LGAI

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Bellaterra:

20th December, 2018

File:

18/18448-2270 Part 1

Petitioner's reference:

ence: Novelis Deutschland GmbH Hannoversche Straβe 1 D-37075 Göttingen

TEST REPORT

Date at which the sample was received: 2018/12/12

1. - OBJECT OF THE TESTS

Fire tests of buildings products in compliance with the following standards:

- UNE EN ISO 1716:2011: "Reaction to fire tests for products Determination of the gross heat of combustion (calorific value) (ISO 1716:2010)".
- UNE-EN 13823:2012+A1:2016: "Reaction to fire tests for building products Building products excluding floorings exposed to the thermal attack by a single burning item".

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2. - PRODUCT CHARACTERISTICS

There were received some lacquered aluminium sheets with the following indications according to technical specifications provided by the petitioner:

Commercial reference of the product: FF2

Aluminium sheet 2mm thick, density 2700 kg/m³, one face coated with polyester primer and fluorpolymer, and reverse side with protective coat epoxy.

Composition

1 st layer primer	19N1-80	PP-29	4 µm	1.74 g/ml
2 nd layer top coat	19Z4-30	FP-1	20 µm	1.88 g/ml
Aluminium	-	-	2 mm	2700 kg/m ³
Protective coat reverse side	29K9-25	Epoxi	3 µm	1.38 g/ml

These constructive system components are installed with an air gap of approximately 20 mm.

Fixation system: The sample was fixed mechanically to the standard substrate (particleboard, not fire retardant treated according to UNE-EN 13238:2011) with screws.

Manufacturer: Novelis Deutschland GmbH. Address: Hannoversche Stra β e 1 – D-37075 Göttingen

3. - MAINTENANCE SPECIFICATION

Not applied.

4. - DESCRIPTION OF THE FINAL CONDITIONS FOR USE

Coating and facades.

5. – CONDITIONING

The product conditioning was conducted in compliance with Standard UNE-EN 13238:2011: "Fire Reaction Tests for construction materials. Conditioning procedures and general rules for the selection of substrates".

The samples were stored in a conditioning chamber at (23±2)°C, and at (50±5)% relative humidity, until a constant weight was reached.



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6.- <u>TESTS</u>

6.1.- Determination of the Combustion Heat – UNE-EN-ISO 1716:2011

Date at which test was performed:	Start:	2018-12-19
· · · · · · · · · · · · · · · · · · ·	End:	2018-12-20

During the tests, the environmental conditions of the laboratory were maintained at a temperature of $(23\pm5)^{\circ}$ C, and relative humidity of $(50\pm20)^{\circ}$ C.

6.1.1- Procedure for non-homogeneous products:

Substantial components

Aluminium sheet, identified as M₂

External non-substantial components

Polyester primer (PP-29)+ Fluorpolymer (FP-1), identified as M_1 Protective coat reverse side (Epoxi), identified as M_3

Polyester Primer (M₁) – (PP-29)

Sample preparation

A minimum mass of 50 gr. was obtained by applying the grating and sieving method. A sufficient amount of fine powder was obtained to carry out a minimum of three determinations.

The sample quantity used in each determination was 0.5 g of product.

Method

Determinations were performed according to the crucible method described in section 7.9 of the test standard.

Equivalent Energy Value (MJ/kg) = 2393.3590



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Samples	1	2	3	Average
Higher Heating Value (in MJ/kg)	16.28	16.37	16.36	16.34
Higher Heating Value (in MJ/m ²)	0.11	0.11	0.11	0.11

Criteria for acceptance or rejection (according to section 11 of the test standard): Max - Min of the 3 reproduced tests must be \leq **0.1 MJ/m²**.

Uncertainty associated to the measurement: \pm 0.15 MJ/kg

Fluorpolymer $(M_1) - (FP-1)$

Sample preparation

A minimum mass of 50 gr. was obtained by applying the grating and sieving method. A sufficient amount of fine powder was obtained to carry out a minimum of three determinations.

The sample quantity used in each determination was 0.5 g of product.

Method

Determinations were performed according to the crucible method described in section 7.9 of the test standard.

Equivalent Energy Value (MJ/kg) = 2393.3590

Samples	1	2	3	Average
Higher Heating Value (in MJ/kg)	12.45	11.98	12.44	12.29
Higher Heating Value (in MJ/m ²)	0.47	0.45	0.47	0.46

Criteria for acceptance or rejection (according to section 11 of the test standard): Max - Min of the 3 reproduced tests must be \leq **0.1 MJ/m²**.

Uncertainty associated to the measurement: \pm 0.15 MJ/kg



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Aluminium sheet (M₂)

The metallic components do not need to be tested, and their higher calorific potential used to calculate the total PCS will be 0 (point 9.4.1 of the Standard).

Protective coat reverse side (M₃) – (Epoxi)

Sample preparation

A minimum mass of 50 gr. was obtained by applying the grating and sieving method. A sufficient amount of fine powder was obtained to carry out a minimum of three determinations.

The sample quantity used in each determination was 0.5 g of product.

Method

Determinations were performed according to the crucible method described in section 7.9 of the test standard.

Equivalent Energy Value (MJ/kg) = 2393.3590

Samples	1	2	3	Average
Higher Heating Value (in MJ/kg)	28.14	26.51	26.03	26.89
Higher Heating Value (in MJ/m ²)	0.12	0.11	0.11	0.11

Criteria for acceptance or rejection (according to section 11 of the test standard): Max - Min of the 3 reproduced tests must be $\leq 0.1 \text{ MJ/m}^2$

Uncertainty associated to the measurement: $\pm \mbox{ 0.15 MJ/kg}$



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6.1.2-Determination of the superficial density

From data provided by the test petitioner, a calculation of the superficial density is made on every component of the product:

Components	Thickness	Density	Superficial density
Primer – Polyester primer (M ₁)	4 µm	1.74 g/ml	0.007 kg/m ²
Top coat - Fluorprymer(M ₁)	20 µm	1.88 g/ml	0.038 kg/m ²
Aluminium sheet (M ₂)	2 mm	2720 kg/m ³	5.44 kg/m ²
Protective coat - Epoxi (M ₃)	3 µm	1.38 g/ml	0.004 kg/m ²

In this heterogeneous product there are different components:

- 2 External non-substantial components: PP-29+FP-1 (M_1) and Epoxi (M_3) .
- 1 Substantial components: Aluminum sheet (M₂).

Components	M 1	M ₂	M ₃	PRODUCT
PCS (MJ/kg)	12.92	0.00	26.89	0.13
PCS (MJ/m ²)	0.58	0.00	0.11	0.69



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6.2.- SBI Test based on Standard UNE EN 13823:2012+A1:2016

Date at which test was performed: Start: 2018-12-17

End: 2018-12-19

During the tests, the environmental conditions of the laboratory were maintained at a temperature of (20 ± 10) °C.

6.2.1.- General Principles of the Test

To determine the fire reaction behaviour of the construction products when these are exposed to the thermal attack of a single burning item.

The product is tested while installed on a sample support positioned at an angle. Each sample consists of two wings: one 1,500 mm x 495 mm-short wing, and one 1,500 mm x 1,000 mm-long wing, by the thickness of the product.

The assembly and installation of the product on the support must be representative of the final use condition of such product.

A minimum of three samples per test are tested for each condition of use. The product is exposed to the flames for approximately 21 minutes. The relevant measurements are continuously recorded every three seconds.

The sample is exposed to the flame of a propane burner with a nominal power of $(30.7 \pm 2kW)$. The burner is located on the base of the angle formed by the corner, at a distance of 40 mm from the surface of the product.

6.2.2.- Expression of the Results

The test makes it possible to assess how much heat and smoke are released by the products subject to the thermal attack. These measurements are the basis to determine the following indexes:

6.2.2.1.-

FIGRA_{0,2MJ} and FIGRA_{0,4MJ} (in W/s)

These are defined as the maximum value of the quotient HRR_{av} (t) / (t-300), multiplied by 1,000. The quotient is only calculated for that part of the exposure time during which the levels of the thresholds for HRR_{av} and THR were exceeded.

If one of the two threshold values of a FIGRA index is not topped during the period of exposure, this FIGRA index equals zero. Two different TRH threshold values are used, which result in $FIGRA_{0,2MJ}$ and $FIGRA_{0,4MJ}$.

THR₆₀₀ (in MJ)

This is the total heat released by the sample during the first 600 s (10 minutes) from the beginning of the exposure to the main burner.

HRR (in kW)

This is the velocity of the heat released.



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6.2.2.2.-

SMOGRA (in m^2/s^2)

This is defined as the maximum value of the quotient SPR_{av} (t) / (t-300), multiplied by 10,000. The quotient is only calculated for the part of the time of exposure during which the levels of the thresholds for SPR_{av} and TSP were exceeded.

If one or the two threshold values are not exceeded during the period of exposure, the SMOGRA value equals zero.

TSP₆₀₀ (in m²)

This is the total amount of smoke released by the sample during the first 600 s (10 minutes) from the beginning of the exposure to the main burner.

SPR (in m²/s): This is the smoke production velocity.

6.3.3.- Assembly specifications

Each test set consists of two items:

1 part measuring $1,500 \times 495$ mm, which is representative of the short wing, and 1 part measuring $1,500 \times 1,000$ mm, representative of the long wing, in accordance with the specifications contained in paragraph 5.1.1.

The samples were assembled by staff of Laboratory and in accordance with the specifications provided by the petitioner.

Fixing system: The sample was fixed to the standard substrate (Particleboard, not fire retardant treated according to UNE-EN 13238:2011) with rivets.

The test was carried out removing the lateral bottom plates of the test wagon, according to section 5.2.2 a) of the test standard and with an air gap of 20 mm.

The assembly was performed with open joints. A horizontal joint at 500 mm from the bottom of the sample, and a vertical joint at 200 mm from inside corner. The width of the mounting board was 10 mm.

The plates were fixed mechanically.

The test was performed according to Annex E of the ETAG 034 guide.



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6.2.4.- Test Results

INDICATIVE TEST (Indermediate color)

6.2.4.1- Sample nº1

Environmental conditions at the beginning of the test:

 Temperature: 20 °C
 HR: 45 %
 Pressure: 100556 Pa

Level of exposure of the burner (kW): 29.18

INDEXES

FIGRA 0.2 MJ (W/s)	0.00
FIGRA _{0.4 MJ} (W/s)	0.00
LFS	< to edge
THR _{600S} (MJ)	0.07
SMOGRA (m^2/s^2)	0.00
$TSP_{600S} (m^2)$	22.07
Release of inflamed material in 600 s	NO

Conditions at the end of the test:

 Temperature:
 21 °C
 HR:
 45 %
 Pressure:
 100444
 Pa

 Light transmission (%):
 99.82 %
 O2 concentration (%):
 20.94 %

CO₂ concentration (%): **0.00 %**



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INDICATIVE TEST (dark color)

6.2.4.1- Sample nº1

Environmental conditions at the beginning of the test:

 Temperature: 21 °C
 HR: 44 %
 Pressure: 100311 Pa

Level of exposure of the burner (kW): 29.98

INDEXES

FIGRA 0.2 MJ (W/s)	0.00
FIGRA _{0.4 MJ} (W/s)	0.00
LFS	< to edge
THR _{600S} (MJ)	0.09
SMOGRA (m^2/s^2)	0.00
TSP _{600S} (m ²)	18.75
Release of inflamed material in 600 s	NO

Conditions at the end of the test:

 Temperature: 19 °C
 HR: 47 %
 Pressure: 100364 Pa

 Light transmission (%): 99.23 %
 O2 concentration (%): 20.95 %

CO₂ concentration (%): **0.00 %**



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Pa

COMPLETE TEST (Light color)

6.2.4.1- Sample nº1

Environmental conditions at the beginning of the test:

Temperature: 20 °C	HR: 43 %	Pressure: 100667

Level of exposure of the burner (kW): 29.70

INDEXES

FIGRA 0.2 MJ (W/s)	2.79
FIGRA _{0.4 MJ} (W/s)	2.79
LFS	< to edge
THR _{600S} (MJ)	0.71
SMOGRA (m^2/s^2)	0.00
TSP _{600S} (m ²)	25.68
Release of inflamed material in 600 s	NO

Conditions at the end of the test:

Temperature: 20 °C

HR: **42 %**

Pressure: 100611 Pa

Light transmission (%): **99.76 %**

O₂ concentration (%): **20.95 %**

CO₂ concentration (%): **0.00 %**



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6.2.4.2.- Sample nº 2

Environmental conditions at the beginning of the test:

 Temperature: 21 °C
 HR: 39 %
 Pressure: 99949 Pa

Level of exposure of the burner (kW): 28.71

INDEXES

FIGRA 0.2 MJ (W/s)	0.00
FIGRA _{0.4 MJ} (W/s)	0.00
LFS	< to edge
THR _{600S} (MJ)	0.21
SMOGRA (m ² /s ²)	0.00
TSP_{600S} (m ²)	14.52
Release of inflamed material in 600 s	NO

Conditions at the end of the test:

Temperature: 22 °C	HR: 38 %	Pressure: 100005 Pa
Light transmission (%): 99.94 %	O ₂ conce	ntration (%): 20.93 %

CO₂ concentration (%): **0.01 %**



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6.2.4.3.- Sample nº3

Environmental conditions at the beginning of the test:

Temperature: 20 °C	HR: 38 %	Pressure: 99963 Pa

Level of exposure of the burner (kW): 28.48

INDEXES

FIGRA 0.2 MJ (W/s)	0.00
FIGRA _{0.4 MJ} (W/s)	0.00
LFS	< to edge
THR _{600S} (MJ)	0.32
SMOGRA (m ² /s ²)	0.00
TSP_{600S} (m ²)	20.11
Release of inflamed material in 600 s	NO

Conditions at the end of the test:

Temperature: 20 °C

HR: **38 %**

Pressure: 100005 Pa

Light transmission (%): **99.76 %**

O₂ concentration (%): 20.94 %

CO₂ concentration (%): **0.01 %**



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6.2.5. - Visual observations

The observation of released material or of inflamed particles during the first 10 minutes of the test lead to the attribution of the identification sub-index "d" to the material, so that:

d0: No release of inflamed material is observed.

d1: release of inflamed material with a flame persistence < 10 s.

d2: Release of inflamed material with a flame persistence > 10 s.

No lateral propagation of the flame over the long wing, or release of inflamed material is observed in any of the three tested test samples.

6.2.6. - Uncertainty associated to the measurement equipment

Set of thermocouples of the extraction pipe	±2°C
Pressure transmitter of the pipe	±2 Pa
Smoke measuring device	±5%
Ambient pressure measuring equipment	±5%
Ambient humidity measuring device	±5%
Ambient temperature measuring device	±2°C



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<u>6.3.- Results</u>

6.3.1.- UNE-EN ISO 1716:2011

Test method	UNE-EN ISO 1716:2011	
	Non-substantial external component, M_1 (Polyester paint)	PCS: 0.58 MJ/m ²
Obtained value	Substantial component, M ₂	PCS: 0.00 MJ/kg
	Non-substantial external component, M_3	PCS: 0.11 MJ/m ²
	Product as a whole	PCS: 0.13 MJ/kg

6.3.2.- UNE-EN 13823:2012+A1:2016

INDICATIVE TEST – Intermediate color

Samples	Ι
FIGRA _{0.2 MJ} (W/s)	0.00
FIGRA _{0.4 MJ} (W/s)	0.00
LFS	< to edge
THR ₆₀₀₅ (MJ)	0.07
SMOGRA (m^2/s^2)	0.00
TSP ₆₀₀₅ (m ²)	22.07
Release of inflamed material in 600 s	NO

INDICATIVE TEST – Dark color

Samples	Ι
FIGRA _{0.2 MJ} (W/s)	0.00
FIGRA _{0.4 MJ} (W/s)	0.00
LFS	< to edge
THR ₆₀₀₅ (MJ)	0.09
SMOGRA (m^2/s^2)	0.00
TSP _{600S} (m ²)	18.75
Release of inflamed material in 600 s	NO



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Samples	Ι	II	III	Average
FIGRA _{0.2 MJ} (W/s)	2.79	0.00	0.00	0.93
FIGRA _{0.4 MJ} (W/s)	2.79	0.00	0.00	0.93
LFS	< to edge	< to edge	< to edge	< to edge
THR _{600S} (MJ)	0.71	0.21	0.32	0.41
SMOGRA (m^2/s^2)	0.00	0.00	0.00	0.00
TSP ₆₀₀₅ (m ²)	25.68	14.52	20.11	20.10
Release of inflamed material in 600 s	NO	NO	NO	NO

COMPLETE TEST – Light color

The test results correspond to the behaviour of test samples of a product under the testing conditions themselves. They do not intend to be the only evaluation criterion to assess the potential fire hazard involved in the use of the product.

The Euro class to which the tested product belongs is defined in Part 2 of the Classification Report.

Responsible of the fire laboratory LGAI Technological Center S.A. (APPLUS) Responsible of Reaction to Fire LGAI Technological Center S.A. (APPLUS)

The results refer exclusively to the samples tested at the time and under the conditions indicated. The uncertainties expressed in this document pertain to the expanded uncertainty, which has been obtained by multiplying the typical measurement uncertainty by the coverage factor k=2 which, for a regular distribution, corresponds to a coverage probability of approximately 95%.

Applus+ guarantees that this task has been carried out in compliance with the requirements of our Quality and Sustainability System, and furthermore, that the contractual terms and legal regulations have been complied with.

In the framework of our improvement programme, we would appreciate any comments you may deem appropriate. These should be addressed to the manager who signs this document, or to the Quality Director of Applus+, at the following address: satisfaccion.cliente@applus.com



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ANNEXES

<u>7.- PHOTOS</u>

8.- CHARTS



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<u>7.- PHOTOS</u>





Photo nº1: Detail of the corner assembly, upper view.

Photo nº2: Detail of the vertical side edge of the long wing, some 500 mm from the bottom of the support.



Photo n°3: View of the corner and anchoring system.



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PHOTO Nº4: View of the product prior to starting the test.



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PHOTO N°5: Sample 1 – Flame attack approx. 10 minutes after the start of the test.



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PHOTO N°6: Sample 1 -State of the product upon completion of the test.



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PHOTO N°7: Sample no. 2 - Flame attack approx. 10 minutes after the start of the test.



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PHOTO N°8: Sample 2 – State of the product upon completion of the test.



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PHOTO N°9: Sample 3 – Flame attack approx. 10 minutes after the start of the test.



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PHOTO Nº10: Sample 3 – State of the product upon completion of the test.



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8.- CHARTS

8.1- CHARTS

INDICATIVE TESTS

Intermediate color: Sample nº1 – Ratios related to the release of heat and smoke

Dark color: Sample nº1 – Ratios related to the release of heat and smoke

COMPLETE TEST – Light color

Sample nº1 – Ratios related to the release of heat and smoke

Sample nº2 – Ratios related to the release of heat and smoke

Sample nº3 – Ratios related to the release of heat and smoke



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NORMA: UNE-EN 13823:2012 + A1:2016 STANDARD

Data del test: 18:12:18 13:23 Test date

Nom del fitxer: 2270xb

Descripció: -Description

Client: NOVELIS

Material: gris

Pes (kg/m²): -Weight(kg/m²) Gruix: -Thickness

HRR av: 29,18 kW

THR 600s: 0,07 MJ FIGRA 0,2MJ: 0,00 W/s FIGRA 0,4MJ: 0,00 W/s

TSP 600s: 22,07 m² SMOGRA: 0,00 m²/s²



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NORMA: UNE-EN 13823:2012 + A1:2016 STANDARD

Data del test: 18:12:18 16:18 Test date

Nom del fitxer: 2270xcmostra1 File name

Descripció: -Description

Client: NOVELIS

Material: negro

Pes (kg/m²): -Weight(kg/m²) Gruix: -Thickness

HRR av: 29,98 kW

THR 600s: 0,09 MJ FIGRA 0,2MJ: 0,00 W/s FIGRA 0,4MJ: 0,00 W/s

TSP 600s: 18,75 m² SMOGRA: 0,00 m²/s²



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NORMA: UNE-EN 13823:2012 + A1:2016 STANDARD

Data del test: 18:12:18 11:50 Test date

Nom del fitxer: 2270xa File name

Descripció: -

Client: NOVELIS

Material: pintura blanca

Pes (kg/m²): -Weight(kg/m²) Gruix: -Thickness

HRR av: 29,70 kW

THR 600s: 0.71 MJ FIGRA 0,2MJ: 2.79 W/s FIGRA 0,4MJ: 2.79 W/s

TSP 600s: 25,68 m² SMOGRA: 0,00 m²/s²



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NORMA: UNE-EN 13823:2012 + A1:2016 STANDARD

Data del test: 19:12:18 16:24 Test date

Nom del fitxer: 2270xamostra2c

Descripció: -Description

Client: NOVELIS

Material: pintura blanca

Pes (kg/m²): -Weight(kg/m²) Gruix: -Thickness

HRR av: 28,71 kW

THR 600s: 0.21 MJ FIGRA 0,2MJ: 0.00 W/s FIGRA 0,4MJ: 0.00 W/s

TSP 600s: 14,52 m² SMOGRA: 0,00 m²/s²



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NORMA: UNE-EN 13823:2012 + A1:2016 STANDARD

Data del test: 19:12:18 17:10 Test date

Nom del fitxer: 2270xamostra3 File name

Descripció: -Description

Client: NOVELIS

Material: pintura blanca

Pes (kg/m²): -Weight(kg/m²) Gruix: -Thickness

HRR av: 28,48 kW

THR 600s: 0.32 MJ FIGRA 0,2MJ: 0,00 W/s FIGRA 0,4MJ: 0,00 W/s

TSP 600s: 20,11 m² SMOGRA: 0,00 m²/s²