



T045 (EN 45001)

I006 (EN 45004)

Smoke and toxicity tests for a profile LTE silicone rubber

Test method:

IMO FTPC Annex 1 Part 2

(IMO Resolution MSC.61(67) Annex 1 Part 2)

Requested by: FP FinnProfiles Oy

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Task **Measuring smoke and toxic products of a profile**

The product tested LTE silicone rubber

Samples of the product will be stored for reference at VTT until 31 December 2002.

The product is specified in Appendix 3 submitted by the manufacturer.

Manufacturer FP FinnProfiles Oy

Date of supply 14 September 2001

Date of tests 29 January - 04 February 2002

Test specimens The sample profile sent by the client was cut at VTT into nine 75 mm long pieces. Each test specimen consisted of one piece of profile measuring 75 mm x 27 mm x 24 mm placed on its side on a thin kaowool layer used as uncombustible backing board. Except the front side the other sides of the test specimen were covered by aluminium folio according to the test method.

The measured mass of the product was about 0,585 kg/m, thickness 24 mm and width 27 mm.

The test specimens were conditioned to constant moisture content at a temperature of 23 ± 2 °C and a relative humidity of 50 ± 5 %.

Test method IMO FTPC, Annex 1, Part 2 - Smoke and toxicity test (IMO Resolution MSC.61(67), Annex 1, Part 2). Description of the test method and requirements are given in Appendix 1.

Toxic fire effluents produced in the above mentioned method were analysed by the standard:
NT FIRE 047 Combustible products: Smoke and gas concentrations, conti-

nuous FTIR analysis except higher temperature of the gas sampling system which has no effect on the results of the low boiling gases reported. Description of the test method is given in Appendix 2.

Test results

The test results are given in tables 1 and 2.

Table 1. Maximum specific optical density values (D_m) of the smoke produced from **LTE silicone rubber** and the results in respect to the criteria (≤ 200) for materials used as surface of bulkheads, linings or ceilings given by IMO FTPC, Annex 1, Part 2.

Test no.	Irradiation kW/m ²	Ignition/ no ignition +/-	D_m	Mean D_m	Criteria $D_m \leq 200$ Pass/ fail
1	25	-	192	199	pass
2	25	-	199		
3	25	-	207		
4	25 ^{pf}	+	138	131	pass
5	25 ^{pf}	+	141		
6	25 ^{pf}	+	115		
7	50	+	179	169	pass
8	50	+	163		
9	50	+	164		

pf: with pilot flame

Table 2. Concentrations of the gases produced from **LTE silicone rubber** and criteria given by IMO FTPC Annex 1 Part 2.

Compound	Concentration (ppm)			Criteria	Pass/ fail
	25 kW/m ²	25 kW/m ² with pilot	50 kW/m ²		
CO	79	142	108	≤ 1450	pass
HCl	<20	<20	<20	≤ 600	pass
HBr	<30	<30	<30	≤ 600	pass
HF	<10	<10	<10	≤ 600	pass
HCN	<2	<2	<2	≤ 140	pass
NO _x	<30	<30	<30	≤ 350	pass
SO ₂	<2	<2	<2	≤ 120	pass

< :The concentration was below the detection limit.

Summary

The tested profile LTE silicone rubber may be regarded to meet the criteria of IMO FTPC, Annex 1, Part 2 (IMO Resolution MSC.61(67), Annex 1, Part 2).

Approval of the product may be obtained only on application to the appropriate administration.

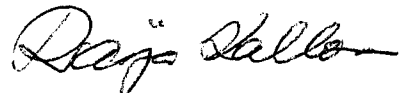
Note

The results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential smoke obscuration and the toxicity hazard of the product in use.

Espoo, 11 March 2002



Matti Lanu
Group manager



Raija Kallonen
Research Scientist

APPENDICES

1. Description of the test method and criteria of IMO FTPC, Annex 1, Part 2
2. Description of the test method for FTIR gas analysis (NT Fire 047)
3. Product specification

DISTRIBUTION

Customer	2 originals
VTT	Original

SMOKE AND TOXIC GAS PRODUCTION

Description of the method IMO FTPC, Annex 1, Part 2 - Smoke and toxicity test (IMO Resolution MSC.61(67), Annex 1, Part 2)

General

Smoke generation is tested in accordance with ISO 5659 Part-2 and toxic gas production in additional test procedures as described below.

Specimens:

Size: 75 mm x 75 mm x ≤ 25 mm. Amount: 9 pcs.

Before the test the specimens should be conditioned to constant moisture content at a temperature of 23 ± 2 °C and a relative humidity of 50 ± 5 %.

Test procedure

The specimen is inserted into horizontal position under the cone radiator inside the smoke density chamber. During the test the smoke and gases produced are distributed in the closed chamber. Three specimens should be tested under each of the following conditions:

- irradiance of 25 kW/m² in the presence of pilot flame
- irradiance of 25 kW/m² in the absence of pilot flame
- irradiance of 50 kW/m² in the absence of pilot flame.

The test should be carried out for at least 10 minutes. If the minimum light transmittance value has not been reached during the 10 minutes exposure the test should be continued for a further 10-minute period.

When making toxicity measurements, the sampling of fumes should be made during the testing of the second or the third specimen at each test condition, when the maximum specific optical density of smoke is reached.

Test results

Specific optical density of smoke as defined below should be recorded during the test period at least every 5 seconds:

$$D_s = \frac{V}{AL} * \log_{10} \frac{100}{T}$$

where

- V = total volume of the chamber (m³)
- A = exposed area of the specimen (m²) and
- L = optical length (m) of smoke measurement
- T = percent light transmittance.

Maximum value of specific optical density of smoke D_m is given as test result.

The concentration of each toxic gas should be determined as ppm in the chamber volume. The gases are analysed according to the standard NT Fire 047.

Criteria

Smoke

An average (D_m) of the maximum of D_s of three tests at each test condition should be within the following limits:

- $D_m \leq 200$ for materials used as the surface of bulkheads, linings or ceilings
- $D_m \leq 400$ for materials used as primary deck covering
- $D_m \leq 500$ for materials used as floor covering
- $D_m \leq 400$ for plastic pipes and electric cables

Toxicity

The gas concentrations measured at each test condition should be within the following limits:

CO	\leq	1450 ppm	HCl	\leq	600 ppm
HCN	\leq	140 ppm	HBr	\leq	600 ppm
NO _x	\leq	350 ppm	HF	\leq	600 ppm
SO ₂	\leq	120 ppm			

Description of the method NT FIRE 047:

COMBUSTIBLE PRODUCTS: SMOKE GAS CONCENTRATIONS, CONTINUOUS FTIR ANALYSIS

This standard specifies a procedure for gas sampling and analysis to determine the smoke gas concentrations of combustible products using an on-line FTIR (Fourier Transform InfraRed) technique. This gas analysis method can be used in connection with dynamic fire tests where combustion gases are collected and the volume flow measured and also in connection with static collecting methods.

Test specimens: The size of the test specimens in the fire test shall be according to the relevant standard, the amount of the specimen material shall however be such that it burns at least 20 s.

Smoke gas sample: Smoke gas samples for the FTIR analysis are taken from a gas collecting system of a fire test method. A part of the mixture is drawn in a continuous and constant flow through glass fiber filters and sampling line and IR absorption cell of FTIR spectrometer which are heated to 130 ± 10 °C.

Test procedure: At the start of the fire test interfered infrared beam is directed through the gas absorption cell and a computer program started which collects spectra at preset (6 s or longer) intervals. The collected spectra present absorption as a function of wave number (cm^{-1}). The concentrations of the gases are calculated by integrating the area (or part of the area) of the absorption band characteristic to the compound in the wide-range absorption spectra of the sample and reference gas mixtures with known concentrations. Calculation routine should be formulated so that if other gases are overlapping only the non-overlapping part should be used. When absorption bands to be analysed are totally overlapped, interference can be removed by subtracting the absorbance of an interfering compound by using a reference spectrum. From the frequently enough acquired successive spectra concentration-time relationship of the gases can be evaluated.

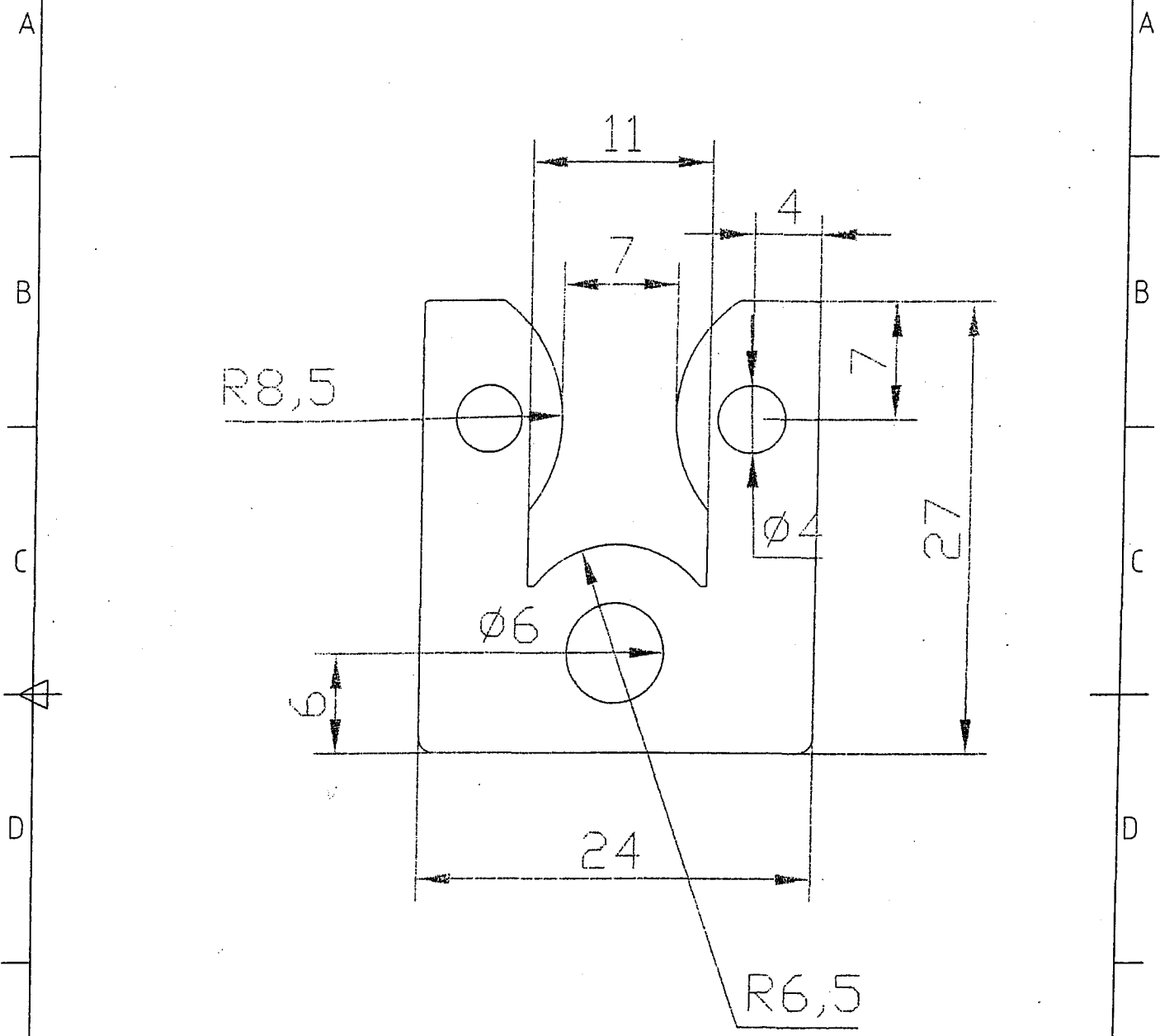
Requirements: According to approving authority.

Details of the gas sampling and analysis in connection with IMO FTPC, Annex 1, Part 2

Sampling gas was pumped to circulate from the smoke chamber to the gas absorption cell of the FTIR analyser through a heated line and back to the chamber. The temperature of gas sampling line, filter holder and gas absorption cell was 170 °C. The gas sampling line was of teflon, the filter holder of stainless steel, the filter of glass fibre and the gas cell of quartz.

Concentrations of carbon monoxide CO, hydrogen chloride HCl, hydrogen bromide HBr, hydrogen fluoride HF, hydrogen cyanide HCN, nitrogen oxides NO_x ($\text{NO} + \text{NO}_2$) and sulphur dioxide SO_2 were measured.

1	2	3	4
RevNo	Revision note	Date	Signature
			Checked



APPENDIX NO. 3 1(1)
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VTT BUILDING AND TRANSPORT

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LTE - silicone rubber				Edition -	Sheet A4