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## Heat release and smoke production according to ISO 5660-1

(3 appendices)

### Introduction

RISE has by request of Finsa Dpto. De Idi + Calidad performed a fire test according to ISO 5660-1. The purpose of the test is to form a basis for technical fire classification.

### Products

According to the client:

MDF board called "FIBRACOLOUR NEGRO IGNIFUGO E-Z".

The product has a nominal area weight of 9.8 – 14.8 kg/m<sup>2</sup>, density of 780 – 820 kg/m<sup>3</sup> and a nominal thickness of 12 – 19 mm. The product has a black colour. The product has an organic content of 81 – 82.5 %.

The product is flame retardant treated with Ammonium salts, content per mass, 121 - 145 kg/m<sup>3</sup> dry weight.

### Manufacturer

Finsa Padron. Padron (A Coruna), Spain.

### Sampling

The sample was delivered by the client. It is not known to RISE Safety – Fire Research if the product received is representative of the mean production characteristics.

The sample was received February 28, 2022 at RISE Safety – Fire Research.

### Test procedure

In the Cone Calorimeter, ISO 5660-1, specimens of 0.1 by 0.1 m are exposed to controlled levels of radiant heating. The specimen surface is therefore heated up and an external spark ignitor ignites the pyrolysis gases from the specimen. The gases are collected by a hood and extracted by an exhaust fan.

The heat release rate (HRR) is determined by measurements of the oxygen consumption derived from the oxygen concentration and the flow rate in the exhaust duct. The specimen is placed on a load cell during testing. A retainer frame covers the periphery of the specimen. Smoke production rate is measured with a laser system.

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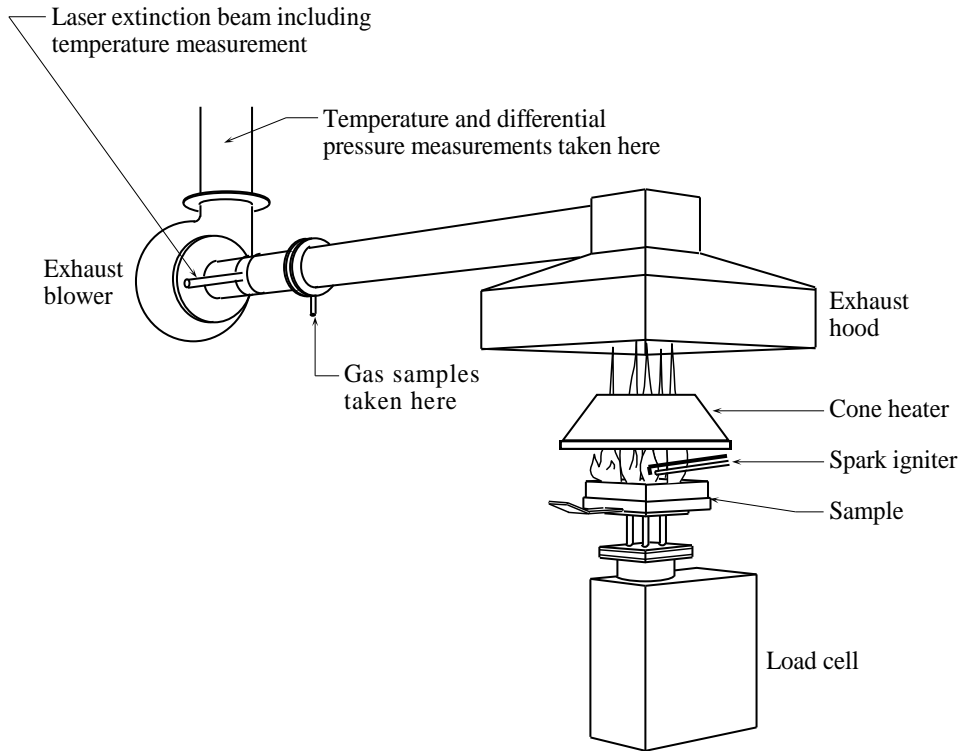
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Accred. No. 1002  
Testing  
ISO/IEC 17025



*Schematic drawing of the Cone calorimeter, ISO 5660-1.*

**Test results**

Detailed test results are given in appendix 1. The test parameter explanation is given in appendix 2.

Below a tabulated summary is given.

Product	Time to ignition (s)	THR (MJ/m <sup>2</sup> )	q <sub>max</sub> (kW/m <sup>2</sup> )	q <sub>180</sub> (kW/m <sup>2</sup> )	SPR <sub>max</sub> (m <sup>2</sup> /m <sup>2</sup> s)	TSP (m <sup>2</sup> /m <sup>2</sup> )
FIBRACOLOUR NEGRO IGNIFUGO E-Z 12 mm	356	81.8	133	114	3.4	410
FIBRACOLOUR NEGRO IGNIFUGO E-Z 19 mm	1005	82.8	87	72	3.0	489

The test results relate only to the behaviour of the test specimens 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 product in use.

**Assessment according to AS 5637.1:2015 Determination of fire hazard properties**

The following classification has been assessed in the accordance with the AS 5637.1:2015 Determination of fire hazard properties. Establishing Group numbers for wall and ceiling linings. Calculation were carried out according to section 8, Determining group numbers by prediction, for predicting a material’s group number for each specimen tested.

Table 1 : FIBRACOLOUR NEGRO IGNIFUGO E-Z, 12 mm.

	Sample 1	Sample 2	Sample 3	Classification
Group number Classification	1	1	1	1

Table 2 : FIBRACOLOUR NEGRO IGNIFUGO E-Z, 19 mm.

	Sample 1	Sample 2	Sample 3	Classification
Group number Classification	1	NA	NA	1

NA – not applicable

Table 3 : The tested samples recorded a specific extinction area, ASEA, AS 3837:1998:

	Sample 1	Sample 2	Sample 3	Average ASEA
ASEA, (m <sup>2</sup> /kg)	< 10	< 10	< 10	< 10

The cone calorimeter testing was carried out on the single specimens. For the purpose of compliance with the AS 5637.1:2015, section 8, the following classification is indicated for the material “FIBRACOLOUR NEGRO IGNIFUGO E-Z”.

Table 4: Classification group number

Product	Classification group number
FIBRACOLOUR NEGRO IGNIFUGO E-Z, 12 - 19 mm	1

**Note**

The accreditation referred to is valid for ISO 5660-1.

**RISE Research Institutes of Sweden AB  
Fire and safety - Reaction to Fire Material Lab**

Performed by



Kristian Törnqvist

Examined by



Per Thureson

**Appendices**

- 1 Test results
- 2 Test parameters explanation

## Appendix 1

**Test results ISO 5660-1:2015/AMD 1:2019****Product**

According to the client:

MDF board called "FIBRACOLOUR NEGRO IGNIFUGO E-Z".

The product has a nominal area weight of 9.8 kg/m<sup>2</sup>, density of 820 kg/m<sup>3</sup> and a nominal thickness of 12 mm. The product has a black colour. The product has an organic content of 81 %.

The product is flame retardant treated with Ammonium salts, content per mass, 145 kg/m<sup>3</sup> dry weight.

**Test specification**

Irradiance level: 50 kW/m<sup>2</sup>.

Calibration constant (C): 0.04479 m<sup>1/2</sup> g<sup>1/2</sup> K<sup>1/2</sup>.

Orientation: Horizontal.

The exposed surface area of test specimen 0.009 m<sup>2</sup>. The retainer frame was used.

Backing: No other than the non-combustible required in the standard.

Radiator cone location: The radiator cone was located so that the lower rim of the radiator cone shade junction was 25 mm above the upper surface of the specimen when oriented in the horizontal position.

## Appendix 1

**Test results**

Property	Name of variable	Test 1	Test 2	Test 3	Average value
Flashing (min:s)	$t_{\text{flash}}$	-	-	-	-
Ignition (min:s)	$t_{\text{ign}}$	09:00	08:29	08:46	05:56
All flaming ceased (min:s)	$t_{\text{ext}}$	41:00	40:29	40:46	27:15
Test time (min:s)	$t_{\text{test}}$	41:00	40:29	40:46	40:53
Heat release rate (kW/m <sup>2</sup> )	$q$	See figure 1	See figure 1	See figure 1	
Peak heat release rate (kW/m <sup>2</sup> )	$q_{\text{max}}$	137	131	132	133
Average heat release, 3 min (kW/m <sup>2</sup> )	$q_{180}$	121	109	111	114
Average heat release, 5 min (kW/m <sup>2</sup> )	$q_{300}$	107	97	100	101
Total heat produced (MJ/m <sup>2</sup> )	THR	97.6	74.1	73.6	81.8
Smoke production rate (m <sup>2</sup> /m <sup>2</sup> s)	SPR	See figure 2	See figure 2	See figure 2	
Peak smoke production (m <sup>2</sup> /m <sup>2</sup> s)	$SPR_{\text{max}}$	3.9	3.5	3.2	3.4
Total smoke production before ignition (m <sup>2</sup> /m <sup>2</sup> )	$TSP_{\text{start-ign}}$	399.1	403.2	407.8	403.5
Total smoke production after ignition (m <sup>2</sup> /m <sup>2</sup> )	$TSP_{\text{ign-end}}$	3.1	46.2	9.9	6.5
Total smoke production (m <sup>2</sup> /m <sup>2</sup> )	TSP	402	449	418	410
Sample mass before test (g)	$M_0$	108.8	108.0	110.2	73.0
Sample mass at sustained flaming (g)	$M_s$	66.0	67.9	69.1	45.1
Sample mass after test (g)	$M_f$	32.4	31.6	33.3	21.9
Average mass loss rate (g/m <sup>2</sup> s)	$MLR_{\text{ign-end}}$	2.4	2.5	2.5	2.4
Average mass loss rate (g/m <sup>2</sup> s)	$MLR_{10-90}$	2.6	2.8	2.8	2.7
Total mass loss (g/m <sup>2</sup> )	TML	4524	4870	4757	4565
Effective heat of combustion (MJ/kg)	$\Delta H_c$	21.6	15.2	15.5	17.9
Max average rate of heat emission (kW/m <sup>2</sup> )	MARHE	50.3	42.5	42.1	45.0
Volume flow in exhaust duct (l/s)	V	24	24	24	43

Appendix 1

Graphs of heat release rate and smoke production rate

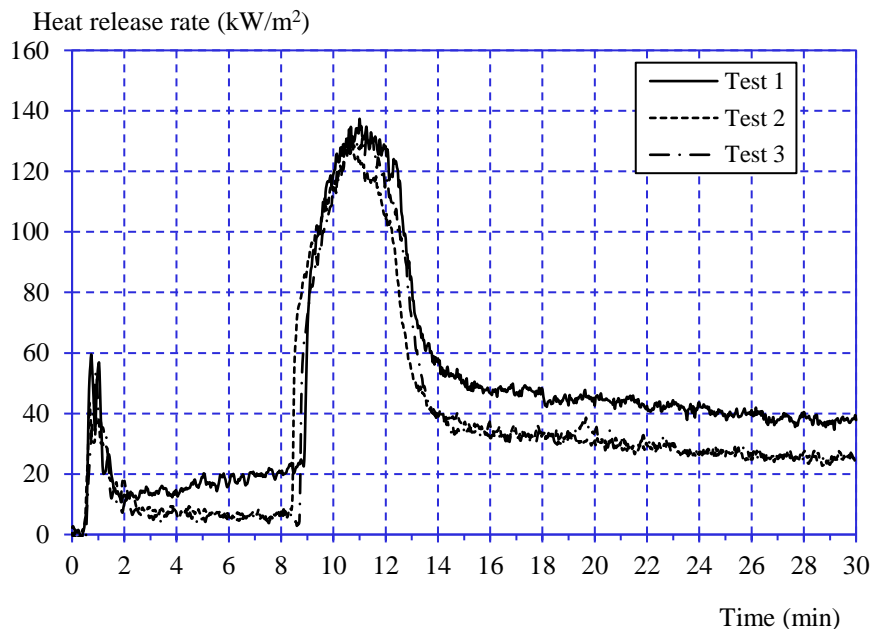


Figure 1 Heat release rate, triplicate tests at an irradiance of 50 kW/m<sup>2</sup>.

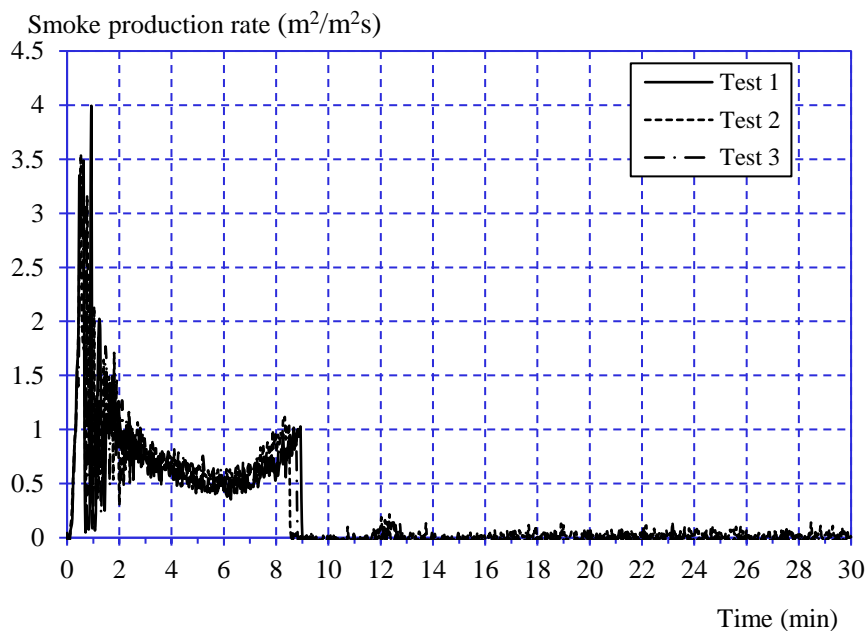


Figure 2 Smoke production rate, triplicate tests at an irradiance of 50 kW/m<sup>2</sup>.

## Appendix 1

**Measured data**

Thickness 12 mm.

Area weight 10.9 kg/m<sup>2</sup>.

Density 890 kg/m<sup>3</sup>.

**Conditioning**

According to ISO 5660-1.

Temperature (23 ± 2) °C.

Relative humidity (50 ± 5) %.

**Operator**

Sven Karlsson, Patrik Nilsson.

**Date of test**

March 10 and 15, 2022.



## Appendix 2

**Test results ISO 5660-1:2015/AMD 1:2019****Product**

According to the client:

MDF board called "FIBRACOLOUR NEGRO IGNIFUGO E-Z".

The product has a nominal area weight of 14.8 kg/m<sup>2</sup>, density of 780 kg/m<sup>3</sup> and a nominal thickness of 19 mm. The product has a black colour. The product has an organic content of 82.5 %.

The product is flame retardant treated with Ammonium salts, content per mass, 121 kg/m<sup>3</sup> dry weight.

**Test specification**

Irradiance level: 50 kW/m<sup>2</sup>.

Calibration constant (C): 0.04479 m<sup>1/2</sup> g<sup>1/2</sup> K<sup>1/2</sup>.

Orientation: Horizontal.

The exposed surface area of test specimen 0.009 m<sup>2</sup>. The retainer frame was used.

Backing: No other than the non-combustible required in the standard.

Radiator cone location: The radiator cone was located so that the lower rim of the radiator cone shade junction was 25 mm above the upper surface of the specimen when oriented in the horizontal position.

## Appendix 2

**Test results**

Property	Name of variable	Test 1
Flashing (min:s)	$t_{\text{flash}}$	-
Ignition (min:s)	$t_{\text{ign}}$	16:45
All flaming ceased (min:s)	$t_{\text{ext}}$	48:45
Test time (min:s)	$t_{\text{test}}$	48:45
Heat release rate (kW/m <sup>2</sup> )	$q$	See figure 1
Peak heat release rate (kW/m <sup>2</sup> )	$q_{\text{max}}$	87
Average heat release, 3 min (kW/m <sup>2</sup> )	$q_{180}$	72
Average heat release, 5 min (kW/m <sup>2</sup> )	$q_{300}$	75
Total heat produced (MJ/m <sup>2</sup> )	THR	82.8
Smoke production rate (m <sup>2</sup> /m <sup>2</sup> s)	SPR	See figure 2
Peak smoke production (m <sup>2</sup> /m <sup>2</sup> s)	$SPR_{\text{max}}$	3.0
Total smoke production before ignition (m <sup>2</sup> /m <sup>2</sup> )	$TSP_{\text{start-ign}}$	481.0
Total smoke production after ignition (m <sup>2</sup> /m <sup>2</sup> )	$TSP_{\text{ign-end}}$	8.4
Total smoke production (m <sup>2</sup> /m <sup>2</sup> )	TSP	489
Sample mass before test (g)	$M_0$	153.2
Sample mass at sustained flaming (g)	$M_s$	83.9
Sample mass after test (g)	$M_f$	55.7
Average mass loss rate (g/m <sup>2</sup> s)	$MLR_{\text{ign-end}}$	2.4
Average mass loss rate (g/m <sup>2</sup> s)	$MLR_{10-90}$	2.6
Total mass loss (g/m <sup>2</sup> )	TML	4644
Effective heat of combustion (MJ/kg)	$\Delta H_c$	17.8
Max average rate of heat emission (kW/m <sup>2</sup> )	MARHE	34.9
Volume flow in exhaust duct (l/s)	V	24

Appendix 2

**Graphs of heat release rate and smoke production rate**

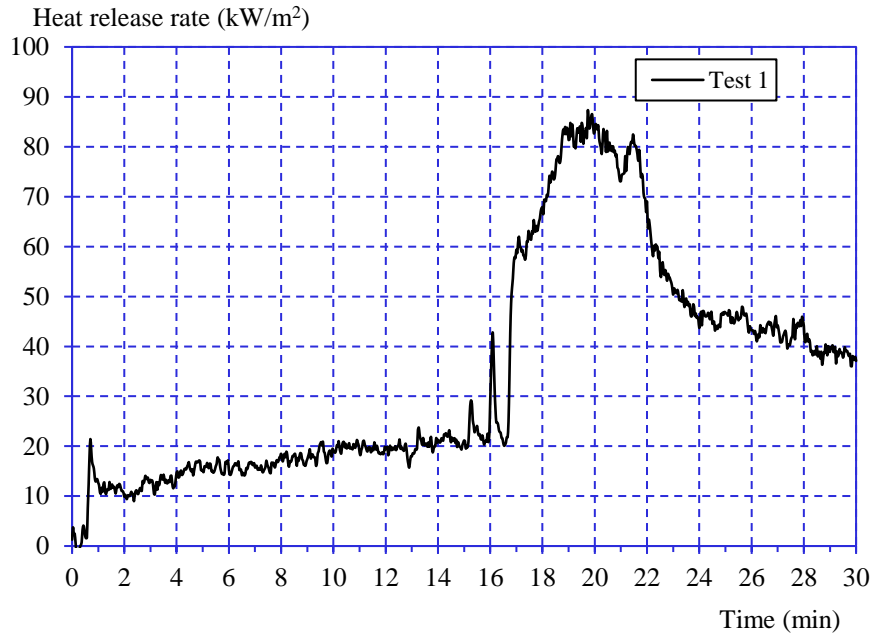


Figure 1 Heat release rate, single test at an irradiance of 50 kW/m<sup>2</sup>.

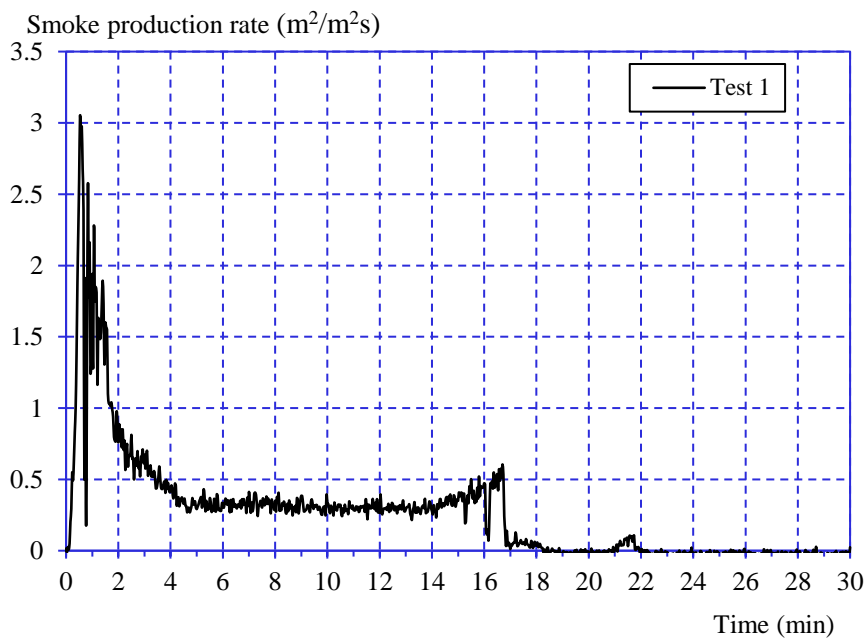


Figure 2 Smoke production rate, single test at an irradiance of 50 kW/m<sup>2</sup>.

## Appendix 2

**Measured data**

Thickness 19 – 20 mm.  
Area weight 15.4 kg/m<sup>2</sup>.  
Density 800 kg/m<sup>3</sup>.

**Conditioning**

According to ISO 5660-1.

Temperature (23 ± 2) °C.  
Relative humidity (50 ± 5) %.

**Operator**

Sven Karlsson, Patrik Nilsson.

**Date of test**

March 10, 2022.

## Appendix 3

### Test results explanation – ISO 5660

Parameter	Explanation
Test start	The test specimen is subjected to the irradiance and the clock is started.
$t_{\text{flash}}$	Time from test start until flames with shorter duration than 1 s.
$t_{\text{ign}}$	Time from test start until sustained flaming with duration more than 10 s.
$T_{\text{ext}}$	Time from test start until the flames have died out.
End of test	Defined as the time when both, the product has been extinguished for 2 minutes, and the mass loss is less than 150 g/m <sup>2</sup> during 1 minute. According to EN 45545-2, end of test is always at 20 min.
$T_{\text{test}}$	Test time. From test start until end of test.
$q_{\text{max}}$	Peak heat release rate during the entire test.
$q_{180}$	Average heat release rate during 3 minutes from ignition. If the test is terminated before, the heat release rate is taken as 0 from the end of test.
$q_{300}$	Average heat release rate during 5 minutes from ignition. If the test is terminated before, the heat release rate is taken as 0 from the end of test.
THR	Total Heat Released from test start until end of test.
$\text{SPR}_{\text{max}}$	Peak Smoke Production Rate from test start until end of test.
TSP	Total Smoke Produced from test start until end of test.
$M_0$	Mass of specimen.
$M_s$	Mass of specimen at sustained flaming.
$M_f$	Mass of specimen at the end of the test.
$\text{MLR}_{\text{ign-end}}$	Mass Loss Rate. Average mass loss rate from ignition until end of test.
$\text{MLR}_{10-90}$	Mass Loss Rate. Average mass loss rate between 10% and 90% of mass loss.
TML	Total mass loss from ignition until end of test.
$\Delta H_c$	Effective heat of combustion calculated as the ratio between total energy released and total mass loss calculated from ignition until end of test.
MARHE	Maximum Average Rate of Heat Emission defined as the maximum of the function (cumulative heat release between $t = 0$ and time = $t$ ) divided by (time = $t$ ).
V	Volume flow rate in exhaust duct. Average during the test.

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