ASSESSMENT REPORT

The fire resistance performance of linear gap sealing systems in aerated concrete if tested in accordance with AS1530.4-2014

EWFA Report No:

45717-02

Report Sponsor:

Soudal NV
Everdongenlaan 18-20
B-2300 Turnhout
Belgium

Testing. Advising. Assuring.

DOCUMENT REVISION STATUS

Date Issued	Issue No	Description
14/08/03	45717-00	Initial Issue
22/06/09	45717-01	Updated product references
31/03/2016	45717-02	Updated referenced standard

CONTACT INFORMATION

Exova Warringtonfire Aus Pty Ltd - ABN 81 050 241 524

NATA Registered Laboratory

Unit 2, 409-411 Hammond Road
Dandenong Victoria 3175
Australia

T: +61 (0)3 9767 1000
F: +61 (0)3 9767 1001

Victoria

Unit 2, 409-411 Hammond Road
Dandenong Victoria 3175
Australia

T: +61 (0)3 9767 1000
F: +61 (0)3 9767 1001

New South Wales

Suite 2002a, Level 20,
44 Market Street
Sydney NSW 2000
Australia

T: +61 (0)2 8270 7600
F: +61 (0)2 9299 6076

Queensland

Northpoint, Unit 29, Level 6
231 North Quay
Brisbane QLD 4000
Australia

T: +61 (0)7 3238 1700
F: +61 (0)7 3211 4833

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1 INTRODUCTION

This report presents an assessment of the fire resistance performance of linear gap sealing systems in aerated concrete if tested in accordance with AS1530.4-2014 and assessed in accordance with AS4072.1-2005.

The tested prototypes described in Section 2 of this report, when subject to the proposed variations described in Section 3, are to perform satisfactorily if tested in accordance with the referenced test method described in Section 4. The conclusions of the report are summarised in Section 5.

The validity of this assessment is conditional on compliance with Sections 7, 8 and 9 of this report.

Summaries of the test data on which this assessment is based are provided in Appendix A. A summary of the critical issues leading to the assessment conclusions including the main points of argument are included in Appendix B.

2 TESTED PROTOTYPES

This assessment is based on test report Nr. 9297C from the University of Gent, which describes a fire resistance test performed on various linear gap sealing systems when installed in vertically orientated gaps within aerated concrete walls.

Permission has been granted from Soudal NV for the data to be used in the preparation of this report.

For the purpose of this report, data considered from this fire resistance test is summarised in Appendix A

3 VARIATION TO TESTED PROTOTYPES

The proposed construction shall be as tested in Nr. 9297C when subjected to following variations:

- Likely performance in accordance with AS1530.4-2014.

4 REFERENCED TEST PROCEDURES

This report is prepared with reference to the requirements of AS1530.4-2014 and AS4072.1-2005 for the determination of a FRL.

5 FORMAL ASSESSMENT SUMMARY

On the basis of the discussion presented in this report, it is the opinion of this testing authority that if the tested prototypes described in Section 2 had been varied as in Section 3, they will achieve the fire resistance performances below when tested in accordance with the test method referenced in Section 4 and subject to the requirements of Section 7.

ID	Wall Thick. (mm)	Gap Width (mm)	Seal depth (mm)	Sealant Reference	Backing Material	Seal	FRL
Joint I	200	11	200	Soudafoam FR	None	Both faces	-/180/180
Joint II	200	41	200	Soudafoam FR	None	Both faces	-/90/90
Joint III	200	20	20	Soudal Firecyl 4H	25 mm diameter Polyethylene	Both faces	-/240/240
Joint IV	200	11	10	Soudal Fire Silicone B1	15 mm diameter Polyethylene	Both faces	-/240/240
Joint V	200	31	20	Soudal Fire Silicone B1	40 mm diameter Polyethylene	Both faces	-/240/180
Joint VI	100	33	20	Soudal Fire Silicone B1	40 mm diameter Polyethylene	Both faces	-/180/90
Joint VII	100	11	10	Soudal Fire Silicone B1	15 mm diameter Polyethylene	Both faces	-/180/120
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	Both faces	-/-/-
Joint XI	100	11	100	Soudafoam FR	None	Both faces	-/90/90

Note:

Soudafoam FR applied through full thickness of the wall

Soudal Fire Silicone B1 and Soudal Firecyl 4H seals applied flush with both faces of the wall using separate backing rods.

6 DIRECT FIELD OF APPLICATION

The results of this assessment are applicable to penetrations in walls exposed to fire from either side otherwise direction stated only.

7 REQUIREMENTS

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.

8 VALIDITY

This assessment report does not provide an endorsement by Exova Warringtonfire Aus Pty Ltd of the actual products supplied.

The conclusions of this assessment 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.

The assessment can therefore only relate only to the actual prototype test specimens, testing conditions and methodology described in the supporting data, and does not imply any performance abilities of constructions 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 be reviewed on or, before, the stated expiry date.

The information contained in this 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.

9 AUTHORITY

9.1 APPLICANT UNDERTAKINGS AND CONDITIONS OF USE

By using this report as evidence of compliance or performance, the applicant(s) confirms 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, and

they agree to withdraw this assessment from circulation should the component or element of structure be 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, and

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, agree to ask the assessing authority to withdraw the assessment.

9.2 GENERAL CONDITIONS OF USE

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9.3 AUTHORISATION ON BEHALF OF EXOVA WARRINGTONFIRE AUS PTY LTD

Prepared by:

D. Nicholson

Reviewed by:

K. Nicholls

9.4 DATE OF ISSUE

31/03/2016

9.5 EXPIRY DATE

31/03/2021

APPENDIX A SUMMARY OF SUPPORTING DATA

A.1 TEST REPORT – NR. 9297C (TRANSLATION TO ENGLISH)

A.1.1 Report Sponsor

A.1.1.1 Soudal NV, Everdongenlaan 18-20, B-2300 Turnhout, Belgium.

A.1.2 Test Laboratory

A.1.2.1 University of Gent, St.-Pieternieuwstraat 41, B-9000 Gent.

A.1.3 Test Date

A.1.3.1 7th December 1999

A.1.4 Test standards prescribed

A.1.4.1 The test was conducted in accordance NBN 713.020 (edition 1968)

A.1.5 Variations to Test Standard

A.1.5.1 The thermocouples were placed in accordance with EN 1366.4-1999.

A.1.6 Description of Tested Assembly

A.1.6.1 Eleven vertically orientated gaps between sections of aerated concrete block separating elements were sealed with different linear gap sealing systems. Six of the specimens were in 100 mm thick sections and the other five were in 200 mm sections. All of the gaps were sealed on the exposed and non-exposed sides.

ID	Wall Thick. (mm)	Gap Width (mm)	Seal depth (mm)	Sealant Reference	Backing Material	Seal Positions
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 IV	200	11	10	Soudal Fire Silicone B1	15 mm diameter Polyethylene	Both faces
Joint V	200	31	20	Soudal Fire Silicone B1	40 mm diameter Polyethylene	Both faces
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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

A.1.7 Test Results

A.1.7.1 The test was discontinued after 240 minutes and the specimens satisfied the performance criteria specified in NBN 713.020 for the following period:

Specimen	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
Joint XI	103	104	109

APPENDIX B ASSESSMENT OF SPECIFIC VARIATIONS

B.1 RELEVANCE OF NBN 713.020 (1968) DATA WITH RESPECT TO AS1530.4-2014

B.1.1 General

B.1.1.1 The test procedures used in the referenced fire test is similar to AS1530.4-2014. The referenced test was conducted in accordance with NBN 713.020 (1968). The relevant minor variations between the methods and their effects on the fire resistance performance of the test specimens are discussed below.

B.1.2 Temperature Regime

B.1.2.1 The furnace heating regime in fire resistance tests conducted in accordance with AS1530.4-2014 is specified by the following s heating rate.

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

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

B.1.2.2 The heating regime described in NBN 713.020 (1968) is similar to AS1530.4-2014 as described above. However, AS1530.4-2014 assumes initial temperature to be 20°C and NBN 713.020-1968 specifies that the initial ambient temperature should be 5 ≤ 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 the reverse would be true.

B.1.2.3 With the allowed tolerance for the furnace temperature control accuracy specified in AS1530.4-2014, the referenced tests considered in this assessment are considered to have been exposed to a very similar heating regime to that in accordance with AS1530.4-2014.

B.1.3 Furnace Thermocouples - Construction

B.1.3.1 The furnace thermocouples specified in AS1530.4-2014 are type K, mineral insulated metal sheathed (MIMS) with a stainless steel sheath having a wire of diameter 1.0mm and an overall diameter of 3mm. The measuring junction protrudes 25mm from the supporting heat resistant tube.

B.1.3.2 The furnace thermocouple types in NBN 713.020 (1968) are specified as follows:

B.1.3.3 "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 0.75mm".

B.1.3.4 Despite the variations in furnace thermocouples, their responses to the furnace conditions are not expected to have a significant effect on the outcome of the referenced fire resistance tests. Variations due to the difference in heat transfer conditions between furnaces (which are not fully controlled by the current fire resistance test standards) would be more likely to influence results rather than the minor differences in the thermocouple construction described above.

B.1.4 Locations

B.1.4.1 The location of the furnace thermocouples relative to the exposed face of the specimen for AS1530.4-2014 is 100mm ± 10mm, maintained where practical at a distance of 50 to 150 mm during the test, while NBN 713.020 (1968) specifies a distance of 100mm without a tolerance, which "must be maintained as constant as possible during the test".

B.1.4.2 As the furnace should be adequately insulated, any possible temperature disparity inside the furnace is expected to be minimal. It is therefore considered that any minor variation due to the relative location of the furnace thermocouples to the exposed face of the specimen would not significantly affect the test results.

B.1.4.3 For a test in a 3m × 3m furnace, AS1530.4-2014 requires 5 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".

B.1.4.4 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 AS1530.4-2014. Thus it is considered that the minor differences in the requirements for the number and distribution of furnace thermocouples would not significantly affect the test results.

B.1.5 Furnace Pressure

B.1.5.1 The furnace pressure required in AS1530.4-2014 at the top of a vertical separating element is similar to that required in NBN 713.020 (1968).

B.1.5.2 It is a requirement of AS1530.4-2014 that for vertical elements, a furnace gauge pressure of zero (0) Pa is established at a height 500mm above the notional floor level. Therefore at the top of a vertical specimen 3000mm high, based on a pressure gradient of 8.5Pa/m as specified in AS1530.4-2014 for typical furnace conditions, the pressure could potentially be 21.25Pa.

B.1.5.3 In NBN 713.020 (1968) the required average overpressure in the furnace is specified 19.6Pa, with the overpressure not less than 14.7Pa or nor more than 24.5Pa in any part of the furnace.

B.1.5.4 The differences in specified furnace pressure between the test standards is not expected to be significant, provided the integrity of the specimen is maintained. Where integrity has been maintained in accordance with NBN 713.020 (1968), it is considered that this would also be achieved for a test in accordance with AS1530.4-2014 as the furnace pressure is less onerous in the latter standard. Thus, it is considered that a specimen, which has passed a test in accordance NBN 713.020 (1968) would not fail a test in accordance with AS1530.4-2014 as a result of the differences in furnace pressure.

B.1.6 Specimen Thermocouples - Construction

B.1.6.1 The specimen thermocouples specified in AS1530.4-2014 are type K, with a wire diameter not exceeding 0.5mm. Each thermocouple shall have the tail of its measuring junction attached by silver soldering to the centre of the face of a copper disc that has dimensions of 12mm diameter and 0.2mm thickness. Each disc or thermocouple measuring junction shall be covered by an over-dry pad, not less than 30mm square and manufactured from material having a value of $\sqrt{(k\rho c)}$ not greater than 600 at 150ºC, and of such thickness as will give thermal resistance between 0.015 K/W and 0.025 K/W at 150ºC. The thermocouple wires shall pass through a hole of 1.5 mm diameter in the centre of the pad.

B.1.6.2 The thermocouples specified in NBN 713.020 (1968) are to have the hot welds (with wire diameter of 0.5mm) placed in direct contact with the surface test sample. They are to be welded to a copper disc 12 mm in diameter and 0.2 mm thick. To protect the hot weld against cooling it is covered with a small plate 30 mm $\times$ 30 mm $\times$ 2 mm of dry asbestos millboard with a weight between 850 kg/m3 and 1200 kg/m3. The hot weld shall be situated at the centre of this small plate. Nothing further is specified for specimen thermocouples.

B.1.6.3 The thermocouples specified above are similar although not identical, and would be expected to differ slightly in their response times and the temperatures they register at a given time. This, however, is not expected to cause significant differences in the temperatures registered and as none of the tested joint temperatures are within 20ºC of failure in accordance with AS1530.4-2014, so the joints are considered likely to satisfy that test.

B.1.7 Locations

B.1.7.1 AS1530.4-2014 specifies thermocouple locations for unpenetrated blank seals, as follows:

B.1.7.2 At least three on the surface of the seal, with one thermocouple for each 0.3m^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).

B.1.7.3 On the surface of the seal 25mm from the edge of the opening, with one thermocouple for each 500mm of the perimeter.

B.1.7.4 On the surface of the separating element 25mm from the edge of the opening, with one thermocouple for each 500mm of the perimeter.

B.1.7.5 NBN 713.020 (1968) states that the average temperature of the non-exposed face of the test sample is to be measured with at least 5 thermocouples, one placed in the centre and the others on the diagonals midway between the centre and the corners. Other thermocouples may be applied where the laboratory personnel consider it necessary, as evenly as possible, where the temperature reached is thought to be higher than elsewhere.

B.1.7.6 Due to the qualitative nature of the thermocouple location selection, report Nr. 9297C is consulted for the tested thermocouple locations. The report shows four thermocouples located on each vertical control joint, with eleven joints and thus forty-four thermocouples in total on the seals. The seals were mounted in a concrete wall with five thermocouples on each half (the 100 mm thick half and the 200 mm thick half).

B.1.7.7 The four thermocouples per control joint comply with AS1530.4-2014, 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 AS1530.4-2014 as none of the tested joints are within 20ºC of failure for the rating they are given in accordance with AS1530.4-2014 and the observations for the test are considered to be sufficiently detailed such that no localised areas of failure (which were not adequately covered by the thermocouples) are considered to have occurred.

B.1.8 AS1530.4-2014 Criteria of Failure

B.1.8.1 AS1530.4-2014 specifies the following performance criteria for linear gap sealing systems (control joints):

Structural Adequacy:

B.1.8.2 Not applicable

Integrity:

B.1.8.3 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:

B.1.8.4 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 K above the initial temperature.

B.1.9 NBN 713.020 (1968) Criteria of Failure

B.1.9.1 The criteria of classification specified in NBN 713.020 (1968) are as follows:

Stability:

B.1.9.2 Stability is considered adequate when the construction sub-assembly: 1) retains its condition, that is to say, the qualities necessary for the maintenance of its own stability and the fulfilment of its function; 2) does not show any distortion incompatible with its function with regard to the stability of the construction; 3) 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:

B.1.9.3 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:

B.1.9.4 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.

B.1.9.5 The insulation criterion is considered to be less onerous for AS1530.4-2014 as the average temperature is not considered in the criteria of failure. The integrity criteria varies between the standards, however the observations noted during the test appear to be sufficient for the determination of the integrity result.

B.1.10 Application of Test Data from Nr. 9297C to AS1530.4 -2014.

B.1.10.1 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.

B.1.10.2 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 AS1530.4-2014 and AS4072.1-2005.