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Fire assessment report

The fire resistance performance of linear gap sealing systems in aerated concrete walls if tested in accordance with AS 1530.4:2014 and assessed in accordance with AS 4072.1:2005

Main sponsor: Soudal NV

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Amendment schedule

Version	Date	Information relating to report			
00	Issue: 28/08/2003	Reason for issue	Initial Issue		
			Prepared by	Reviewed by	Approved by
		Name	R. Parker	J. P. England	
01	Issue: 22/06/2009	Reason for issue	Updated product references		
			Prepared by	Reviewed by	Approved by
		Name	M. Kamal	S. Kettle	
02	Issue: 31/03/2016	Reason for issue	Updated referenced standard		
			Prepared by	Reviewed by	Approved by
		Name	D. Nicholson	K. Nicholls	
R3.0	Issue: 11/06/2020	Reason for issue	Issued to update the report with removing the sealant combination of Fire Silicone F1 with PU backing rods, and further extend the validity of the report by five years.		
			Prepared by	Reviewed by	Approved by
	Expiry: 31/03/2026	Name	Imran Ahamed	Mahmoud Akl	Mahmoud Akl
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The data, methodologies, calculations and results documented in this report specifically relate to the tested/assessed specimen/s and must not be used for any other purpose.

All work and services carried out by Warringtonfire Australia are subject to and conducted in accordance with our standard terms and conditions. These are available on request and at https://www.element.com/terms/terms-and-conditions.

Executive summary

This report presents an assessment of the fire resistance performance of linear gap sealing systems in aerated concrete walls if tested in accordance with AS 1530.4:2014 and assessed in accordance with AS 4072.1:2005 (R2016).

The tested prototypes described in section 3.2 of this report, when subject to the proposed variations described in section 3.3, and tested in accordance with the referenced method described in section 3.4, are likely to achieve the outcomes described in section 5.4 and the fire resistance performance described in Table 1.

Table 1 Assessment summary

ID	Wall thickness (mm)	Gap width (mm)	Seal depth (mm)	Sealant	Backing material	Seal location	FRL
Joint I	200	11	200	Soudafoam FR	None	Throughout the depth	-/180/180
Joint II	200	41	200	Soudafoam FR	None	Throughout the depth	-/90/90
Joint III	200	20	20	Soudal Firecyl 4H	25 mm diameter Polyethylene	Both faces	-/240/240
Joint VIII	100	21	20	Soudal Firecyl 4H	25 mm diameter Polyethylene	Both faces	-/240/180
Joint IX	100	11	10	Soudal Firecyl 4H	15 mm diameter Polyethylene	Both faces	-/240/180
Joint X	100	31	100	Soudafoam FR	None	Throughout the depth	-/-/-
Joint XI	100	11	100	Soudafoam FR	None	Throughout the depth	-/90/90
Soudafoam FR must be applied through full thickness of the wall Soudal Firecyl 4H seals must be applied flush with both faces of the wall using separate backing rods.							

The variations and outcome of this assessment are subject to the limitations and requirements described in sections 2, 4 and 6 of this report. The results of this report are valid until 31 March 2026.

Contents

1. Introduction

This report presents an assessment of the fire resistance performance of linear gap sealing systems in aerated concrete walls if tested in accordance with AS 1530.4:2014[1] and assessed in accordance with AS 4072.1:2005 (R2016)[2].

This assessment was carried out at the request of Soudal NV. The sponsor details are included in Table 2.

Table 2 Sponsor details

Sponsor	Address
Soudal NV	Everdongenlaan 18-20 B-2300 Turnhout Belgium

2. Framework for the assessment

An assessment is an opinion about the likely performance of a component or element of structure if it were subject to a standard fire test.

No specific framework, methodology, standard or guidance documents exists in Australia for doing these assessments. We have therefore followed the Guide to Undertaking Assessments In Lieu of Fire Tests prepared by the Passive Fire Protection Federation (PFPF) in the UK[3].

This guide provides a framework for undertaking assessments in the absence of specific fire test results. *'Some areas where assessments may be offered are:*

- *Where a modification is made to a construction which has already been tested*
- *The interpolation or extrapolation of results of a series of fire resistance tests, or utilisation of a series of fire test results to evaluate a range of variables in a construction design or a product*
- *Where, for various reasons – eg size or configuration – it is not possible to subject a construction or a product to a fire test.'*

Assessments will vary from relatively simple judgements on small changes to a product or construction through to detailed and often complex engineering assessments of large or sophisticated constructions.

2.1 Requirements of the assessment

- This report details the methods of construction, test conditions and assessed results that would have been expected had the specific elements of construction described herein been tested in accordance with AS 1530.4-2014.
- The supporting wall construction shall be capable of providing effective support of the proposed construction for the required fire resistance period (FRL).
- The service penetrations shall be continuous or otherwise supported and shall not rely upon the seal only.
- Any further variations with respect to size, constructional details, loads, stresses, edge or end conditions, other than those identified in this report, may invalidate the conclusions drawn in this report.

[1] Standards Australia, 2014, *Methods for fire tests on building materials, components and structures: Fire-resistance tests for elements of construction*, AS 1530.4:2014, Standards Australia, NSW
[2] Standards Australia, 2005, *Components for the protection of openings in fire-resistant separating elements: Service penetrations and control joints*, AS 4072.1-2005 (R2016), Standards Australia, NSW
[3] Passive Fire Protection Forum (PFPF) 2019, *Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence*, Passive Fire Protection Forum (PFPF), UK

2.2 Declaration

The guide to undertaking assessments in lieu of fire tests prepared by the PFPF in the UK requires a declaration from the client. By accepting our fee proposal dated 21 April 2020, Soudal NV confirmed that

- To their knowledge the component or element of structure, which is the subject of this assessment, has not been subjected to a fire test to the standard against which this assessment is being made.
- They agree to withdraw this assessment from circulation if the component or element of structure is the subject of a fire test by a test authority in accordance with the standard against which this assessment is being made and the results are not in agreement with this assessment.
- They are not aware of any information that could adversely affect the conclusions of this assessment and – if they subsequently become aware of any such information, they agree to ask the assessing authority to withdraw the assessment.

3. Description of the specimen and variations

3.1 System description

The assessed systems consist of various linear seals of different widths in aerated concrete wall – with a stated density of 550 kg/m^3. The linear seals are protected using combinations of one or more Soudafoam FR, Firecryl 4H and Fire Silicone B1 sealants.

3.2 Referenced test data

The assessment of the variation to the tested system and the determination of the likely performance is based on the results of the fire test report Nr. 9297C which describes a fire resistance test performed on various linear gap sealing systems when installed in vertically orientated gaps within aerated concrete wall.

Soudal NV has granted permission for Warringtonfire to use the test data to prepare this assessment report. Further details of the tested system are described in Appendix A.

3.3 Variations to the tested systems

Identical systems have not been subjected to standard fire tests in accordance with AS 1530.4:2014. We have therefore assessed the systems using baseline test information for similar systems. The variations to the tested systems together with the referenced baseline standard fire tests are described in Table 3.

Table 3 Variation to tested systems

Item no.	Reference test	Description	Variations
1	Nr. 9297C	The referenced fire resistance test was conducted using the principles of NBN 713.020 (1968 edition) with thermocouples instrumented in accordance with EN 1366-4:1999[4]. The test demonstrates the fire resistance performance of Soudafoam FR, Firecryl 4H and Fire Silicone B1 sealants.	The proposed variation is to assess the likely fire resistance performance of linear seals if tested in accordance with AS 1530.4:2014 and AS 4072.1:2005 (R2016).

[4] European Committee for Standardization, 1999, *Fire resistance tests for service installations. Linear joint seals*, EN 1366-4:1999, European Committee for Standardization, Brussels, Belgium

3.4 Purpose of the test method

Section 2 of AS 1530.4:2014 specify the general requirements for conducting fire resistance tests. Section 10 of AS 1530.4:2014 give guidelines for determining the fire resistance of elements of construction penetrated by services such as control joints. As per section 10.3 of AS 1530.4:2014, the purpose of the test covering service penetrations and control joints is to assess-

- The effect of the penetration or control joint on the integrity and insulation of the element
- Insulation or integrity failure of the penetrating service or control joint

AS 4072.1:2005 (R2016) sets out the minimum requirements for the construction, installation and application of fire resistance tests to sealing systems. These include control joints between building elements that are required to have a fire resistance level (FRL).

3.5 Schedule of components

Table 4 outlines the schedule of components for the assessed systems subject to a fire test, as referenced in Appendix A.

Table 4 Schedule of components of assessed systems

Item	Description
1	Soudaform FR – one component self-expanding, ready to use polyurethane form
2	Firecryl 4H
3	Fire Silicone B1 – high quality, neutral, elastic one-component sealant based on silicones
4	PE-Backer rod – 15 mm diameter round profile in extruded closed cell polyurethane form
5	PE-Backer rod – 25 mm diameter round profile in extruded closed cell polyurethane form
6	PE-Backer rod – 40 mm diameter round profile in extruded closed cell polyurethane form
7	Aerated concrete wall with a thickness of 100 mm or 200 mm.

4. Scope, objective and assumptions

- The scope of this report is limited to an assessment of the variations to the tested systems described in section 3.3.
- This report details the methods of construction, test conditions and assessed results that would have been expected if the specific elements of construction described here had been tested in accordance with AS 1530.4:2014 and AS 4072.1:2005 (R2016).
- The results of this assessment are applicable to control joints in walls exposed to fire from either side, but not simultaneously.
- This report is only valid for the assessed systems. Any changes with respect to size, construction details, loads, stresses, edge or end conditions, other than those identified in this report, may invalidate the findings of this assessment. If there are changes to the system, a reassessment will be needed to verify consistency with the assessment in this report.
- This report has been prepared based on information provided by others. Warringtonfire has not verified the accuracy and/or completeness of that information and will not be responsible for any errors or omissions that may be incorporated into this report as a result.

5. Assessment – Assessment of likely fire performance with respect to AS 1530.4:2014 and AS 4072.1:2005 (R2016)

5.1 Description of variation

The assessment refers to fire test report Nr. 9297C, which consisted of 11 various linear seals in an aerated concrete wall. The linear seals were protected using combinations of one or more Soudafoam FR, Firecryl 4H and Fire Silicone B1 sealants. The test was conducted using the principles of NBN 713.020 (1968 edition) with thermocouples instrumented in accordance with EN 1366-4:1999. It has been therefore proposed to assess the likely fire resistance performance of these linear seals in accordance with AS 1530.4:2014 and AS 4072.1:2005 (R2016).

5.2 Methodology

The approach and method of assessment used for this assessment is summarised in Table 5.

Table 5 Method of assessment

Assessment method	
Level of complexity	Intermediate assessment
Type of assessment	Comparative

5.3 Assessment

The referenced fire test report using the principles of NBN 713.020 (1968 edition). This standard slightly differs from AS 1530.4:2014 and AS 4072.1:2005 (R2016). Therefore, the effect of these differences on the fire resistance performance of tested linear seals are discussed below.

5.3.1 Furnace temperature measurement

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 diameter of less than 1.0 mm and an overall diameter of 3 mm. The measuring junction protrudes at least 25 mm from the supporting heat resistant tube.

The furnace thermocouple types in NBN 713.020 (1968) are specified as follows:

"*The length of the part exposed to the heat of the refracting sheath fitted with a thermocouple is not less than 170 mm. The thermocouple wires are exposed over a length of 25 mm measured from the hot weld and its minimal diameter is 0.75 mm*".

The location of the furnace thermocouples relative to the exposed face of the specimen for AS 1530.4:2014 is 100 mm ± 10 mm, maintained where practical at a distance of 50 mm to 150 mm during the test, while NBN 713.020 (1968) specifies a distance of 100 mm without a tolerance – which must be maintained as constant as possible during the test.

For a test in a 3 m ×3 m furnace, AS 1530.4:2014 requires five furnace thermocouples, arranged symmetrically, and distributed so as to give a reliable indication of the average temperature in the vicinity of the test specimen. NBN 713.020 (1968) requires at least 10 thermocouples evenly distributed on the exposed surface of the test sample. The requirements for the distribution of furnace thermocouples are considered to be sufficiently similar and the increased number of thermocouples for NBN 713.020 (1968) is considered to be sufficient to cover the locations as required by AS 1530.4:2014.

Thus, it is considered that the minor differences in the requirements of furnace thermocouples and their locations would not significantly affect the test results

5.3.2 Temperature Regime

The furnace heating regime in fire resistance tests conducted in accordance with AS 1530.4:2014 is specified by the following s heating rate.

$T = 345log_{10}(8t + 1) + 20$

Where:

T = furnace temperature at time t, in degrees Celsius

t = the time into the test, measured in minutes from the ignition of the furnace

The heating regime described in NBN 713.020 (1968) is similar to AS 1530.4:2014. However, AS 1530.4:2014 assumes initial temperature to be 20°C and NBN 713.020-1968 specifies that the initial ambient temperature can be between 5°C to 30°C. A test conducted in accordance with NBN 713.020 (1968) on a warm day (ambient temperature above 20°C) would therefore be slightly more onerous than that in accordance with AS1530.4:2014. However, on a cold day, AS 1530.4:2014 would be slightly more onerous. Nevertheless, with the allowed tolerance for the furnace temperature control accuracy specified in AS 1530.4:2014, the referenced test considered in this assessment is considered to have been exposed to a very similar heating regime to that in accordance with AS 1530.4:2014.

5.3.3 Furnace pressure regime

The furnace pressure required in AS 1530.4:2014 at the top of a vertical separating element is similar to that required in NBN 713.020 (1968). It is a requirement of AS 1530.4:2014 that for vertical elements, a furnace gauge pressure of zero (0) Pa is established at a height 500 mm above the notional floor level. Therefore, the pressure at the top of a vertical specimen of 3000 mm high – based on a pressure gradient of 8.0 Pa/m – could potentially be 20.0 Pa.

In NBN 713.020 (1968), the required average overpressure in the furnace is specified as 19.6 Pa, with the overpressure in the range of 14.7 Pa and 24.5 Pa during the test. Therefore, the differences in specified furnace pressure between the test standards is considered to be minor and thus not expected to be significant.

5.3.4 Specimen temperature measurement

For linear seals, AS 1530.4:2014 specifies the following requirements when placing thermocouples on the unexposed face in clause 10.5.1 (f).

- At least three on the surface of the seal, with one thermocouple for each 0.3 m^2 of surface area, up to a maximum of five, uniformly distributed over the area (one thermocouple being located at the centre of the seal)
- On the surface of the seal, 25 mm from the edge of the opening, with one thermocouple for each 500 mm of the perimeter.
- On the surface of the separating element, 25 mm from the edge of the opening, with one thermocouple for each 500 mm of the perimeter.

Furthermore, Clause 10.5.3 of AS 1530.4:2014 specifies that thermocouples used for the evaluation of the insulation performance of linear seals shall be positioned on the unexposed face of the sealing system and the separating element, except where the unexposed face of the seal is recessed within the separating element. Where this occurs, thermocouples shall only be fitted to the seal when the joint width is greater than or equal to 12 mm. Under such circumstances, the size of the pad may be reduced to facilitate the fitting of the thermocouple.

With reference to the Nr. 9297C test report, four thermocouples were placed on each vertical linear seal. The four thermocouples per the linear seal comply with AS 1530.4:2014, but the requirement of one thermocouple per 500 mm of the perimeter and 25 mm from the edge is not satisfied. It is however considered acceptable to apply the test results to AS 1530.4:2014 as none of the tested joints are within 20ºC of failure for the insulation rating they are given in accordance with AS 1530.4:2014. In addition, added confidence is gained by the fact that the observations for the test were considered to be sufficiently detailed and no localised areas of failure (which were not adequately covered by the thermocouples) were observed.

5.3.5 AS 1530.4:2014 criteria of failure

AS 1530.4:2014 specifies the following performance criteria for linear gap sealing systems:

Structural adequacy

Not applicable

Integrity

Failure in relation to integrity shall be deemed to have occurred if the specimen:

- Collapses.
- Sustained flaming on the non-fire side in excess of 10 seconds.
- Ignition of a cotton pad within 30 seconds when applied.

Insulation

Failure in relation to insulation shall be deemed to have occurred when the temperature of any of the relevant thermocouples attached to the unexposed face of the test specimen rises by more than 180°C above the initial temperature.

5.3.6 NBN 713.020 (1968) Criteria of Failure

The criteria of classification specified in NBN 713.020 (1968) are as follows:

Stability

Stability is considered adequate when the construction sub-assembly:

- retains its condition, that is to say, the qualities necessary for the maintenance of its own stability and the fulfilment of its function.
- does not show any distortion incompatible with its function with regard to the stability of the construction.
- where necessary, bears without any failure, during a given period of time after the test, the load applied to it during the test.

Imperviousness to flames

The construction sub-assembly is no longer considered impervious to flames when a layer of cotton which has moved slowly a distance of 2 to 3 cm from a crack or any other opening that may have occurred on the side of the non-exposed surface of the test sample ignites spontaneously when the overpressure in the heated chamber is 2 kg/m^2.

Thermal insulation

A construction sub-assembly is considered to have an adequate degree of thermal insulation when the average and maximum temperatures are less than 140ºC and 180ºC above the initial temperature respectively. The insulation criterion is considered to be less onerous for AS 1530.4:2014 as the average temperature is not considered in the criteria of failure. The integrity criteria vary between the standards, however the observations noted during the test appear to be sufficient for the determination of the integrity result.

5.3.7 Application of test data from Nr. 9297C to AS 1530.4:2014

The variations in furnace heating regimes, furnace thermocouples and the responses of the different thermocouple types to the furnace conditions are not expected to have significant effect on the outcome of the referenced fire resistance tests. Based on the above discussion, it is considered that the results relating to the integrity performance of the tested penetrations in Nr. 9297C can be used to assess the FRL in accordance with AS 1530.4:2014 and AS 4072.1:2005 (R2016).

5.4 Conclusion

This assessment demonstrates that the linear seals that was tested in Nr. 9297C are likely to achieve the FRLs shown in Table 6, if tested in accordance with AS 1530.4:2014 and AS 4072.1:2005 (R2016).

Table 6 Assessment summary

ID	Wall thickness (mm)	Gap width (mm)	Seal depth (mm)	Sealant	Backing material	Seal location	FRL
Joint I	200	11	200	Soudafoam FR	None	Throughout the depth	-/180/180
Joint II	200	41	200	Soudafoam FR	None	Throughout the depth	-/90/90
Joint III	200	20	20	Soudal Firecyl 4H	25 mm diameter Polyethylene	Both faces	-/240/240
Joint VIII	100	21	20	Soudal Firecyl 4H	25 mm diameter Polyethylene	Both faces	-/240/180
Joint IX	100	11	10	Soudal Firecyl 4H	15 mm diameter Polyethylene	Both faces	-/240/180
Joint X	100	31	100	Soudafoam FR	None	Throughout the depth	-/-/-
Joint XI	100	11	100	Soudafoam FR	None	Throughout the depth	-/90/90
Soudafoam FR must be applied through full thickness of the wall Soudal Firecyl 4H seals must be applied flush with both faces of the wall using separate backing rods.							

6. Validity

Warringtonfire Australia does not endorse the tested or assessed product in any way. The conclusions of this assessment 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 conditions.

Due to the nature of fire 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 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 subject to constant review and improvement. It is therefore recommended that this report be reviewed on or, before, the stated expiry date.

This assessment represents our opinion about the performance likely to be demonstrated on a test in accordance with AS 1530.4:2014 and AS 4072.1:2005 (R2016), based on the evidence referred to in this report.

This assessment is provided to the Soudal NV for its own purposes and we cannot express an opinion on whether it will be accepted by building certifiers or any other third parties for any purpose.

Appendix A Summary of supporting test data

A.1 Test report – Nr. 9297C

Table 7 Information about test report

Item	Information about test report
Report sponsor	Soudal NV, Everdongenlaan 18-20, B-2300 Turnhout, Belgium.
Test laboratory	University of Gent, St.-Pieternieuwstraat 41, B-9000 Gent.
Test date	The fire resistance test was completed on 07/12/1999.
Test standards	The test was conducted in accordance NBN 713.020 (edition 1968).
General description of tested specimen	The tested specimen consisted of 11 vertically orientated gaps in an aerated concrete block wall. Six of the specimens were in 100 mm thick section and the other five were in 200 mm thick wall section. The linear seals were sealed with different sealing systems as shown in Table 8.
Instrumentation	The test report states that the instrumentation was in accordance with EN 1366-4:1999.

Table 8 tested sealant configurations

ID	Wall thickness (mm)	Gap width (mm)	Seal depth (mm)	Sealant	Backing material	Seal location
Joint I	200	11	200	Soudafoam FR	None	Both faces
Joint II	200	41	200	Soudafoam FR	None	Both faces
Joint III	200	20	20	Soudal Firecyl 4H	25 mm diameter Polyethylene	Both faces
Joint VIII	100	21	20	Soudal Firecyl 4H	25 mm diameter Polyethylene	Both faces
Joint IX	100	11	10	Soudal Firecyl 4H	15 mm diameter Polyethylene	Both faces
Joint X	100	31	100	Soudafoam FR	None	Both faces
Joint XI	100	11	100	Soudafoam FR	None	Both faces

The test specimen achieved the results shown in Table 9.

Table 9 Results summary

ID	Time to failure in minutes		
	Thermic Insulation	Flame resistance	Stability
Joint I	229	229	≥ 240
Joint II	110	110	116
Joint III	≥ 240	≥ 240	≥ 240
Joint IV	≥ 240	≥ 240	≥ 240
Joint V	225	≥ 240	≥ 240
Joint VI	116	187	189
Joint VII	146	202	≥ 240
Joint VIII	210	≥ 240	≥ 240

Joint IX	187	≥ 240	≥ 240
Joint X	50	50	63