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V/F Page 1

Bellaterra:

9th April, 2019

File:

18/17532-1344 Part 1

Petitioner's reference:

NICHIHA CORPORATION 12 Shiotome-cho, Minato-ku Nagoya, 455-8550, Japan



TEST REPORT

Date at which the sample was received: 3-07-2018 / 15-07-2018 / 8-01-2019

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 panels with the following indications according to technical specifications provided by the petitioner:

The NICHIHA EX Series is material primarily used as exterior wall claddings, and is a material formed into a plate shape using cement, a siliceous material, admixture as a main raw material, and others.

Product trade name: NICHIHA EX Series

The product has three different layers:

-Layer 1: Surface paint with maximum grammage of 139 g/m² (solid amount) and various colours.

-Layer 2: Fiber cement board, 16 mm (nominal value) in thickness and density of 1080 kg/m³ (oven-dry, nominal value).

-Layer 3: Backside paint with maximum grammage of 80 g/m² (solid amount) and transparent colour.

A compressible sealing strips (max. 25g/m2 in gramme) is bonded onto the tongue which enables the panels to fit neatly together to form a weather resistant joint.

1. Fixing system:

Aluminium omega profiles were fixed to the standard substrate (Particleboard, not fire retardant treated according to UNE-EN 13238:2011) with screws. Timber subframes were fixed with screws on the aluminium omega profiles. Subframes are fixed to substrate.

The panels were fixed to the timber subframe with clip and screws.

- 2. Insulation: mineral wool panels, 20 mm thick, fixed to substrate through metallic fixation.
- 3. Waterproof material: Waterproof paper is installed over the insulation.

These constructive system components are installed with an air gap of approximately 20 mm between the inner skin of the panel and the exterior face of the insulation.

Manufacturer: NICHIHA CORPORATION. Address: 12 Shiotome-cho, Minato-ku, Nagoya, 455-8550, Japan.



3. - MAINTENANCE SPECIFICATION

The durability of the NICHIHA EX Series can be enhanced by periodic inspection and maintenance. Repainting, putty repair, and replacement of the NICHIHA EX series are carried out as necessary.

4.- DESCRIPTION OF THE FINAL CONDITIONS FOR USE

NICHIHA EX Series is used in residential, commercial, educational buildings and etc.

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 $(23\pm2)^{\circ}$ C, and at $(50\pm5)^{\circ}$ relative humidity, until a constant weight was reached.

6.- <u>TESTS</u>

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

Date at which test was performed:	Start:	24-07-2018
	End:	29-10-2018

During the tests, the environmental conditions of the laboratory were maintained at a temperature of $(23\pm5)^{\circ}$ C, and relative humidity of (50 ± 20) %.

6.1.1- Procedure for non-homogeneous products:

Substantial components Fiber cement board, identified as M₁

External non-substantial components

Surface paint, identified as M₂ Backside paint, identified as M₃

Internal non-substantial component

Synthetic rubber, identified as M₄



Products reference

Surface Paints White / Red / Black

Fiber cement panel A

Backside paint

Adhesive

Substantial component

Fiber cement panel (A)

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 0.6 g (0.5 g of product + 0.1 g of benzoic acid).

Method

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

Samples123AverageHigher Heating Value
(in MJ/kg)2.612.612.652.62

Equivalent Energy Value (MJ/kg) = 2402.3040

Criteria for acceptance or rejection (according to section 11 of the test standard): Max - Min of the 3 reproduced tests must be **within** \leq **0.2 MJ/kg** Uncertainty associated with the measure: \pm 0.15 MJ/kg



External non-substantial component

Surface paint

White colour

Preparation of the Samples

Coating was applied according to petitioner specifications for subsequent drying. Once dried at ambient temperature, paint was scraped and sieved. Starting from a minimum mass of 10 g, it was obtained enough fine powder for performing a minimum of 3 determinations.

The quantity of sample used in every determination was of 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) = 2402.3040

Samples	1	2	3	Average
Gross heat of combustion (in MJ/kg)	15.50	15.52	15.59	15.54

Criteria for acceptance or rejection (according to section 11 of the test standard): Max - Min of the 3 reproduced tests must be $\leq 10\%$



Red colour

Preparation of the Samples

Coating was applied according to petitioner specifications for subsequent drying. Once dried at ambient temperature, paint was scraped and sieved. Starting from a minimum mass of 10 g, it was obtained enough fine powder for performing a minimum of 3 determinations.

The quantity of sample used in every determination was of 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) = 2402.3040

Samples	1	2	3	Average
Gross heat of combustion (in MJ/kg)	27.48	27.59	27.62	27.56

Criteria for acceptance or rejection (according to section 11 of the test standard): Max - Min of the 3 reproduced tests must be $\leq 10\%$



Black colour

Preparation of the Samples

Coating was applied according to petitioner specifications for subsequent drying. Once dried at ambient temperature, paint was scraped and sieved. Starting from a minimum mass of 10 g, it was obtained enough fine powder for performing a minimum of 3 determinations.

The quantity of sample used in every determination was of 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) = 2402.3040

Samples	1	2	3	Average
Gross heat of combustion (in MJ/kg)	28.78	28.58	28.46	28.61

Criteria for acceptance or rejection (according to section 11 of the test standard): Max - Min of the 3 reproduced tests must be $\leq 10\%$



Backside paint

Preparation of the Samples

Coating was applied according to petitioner specifications for subsequent drying. Once dried at ambient temperature, paint was scraped and sieved. Starting from a minimum mass of 10 g, it was obtained enough fine powder for performing a minimum of 3 determinations.

The quantity of sample used in every determination was of 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) = 2402.3040

Samples	1	2	3	Average
Gross heat of combustion (in MJ/kg)	8.87	8.64	8.64	8.72

Criteria for acceptance or rejection (according to section 11 of the test standard): Max - Min of the 3 reproduced tests must be $\leq 10\%$



Internal non-substantial component

Synthetic rubber

Preparation of the Samples

Coating was applied according to petitioner specifications for subsequent drying. Once dried at ambient temperature, paint was scraped and sieved. Starting from a minimum mass of 10 g, it was obtained enough fine powder for performing a minimum of 3 determinations.

The quantity of sample used in every determination was of 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) = 2402.3040

Samples	1	2	3	Average
Gross heat of combustion (in MJ/kg)	44.64	44.65	44.36	44.55

Criteria for acceptance or rejection (according to section 11 of the test standard): Max - Min of the 3 reproduced tests must be $\leq 10\%$



SUMMARY OF RESULTS

PRODUCT	GROSS HEAT OF COMBUSTION (in MJ/kg)		
	SURFACE PAINT		
White	15.54		
Red	27.56		
Black	28.61		
FIBER CEMENT PANELS			
А	2.62		
BACKSIDE PAINT			
8.72			
SYNTHETIC RUBBER			
44.55			

WORST CASE DEFINITION

Surface paint: Black colour Fiber cement panel: Panel A



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
Surface paint – black colour (M ₂)	-	-	0.139 kg/m ²
Fiber cement panel-A (M ₁)	16 mm	1080 kg/m ³	17.3 kg/m ²
Backside paint (M ₃)	-	-	0.080 kg/m ²
Synthetic rubber (M ₄)	-	-	0.025 kg/m ²

In this heterogeneous product there are different components:

- 2 External non-substantial components: surface paint (M₂) and backside paint (M₃)
- 1 Internal non-substantial components: Synthetic rubber (M₄)
- 1 Substantial component: Fiber cement board (M₁)

Components	M ₂	M1	M 4	M ₃	PRODUCT
PCS (MJ/kg)	28.61	2.62	44.55	8.72	2.91
PCS (MJ/m ²)	3.98	45.27	1.11	0.70	51.06



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

Date at which test was performed:

Start: 4-02-2019 End: 6-02-2019

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.



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: Aluminium omega profiles were fixed to the standard substrate (Particleboard, not fire retardant treated according to UNE-EN 13238:2011) with screws.

Timber subframes were fixed with screws on the aluminium omega profiles.

The sample was fixed to the timber subframe with clip and screws.

Test performed with mineral wool with 20 mm in thickness and waterproof paper.

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.



6.2.4.- Test Results

INDICATIVE TEST : Smooth appearance

6.2.4.1- Sample nº1

Environmental conditions at the beginning of the test:

 Temperature: 20°C
 HR: 35 %
 Pressure: 100685 Pa

Level of exposure of the burner (kW): 30.45

INDEXES

FIGRA 0.2 MJ (W/s)	0.00
FIGRA 0.4 MJ (W/s)	0.00
LFS	< to edge
THR _{600S} (MJ)	0.16
SMOGRA (m^2/s^2)	0.00
TSP _{600S} (m ²)	20.86
Release of inflamed material in 600 s	NO

Conditions at the end of the test:

 Temperature:
 19 °C
 HR:
 37 %
 Pressure:
 100681 Pa

Light transmission (%): 96.99 %

O₂ concentration (%): **20.92 %**

CO₂ concentration (%): **0.01 %**



COMPLETE TEST : Ruggous appearance

6.2.4.2.- Sample nº 1

Environmental conditions at the beginning of the test:

 Temperature: 20 °C
 HR: 40 %
 Pressure: 100935 Pa

Level of exposure of the burner (kW): 29.92

INDEXES

FIGRA 0.2 MJ (W/s)	0.00
FIGRA 0.4 MJ (W/s)	0.00
LFS	< to edge
THR _{600S} (MJ)	0.18
SMOGRA (m ² /s ²)	0.00
TSP _{600S} (m ²)	22.82
Release of inflamed material in 600 s	NO

Conditions at the end of the test:

 Temperature: 21 °C
 HR: 35 %
 Pressure: 100837 Pa

Light transmission (%): 99.82 %

O₂ concentration (%): **20.93 %**

CO₂ concentration (%): **0.02 %**



6.2.4.3.- Sample nº 2

Environmental conditions at the beginning of the test:

Temperature: 16 °C	HR: 46 %	Pressure: 100953 Pa

Level of exposure of the burner (kW): 30.54

INDEXES

FIGRA 0.2 MJ (W/S)	5.38		
FIGRA 0.4 MJ (W/s)	5.38		
LFS	< to edge		
THR _{600S} (MJ)	0.36		
SMOGRA (m^2/s^2)	1.93		
TSP _{600S} (m ²)	26.21		
Release of inflamed material in 600 s	NO		

Conditions at the end of the test:

 Temperature:
 16 °C
 HR:
 45 %
 Pressure:
 100916 Pa

Light transmission (%): 92.46 %

O₂ concentration (%): **20.95 %**

CO₂ concentration (%): **0.03 %**



6.2.4.4.- Sample nº3

Environmental conditions at the beginning of the test:

 Temperature: 17 °C
 HR:59 %
 Pressure: 100913 Pa

Level of exposure of the burner (kW): 29.77

INDEXES

FIGRA 0.2 MJ (W/s)	0.00		
FIGRA 0.4 MJ (W/s)	0.00		
LFS	< to edge		
THR _{600S} (MJ)	0.94		
SMOGRA (m ² /s ²)	0.00		
TSP _{600S} (m ²)	29.30		
Release of inflamed material in 600 s	NO		

Conditions at the end of the test:

Temperature: 17 °C

HR: **63 %**

Pressure: 100935 Pa

Light transmission (%): 93.73 %

O₂ concentration (%): 20.93 %

CO₂ concentration (%): **0.01 %**



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	± 2ºC

6.3.- Results

6.3.1.- UNE-EN ISO 1716:2011

Test method	UNE-EN ISO 1716:2011	
	Non-substantial external component, M ₂ (surfacepaint)	PCS: 3.98 MJ/m ²
	Substantial component, M_1	PCS: 2.62 MJ/kg
Obtained value	Non-substantial internal component, M ₄	PCS: 0.44 MJ/m ²
	Non-substantial external component, M ₃	PCS: 0.70 MJ/m ²
	Product as a whole	PCS: 2.87 MJ/kg



Samples	I	II	III	Average
FIGRA 0.2 MJ (W/s)	0.00	5.38	0.00	1.79
FIGRA _{0.4 MJ} (W/s)	0.00	5.38	0.00	1.79
LFS	< to edge	< to edge	< to edge	< to edge
THR _{600s} (MJ)	0.18	0.36	0.94	0.49
SMOGRA (m ² /s ²)	0.00	1.93	0.00	0.64
TSP _{600S} (m ²)	22.82	26.21	29.30	26.11
Release of inflamed material in 600 s	NO	NO	NO	NO

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

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:<u>satisfaccion.cliente@applus.com</u>



ANNEXES

<u>7.- PHOTOS</u>

8.- CHARTS



Page 21

File nº 18/17532-1344 Part 1

<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 nº3: View of the corner and anchoring system.



Page 22



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



Page 23



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



Page 24



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



Page 25



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



Page 26



PHOTO Nº8: Sample 2 – State of the product upon completion of the test.



Page 27



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



Page 28



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



Page 29

8.- CHARTS

Sample $n^{o}1$ – 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



INDICATIVE TEST – Smooth appearance









Page 30

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

Data del test: 05:02:19 15:54 Test date

Nom del fitxer: 50219nichihaliso1 File name

Descripció: -Description

Client: NICHIHA CORPORATION

Material: EX SERIES (EFM318X)

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

HRR av: 30,45 kW

THR 600s: 0,16 MJ FIGRA 0,2MJ: 0,00 W/s FIGRA 0,4MJ: 0,00 W/s

TSP 600s: 20,86 m² SMOGRA: 0,00 m²/s²



COMPLETE TEST – Rugous appearance









Page 31

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

Data del test: 05:02:19 12:31 Test date

Nom del fitxer: 50219bnichiha File name

Descripció: -Description

Client: NICHIHA CORPORATION

Material: EX SERIES (EFF056X)

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

HRR av: 29,92 kW

THR 600s: 0,18 MJ FIGRA 0,2MJ: 0,00 W/s FIGRA 0,4MJ: 0,00 W/s

TSP 600s: 22,82 m² **SMOGRA:** 0,00 m²/s²











Page 32

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

Data del test: 06:02:19 10:24 Test date

Nom del fitxer: 50219nichiha2 File name

Descripció: -Description

Client: NICHIHA CORPORATION

Material: EX SERIES (EFF056X)

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

HRR av: 30,54 kW

THR 600s: 0,36 MJ FIGRA 0,2MJ: 5,38 W/s FIGRA 0,4MJ: 5,38 W/s

TSP 600s: 26,21 m² **SMOGRA:** 1,93 m²/s²











Page 33

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

Data del test: 06:02:19 11:25 Test date

Nom del fitxer: 50219nichiha3 File name

Descripció: -Description

Client: NICHIHA CORPORATION

Material: EX SERIES (EFF056X)

Pes (kg/m²): -Weight(kg/m²) Gruix: -

Thickness

HRR av: 29,77 kW

THR 600s: 0,94 MJ FIGRA 0,2MJ: 0,00 W/s FIGRA 0,4MJ: 0,00 W/s

TSP 600s: 29,30 m² **SMOGRA:** 0,00 m²/s²