

**IMO Resolution MSC
61 (67) 1996; Annex 1,
Part 2**

Smoke & Toxicity Test

WF Report Number:

169696

Date:

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Test Sponsor:

Recticel nv



**Bodycote warringtonfire Test
Report No. 169696**

**International Maritime
Organisation
Resolution MSC 61 (67) 1996; The
International Code For Application
Of Fire Test Procedures; Annex 1,
Part 2 -
Smoke & Toxicity Test**

Sponsored By

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Test Details

Introduction	<p>This test method, adopted by the International Maritime Organisation, is used for measuring fire characteristics of bulkhead, ceiling and deck finish materials as a basis for characterising their production of smoke and toxic products and thus their suitability for use in maritime construction.</p> <p>The tests were performed in accordance with the procedure specified in IMO Resolution MSC, 61(67) Annex 1, Part 2 as amended by MSC/Circ.916 dated 4th June 1999 and revised by MSC/Circ.1008 dated 8th June 2001, and it is advised that this report is read in conjunction with these documents.</p>
Scope of test	<p>The IMO Resolution MSC, 61(67) Annex 1, Part 2 (Ref.1) specifies that smoke generation tests should be conducted in accordance with ISO 5659 Part 2 (Ref.2).</p> <p>The Resolution also details a classification system based on the maximum specific optical density of smoke occurring during the test, averaged over three replicate tests, carried out in each of three test conditions.</p> <p>In addition, the Resolution specifies limits for 7 toxic gases which must not be exceeded in any of the three test conditions.</p>
Fire test study group/EGOLF	<p>Certain aspects of some fire test specifications are open to different interpretations. The Fire Test Study Group and EGOLF have identified a number of such areas and have agreed Resolutions which define common agreement of interpretations between fire test laboratories which are members of the Groups. Where such Resolutions are applicable to this test they have been followed.</p>
Instruction to test	<p>The test was conducted on the 19th December 2007 and 2nd January 2008 at the request of Recticel nv, the sponsor of the test.</p>
Conditioning of specimens	<p>The specimens were received on the 22nd November 2007.</p> <p>Prior to the tests, the specimens were conditioned to constant mass at a temperature of $23 \pm 2^{\circ}\text{C}$ and a relative humidity of $50 \pm 10\%$.</p>
Exposed face	<p>The foil face of the specimens was exposed to the radiant heat of the furnace when the specimens were mounted in the test position.</p>
Substrate	<p>The specimens were tested without a substrate present.</p>
Provision of test specimens	<p>The specimens were supplied by the sponsor of the test. Bodycote warringtonfire was not involved in any selection or sampling procedure.</p>

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Description of Test Specimens

The description of the specimens given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

Trade name / product reference		"Recticel IMO 4mm"	
General description		Underlay	
Overall thickness		4mm (stated by sponsor of the test) 3.8mm (measured by Bodycote warringtonfire)	
Overall density		156kg/m ³ (measured by Bodycote warringtonfire)	
Name of manufacturer		Recticel	
Foil / film composite facing (test face)	Trade name / product reference	"Compound Alu / Polyester FR"	
	Name of manufacturer	W.Bosch + Co	
	Thickness	31 microns	
	Weight per unit area	61g/m ²	
	Colour	Natural aluminium (silver)	
	Foil	Trade name / product reference	"Aluminium Foil"
		Generic type	Aluminium foil
		Name of manufacturer	W.Bosch + Co
		Thickness	12 microns
		Weight per unit area	33g/m ²
	Flame retardant details		The foil is inherently flame retardant
	Film	Trade name / product reference	"Polyester FR"
		Generic type	Flame retardant grade, poly(ethylene terephthalate)
		Name of manufacturer	W.Bosch + Co
		Thickness	19 microns
Weight per unit area		28g/m ²	
Flame retardant details		See note 1 below	
Hot melt adhesive	Trade name / product reference	See note 1 below	
	Generic type	See note 1 below	
	Name of manufacturer	Protechnic	
	Thickness	See note 1 below	
	Weight per unit area	29g/m ²	
Flame retardant details		See note 2 below	
Foam Core	Trade name / product reference	"Recfoam U140"	
	Generic type	Polyurethane (PU) foam	
	Name of manufacturer	Recticel	
	Thickness	4mm	
	Density	140kg/m ³	
Flame retardant details		See note 3 below	
Hot melt adhesive	Trade name / product reference	See note 1 below	
	Generic type	See note 1 below	
	Name of manufacturer	Protechnic	
	Thickness	See note 1 below	
	Weight per unit area	29g/m ²	
Flame retardant details		See note 2 below	

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Film Face (reverse)	Trade name / product reference	"Spun PP Zwart"
	Generic type	Polypropylene (spunbound non-woven)
	Name of manufacturer	Voltex
	Thickness	5 microns
	Weight per unit area	28g/m ²
	Colour	Black
	Flame retardant details	See note 2 below
Brief description of manufacturing process		The facing were laminated to the foam utilising the hot melt adhesive.

Note 1 - The sponsor of the test was unable to obtain this information.

Note 2 - The sponsor of the test has confirmed that no flame retardant additives were utilised in the production of the product / component.

Note 3 - The sponsor of the test was unwilling to provide this information.

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Test Results

Test procedure

A 75mm x 75mm specimen was mounted horizontally inside a smoke chamber of the design specified in ISO 5659 Part 2, 25mm below a cone shaped, radiant electric heater capable of producing a uniform irradiance of 50kW/m² on the specimen surface. A premixed propane/air pilot flame of length 30mm may be applied 10mm above the specimen surface.

Three replicate specimens are tested in each of 3 test conditions:

1. Irradiance of 25kW/m² in the presence of pilot flame.
2. Irradiance of 25kW/m² in the absence of pilot flame.
3. Irradiance of 50kW/m² in the absence of pilot flame.

The attenuation of a light beam passing through the evolved smoke is measured and the results are reported in terms of the maximum Specific Optical Density attained during the test, given by the equation:

$$D_s = (V/(A*L)) * \log_{10} (100/T)$$

Where:

V	=	total volume of the chamber (m ³)
A	=	exposed area of the specimen (m ²)
L	=	optical length (m) of smoke measurement
T	=	% light transmitted.

Test duration is a minimum of 10 minutes. This period is extended by a further 10 minutes if the maximum Specific Optical Density has not been reached.

The sampling of the fire effluent created in the chamber during the test for the analysis of the concentration of the 7 different gases for which criteria are given is conducted using a variety of methods.

In all cases, the sample is taken from the geometric centre of the chamber and sample lines with the exception of those for the Carbon Monoxide and Oxides of Nitrogen are kept as short as possible between the top of the smoke chamber and the sampling media.

For the analysis of oxides of nitrogen and carbon monoxide, continuous measurements are made throughout the duration of the test. For the other gases, single point analysis is conducted. The gases are absorbed into aqueous media and analysed remotely. Two types of media are used; 0.1M sodium hydroxide solution and 0.3% Hydrogen Peroxide solution.

The gases are sampled over the three minute period of maximum smoke density by bubbling the gases through the media using a fritted funnel Dreschel bottle arrangement. Analysis of the gases is conducted using the methods given in ISO TR 9122-3.

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Carbon monoxide (CO) is determined continuously using a pre-calibrated non-dispersive infra-red analyser with a range of 0 to 0.5% CO. The values reported are those averaged over a 3 minute period of maximum smoke obscuration.

Oxides of Nitrogen (NO_x) are determined continuously using a chemiluminescence analyser with a range of 0 to 500ppm. Again, the values reported are those averaged over a 3 minute period of maximum smoke obscuration.

Hydrogen Cyanide (HCN) is determined from gases absorbed into a solution of sodium hydroxide and analysed using Ion chromatography via an ion exchange column and eluent as specified in ISO TR 9122-3. Hydrogen Fluoride (HF), Hydrogen Chloride (HCl) and Hydrogen Bromide (HBr) are absorbed into a solution of 0.3% hydrogen peroxide and are also analysed by ion chromatography.

Sulphur Dioxide (SO₂) is analysed by absorbing into an aqueous solution and using ion chromatography to determine concentrations.

Summary of results

Specimens of nominally 4mm thick carpet underlay (product reference "Rectical IMO 4mm") have been tested for smoke generation and toxicity in accordance with IMO Resolution MSC 61 (67), Annex 1, Part 2 as amended by MSC/Circ.916 dated 4th June 1999 and revised by MSC/Circ.1008 dated 8th June 2001.

The specimens as tested achieved the criteria for smoke generation and toxicity for primary deck coverings and floor coverings as specified in the Resolution.

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Table 1

Summary of Results.

GAS		Limit (ppm)	Reading (ppm)		
			Condition 1	Condition 2	Condition 3
Carbon Monoxide	CO	1450	29	9	109
Hydrochloric Acid	HCl	600	ND	ND	2
Hydrogen Bromide	HBr	600	ND	ND	ND
Hydrogen Fluoride	HF	600	ND	ND	ND
Hydrogen Cyanide	HCN	140	ND	ND	ND
Nitrous Fumes	NO _x	350	15	ND	ND
Sulphur Dioxide	SO ₂	120	ND	ND	ND
Averaged Specific Optical Density		*	6	29	253

Where ND indicates non-detected.

* indicates SOD ≤ 400 for primary deck coverings and SOD ≤ 500 for floor coverings

The test results relate only to the behaviour of the specimens of the 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.

The tests results relate only to the specimens of the product in the form in which they are tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product which is supplied or used is fully represented by the specimens which were tested.

The quantity of each specific toxic gas species generated is dependant upon the fire model used and the burning behaviour of the specimen during each individual fire test. The quantitative determination of combustion products therefore relates only to the specimens tested under the conditions stated and when combustion occurs as described in this test report.

The test results relating to smoke production are contained in Table 2.

The toxicity data generated during the tests are contained in Table 3.

Time to maximum Specific Optical Density and mass loss during the test are contained in Table 4.

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Specimen Behaviour

- Condition 1** In the case of each specimen, light coloured smoke was produced from the early stages of the test.
- Condition 2** In the case of each specimen, light coloured smoke was produced from the early stages of the test.
- Condition 3** In the case of each specimen, light coloured smoke was produced from the early stages of the test.

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References

1. International Maritime Organisation Resolution MSC 61(67) 1996; The International Code for Application of Fire Test Procedures, Annex 1, Part 2: Smoke and Toxicity Test.
2. ISO 5659 Plastics - Smoke Generation - Part 2 1994: Determination of Optical Density by a Single Chamber Test.
3. ISO/TR 9122 Toxicity Testing of Fire Effluents - Part 3: Methods for the Analysis of Gases and Vapours in Fire Effluents.

Validity


The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over five years old should be considered by the user. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.


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Signatories

PH


Tested By D Hird *


Approved B Dean * Senior Analytical Chemist


Authorised C Dean * Operations Manager

* For and on behalf of **Bodycote warringtonfire**

<i>Report Issued: 12th March 2008</i>
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Table 2

Condition		25kW/m ² In The Presence Of A Pilot Flame	25kW/m ² In The Absence Of A Pilot Flame	50kW/m ² In The Absence Of A Pilot Flame	
Maximum Specific Optical Density	Specimen 1	Ds (max)	5	34	230
		D (Clear beam)	1	2	22
	Specimen 2	Ds (max)	10	30	259
		D (Clear beam)	1	1	20
	Specimen 3	Ds (max)	4	24	293
		D (Clear beam)	1	2	23
	Specimen 4	Ds (max)	NA	NA	277
		D (Clear beam)	NA	NA	22
	Specimen 5	Ds (max)	NA	NA	207
		D (Clear beam)	NA	NA	14
	Specimen 6	Ds (max)	NA	NA	254
		D (Clear beam)	NA	NA	16
	Averaged Ds (max)		6	29	253
	Limit		*	*	*

* indicates SOD ≤ 400 for primary deck coverings and SOD ≤ 500 for floor coverings

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Table 3

GAS		Limit (ppm)	Reading (ppm)		
			Condition 1	Condition 2	Condition 3
Carbon Monoxide	CO	1450	29	9	109
Hydrochloric Acid	HCl	600	ND	ND	2
Hydrogen Bromide	HBr	600	ND	ND	ND
Hydrogen Fluoride	HF	600	ND	ND	ND
Hydrogen Cyanide	HCN	140	ND	ND	ND
Nitrous Fumes	NO _x	350	15	ND	ND
Sulphur Dioxide	SO ₂	120	ND	ND	ND

Where ND indicates non-detected.

Table 4

Condition	Specimen Number	Time To Ds (Max) (s)	Mass Loss (g)
25kW/m ² in the presence of a pilot flame	1	1200	0.5
	2	1200	0.4
	3	1200	2.3
25kW/m ² in the absence of a pilot flame	1	1200	1.1
	2	1200	0.5
	3	1200	0.5
50kW/m ² in the absence of a pilot flame	1	1200	2.3
	2	1200	3.9
	3	870	4.4
	4	990	2.6
	5	1110	2.0
	6	1050	2.1

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