

BRANZ Type Test

FH14268-02-1

CONE CALORIMETER TEST AND NZBC ACCEPTABLE SOLUTION C/AS1 EXTERIOR SURFACE FINISH PERFORMANCE OF GRAPHEX SUBSTRATE AND XTHERM GOLD SUBSTRATE

CLIENT

Rockcote Resene Ltd
T/A Resene Construction Systems
5 Venture Place, Middleton,
Christchurch, 8024
New Zealand



All tests and procedures reported herein, unless indicated, have been performed in accordance with the laboratory's scope of accreditation



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TEST SUMMARY

Objective

To conduct cone calorimeter testing and reduce the data in accordance with ISO 5660 (2002) as specified in New Zealand Building Code (NZBC) Acceptable Solutions C/AS1 Appendix C C7.1 on client supplied specimens for the purposes of determination of performance in accordance with:

- NZBC Acceptable Solutions C/AS1 Section 5.4 Exterior Surface Finishes

Test sponsor

Rockcote Resene
5 Venture Place, Middleton,
Christchurch, 8024
New Zealand

Description of test specimens

The products as described by the client as Graphex Substrate and XTherm Gold Substrate with Resene Lumbersider or Resene X200 painted finish.

Date of tests

12 and 17 November 2021, and 22 March 2022

Test results

For the purposes of compliance with the relevant building code documents, the following performance is considered applicable to the tested samples as described in Section 1.

Graphex Substrate with Lumbersider or X200.

Building Code Document	Criteria	Result	Performance
NZBC Acceptable Solution C/AS1	Peak Heat Release rate (kW/m ²)	76.4	≤100 kW/m ²
	Total Heat Release (MJ/m ²)	14.2	≤ 25 MJ/m ²

XTherm Gold Substrate with Lumbersider or X200.

Building Code Document	Criteria	Result	Performance
NZBC Acceptable Solution C/AS1	Peak Heat Release rate (kW/m ²)	52.2	≤100 kW/m ²
	Total Heat Release (MJ/m ²)	16.6	≤ 25 MJ/m ²



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LIMITATION

The results reported here relate only to the item/s tested.

TERMS AND CONDITIONS

This report is issued in accordance with the Terms and Conditions as detailed and agreed in the BRANZ Services Agreement for this work.



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DOCUMENT REVISION STATUS

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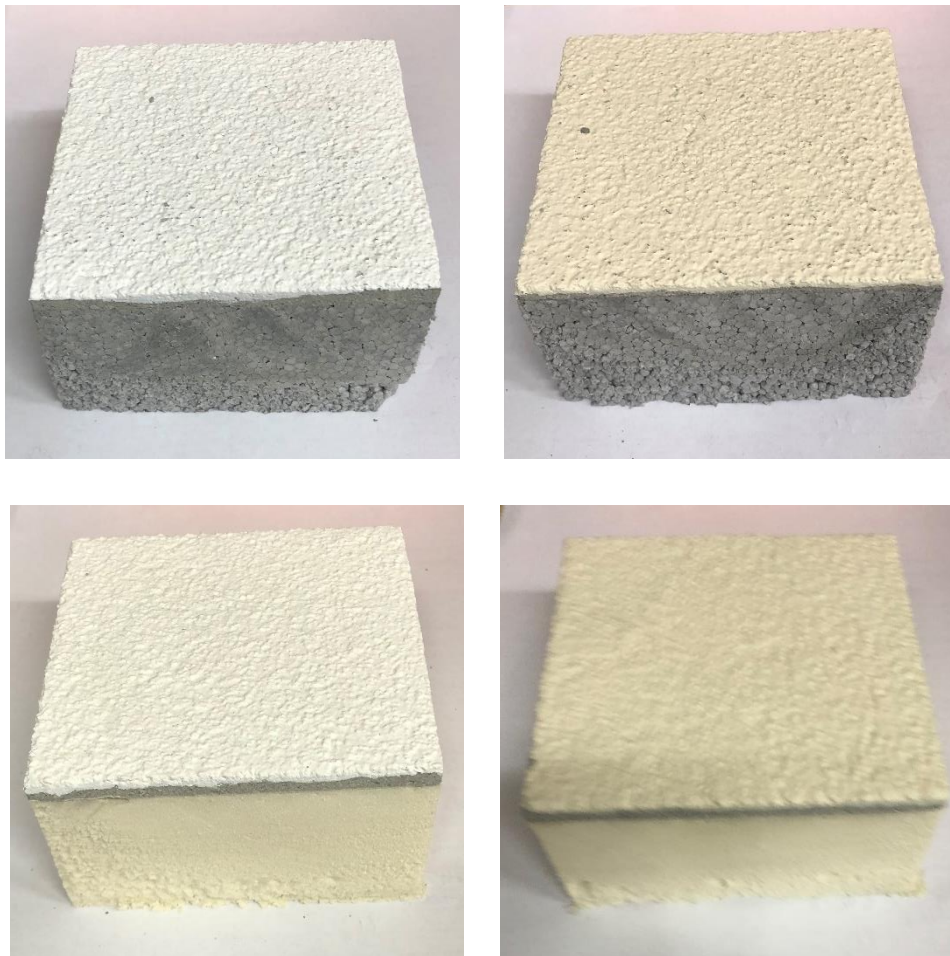
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1. GENERAL

The products submitted by the client for testing were identified by the client as Graphex Substrate and XTherm Gold Substrate with Resene Lumbersider or Resene X200 painted finish. The nominally 50 mm thick panel systems comprised of a foam substrate (Graphex Substrate: expanded polystyrene, Xtherm Gold Substrate: polyisocyanurate) with multi-layered render finish of mineral base coat, mineral texture, Resene Limelock, and Resene Lumbersider or X200 painted finish. Figure 1 illustrates representative specimens of that tested.

Figure 1: Representative specimens (top row, left to right: Graphex with Lumbersider, Graphex with X200. Bottom row, left to right: XTherm Gold PIR with Lumbersider, Xtherm Gold PIR with X200)



1.1 Sample measurements

The following physical parameters were measured for each specimen prior to testing.

Table 1: Physical parameters

Product ID	Specimen ID	Initial properties		Overall apparent density (kg/m ³)	Colour
		Mass (g)	Mean thickness* (mm)		
Graphex with Lumbersider	FH14268-3-50-1	123.3	40.0	308	White
Graphex with X200	FH14268-4-50-1	80.5	39.4	204	Cream
	FH14268-4-50-2	82.4	40.2	205	Cream
	FH14268-4-50-3	84.9	40.2	211	Cream
XTherm Gold with Lumbersider	FH14268-7-50-1	113.6	40.4	281	White
XTherm Gold with X200	FH14268-8-50-1	116.5	39.9	292	Cream
	FH14268-8-50-2	112.9	39.8	284	Cream
	FH14268-8-50-3	110.1	40.4	273	Cream

Shaded rows – indicative test specimen only

* Thickness reduced by cutting away the unexposed face

2. EXPERIMENTAL PROCEDURE

2.1 Test standard

The tests were carried out and data reduced according to the test procedures described in ISO 5660: (2002), Reaction-to-fire tests – Heat release, smoke production and mass loss – Part 1: Heat release rate. The sample preparation and test procedure are as described in 2.4 and 2.5.

2.2 Test date

The tests were conducted on the 12 and 17 November 2021, and 22 March 2022 by Mr James Quilter and Mr James Stallinger respectively, at BRANZ Limited laboratories, Judgeford, New Zealand.

2.3 Specimen conditioning

All specimens were conditioned to moisture equilibrium (constant weight), at a temperature of $23 \pm 2^\circ\text{C}$ and a relative humidity of $50 \pm 5\%$ immediately prior to testing.

2.4 Special weathering

According to Acceptable Solutions Appendix C C7.1.3, timber claddings which have a fire-retardant treatment incorporated in or applied to them are required to be subjected to the regime of accelerated weathering described in ASTM D 2898 Method B with the water flow rate from Method A before testing. The tested specimens were not timber claddings and therefore were not subjected to the accelerated weathering.

2.5 Specimen wrapping and preparation

All tests were conducted, and the specimens prepared in accordance with the test standard. The spark igniter and the stainless-steel retainer frame were used during testing. All specimens were wrapped in a single layer of aluminium foil, covering the unexposed surfaces.

Samples as supplied by the client were greater than 50 mm thick. In accordance with the standard, the requisite specimens were obtained by cutting away the unexposed face to reduce the thickness.

2.6 Test programme

The test programme consisted of three replicate specimens and one indicative specimens, as identified in the Table 1, tested at an irradiance level of 50 kW/m^2 . All tests were carried out with the specimen horizontal, and with a nominal duct flow rate of $0.024 \text{ m}^3/\text{s}$.

2.7 Specimen selection

BRANZ was not involved in the selection of the materials submitted for testing. The test materials used were supplied to the laboratory by the client.

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3. TEST RESULTS AND REDUCED DATA

3.1 Test results and reduced data in accordance with NZBC Acceptable Solution C/AS1 Appendix C7.1

Table 2: Test results and reduced data for Graphex Substrate with X200

Material	Test specimens as described in Section 1			Mean
Specimen test number	FH14268-4-50-1	FH14268-4-50-2	FH14268-4-50-3	
Test Date	17/11/2021	22/03/2022	22/03/2022	
Time to sustained flaming s	64	60	61	62
Observations ^a	-	-	-	
Test duration ^b s	900	900	900	900
Mass remaining, m _f g	72.5	73.4	76.7	74.2
Mass pyrolyzed %	10.0%	10.9%	9.7%	10.2%
Specimen mass loss ^c kg/m ²	0.8	0.9	0.8	0.9
Specimen mass loss rate ^c g/m ² .s	1.0	1.1	1.0	1.0
Heat release rate				
peak, \dot{q}_{max}'' kW/m ²	83.8	72.4	72.9	76.4
average, \dot{q}_{avg}''				
Over 60 s from ignition kW/m ²	41.0	40.5	38.1	39.9
Over 180 s from ignition kW/m ²	22.0	30.1	31.9	28.0
Over 300 s from ignition kW/m ²	18.6	30.5	30.3	26.5
Total heat released MJ/m ²	9.7	18.5	14.4	14.2
Average Specific Extinction Area m ² /kg	40.1	63.0	42.4	48.5
Effective heat of combustion ^d , $\Delta h_{c,eff}$ MJ/kg	10.7	18.1	15.5	14.8

Notes:

^a no significant observations were recorded

^b determined by test duration of 15 minutes (900 sec) as specified in NZBC Acceptable Solutions C/AS1 Appendix C C7.1.2

^c from ignition to end of test

^d from the start of the test

+ value calculated using data beyond the official end of test time according to the test standard.

NR not recorded



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3.2 Test results and reduced data in accordance with NZBC Acceptable Solution C/AS1 Appendix C7.1

Table 3: Test results and reduced data for Xtherm Gold Substrate with X200

Material	Test specimens as described in Section 1			Mean
	FH14268-8-50-1	FH14268-8-50-2	FH14268-8-50-3	
Specimen test number	FH14268-8-50-1	FH14268-8-50-2	FH14268-8-50-3	
Test Date	17/11/2021	22/03/2022	22/03/2022	
Time to sustained flaming	s	96	101	87
Observations ^a	-	-	-	
Test duration ^b	s	900	900	900
Mass remaining, m _f	g	102.5	99.2	96.4
Mass pyrolyzed	%	12.0%	12.1%	12.4%
Specimen mass loss ^c	kg/m ²	1.4	1.4	1.4
Specimen mass loss rate ^c	g/m ² .s	1.7	1.7	1.7
Heat release rate				
peak, \dot{q}''_{max}	kW/m ²	49.3	47.1	60.2
average, \dot{q}''_{avg}				
Over 60 s from ignition	kW/m ²	28.5	26.0	35.3
Over 180 s from ignition	kW/m ²	17.0	16.5	32.9
Over 300 s from ignition	kW/m ²	27.3	18.8	38.4
Total heat released	MJ/m ²	17.5	12.7	19.7
Average Specific Extinction Area	m ² /kg	178.0	138.5	130.3
Effective heat of combustion ^d , $\Delta h_{c,eff}$	MJ/kg	11.0	8.1	12.7

Notes:

^a no significant observations were recorded

^b determined by test duration of 15 minutes (900 sec) as specified in NZBC Acceptable Solutions C/AS1 Appendix C 7.1.2

^c from ignition to end of test

^d from the start of the test

+ value calculated using data beyond the official end of test time according to the test standard.

NR not recorded



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4. SUMMARY

4.1 Graphex Substrate with X200 painted finish

The test standard requires that the mean heat release rate (HRR) readings over the first 180 s from ignition for the three specimens should differ by no more than 10% of the arithmetic mean of the three readings. In the event of this criterion not being met, a further three specimens are required to be tested.

Table 4: Heat release rate

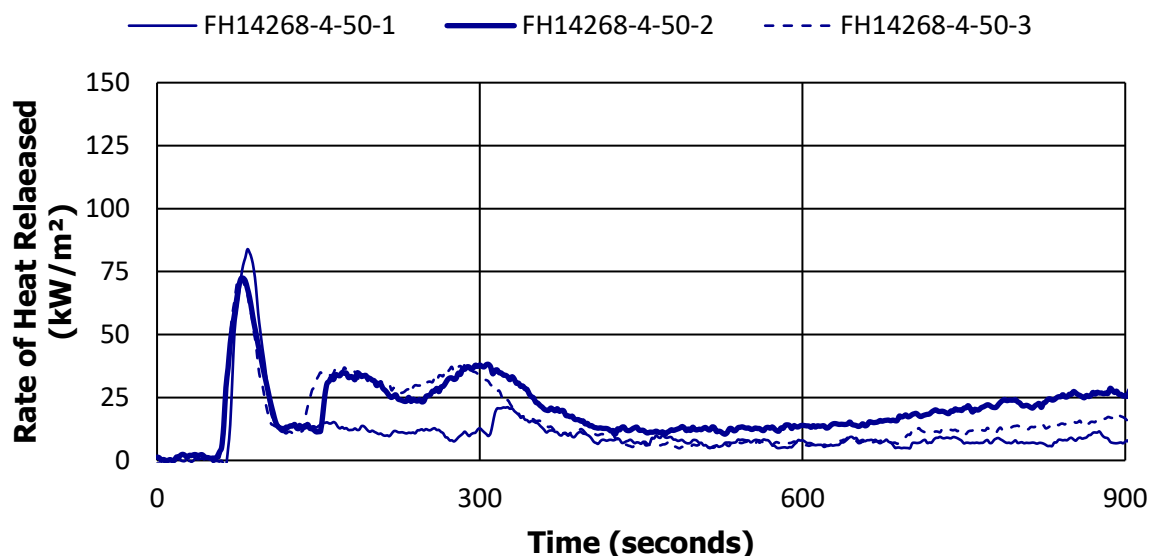
Specimen ID	Average HRR over 180 s from ignition	Arithmetic mean	% difference from the arithmetic mean
FH14268-4-50-1	22.0	28.0	-21.4%
FH14268-4-50-2	30.1		7.6%
FH14268-4-50-3	31.9		13.8%

Table 4 identifies two specimens exposed to 50 kW/m² irradiance exceeded the acceptance criteria. Although outside of the variability criteria of the test standard, a further set of three tests as required by the test standard was deemed not to be necessary and would not be expected to lead to an alteration of the performance.

Table 5: Report summary

Mean Specimen thickness (mm)	Irradiance (kW/m ²)	Mean Time to Ignition (s)	Mean Peak Heat Release Rate (kW/m ²)	Mean Total Heat Released (MJ/m ²)
39.9	50	62	76.4	14.2

Figure 2: Rate of heat release versus time



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4.2 XTherm Gold Substrate with X200 painted finish

The test standard requires that the mean heat release rate (HRR) readings over the first 180 s from ignition for the three specimens should differ by no more than 10% of the arithmetic mean of the three readings. In the event of this criterion not being met, a further three specimens are required to be tested.

Table 6: Heat release rate

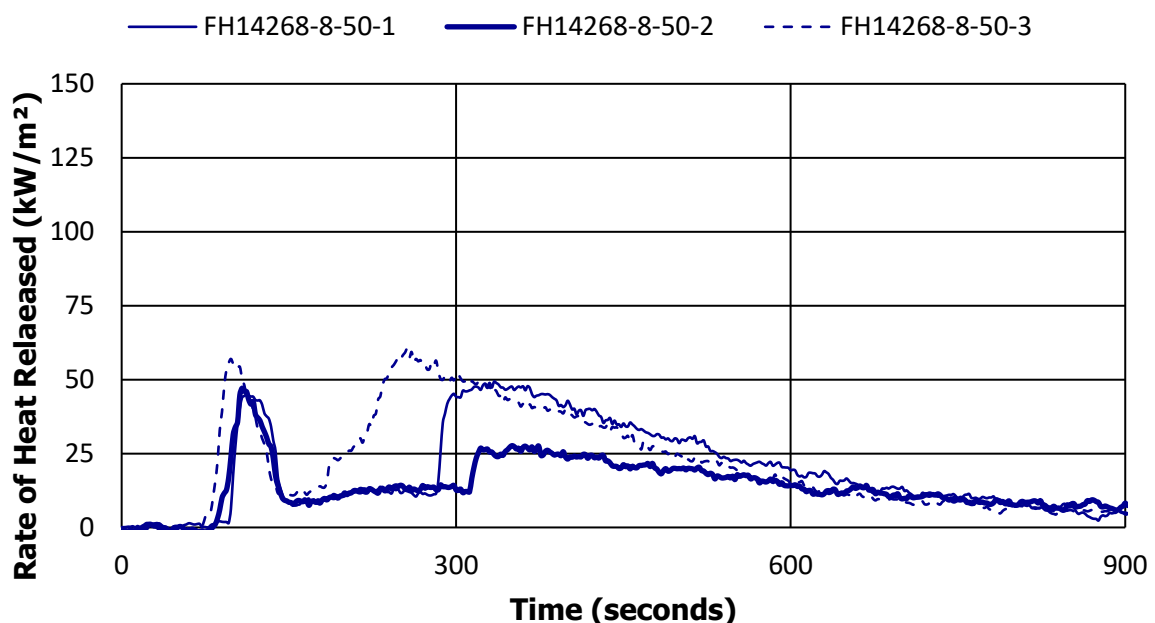
Specimen ID	Average HRR over 180 s from ignition	Arithmetic mean	% difference from the arithmetic mean
FH14268-8-50-1	17.0	22.1	-23.3%
FH14268-8-50-2	16.5		-25.4%
FH14268-8-50-3	32.9		48.8%

Table 4 identifies the specimens exposed to 50 kW/m² irradiance exceeded the acceptance criteria. Although outside of the variability criteria of the test standard, a further set of three tests as required by the test standard was deemed not to be necessary and would not be expected to lead to an alteration of the performance.

Table 7: Report summary

Mean Specimen thickness (mm)	Irradiance (kW/m ²)	Mean Time to Ignition (s)	Mean Peak Heat Release Rate (kW/m ²)	Mean Total Heat Released (MJ/m ²)
40.0	50	95	52.2	16.6

Figure 3: Rate of heat release versus time



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4.3 Indicative tests

Indicative tests were completed on Graphex Substrate and Xtherm Gold Substrate samples with Lumbersider painted finish to evaluate the alternative painted finish. The following table summarises the indicative results against the mean results for replicate tested X200 painted samples.

Product ID	Time to Ignition (s)	Peak Heat Release Rate (kW/m ²)	Total Heat Released (MJ/m ²)
Graphex with Lumbersider	100	37.5	11.6
Graphex with X200	62*	76.4*	14.2*
Xtherm Gold with Lumbersider	218	68.0	22.1
Xtherm Gold with X200	95*	52.2*	16.6*

Note: * - mean value across three replicate samples

5. DISCUSSION

No significant variations were detected in the indicative testing of Graphex and Xtherm Gold PIR systems with Lumbersider when compared to replicate tested X200 painted finish. It is expected that the Lumbersider finish would meet the performance provided in Section 7.

6. RESULTS FOR NZBC ACCEPTABLE SOLUTION C/AS1 EXTERIOR SURFACE FINISHES

In accordance with NZBC Acceptable Solution C/AS1 Table 5.1 for external wall claddings the mean test results must not exceed the Peak Heat Release rate and Total Heat Release shown in Table 5.

Table 8: NZBC Acceptable Solution C/AS1 Table 5.1

	NZBC Acceptable Solution Requirement	
	Column B	Column D
Peak Heat Release rate (kW/m ²)	≤100	≤ 150
Total Heat Release (MJ/m ²)	≤ 25	≤ 50

The samples as described in Section 1 had the following results when reduced over the 15-minute (900 s) period as specified in Appendix C C7.1.2 as shown in Table 6.

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Table 9: NZBC Classification of external wall claddings – Graphex system

	Sample 1	Sample 2	Sample 3	Mean
Peak Heat Release rate (kW/m ²)	83.8	72.4	72.9	76.4
Total Heat Release (MJ/m ²)	9.7	18.5	14.4	14.2

The tested samples recorded a mean Peak Heat Release of 76.4 KW/m² and a mean Total Heat Release of 14.2 MJ/m² and it is therefore considered to satisfy the requirements of NZBC Acceptable Solutions C/AS1 Table 5.1 Requirements for external wall claddings, Column B.

Table 10: NZBC Classification of external wall claddings – Xtherm Gold PIR system

	Sample 1	Sample 2	Sample 3	Mean
Peak Heat Release rate (kW/m ²)	49.3	47.1	60.2	52.2
Total Heat Release (MJ/m ²)	17.5	12.7	19.7	16.6

The tested samples recorded a mean Peak Heat Release of 52.2 KW/m² and a mean Total Heat Release of 16.6 MJ/m² and it is therefore considered to satisfy the requirements of NZBC Acceptable Solutions C/AS1 Table 5.1 Requirements for external wall claddings, Column B.

7. NZBC CONCLUSION

For the purposes of compliance with the relevant building code documents, the following performance is considered applicable to the tested samples as described in Section 1.

Graphex Substrate with Lumbersider and X200.

Parameter	Criteria	Result	Performance
Peak Heat Release rate (kW/m ²)	≤100 kW/m ²	76.4	Pass
Total Heat Release (MJ/m ²)	≤ 25 MJ/m ²	14.2	Pass

XTherm Gold Substrate with Lumbersider and X200.

Parameter	Criteria	Result	Performance
Peak Heat Release rate (kW/m ²)	≤100 kW/m ²	52.2	Pass
Total Heat Release (MJ/m ²)	≤ 25 MJ/m ²	16.6	Pass

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FH14268-02-1-C1 NZBC CLASSIFICATION



This is to certify that the specimen described below was tested by BRANZ in accordance with ISO 5660-1:2002

Test Sponsor

Rockcote Resene Limited
T/A Resene Construction Systems
5 Venture Place, Middleton,
Christchurch, 8024
New Zealand

Date of tests

12 and 17 November 2021, and 22 March 2022

Reference BRANZ Test Report

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Test specimens as described by the client

Graphex Substrate and XTherm Gold Substrate with Resene Lumbersider or Resene X200 painted finish. The nominally 50 mm thick panel systems are comprised of a foam substrate (Graphex Substrate: polystyrene, Xtherm Gold Substrate: polyisocyanurate) with multi-layered render finish consisting of mineral base coat, mineral texture, Resene Limelock, and Resene Lumbersider or X200 painted finish.

Product ID	Specimen ID	Mean values			Colour
		Mass (g)	Thickness (mm)	Apparent Density (kg/m ³)	
Graphex with Lumbersider	FH14268-3-50-1	123.3	40.0*	308	White
Graphex with X200	FH14268-4-50-1/2/3	82.6	39.9*	207	Cream
Xtherm Gold PIR with Lumbersider	FH14268-7-50-1	113.6	40.4*	281	White
Xtherm Gold PIR with X200	FH14268-8-50-1/2/3	113.2	40.0*	283	Cream

* Specimen thickness reduced prior to test

Classification in accordance with the New Zealand Building Code

Calculations were carried out according to NZBC Acceptable Solutions C/AS1 Appendix C7.1. The performance for the samples as described above is given in the table below.

Building Document	Code	Parameter	Criteria	Performance
NZBC Acceptable Solution C/AS1		Peak Heat Release rate (kW/m ²)	≤100 kW/m ²	Pass
		Total Heat Release (MJ/m ²)	≤ 25 MJ/m ²	Pass

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Regulatory authorities are advised to examine test reports before approving any product.



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