in section 2 meet the requirements of the standard fire test standards listed in section 4 of the report. The proposed variations to the tested construction presented in section 3 are subject to an analysis in Appendix B and the conclusions are presented in Section 5 of this report.

The field of applicability of the results of this assessment report is presented in Section 6 and subject to the requirements, validity and limitations of Section 7, 8 and 9.

# 2 Supporting Data

This assessment report refers to various test reports to support the analysis and conclusions of this report. They are listed below;

**Table 1: Reference test data**

| Report Reference | Test Standard | Outline of Test Specimen |
|---|---|---|
| TE 91647 | prEN1366 Part 3:1996 | A fire resistance testing of 9 metal pipes penetrating a 150mm thick AAC block wall, protected with various sealing systems. |

The report TE 91647 was undertaken by Loss Prevention Council Laboratories, UK and sponsored by Tyne & Wear, who has confirmed CSIRO can use the above reports for this assessment.

# 3 Proposed Variations

The proposed construction shall be for pipes tested in TE 91647 and subject to the following variations;

- Confirmation of performance when tested in accordance with AS 1530.4 - 2014
- 3mm thick Fire rated low modulus Neutral - cure silicon (ref. 3059) shall be added to the unexposed face of TE 91647 specimens 6-9 to seal off the pipe cladding.

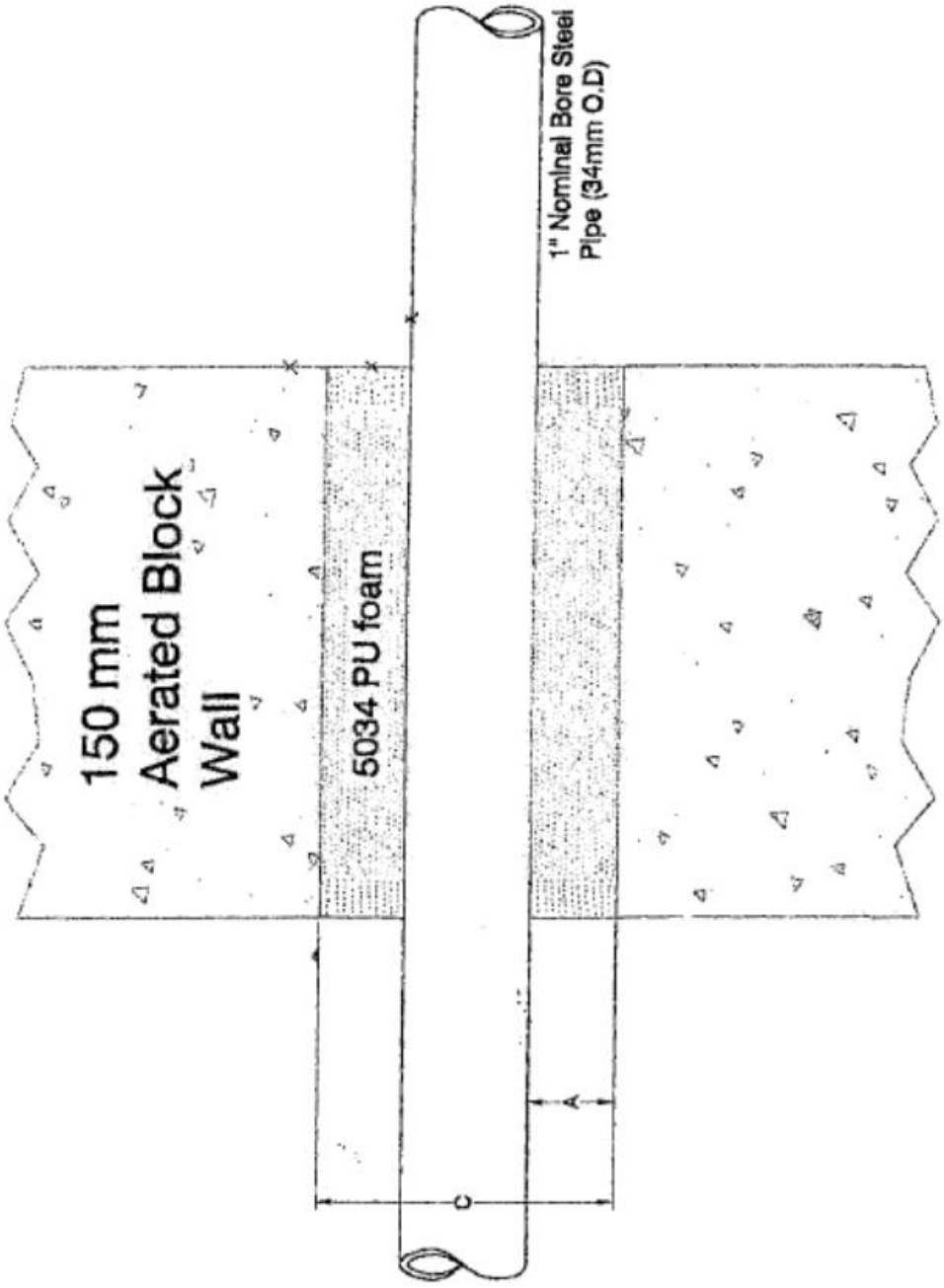


**Figure 1: System 1**

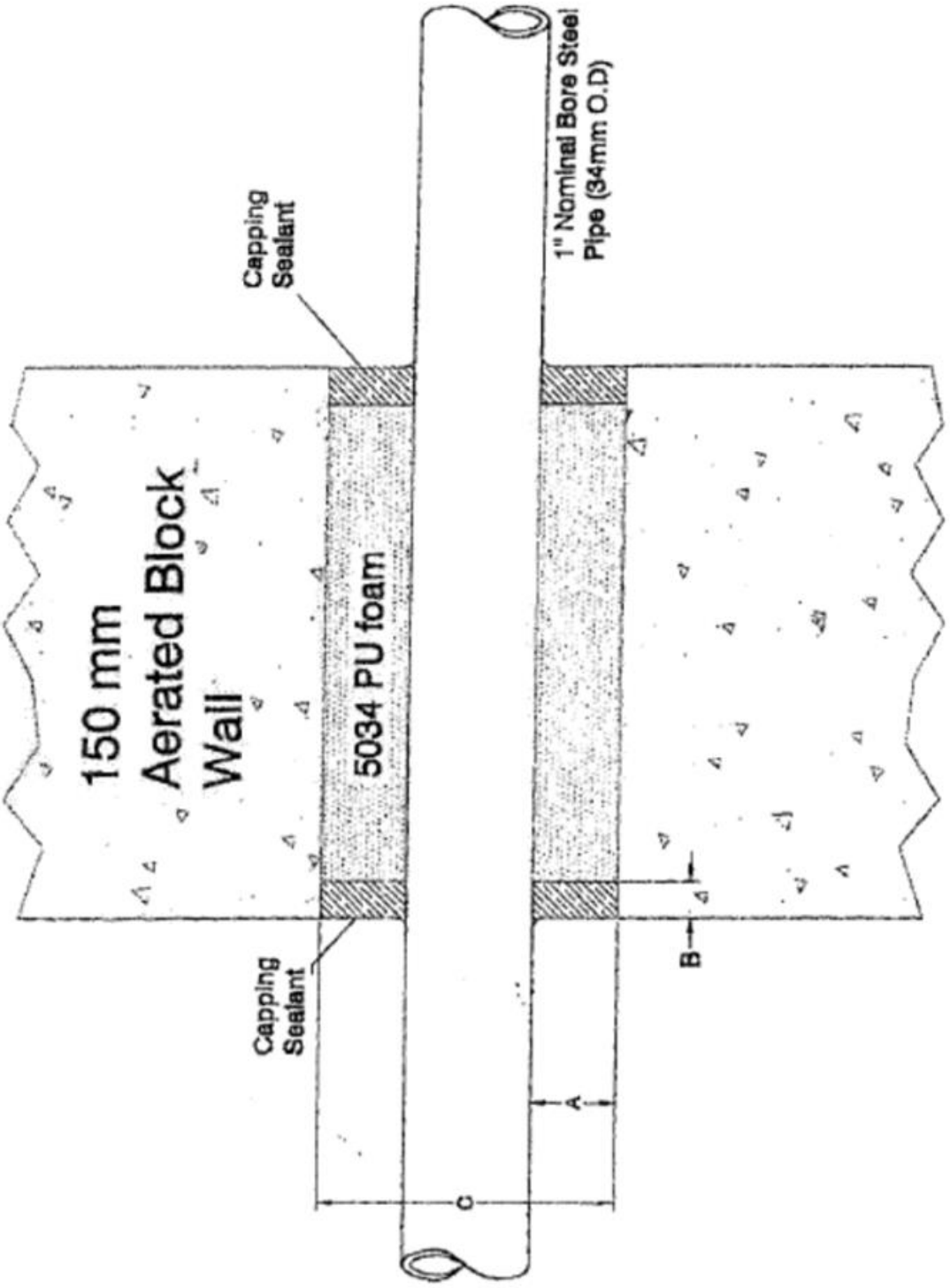


**Figure 2: System 2 to 5**

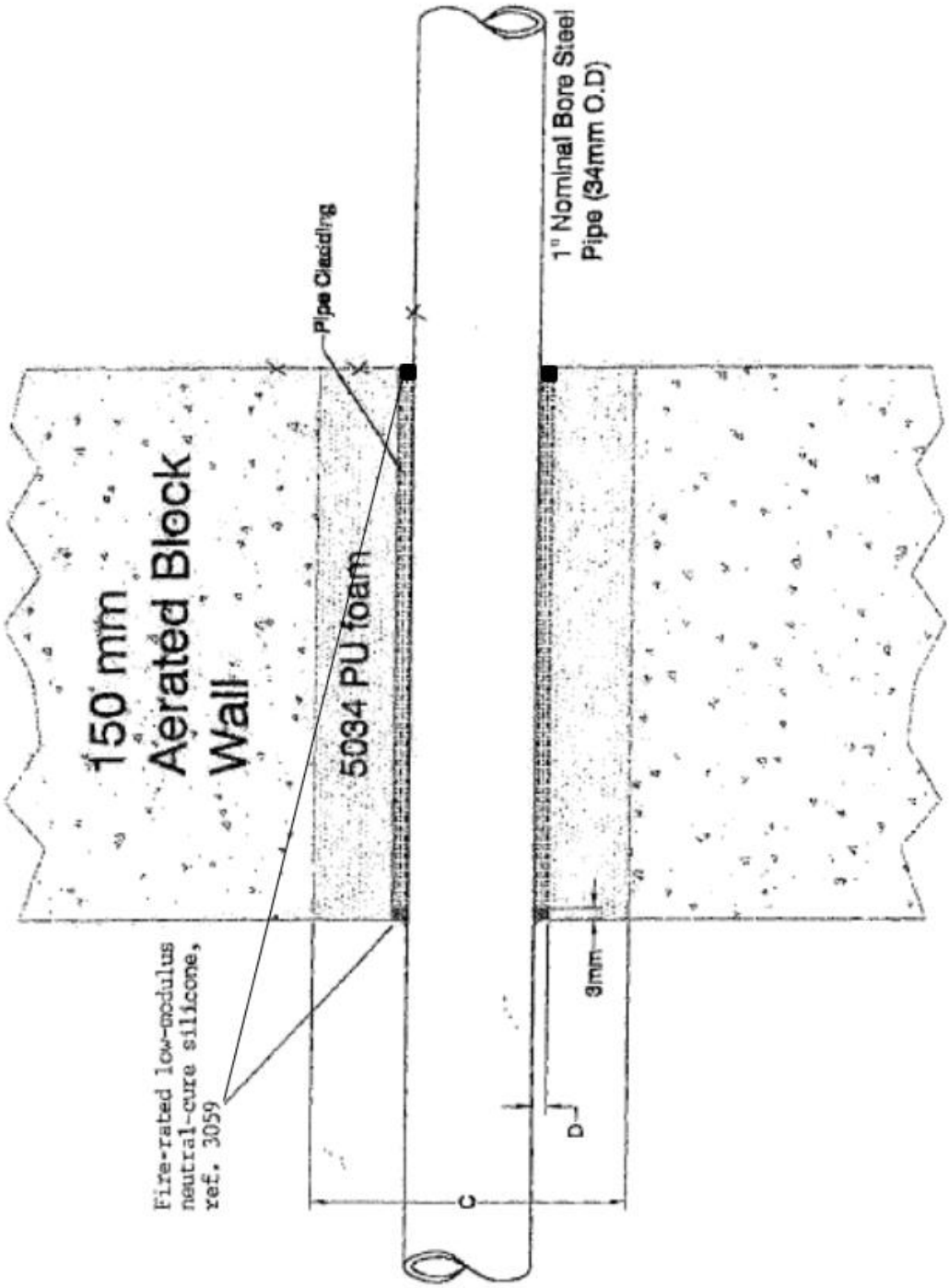


**Figure 3: System 6 to 9**

# 4 Referenced Standards

| | |
|---|---|
| AS 1530.4-2014 | Methods for fire tests on building materials, components and structures Part 4: Fire resistance tests of elements of building construction, Section 10 as appropriate for service penetrations. |
| AS 4072.1-2005 | Components for the protection of openings in fire-resistant separating elements Part 1: Service penetrations and control joints |

# 5 Conclusion

On the basis of the analysis presented in this report, it is the opinion of this Accredited Testing Laboratory that the tested prototypes described in Section 2 when varied as described in Section 3 will achieve the Fire Resistance stated below when submitted to a standard fire test in accordance with the test methods referenced in Section 4 and subject to the requirements of section 7, the validity of section 8 and limitation of section 9.

**Table 2: FRL of metal pipes**

<table>
<tr><th>System</th><th>Metal pipe</th><th>Substrate</th><th>Aperture size (mm)</th><th>Polyurethane canister foam</th><th>Capping sealant/pipe cladding</th><th>Sealant on each side of pipe cladding</th><th>Figure</th><th>FRL</th></tr>
<tr><td>1</td><td rowspan="9">1” NB Steel pipe (34mm OD)</td><td rowspan="9">150mm thick AAC blockwall</td><td rowspan="5">80</td><td rowspan="9">FR Canister Foam (ref.5034 )<br><br>marketed locally as Ramset FRF700</td><td>N/A</td><td rowspan="5">N/A</td><td>1</td><td>-/60/60</td></tr>
<tr><td>2</td><td>10mm thick Intumescent Acrylic FR sealant (ref.2731)</td><td rowspan="5">2</td><td>-/240/90</td></tr>
<tr><td>3</td><td>10mm thick Low Modulus Neutral cure FR Silicone sealant (ref.3059)</td><td>-/240/90</td></tr>
<tr><td>4</td><td>10mm thick Intumescent putty (ref.8051)</td><td>-/240/60</td></tr>
<tr><td>5</td><td>1.5mm thick Intumescent paint (ref.8455)</td><td>-/180/60</td></tr>
<tr><td>6</td><td rowspan="2">85</td><td>4mm thick Intumescent rubber (ref.8152)</td><td rowspan="4">3mm thick Fire rated low modulus Neutral -cure silicon (ref. 3059)</td><td rowspan="4">3</td><td>-/240/90</td></tr>
<tr><td>7</td><td>4mm thick Intumescent fibre (ref.8253)</td><td>-/180/60</td></tr>
<tr><td>8</td><td>105</td><td>14mm thick Intumescent rubber and foam composite (ref.8354)</td><td>-/120/60</td></tr>
<tr><td>9</td><td>85</td><td>4mm thick Ceramic tape (ref.8556)</td><td>-/90/60</td></tr>
</table>

# 6 Direct Field of Application of Results

The results of this report are applicable to metal pipes in walls exposed to fire from either side

# 7 Requirements

It is required that the supporting construction is tested or assessed to achieve the required FRL up to the required FRL based on the assessed design in accordance with AS 1530.4.

Any variations concerning size, constructional details, loads, stresses, edge or end conditions that are other than those identified in this report, may invalidate the conclusions drawn in this report.

# 8 Term of Validity

This assessment report will lapse on 30th April 2025. Should you wish us to re-examine this report with a view to the possible extension of its term of validity, would you please apply to us three to four months before the date of expiry. This Division reserves the right at any time to amend or withdraw this assessment in the light of new knowledge.

# 9 Limitations

The conclusions of this assessment report may be used to directly assess the fire resistance performance under such conditions, but it should be recognised that a single test method will not provide a full assessment of the fire hazard under all fire conditions.

Because of the nature of fire resistance testing, and the consequent difficulty in quantifying the uncertainty of measurement, it is not possible to provide a stated degree of accuracy. The inherent variability in test procedures, materials and methods of construction, and installation may lead to variations in performance between elements of similar construction.

This assessment report does not provide an endorsement by CSIRO of the actual products supplied to industry. The referenced assessment can therefore only relate to the actual prototype test specimens, testing conditions and methodology described in the supporting data, and does not imply any performance abilities of construction of subsequent manufacture.

This assessment is based on information and experience available at the time of preparation. The published procedures for the conduct of tests and the assessment of test results are the subject of constant review and improvement and it is recommended that this report is reviewed on or, before, the stated expiry date.

The information contained in this assessment report shall not be used for the assessment of variations other than those stated in the conclusions above. The assessment is valid provided no modifications are made to the systems detailed in this report. All details of construction should be consistent with the requirements stated in the relevant test reports and all referenced documents.

# Appendix A Supporting Test Data

## A.1. Loss Prevention Council Laboratories, UK report numbered TE 91647

On 5 October 1998 nine pipe penetration sealing systems each fitted to a 34-mm diameter steel pipe passing through separate apertures in a 150-mm thick aerated concrete blockwork wall were submitted to an ad-hoc fire-resistance test in accordance with the procedures and criteria of draft Standard prEN1366-3:1996.

System 1 comprised an 80-mm diameter aperture sealed with polyurethane canister foam ref. 5034. The system failed insulation at 60 minutes and integrity at 84 minutes due to the ignition of the cotton pad.

System 2 comprised an 80-mm diameter aperture sealed with polyurethane canister foam, ref. 5034, capped on each face with 10-mm thick intumescent acrylic sealant, ref. 2731. The system failed insulation at 114 minutes but did not fail integrity for the full 240-minute duration of the test.

System 3 comprised an 80-mm diameter aperture sealed with polyurethane canister foam, ref. 5034, capped on each face with 10-mm thick low-modulus neutral-cure silicone, ref. 3059. The system failed insulation at 102 minutes but did not fail integrity for the full 240-minute duration of the test.

System 4 comprised an 80-mm diameter aperture sealed with polyurethane canister foam, ref. 5034, capped on each face with 10-mm thick intumescent putty, ref. 8051. The system failed insulation at 82 minutes but did not fail integrity for the full 240-minute duration of the test.

System 5 comprised an 80-mm diameter aperture sealed with polyurethane canister foam, ref. 5034, capped on each face with 1.5-mm thick intumescent paint, ref. 8455. The system failed insulation at 65 minutes and failed integrity at 187 minutes because of sustained flaming.

System 6 comprised an 85-mm aperture sealed with intumescent rubber, ref. 8152, wrapped around the pipe to a thickness of 4 mm and the void filled with polyurethane canister foam, ref. 5034. The system failed insulation at 109 minutes but did not fail integrity for the full 240-minute duration of the test.

System 7 comprised an 85-mm aperture sealed with 4-mm thick intumescent fibre, ref. 8253, wrapped around the pipe and the void filled with polyurethane canister foam, ref. 5034. The system failed insulation at 75 minutes but did not fail integrity for the full 240-minute duration of the test.

System 8 comprised a 105-mm aperture sealed with 14-mm thick intumescent rubber and foam composite, ref. 8354, wrapped around the pipe and the void filled with polyurethane canister foam, ref. 5034. The system failed insulation at 75 minutes and failed integrity at 146 minutes due to the ignition of the cotton pad.

System 9 comprised an 85-mm aperture sealed with ceramic tape, ref. 8556, wrapped around the pipe to a thickness of 4 mm and the void filled with polyurethane canister foam, ref. 5034. The system failed insulation at 60 minutes and failed integrity at 110 minutes due to the ignition of the cotton pad.

## A.2. The relevance of referenced test data to AS 1530.4-2014

*General*

The fire resistance test TE 91647 was conducted in accordance with prEN1366-3:1996 which follows the heating conditional and furnace atmosphere outlined in prEN1363-1:1996. This standard differs from AS 1530.4 - 2014 and the significance of these differences relevant to section 10 and is discussed below.

*Temperature Regime*

The furnace temperature regime for fire resistance tests conducted in accordance with AS 1530.4-2014 follows the same trend as prEN1363-1: 1996.

The parameters outlining the accuracy of control of the furnace temperature in AS 1530.4- 2014 and prEN1363-1: 1996 are not appreciably different.

*Furnace Thermocouples*

The furnace thermocouples specified in AS 1530.4-2014 are type K, mineral insulated metal sheathed (MIMS) with a stainless steel sheath having a wire of a diameter of not less than 1.0mm and an overall diameter of 3mm. The measuring junction protrudes at least 25mm from the supporting heat resistant tube.

In the referenced test, the thermocouples used were different from the ones specified by prEN1363-1: 1996. The furnace temperatures were measured by five bare-wire chromel/alumel thermocouples (1.0mm diameter wires) positioned symmetrically in the furnace with their measuring junctions normally 100mm from the test specimen. The furnace was controlled so that the mean of the readings followed the time and temperature relationships specified in prEN1363-1: 1996.

The thermocouples used in the referenced test although of a 1mm wire diameter as required by AS1530.4-2014, they were not MIMs thermocouple and were likely separated by ceramic tubes. This type of thermocouple has a relatively low thermal response time as does the AS1530.4-2014 specified thermocouples compared to all other types of furnace control thermocouples used in fire resistance testing standards around the world. As the thermocouples used in the referenced tests can in theory have are more responsive than those specified by AS 1530.4-2014 in practice they are both very thermally responsive so the difference in practice will be negligible and in particular for a long duration test.

The relative location of the furnace thermocouples for the exposed face of the specimen for AS 1530.4-2014 is not appreciably different from those on the referenced test.

*Furnace Pressure*

It is a requirement of AS 1530.4-2014 and for prEN1363-1: 1996 that for vertical elements, a furnace gauge pressure of 15+3Pa is established at the lowest penetration.

The parameters outlining the accuracy of control of the furnace pressure in AS 1530.4-2014 and prEN1363-1: 1996 are not appreciably different.

*Specimen Configuration*

AS 1530.4-2014 specifies that the service(s) shall be installed so that they project a minimum 500mm on the exposed side of the supporting construction which at least 200mm shall extend beyond the extremities of the penetration sealing system. The penetration sealing system shall include any coating, wrapping or other protections to the services.

prEN1366-3: 1996 specifies that a penetration shall be installed so that it projects a minimum of 500mm on each side of the support construction, of which at least 150mm shall extend beyond the extremities of protection seal.

The specimen configuration between AS 1530.4-2014 and prEN1366-3: 1996 is not appreciably different.

*Specimen thermocouples*

The specimen thermocouple specification for service penetrations is generally the same for AS 1530.4-2014 and prEN1366-3: 1996.

For the penetration construction considered, AS1530.4-2014 specifies the following locations for thermocouples to be placed:

- At not less than two points located approximately 25mm from the edge of the hole made for the passage of the service (one in the uppermost vertical plane).
- On the surface of the penetrating service, at least two thermocouples located approximately 25mm from the plane of the general surface of the penetrated element (one in the uppermost vertical plane).
- At least two positions 25 mm from the interface of the separating element and the main penetration seal.

For penetration sealing systems tested in the referenced test, there was only one thermocouple above the penetration on the substrate, on the pipe and on the seal above the pipe.

The use of a single specimen thermocouple at each location other than the two specified by AS 1530.4 – 2014 could potentially miss earlier failures. However, in this test, the specimen thermocouples were installed above the penetration and this is usually the most onerous location for vertical specimens penetrated by services.

*Criteria for failure*

Specimens shall be deemed to have failed the integrity criterion in accordance with AS 1530.4-2014 when any of the following occur:

- sustained flaming for 10 seconds.
- a gap forms that allows the passage of hot gases to the unexposed face and ignite the cotton pad when applied for up to 30 seconds.
- a gap forms that allow the penetration of a 25mm gap gauge anywhere on the specimen.
- a gap forms that allow a 6mm × 150mm gap gauge to penetrate the specimen anywhere on the specimen.

Performance criteria in accordance with prEN1363-1: 1996:

Integrity: Failure, is deemed to occur:

- when sustained flaming for not less than 10s on the unexposed face occurs;
- when cracks, gaps or fissures allow flames or hot gases to cause flaming or glowing of a cotton fibre pad;
- when a 6mm-diameter gap gauge can penetrate through a gap into the furnace and be moved in the gap for a distance of at least 150mm, or a 25mm- diameter gap gauge can penetrate through a gap into the furnace.

Insulation: Failure is deemed to occur:

- when the temperature recorded at any position on the unexposed face is in excess of 180°C above the initial mean unexposed face temperature;

The criteria for the referenced tests are not significantly different for tests undertaken in accordance with prEN1363-1: 1996 and Section 10 of AS 1530.4-2014.

However, it was observed that specimen 7 was noted to have developed a 10mm x 8mm hole through to the furnace at top of the seal at 230 minutes. However, no cotton pad was applied for the remaining 10 minutes of the test.

As a cotton pad was not applied between 230 minutes to 240minutes when a gap formed and as such, the integrity was not measured in accordance the AS 1530.4-2014 after this gap formed for specimen 7.

*Conclusion*

The variations in furnace heating regimes, furnace thermocouples and the number of specimen thermocouples are not expected to have a significant effect on the outcome of the referenced fire resistance test.

Based on the above discussion it is considered that the results relating to the integrity and insulation performance of the referenced prEN1366-3: 1996 tests are applicable up to 180 or 240 minutes when tested in accordance with AS 1530.4-2014 and when assessed in accordance with AS 4072.1 -2005.

# Appendix B Supporting Test Data

## B.1 Variation to specimen

The proposed construction shall be for pipes tested in TE 91647 and subject to the following variations;

- 3mm thick Fire rated low modulus Neutral - cure silicon (ref. 3059) shall be added to the unexposed face of TE 91647 specimens 6-9 to seal off the pipe cladding.

With reference to TE 91647, specimens 6-9 all had 3mm thick Fire rated low modulus Neutral -cure silicon (ref. 3059) applied to the exposed side of the pipe cladding.

It is expected that the addition of Fire rated low modulus Neutral - cure silicon on the unexposed side will improve the integrity performance of the specimen seal by a small margin.

It is confirmed that all the specimens in TE 91647 were all located at more than 40mm away from each other and thus complies with 4072.1- 2005 Clause 4.9.3.

Based on the above, it is expected that proposed construction will not detrimentally affect the performance of TE 91647, specimens 6-9 when tested in accordance with AS 1530.4-2014 and assessed in accordance with 4072.1- 2005.

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