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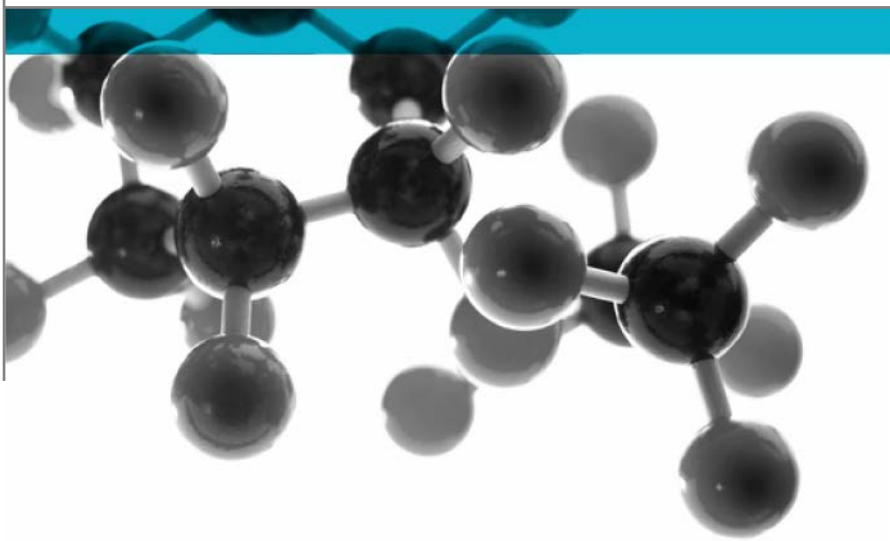
BS EN ISO 1716:2018



Determination Of The Heat Of Combustion For Building Products

A Report To: Aldom Aluminyum San. Tic. A.S.

Document Reference: 432779

Date: 29th October 2020

Issue No.: 1

0249

Executive Summary

Objective To determine the performance of the following composite when tested in accordance with BS EN ISO 1716: 2018.

Generic Description	Product reference	Thickness	Weight per unit area or application rate
A composite panel incorporating a layer of mineral filled / flame retardant inorganic A2 grade core bonded & backed with coated, chromium treated aluminium sheet	"ARESBOND U.S.A FR-A2"	4mm	8kg/m²
Individual components used to manufacture composite:			
Coating	"Polyvinylidene Fluoride (PVDF) Coating"	First coat - 0.02mm Second coat - 0.01mm	0.07kg/m²
Primer	"Polyester (PE) Coating"	0.007mm	0.02kg/m²
Aluminium	"Aluminium Coil"	0.5mm	1.35kg/m²
Adhesive	"Bonding Film"	Unwilling to provide	32.5g/m²
Core	"FR Core A2 Level"	3mm	5.4kg/m²
Adhesive	"Bonding Film"	Unwilling to provide	32.5g/m²
Aluminium	"Aluminium Coil"	0.5mm	1.35kg/m²
Coating	"Polyester (PE) Coating"	0.007mm	0.02kg/m²
Please see page 5, 6 & 7 of this test report for the full description of the product tested			

Test Sponsor Aldom Aluminyum San. Tic. A. S, Velikoy Sanayi Bolgesi Cerkezkoy, Tekirdag, Turkey

Test Results:

Component part	PCS per mass (MJ/kg)	PCS per area (MJ/m²)
Coating	**14.7918**	**1.0354**
Primer	**19.3586**	**0.3872**
Aluminium	**0.0000**	**0.0000**
Adhesive	**43.6718**	**1.4193**
Core	**1.5880**	**8.5752**
Adhesive	**43.6718**	**1.4193**
Aluminium	**0.0000**	**0.0000**
Coating	**19.3586**	**0.3872**
Total product:	**1.5980**	**13.2236**

Date of Test 13th & 16th September 2019 & 3rd March 2020 & 28th August 2020

Signatories

	
Responsible Officer H. Harper* Testing Officer	Authorised C Jacques * Senior Technical Officer

* For and on behalf of Warringtonfire.

Report Issued: 29th October 2020

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Test Details

Purpose of test

To determine the calorific potential of a building material during combustion when it is tested in accordance with the test specified in BS EN ISO 1716:2018 "Reaction To Fire Tests For Building Products – Determination Of The Heat Of Combustion".

The test was performed in accordance with the procedure specified in BS EN ISO 1716:2018 and this test report should be read in conjunction with that European Standard.

Scope of test

BS EN ISO 1716 specifies a method of test for determining the heat of combustion of building materials at constant volume in a bomb calorimeter. Results are reported as individual values which may be interpreted by reference to other documents; e.g. EN 13501-1:2018 "Fire Classification of Construction Products and Building Elements Part 1 Classification using Test Data from Reaction to Fire Tests.

The test is intended for materials or products whether composite products or coated products.

Fire test study group/EGOLF

Certain aspects of some fire test specifications are open to different interpretations. The Fire Test Study Group and EGOLF have identified a number of such areas and has agreed Resolutions which define common agreement of interpretations between fire test laboratories which are members of the Groups. Where such Resolutions are applicable to this test they have been followed.

Instruction to test

The test was conducted on the 13th & 16th September 2019 & 3rd March 2020 & 28th August 2020 at the request of Aldom Aluminyum San. Tic. A.S., the sponsor of the test.

Provision of test specimens

The specimens were supplied by the sponsor of the test. Warringtonfire was not involved in any selection or sampling procedure. The results stated in this report apply to the samples as received.

Conditioning of specimens

The specimens were received on the 12th August 2019 & 6th September 2019 & 8th April 2020. Prior to test the prepared specimens were conditioned for at least 48 hours at a temperature of 23 ± 2°C and a relative humidity of 50 ± 5%, in accordance with BS EN 13238:2010.

Test procedure

The specimens were tested using an additional combustible substance of known and high calorific value which for this test was paraffin oil. The specimens were tested using the crucible/cigarette method in an isoperibol bomb calorimeter.

The water equivalent (E) of the bomb calorimeter was 0.01009 & 0.01010 & 0.01012MJ/K.

Description of Test Specimens

The description of the system given below has been prepared from information provided by the sponsor of the test. This information has not been independently verified by Warringtonfire**.** All values quoted are nominal, unless tolerances are given.

General description		A composite panel incorporating a layer of mineral filled / flame retardant inorganic A2 grade core bonded& backed with a coated, chromium treated aluminium sheet.
Product reference of overall composite		"ARESBOND U.S.A FR-A2"
Name of manufacturer of overall composite		Aldom Alüminyum San. Tic. A.S.
Overall thickness		4mm (stated by sponsor) 4.43mm (determined by Warringtonfire)
Overall weight per unit area		8kg/m^2 (stated by sponsor) 8.71kg/m² (determined by Warringtonfire)
Coating (test face)	Generic type	Polyvinylidene fluoride (PVDF)
	Product reference	"Polyvinylidene fluoride (PVDF) Coating"
	Name of manufacturer	**See Note 1 below**
	Colour reference	"ARW 3808 DARK TEAK"
	Number of coats	2
	Application thickness	First coat – 0.02mm Second coat – 0.01mm
	Application rate per coat	0.07kg/m^2
	Specific gravity	1.6-1.8 (dry)
	Application method	Coil coating
	Curing process per coat	30 seconds at 250^{0}C
	Flame retardant details	**See Note 2 below**
Primer	Generic type	Solvent based paint
	Product reference	"Polyester (PE) Coating"
	Name of manufacturer	**See Note 1 below**
	Colour reference	**See Note 1 below**
	Number of coats	1
	Application thickness	0.007mm
	Application rate	0.02kg/m^2
	Specific gravity	1.42 (dry)
	Application method	Coil coating
	Curing process	30 seconds at 240^{0}C
	Flame retardant details	**See Note 2 below**

Continued on next page

Aluminium	Generic type	Aluminium
	Product reference	“Aluminium Coil”
	Detailed description / composition details	Each face of the aluminium was coated with chromic acid to a thickness of 0.008mm before being cured at a temperature of between 120 and 150^{0}C
	Name of manufacturer	**See Note 1 below**
	Thickness	0.5mm
	Weight per unit area	1.35kg/m^2
	Flame retardant details	The component is inherently flame retardant
Adhesive	Generic type	Adhesive film
	Product reference	“Bonding Film”
	Name of manufacturer	**See Note 1 below**
	Colour reference	“White”
	Application rate / thickness	32.5g/m²
	Application method	Heat lamination
	Flame retardant details	**See Note 2 below**
	Curing process	**See Note 1 below**
Core	Generic type	Fire retardant non-combustible, inorganic mineral core
	Product reference	“FR Core A2 level”
	Detailed description / composition details	**See Note 1 below**
	Name of manufacturer	**See Note 1 below**
	Thickness	3mm
	Weight per unit area	5.4kg/m^2
	Colour reference	“Green / White”
	Flame retardant details	**See Note 1 below**
Adhesive	Generic type	Adhesive film
	Product reference	“Bonding Film”
	Name of manufacturer	**See Note 1 below**
	Colour reference	“White”
	Application rate / thickness	32.5g/m²
	Application method	Heat lamination
	Flame retardant details	**See Note 2 below**
	Curing process	**See Note 1 below**
Aluminium	Generic type	Aluminium
	Product reference	“Aluminium Coil”
	Detailed description / composition details	Each face of the aluminium was coated with chromic acid to a thickness of 0.008mm before being cured at a temperature of between 120 and 150^{0}C
	Name of manufacturer	**See Note 1 below**
	Thickness	0.5mm
	Weight per unit area	1.35kg/m^2
	Flame retardant details	The component is inherently flame retardant

Continued on next page

Primer	Generic type	Solvent based paint
	Product reference	"Polyester (PE) Coating"
	Name of manufacturer	**See Note 1 below**
	Colour reference	**See Note 1 below**
	Number of coats	1
	Application thickness	0.007mm
	Application rate	0.02kg/m^2
	Specific gravity	1.42 (dry)
	Application method	Coil coating
	Curing process	30 seconds at 240^{0}C
	Flame retardant details	**See Note 2 below**
Brief description of manufacturing process		**See Note 1 below**

Note 1. The sponsor of the test was unwilling to provide this information.

Note 2. The sponsor of the test has confirmed that no flame retardant additives were utilised in the production of the component.

The specimen was heterogeneous in nature. The specimen comprised three substantial components, three external non substantial components and two internal non substantial components.

The table below gives the thickness and the weight per unit area values of the component parts of the specimen.

Component description	Location / type	Thickness (mm)	Weight / unit area (kg/m²)
PVDF Coating	External non substantial	0.030	0.070
PE Coating	External non substantial	0.007	0.020
Aluminium	Substantial	0.500	1.350
Adhesive	Internal non substantial	Unwilling to provide	0.0325
Core	Substantial	3.000	5.400
Adhesive	Internal non substantial	Unwilling to provide	0.0325
Aluminium	Substantial	0.500	1.350
PE coating	External non substantial	0.007	0.020

Specimen preparation

The sample was composed of a heterogenous material which was impossible to separate into its constituents. The specimens were therefore prepared from individual specimens of the individual constituent parts supplied by the manufacturer, who also provided evidence of the ratio of masses of components in the finished product together with their mass per unit area values. These were then ground and reduced to a fine powder and mixed thoroughly together prior to conditioning for test.

Test Results

Results of test

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product which is supplied or used is fully represented by the specimens which were tested.

The test results relate to the behaviour of the test specimen of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the material in use.

The test results are given in Table 1 of this report.

Results on component layers already tested

The table below details the results of previous analysis of calorific value for the component part/s being evaluated in this report:

These results are used in this report to provide total product evaluation.

Copies of all test reports are held on our confidential file at Warringtonfire.

Component part	Report No.	Average Calorific Value (MJ/kg)	Average Calorific Value (MJ/m^2)
PVDF Coating	418671	14.7918	1.0354
PE Coating	428246	19.3586	0.3872
Aluminium	Not applicable	0.0000	0.0000
Adhesive	417768	43.6718	1.4193
Core	417767	1.5880	8.5752
Adhesive	417768	43.6718	1.4193
Aluminium	Not applicable	0.0000	0.0000
PE coating	428246	19.3586	0.3872

Validity

The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over five years old should be considered by the user. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

Table 1

Table 1 - Bomb Calorimeter Calculations

Product / Layer Description

The product is heterogenous and fabricated as follows:

Component Part	Type	Description
1	External Non Substantial	PVDF Coating
2	External Non Substantial	PE Coating
3	Substantial	Aluminium
4	Internal Non Substantial	Adhesive
5	Substantial	Core
6	Internal Non Substantial	Adhesive
7	Substantial	Aluminium
8	External Non Substantial	PE Coating

Component Part 1 **Coating (External Non Substantial)**

Mass of sample:- **0.0700** **kg/m²**

Results obtained:-

Test 1:-	sample weight =	0.7114	g			
	calorific value =	14.8443	MJ/kg	=	**14844.3**	**kJ/kg**
	temperature rise =	2.4421	°C			
Test 2:-	sample weight =	0.7138	g			
	calorific value =	14.7310	MJ/kg	=	**14731.0**	**kJ/kg**
	temperature rise =	2.5090	°C			
Test 3:-	sample weight =	0.7288	g			
	calorific value =	14.8001	MJ/kg	=	**14800.1**	**kJ/kg**
	temperature rise =	2.5144	°C			
				Average =	**14791.8**	**kJ/kg**
					14.7918	**MJ/kg**

Gross Calorific Potential Per Unit Area
(Calorific value x mass per unit area)

Test 1:- **1039.1010 kJ/m²**
Test 2:- **1031.1700 kJ/m²**
Test 3:- **1036.0070 kJ/m²**

Average gross calorific potential = **1035.4 kJ/m²**
1.0354 MJ/m²

Component Part 2 **PE Coating (External Non Substantial)**

Mass of sample:- **0.02000 kg/m²**

Results obtained:-

Test 1:-	sample weight =	0.7221	g			
	calorific value =	19.4410	MJ/kg	=	**19441.0**	**kJ/kg**
	temperature rise =	2.7825	°C			
Test 2:-	sample weight =	0.7239	g			
	calorific value =	19.2857	MJ/kg	=	**19285.7**	**kJ/kg**
	temperature rise =	2.7780	°C			
Test 3:-	sample weight =	0.7184	g			
	calorific value =	19.3490	MJ/kg	=	**19349.0**	**kJ/kg**
	temperature rise =	2.8181	°C			
				Average =	**19358.6**	**kJ/kg**
					19.3586	**MJ/kg**

Gross Calorific Potential Per Unit Area
(Calorific value x mass per unit area)

Test 1:- **388.8200 kJ/m²**
Test 2:- **385.7140 kJ/m²**
Test 3:- **386.9800 kJ/m²**

Average gross calorific potential = **387.2 kJ/m²**
0.3872 MJ/m²

Component Part 3 **Aluminium (Substantial)**

Mass of sample:- **1.3500** **kg/m²**

Results obtained:-

Test 1:-	sample weight =	0.0000	g			
	calorific value =	0.0000	MJ/kg	=	**0.0000**	**kJ/kg**
	temperature rise =	0.0000	°C			
Test 2:-	sample weight =	0.0000	g			
	calorific value =	0.0000	MJ/kg	=	**0.0000**	**kJ/kg**
	temperature rise =	0.0000	°C			
Test 3:-	sample weight =	0.0000	g			
	calorific value =	0.0000	MJ/kg	=	**0.0000**	**kJ/kg**
	temperature rise =	0.0000	°C			
				Average =	**0.0000**	**kJ/kg**
					0.0000	**MJ/kg**

Gross Calorific Potential Per Unit Area
(Calorific value x mass per unit area)

Test 1:-	**0.0000**	**kJ/m²**
Test 2:-	**0.0000**	**kJ/m²**
Test 3:-	**0.0000**	**kJ/m²**

Average gross calorific potential = **0.0000** **kJ/m²**
0.0000 **MJ/m²**

Component Part 4 **Adhesive (Internal Non substantial)**

Mass of sample:- **0.0325** **kg/m²**

Results obtained:-

Test 1:-	sample weight =	0.7184	g			
	calorific value =	43.6838	MJ/kg	=	**43683.8**	**kJ/kg**
	temperature rise =	4.6633	°C			
Test 2:-	sample weight =	0.7132	g			
	calorific value =	43.5754	MJ/kg	=	**43575.4**	**kJ/kg**
	temperature rise =	4.4831	°C			
Test 3:-	sample weight =	0.7108	g			
	calorific value =	43.7562	MJ/kg	=	**43756.2**	**kJ/kg**
	temperature rise =	3.0850	°C			
				Average =	**43671.8**	**kJ/kg**
					43.6718	**MJ/kg**

Gross Calorific Potential Per Unit Area
(Calorific value x mass per unit area)

Test 1:-	**1419.7235**	**kJ/m²**
Test 2:-	**1416.2005**	**kJ/m²**
Test 3:-	**1422.0765**	**kJ/m²**

Average gross calorific potential = **1419.3** **kJ/m²**
1.4193 **MJ/m²**

Component Part 5 **Core (Substantial)**

Mass of sample:- **5.4000** **kg/m²**

Results obtained:-

Test 1:-	sample weight =	0.7090	g			
	calorific value =	1.5498	MJ/kg	=	**1549.8**	**kJ/kg**
	temperature rise =	1.5730	°C			
Test 2:-	sample weight =	0.7388	g			
	calorific value =	1.6497	MJ/kg	=	**1649.7**	**kJ/kg**
	temperature rise =	1.6027	°C			
Test 3:-	sample weight =	0.7199	g			
	calorific value =	1.5645	MJ/kg	=	**1564.5**	**kJ/kg**
	temperature rise =	1.4672	°C			
				Average =	**1588.0**	**kJ/kg**
					1.5880	**MJ/kg**

Gross Calorific Potential Per Unit Area
(Calorific value x mass per unit area)

Test 1:-	**8368.9200**	**kJ/m²**
Test 2:-	**8908.3800**	**kJ/m²**
Test 3:-	**8448.3000**	**kJ/m²**

Average gross calorific potential = **8575.2** **kJ/m²**
8.5752 **MJ/m²**

Component Part 6 **Adhesive (Internal Non Substantial)**

Mass of sample:- **0.0325** **kg/m²**

Test 1:-	sample weight =	0.7184	g			
	calorific value =	43.6838	MJ/kg	=	**43683.8**	**kJ/kg**
	temperature rise =	4.6633	°C			
Test 2:-	sample weight =	0.7132	g			
	calorific value =	43.5754	MJ/kg	=	**43575.4**	**kJ/kg**
	temperature rise =	4.4831	°C			
Test 3:-	sample weight =	0.7108	g			
	calorific value =	43.7562	MJ/kg	=	**43756.2**	**kJ/kg**
	temperature rise =	3.0850	°C			
				Average =	**43671.8**	**kJ/kg**
					43.6718	**MJ/kg**

Gross Calorific Potential Per Unit Area

(Calorific value x mass per unit area)

Test 1:-	**1419.7235**	**kJ/m²**
Test 2:-	**1416.2005**	**kJ/m²**
Test 3:-	**1422.0765**	**kJ/m²**

Average gross calorific potential = **1419.3** **kJ/m²**

1.4193 **MJ/m²**

Component Part 7 **Aluminium (Substantial)**

Mass of sample:-		**1.3500**	**kg/m²**			
Test 1:-	sample weight =	0.0000	g			
	calorific value =	0.0000	MJ/kg	=	**0.0000**	**kJ/kg**
	temperature rise =	0.0000	°C			
Test 2:-	sample weight =	0.0000	g			
	calorific value =	0.0000	MJ/kg	=	**0.0000**	**kJ/kg**
	temperature rise =	0.0000	°C			
Test 3:-	sample weight =	0.0000	g			
	calorific value =	0.0000	MJ/kg	=	**0.0000**	**kJ/kg**
	temperature rise =	0.0000	°C			
				Average =	**0.0000**	**kJ/kg**
					0.0000	**MJ/kg**

Gross Calorific Potential Per Unit Area
(Calorific value x mass per unit area)

Test 1:-	**0.0000**	**kJ/m²**
Test 2:-	**0.0000**	**kJ/m²**
Test 3:-	**0.0000**	**kJ/m²**

Average gross calorific potential =	**0.0000**	**kJ/m²**
	0.0000	**MJ/m²**

Component Part 8 **PE Coating (External Non Substantial)**

Mass of sample:-		**0.0200**	**kg/m²**			
Test 1:-	sample weight =	0.7221	g			
	calorific value =	19.4410	MJ/kg	=	**19441.0**	**kJ/kg**
	temperature rise =	2.7825	°C			
Test 2:-	sample weight =	0.7239	g			
	calorific value =	19.2857	MJ/kg	=	**19285.7**	**kJ/kg**
	temperature rise =	2.7780	°C			
Test 3:-	sample weight =	0.7184	g			
	calorific value =	19.3490	MJ/kg	=	**19349.0**	**kJ/kg**
	temperature rise =	2.8181	°C			
				Average =	**19358.6**	**kJ/kg**
					19.3586	**MJ/kg**

Gross Calorific Potential Per Unit Area
(Calorific value x mass per unit area)

Test 1:-	**388.8200**	**kJ/m²**
Test 2:-	**385.7140**	**kJ/m²**
Test 3:-	**386.9800**	**kJ/m²**

Average gross calorific potential =	**387.2**	**kJ/m²**
	0.3872	**MJ/m²**

Calculation of Total Calorific Potential (MJ/kg) for the Product

Mass per 1m² of Component 1	0.0700	kg
Mass per 1m² of Component 2	0.0200	kg
Mass per 1m² of Component 3	1.3500	kg
Mass per 1m² of Component 4	0.0325	kg
Mass per 1m² of Component 5	5.4000	kg
Mass per 1m² of Component 6	0.0325	kg
Mass per 1m² of Component 7	1.3500	kg
Mass per 1m² of Component 8	0.0200	kg
Total Mass per 1m² of Product	**8.2750**	**kg**

Percentage Mass of Constituent Parts

% Component 1	0.8459	%
% Component 2	0.2417	%
% Component 3	16.3142	%
% Component 4	0.3927	%
% Component 5	65.2568	%
% Component 6	0.3927	%
% Component 7	16.3142	%
% Component 8	0.2417	%

Average Calorific Potential Component 1	14.7918	MJ/kg
Average Calorific Potential Component 2	19.3586	MJ/kg
Average Calorific Potential Component 3	0.0000	MJ/kg
Average Calorific Potential Component 4	43.6718	MJ/kg
Average Calorific Potential Component 5	1.5880	MJ/kg
Average Calorific Potential Component 6	43.6718	MJ/kg
Average Calorific Potential Component 7	0.0000	MJ/kg
Average Calorific Potential Component 8	19.3586	MJ/kg

Contribution of Each Component to Total Calorific Potential

Component 1	0.1251	MJ/kg
Component 2	0.0468	MJ/kg
Component 3	0.0000	MJ/kg
Component 4	0.1715	MJ/kg
Component 5	1.0363	MJ/kg
Component 6	0.1715	MJ/kg
Component 7	0.0000	MJ/kg
Component 8	0.0468	MJ/kg

Total Calorific Potential for the Total Product	**1.5980**	**MJ/kg**

Summary of Results

Component Part	PCS per Mass (MJ/kg)	PCS per Area (MJ/m²)
1 PVDF Coating	14.7918	1.0354
2 PE Coating	19.3586	0.3872
3 Aluminium	0.0000	0.0000
4 Adhesive	43.6718	1.4193
5 Core	1.5880	8.5752
6 Adhesive	43.6718	1.4193
7 Aluminium	0.0000	0.0000
8 PE Coating	19.3586	0.3872
Total Product	1.5980	13.2236

Revision History

Issue No :	Re-issue Date:
Revised By:	Approved By:
Reason for Revision:	

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