REPORT
issued by an Accredited Testing Laboratory

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AB Ludvig Svensson
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Reaction to fire tests – Part 1: Heat release rate (cone calorimeter method) according to ISO 5660-1

(3 appendices)

Introduction

RISE has by request of AB Ludvig Svensson to perform a fire test according to ISO 5660-1. The purpose of the test is to form a basis for reaction to fire classification according to EN 45545-2:2013+A1:2015.

Product

According to the client: Roller blind called "Incendo", consisting of 100 % Trevira CS. The product has a nominal thickness of 0.5 ± 0.1 mm, a nominal area weight of 170 g/m^2 and the colour is grey (8400). Detailed product description is filed at RISE. A photograph of a specimen of the tested product is shown in appendix 3.

According to the standard EN 45545-2, table 2, the product is defined as a "Listed Product" to which the following parameters apply:

Product No:	IN8
Location:	Interior
Description:	Interiors
Product name:	Curtains and sunblind in passenger and staff area, staff compartments
Requirement Set:	R1

Manufacturer

AB Ludvig Svensson.

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 on February 2, 2018 at RISE Safety – Fire Research.
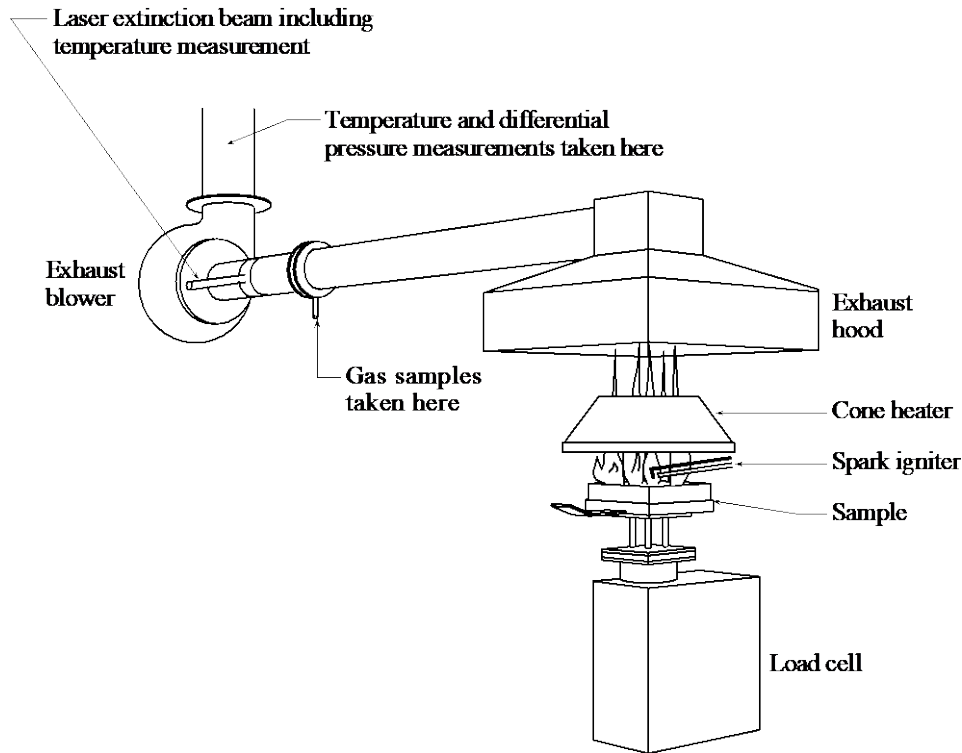
Test procedure

The specimen is placed horizontally and exposed to a constant irradiance level of 50 kW/m^2. The specimen surface is heated and pyrolysis gases are formed, an external spark ignites the pyrolysis gases. 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. During the test a retainer frame of steel covers the edges and periphery of the specimen.

Accred. No. 1002
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Schematic drawing of the Cone calorimeter, ISO 5660.

Test results

A summary of the test results is shown in the table below. Detailed test results are given in appendix 1. A photograph of a specimen of the tested product is shown in appendix 2. Test results explanation is given in appendix 3.

Mean value for MARHE (kW/m^2) (three tests)
63

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.

Classification criteria

According to EN 45545-2 table 5, requirement set No. R1, classification criteria regarding test results from test according to ISO 5660-1 are tabulated below.

In order to achieve reaction to fire classification according to EN 45545-2, the product should be tested according to several test methods listed by requirement set No. R1.

Test method, Parameter (Unit)	Requirement Definition	HL1	HL2	HL3
ISO 5660-1: 50 kW/m^2, MARHE (kW/m^2)	Maximum	-	90	60

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Note

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

The smoke production data as described by the standard is not presented in this report.

RISE Research Institutes of Sweden AB
Safety - Fire Research, Fire Dynamics

Performed by   Examined by

Anna Bergstrand   Per Thureson

Appendices

1.   Test results
2.   Photograph of a specimen of the tested product
3.   Test results explanation

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Appendix 1

Test results ISO 5660-1:2015

Product

According to the client: Roller blind called "Incendo", consisting of 100 % Trevira CS. The product has a nominal thickness of 0.5 ± 0.1 mm, a nominal area weight of 170 g/m^2 and the colour is grey (8400). Detailed product description is filed at RISE. A photograph of a specimen of the tested product is shown in appendix 3.

Test specification

Irradiance level:	50 kW/m^2.
Calibration constant (C):	0.04459 and 0.04408 $m^{1/2} g^{1/2} K^{1/2}$.
Orientation:	Horizontal.
The exposed surface area of test specimen	0.009 m^2. The retainer frame was used.
Backing:	No other than the non-combustible required in the standard.
Specimen mounting:	Mounting according to EN 45545-2, appendix D. The wire grid was used during the test to avoid distortion of the specimen.

Test results

Property	Name of variable	Test 1	Test 2	Test 3	Average value
Flashing (min:s)	t_{flash}	-	-	-	-
Ignition (min:s)	t_{ign}	00:24	00:25	00:24	00:24
All flaming ceased (min:s)	t_{ext}	00:45	00:54	00:52	00:50
Test time (min:s)	t_{test}	20:00	20:00	20:00	20:00
Heat release rate (kW/m²)	q	See figure 1	See figure 1	See figure 1	
Peak heat release rate (kW/m²)	q_{max}	267	211	248	242
Average heat release, 3 min (kW/m²)	q_{180}	15	13	16	14
Average heat release, 5 min (kW/m²)	q_{300}	8	7	9	8
Total heat produced (MJ/m²)	THR	2.8	2.8	3.2	2.9
Sample mass before test (g)	M_0	1.8	1.8	1.8	1.8
Sample mass at sustained flaming (g)	M_s	1.2	1.6	1.1	1.3
Sample mass after test (g)	M_f	0.0	0.0	0.0	0.0
Average mass loss rate (g/m²s)	$MLR_{ign-end}$	0.2	0.2	0.2	0.2
Average mass loss rate (g/m²s)	MLR_{10-90}	8.5	2.3	23.9	11.6
Total mass loss (g/m²)	TML	211	320	239	257
Effective heat of combustion (MJ/kg)	ΔH_c	13.1	8.8	13.6	11.8
Max average rate of heat emission (kW/m²)	MARHE	62.8	59.5	67.1	63.1
Volume flow in exhaust duct (l/s)	V	24	24	24	24

Note

In all three tests the specimen started to shrink at approx. 5 seconds.

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Appendix 1

Graphs of heat release rate

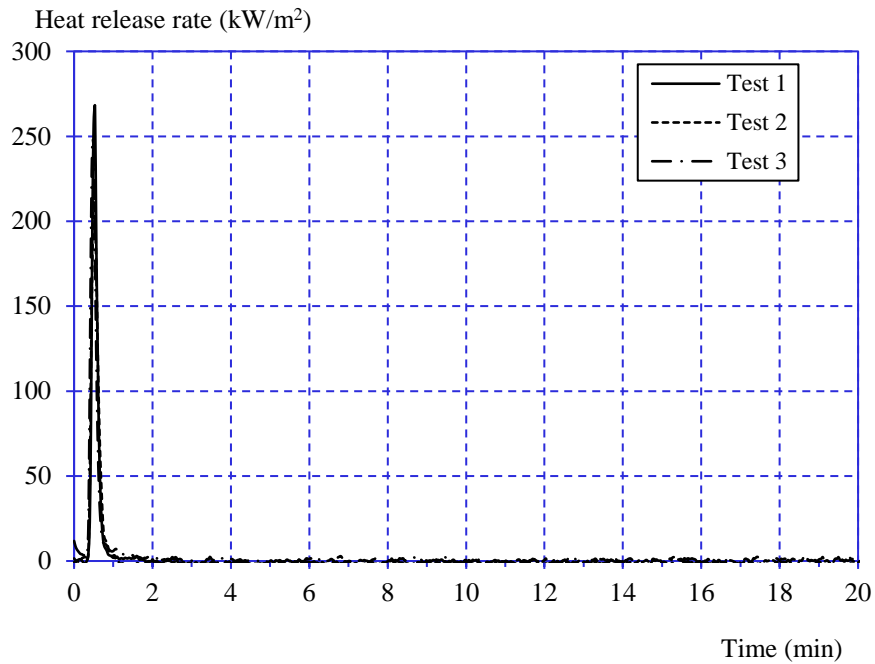Heat release rate (kW/m^2)

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

Measured data

Thickness 0.6 mm approx.
Area weight 180 g/m^2 approx.

Conditioning

According to ISO 5660-1.

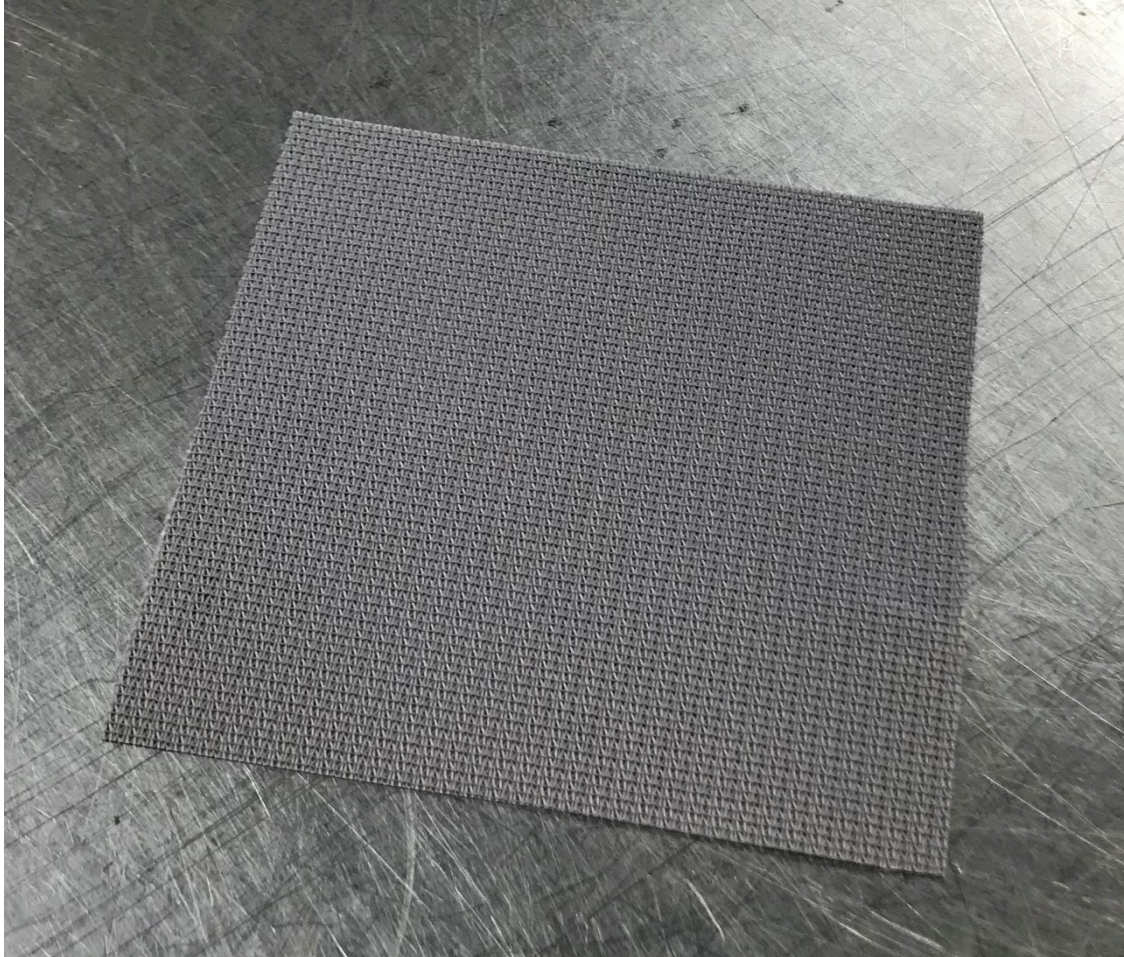Temperature (23 ± 2) °C.
Relative humidity (50 ± 5) %.

Operator

Sven-Ove Vendel.

Date of test

March 1 and 2, 2018.

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Appendix 2

Photograph of a specimen of the tested product

Specimen dimensions are 100 x 100 [mm].

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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_{flash}	Time from test start until flames with shorter duration than 1 s.
t_{ign}	Time from test start until sustained flaming with duration more than 10 s.
T_{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^2 during 1 minute. According to EN 45545-2, end of test is always at 20 min.
T_{test}	Test time. From test start until end of test.
q_{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.
M_0	Mass of specimen.
M_s	Mass of specimen at sustained flaming.
M_f	Mass of specimen at the end of the test.
$MLR_{ign-end}$	Mass Loss Rate. Average mass loss rate from ignition until end of test.
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.
ΔH_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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