

Cone Calorimeter Tests for REPLAS at 25kW/m² in accordance with AS3837:1998

Fire Testing Report

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Report Number: EP18106

Quote Number: FE2887

Date: 20 February 2018

Version: Revision B

Client: REPLAS

Commercial-in-confidence

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Test Report Details

Document: Fire Testing Report

Test Standard: AS3837:1998




Client: REPLAS

Quote Number: FE2887

Test Report Status and Revision History

VERSION	STATUS	DATE	DISTRIBUTION	COMMENT	FORMAT
Revision A	Draft for internal review	29 May 2017	CSIRO	CSIRO	Word
Revision B	Final for issue	20 February 2018	CSIRO	CSIRO	Pdf

Test Report Authorisation

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20 February 2018	20 February 2018	20 February 2018

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Contents

1	Summary	4
2	Test Details.....	4
	2.1 Sample Identification	4
	2.2 Sponsor	4
	2.3 Manufacturer	4
	2.4 Job Number	4
	2.5 Nomenclature	4
	2.6 Test Date & Operator.....	4
	2.7 Description of Sample.....	5
3	Method.....	5
	3.1 Conditioning of Specimens	5
	3.2 Test Method.....	5
	3.3 Departure from Standard	6
	3.4 Duration of Test	6
4	Results and Observations.....	6
	4.1 Observations	6
	4.2 Results of Tests	8
	4.3 HRRPUA Graphs	9
	4.4 Specimen Photos	10
5	References.....	10

Tables

Table 1 Material Description	5
Table 2 Test Observations	6
Table 3 Results of test	8

Figures

Figure 1 HRRPUA for FE2887-1 “Product 1 – with fire retardants” at 25 kW/m ²	9
Figure 2 HRRPUA for FE2887-1 “Product 2 – without fire retardants” at 25 kW/m ²	9
Figure 3 FE2887-1 – “Product 1 – with fire retardants”	10
Figure 4 FE2887-2 – “Product 2 – without fire retardants”	10

1 Summary

CSIRO has been engaged by REPLAS to conduct cone calorimeter tests in accordance with AS3837^[1] on two products as provided in Table 1. The materials were tested at a heat flux of 25 kW/m².

Sponsored Investigation Report Number: EP18106

Title of Report: Cone Calorimeter Tests for REPLAS in Accordance With AS3837:1998.

CSIRO was not responsible for sampling of test specimens. All test specimens were sampled and supplied by REPLAS.

The results of these fire tests may be used to directly assess fire hazard, but it should be recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions.

The results reported herein shall not be used to derive a Group Number in accordance with the NCC without undertaking validation of the performance that is predicted.

2 Test Details

2.1 Sample Identification

See Table 1.

2.2 Sponsor

REPLAS
27 Titan Drive,
Carrum Downs, VIC

2.3 Manufacturer

Repeat Plastics Australia

2.4 Job Number

FE2887

2.5 Nomenclature

HRR	Heat Release Rate (kW)
HRRPUA	Heat release rate per unit area (kW/m ²)
EHC	Effective heat of combustion (MJ/kg)
SEA	Specific extinction area, for smoke (m ² /kg)

2.6 Test Date & Operator

All the tests were conducted on 18th December 2017 by Joe Abraham of CSIRO.

2.7 Description of Sample

The material description provided in the table below was provided by UGL/ suppliers.

Table 1 Material Description

CSIRO specimen ID	Heat flux (kW/m ²)	Description	Colour	Thickness (mm)
FE2887-1	25	Product Name: Product 1 Description: Recycled plastic. Smooth Surface with fire retardants embedded within. Plastic type and fire retardant details not disclosed Manufacturer: Repeat Plastics Pty Ltd Manufacturer's address: 27 Titan Drive, Carrum Downs Specific Gravity: 1.3 Adhesive: Absent	Grey	20
FE2887-2	25	Product Name: Product 1 Description: Recycled plastic Rough Surface without fire retardants embedded within. Plastic type details not disclosed Manufacturer: Repeat Plastics Pty Ltd Manufacturer's address: 27 Titan Drive, Carrum Downs Specific Gravity: 0.8 Adhesive: Absent	Grey	20

3 Method

3.1 Conditioning of Specimens

The specimens were conditioned to constant mass at a temperature of $23 \pm 2^\circ\text{C}$ and a relative humidity of $50 \pm 10\%$ prior to testing.

3.2 Test Method

Tests were performed in accordance with AS3837:1998 Method of test for heat and smoke release rates for materials and products using an oxygen consumption calorimeter with changes specified by the client. All test specimens were exposed in the horizontal orientation with the standard pilot operating.

Nominally 100 x 100-mm specimens were tested as supplied. All specimens were tested with the use of an edge frame. The edge frame reduces the test surface area to 0.0088-m² and this is the area used in calculations.

For the test, specimens were wrapped in aluminium foil so that the four edges and the bottom of the specimen were covered. The foil formed a shallow tray that retained any molten material during testing.

Three specimens of the same material were tested at an irradiance levels given in Table 1. The products tested were homogenous. The heat release rate will vary depending on how the materials char, crack and expose the materials behind it.

The nominal exhaust system flow rate for all tests was 0.024-m³/s.

3.3 Departure from Standard

In performing heat release rate calibration to determine the calibration constant, C , an alternative procedure was employed as specified in Clause 10.2.4 of ISO 5660-1:2002(E)^[2] by burning a measured quantity of absolute methanol.

The cone calorimeter used a fan speed controller to maintain the nominal exhaust system flow rate throughout all tests at 0.024-m³/s. The standard only requires that the exhaust system flow rate be manually set to 0.024-m³/s at ambient temperature conditions prior to each test. This results in slight fluctuations in flow rate during tests with high HRRPUA due to reduction in air density with increase in air temperature.

Carbon monoxide and carbon dioxide exhaust gas concentrations were not measured. This is stated in the standard to be an optional additional measurement.

The test method for AS/NZS 3837 requires six samples to be tested if the 180 s mean heat release rate readings for three samples differ more than 10% from the arithmetic mean. Three replicates for each material were tested irrespective of their variation from 180s mean heat release rate.

3.4 Duration of Test

The test is terminated when any one of the following is applicable:

1. 2 minutes have passed after all flaming from the specimen ceased; and
2. the average mass loss over a 1 minute period has dropped below 150-g/m²;
3. 60 minutes have elapsed; or
4. The specimen fails to ignite after a 10 minute exposure.

4 Results and Observations

4.1 Observations

The table below summarises the test observations noted for each material.

Table 2 Test Observations

CSIRO specimen ID	Material	Heat flux (kW/m ²)	Observation
FE2887-1	Product 1	25	Volatiles were released from the specimens 90 seconds after the exposure to the tests. The front face of the specimens ignited after 180 seconds of the test. The specimens intumesced 1-3mm above the edge frame during the test. It was deemed that a retaining grid is not required to be used. The specimens were completely burnt through its thickness. The test was terminated when average mass loss over a 1 minute period has dropped below 150-g/m ² .
FE2887-2	Product 2	25	Volatiles were released from the specimens 30 seconds after the exposure to the tests. The front face of the specimens ignited after 60 seconds of the test. The specimens intumesced 1-3mm above the edge frame during the test. It was deemed that a retaining grid is not required to be used. The specimens were completely burnt through its thickness. The test was terminated when average mass loss over a 1 minute period has dropped below 150-g/m ² .

4.2 Results of Tests

The results of tests as specified in the Standard are summarised in Table 3. All the tests were carried out on the 18th December 2017.

Table 3 Results of test

Test No.	Date	Specimen	Material	Specimen			Heat Flux (kW/m ²)	Calibration Factor	Time to Ignition (s)	Flame out (s)	End of Test (s)	Mass Loss (kg/m ²)	Final Mass (g)	Average Mass Loss Rate (g/m ² s)	Total Heat Released (MJ/m ²)	Peak Heat Release Rate (kW/m ²)	Time of Peak HRR (s)	Average HRR over 60s (kW/m ²)	Average HRR over 180s (kW/m ²)	Average HRR over 300s (kW/m ²)	Average EHC (MJ/kg)	Average SEA (m ² /kg)
				Thickness (mm)	Mass (g)	Area (m ²)																
FE2887 - 2	18-Dec-17	FE2887-2C25	Repeat Plastics - Product 2 (without fire retardants)	20	172.2	0.0088	25	0.04186	65	N/A	2320	11.1	74.2	5	484.1	326.7	250	197.1	280.5	295	43.5	396
FE2887 - 2	18-Dec-17	FE2887-2B25	Repeat Plastics - Product 2 (without fire retardants)	20	168.1	0.0088	25	0.04186	63	N/A	2040	11.2	69.4	5.7	446.2	342.9	150	223.2	297.9	302.3	39.9	353.9
FE2887 - 2	18-Dec-17	FE2887-2A25	Repeat Plastics - Product 2 (without fire retardants)	20	167	0.0088	25	0.04186	54	N/A	2745	13.6	47.7	5.1	527.1	355.5	230	100	255.2	291.6	38.9	329.6
Mean					169.10				60.67		2368.33	11.97	63.77	5.27	485.80	341.70	210.00	173.43	277.87	296.30	40.77	359.83
SD					2.74				5.86		354.98	1.42	14.12	0.38	40.48	14.44	52.92	64.92	21.47	5.47	2.42	33.60
FE2887 - 1	18-Dec-17	FE2887-1C25	Repeat Plastics - Product 1 (with fire retardants)	20	267.7	0.0088	25	0.04186	183	N/A	340	0.5	263.2	3.2	14.3	113.2	230	90.3	93	81.6	28.9	177
FE2887 - 1	18-Dec-17	FE2887-1B25	Repeat Plastics - Product 1 (with fire retardants)	20	270.7	0.0088	25	0.04186	188	N/A	330	0.4	267.5	3.1	13.8	118.8	245	95.7	98	86.2	39.2	264.8
FE2887 - 1	18-Dec-17	FE2887-1A25	Repeat Plastics - Product 1 (with fire retardants)	20	253	0.0088	25	0.04186	208	N/A	315	0.3	250.3	3.1	9.6	109.7	260	90.8	91	80.5	33.8	219.6
Mean				20.00	263.80				193.00		328.33	0.40	260.33	3.13	12.57	113.90	245.00	92.27	94.00	82.77	33.97	220.47
SD				0.00	9.47				13.23		12.58	0.10	8.95	0.06	2.58	4.59	15.00	2.98	3.61	3.02	5.15	43.91

4.3 HRRPUA Graphs

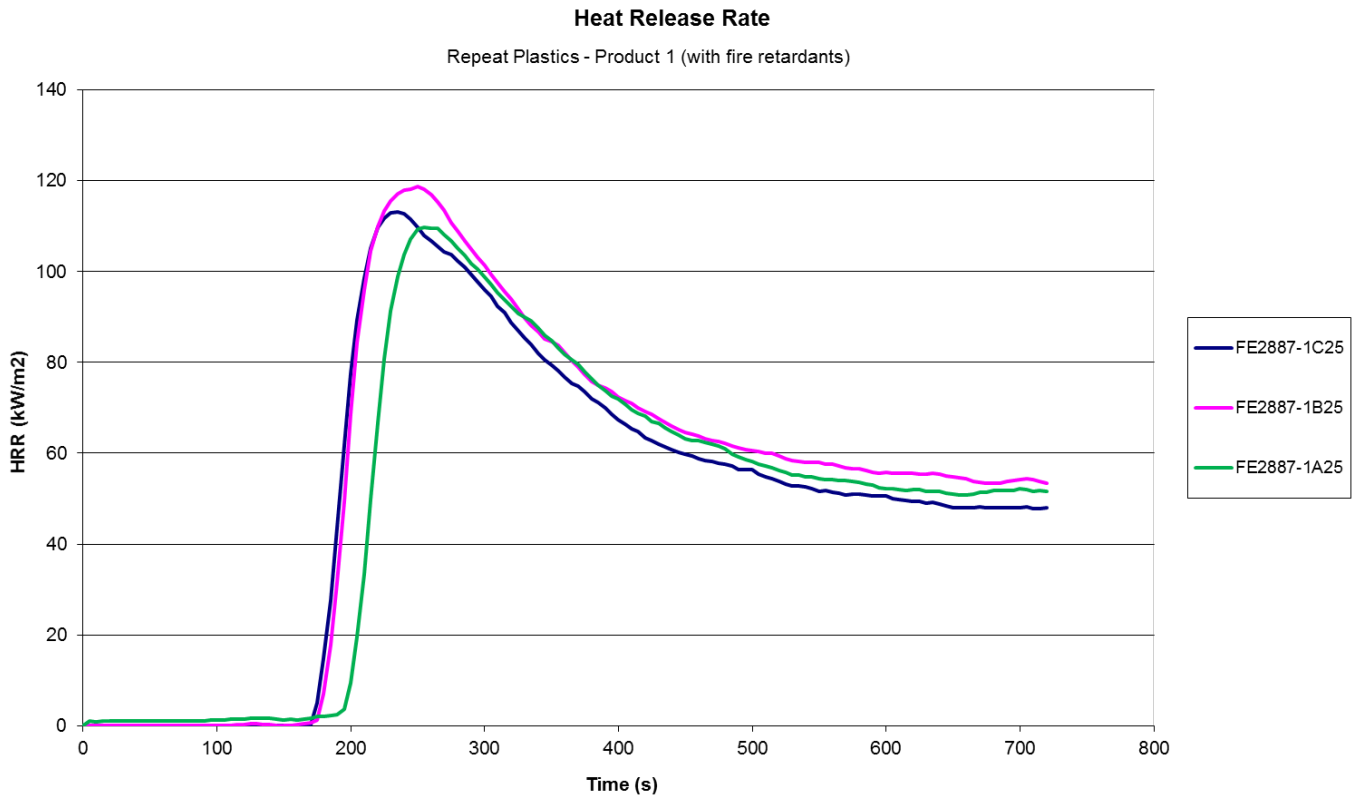


Figure 1 HRRPUA for FE2887-1 “Product 1 – with fire retardants” at 25 kW/m²

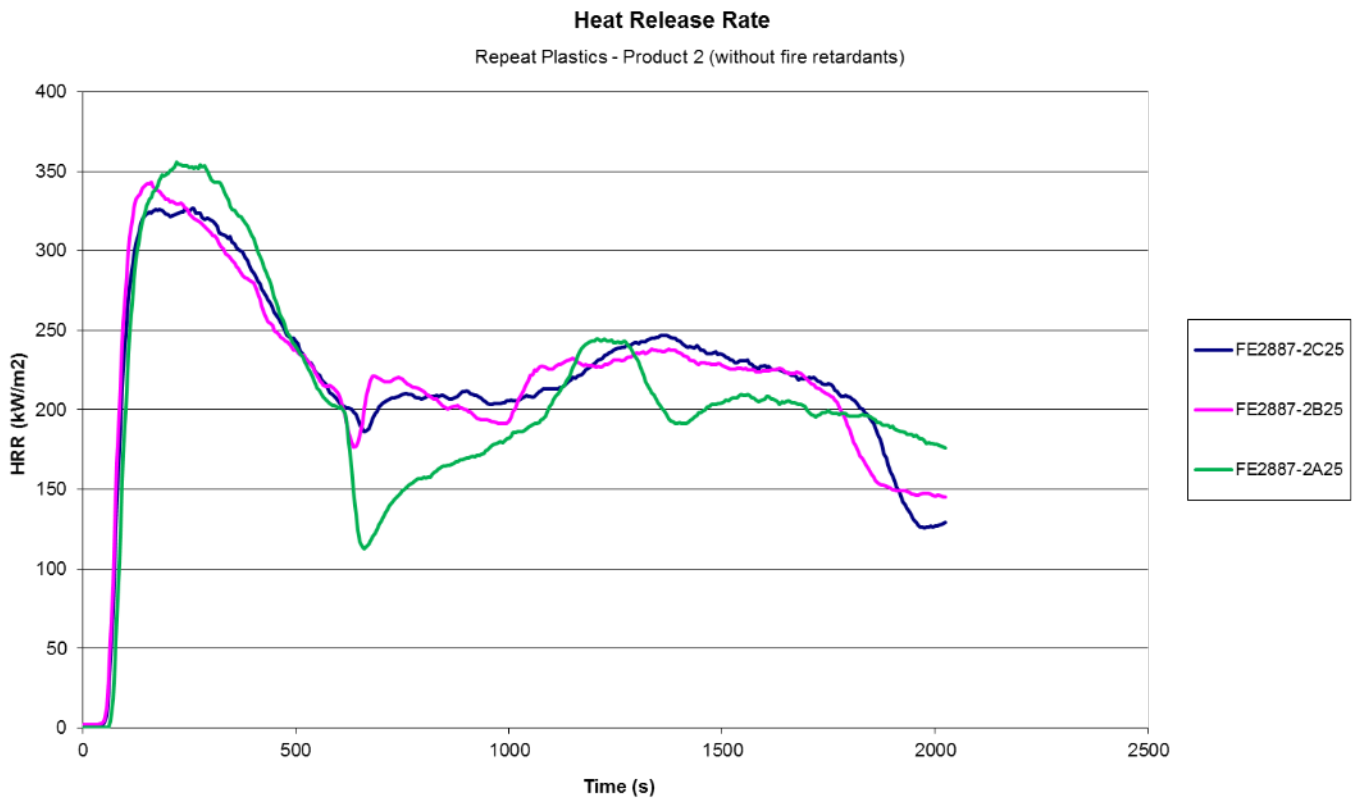


Figure 2 HRRPUA for FE2887-1 “Product 2 – without fire retardants” at 25 kW/m²

4.4 Specimen Photos

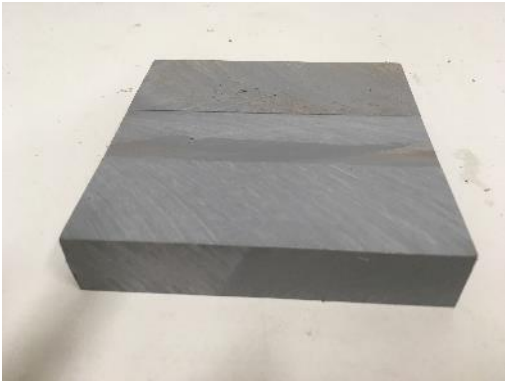


Figure 3 FE2887-1 – “Product 1 – with fire retardants”

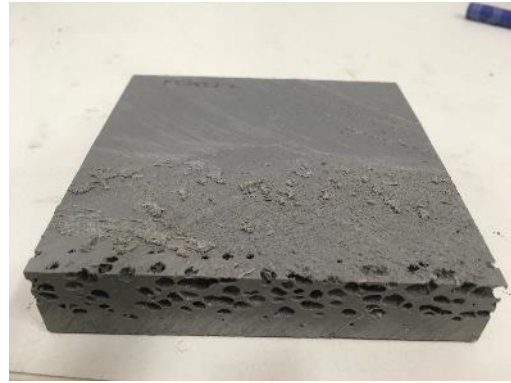


Figure 4 FE2887-2 – “Product 2 – without fire retardants”

5 References

1. Australia S. (1998) AS/NZS 3837 Method of test for smoke and heat release rates for materials and products using an oxygen consumption calorimeter. Sydney, Australia: 1998.
2. ISO. (2002) ISO 5660-1: Reaction-to-fire tests - Heat release, smoke production and mass loss rate - Part 1: Heat release rate (cone calorimeter method). Geneva, Switzerland: International Organization for Standardization, 2002.

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