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**Test Report: ICL/H13/2979 Rev 2**

**International Maritime Organisation.  
INTERNATIONAL CODE FOR APPLICATION  
OF FIRE TEST PROCEDURES, 2010  
(2010 FTP CODE)  
Part 2 – Smoke and toxicity test**

**Sponsored By**  
The Amtico Company Ltd  
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Report No. ICL/H13/2979 Rev 2

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**1 Introduction**

International Maritime Organisation, INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES, 2010 (2010 FTP CODE) Part 2 - "Smoke and Toxicity" requires test to be carried out using the test apparatus and methodology detailed in ISO 5659-2: 1994. Toxicity measurements are carried at when maximum specific density of smoke is reached (DmST) is reached.

The principle of the test method, ISO 5659-2, is to expose a material to specified thermal conditions of pyrolysis and combustion in a continuous procedure. The change in optical density of the smoke produced when dispersed within a fixed volume of air is recorded throughout the period of test.

The test method provides a means for the comparative assessment of products, however, it does not model a real fire situation and the results cannot therefore be used to describe the fire hazard of materials under actual fire conditions.

**2 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.

The product was a 2mm thick PVC/Acrylic based multilayer heterogenous flooring tile referenced "Amtico Marine Design reference "AN5W2504" having a mass of 2.55kg/m<sup>2</sup> and consisting of a Clear wear layer, Design Print and Filled backing layers.

The flooring was supplied bonded to one face of a 12mm thick calcium silicate board using Amtico Universal 2-Part Adhesive applied at the rate of 2-2.5 m<sup>2</sup>/kg.

The sponsor of the test has provided a Technical reference sheet relating to this product and this is given in Annex 1.

### 3 Conditioning of Specimens

The specimens were received on 10 December 2013.

The specimens were conditioned to constant mass at  $23 \pm 3^{\circ}\text{C}$  and  $50 \pm 5\%$  RH, before testing.

### 4 Date of Test

The tests were performed on 20 December 2013.

### 5 Test Procedure

The test was performed in accordance with the procedure called up in International Maritime Organisation, INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES, 2010 (2010 FTP CODE) Part 2- "Smoke and Toxicity" and this report should be read in conjunction with that Standard.

Gas samples were taken at DmST and analysed using FTIR apparatus having:

Gas cell having a volume of: 1.33 l  
 Length of gas sampling line: 2 m  
 Inner volume gas sampling tube: 56 cm<sup>3</sup>  
 Capacity of gas sampling pump: 3 l/min

### 6 Test Results

The test 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 and toxic emission hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and will therefore invalidate the test results. It is the responsibility of the supplier of the product to ensure that the product, which is supplied, is identical with the specimens, which were tested.

The results of tests are summarised below:-

**Smoke emission:** The maximum Ds values, average of three tests in each mode, are given below:

Test Mode	25kW m <sup>-2</sup>	25kW m <sup>-2</sup> with pilot flame	50kW m <sup>-2</sup>
Ds max (average)	403.56	267.97	475.74

Full results are given in Appendix 1.

**Toxic gas emission:** Toxic gas emission result are summarised in Table 1 below:

Table 1:

Gas Species	Average Concentration in each mode (ppm)		
	25 kWm <sup>-2</sup>	25 kWm <sup>-2</sup> with pilot	50 kWm <sup>-2</sup>
Carbon Monoxide, CO	80	48	114
Hydrogen Chloride, HCl	53	21	81
Hydrogen Bromide, HBr	ND	ND	ND
Hydrogen Cyanide, HCN	ND	ND	ND
Hydrogen Fluoride, HF	ND	ND	ND
Sulphur Dioxide, SO <sub>2</sub>	ND	ND	17
Nitrous Fumes, NO <sub>x</sub>	ND	ND	ND

Where ND = not detected

Full results are given in Appendix 2.

## 7 **Requirements**

### **Smoke:**

An average (Dm) of the maximum of Ds of three tests at each test conditions shall satisfy the following requirements:

<b>Product type</b>	<b>Ds max</b>
1. Bulkhead, Lining or ceiling	200
2. Primary deck covering	400
3. Floor Covering	500
4. Plastic pipes and electric cables	400

### **Toxicity**

The gas concentration measured at each test condition shall not exceed the following limits in any of the three test modes:

<b>Gas Species</b>	<b>Requirements (ppm)</b>
Carbon Monoxide, CO	≤1450
Hydrogen Chloride, HCl	≤600
Hydrogen Bromide, HBr	≤600
Hydrogen Cyanide, HCN	≤140
Hydrogen Fluoride, HF	≤600
Sulphur Dioxide, SO <sub>2</sub>	≤120 (≤200 for floor coverings)
Nitrous Fumes, NO <sub>x</sub>	≤350

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**8**     **Conclusion**

When tested in accordance with the procedure called up in International Maritime Organisation, Fire Test Procedure Code Part 2: Smoke and Toxicity test Including Revision MSC/Circ 1008, the product satisfies the smoke and the toxicity requirements for use as floor covering.

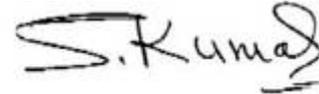
**Prepared by**

A handwritten signature in black ink, appearing to read "C. B. Chong", written over a horizontal line.

**C. B. Chong**  
**Fire Scientist**

**Date of Issue: 24 January 2014.**

**Approved by**

A handwritten signature in black ink, appearing to read "S. Kumar", written over a horizontal line.

**S. Kumar**  
**Technical Manager**

**Date of Issue Rev 1: 12 February 2014.**

**Reason of this revision:**

The sponsor has provided additional information relating to the product that is now given in Annex 1.

**Date of Issue Rev 2: 28 February 2014.**

**Reason of this revision:**

The sponsor has requested that the Clear Wear-Layer thickness in the original data sheet (550µm) was incorrect and asked for it to be changed to 520µm. There is no other change in this report.

**Appendix 1**

**25kW/m<sup>2</sup> without pilot flame**

<b>Run</b>	<b>Maximum specific density (Ds<sub>max</sub>)</b>	<b>Time to maximum specific density (s)</b>	<b>Time to ignition (s)</b>
1	409.97	1000.00	No ignition
2	396.71	1084.00	No ignition
3	404.02	995.00	No ignition
<b>Average</b>	<b>403.56</b>	<b>1026.33</b>	

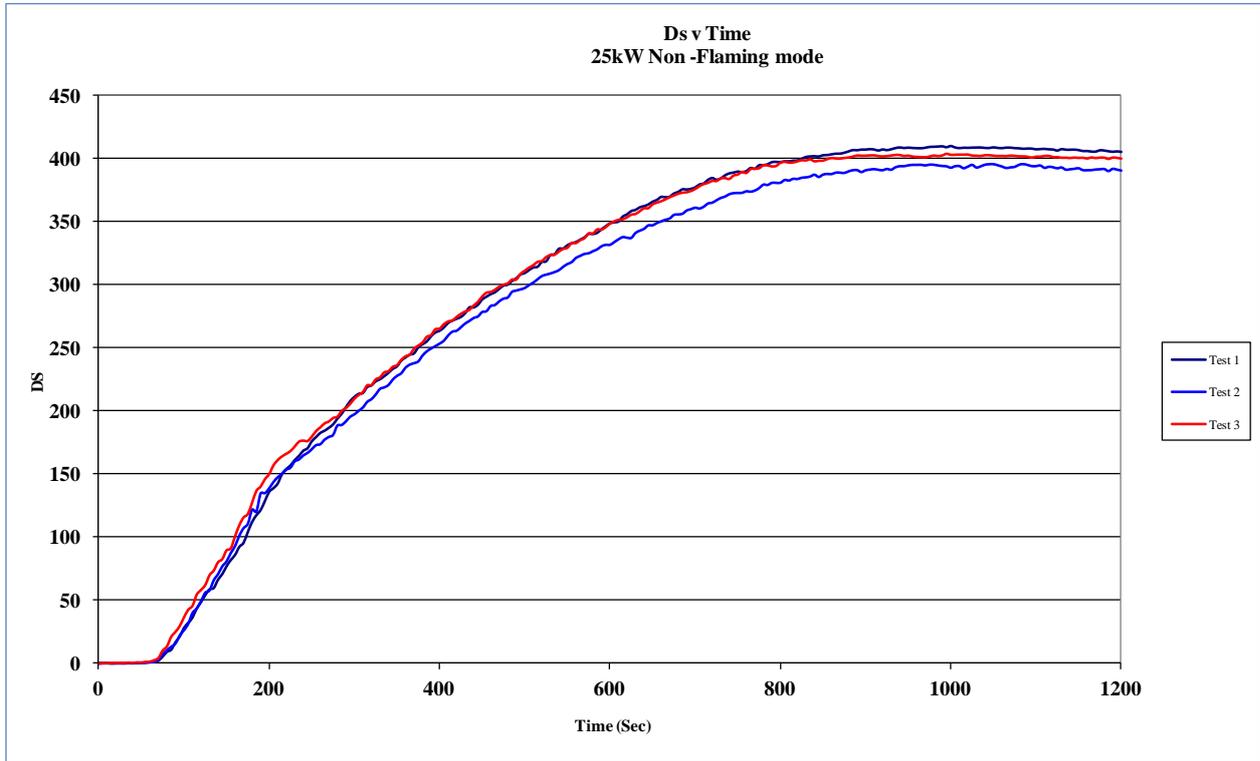
**25kW/m<sup>2</sup> with pilot flame**

<b>Run</b>	<b>Maximum specific density (Ds<sub>max</sub>)</b>	<b>Time to maximum specific density (s)</b>	<b>Time to ignition (s)</b>
1	272.76	236.00	98
2	288.00	213.00	94
3	243.14	218.00	90
<b>Average</b>	<b>267.97</b>	<b>222.33</b>	<b>94</b>

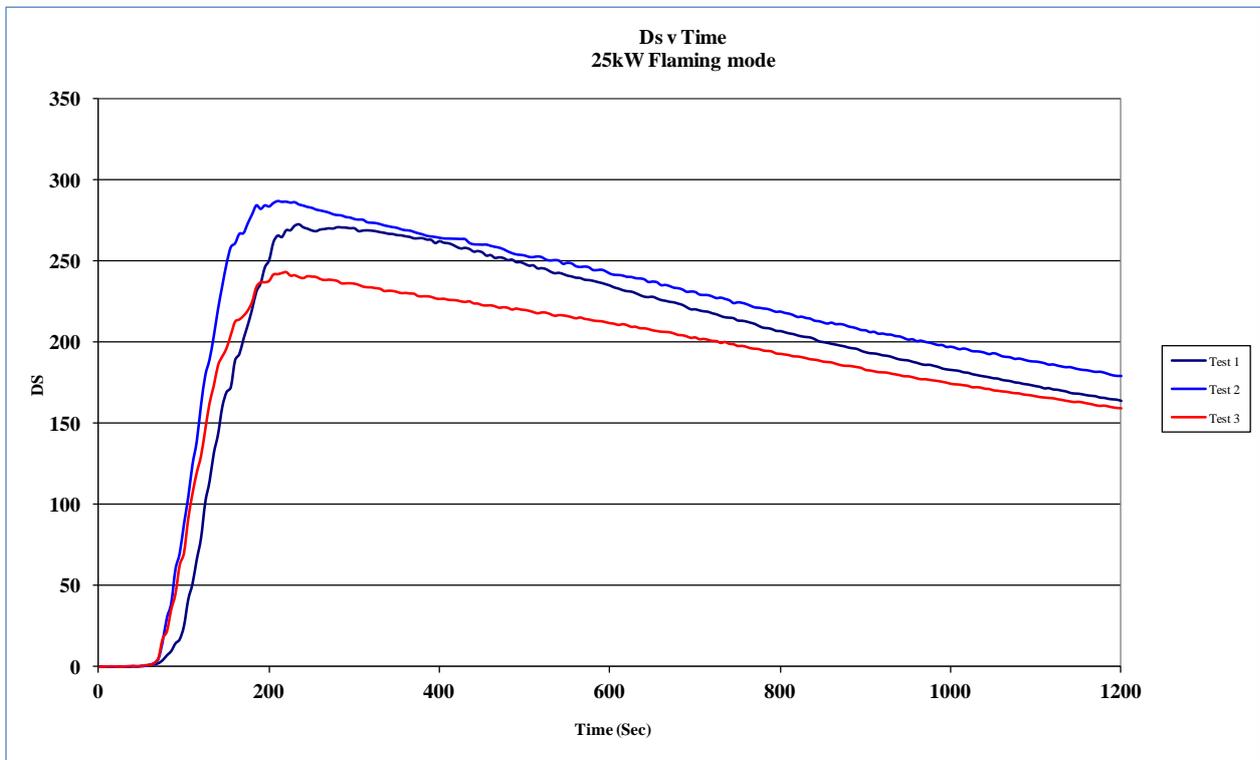
**50kW/m<sup>2</sup> without pilot flame**

<b>Run</b>	<b>Maximum specific density (Ds<sub>max</sub>)</b>	<b>Time to maximum specific density (s)</b>	<b>Time to ignition (s)</b>
1	478.57	132.00	27
2	466.81	111.00	23
3	481.86	104.00	24
<b>Average</b>	<b>475.74</b>	<b>115.67</b>	<b>25</b>

## Smoke Data

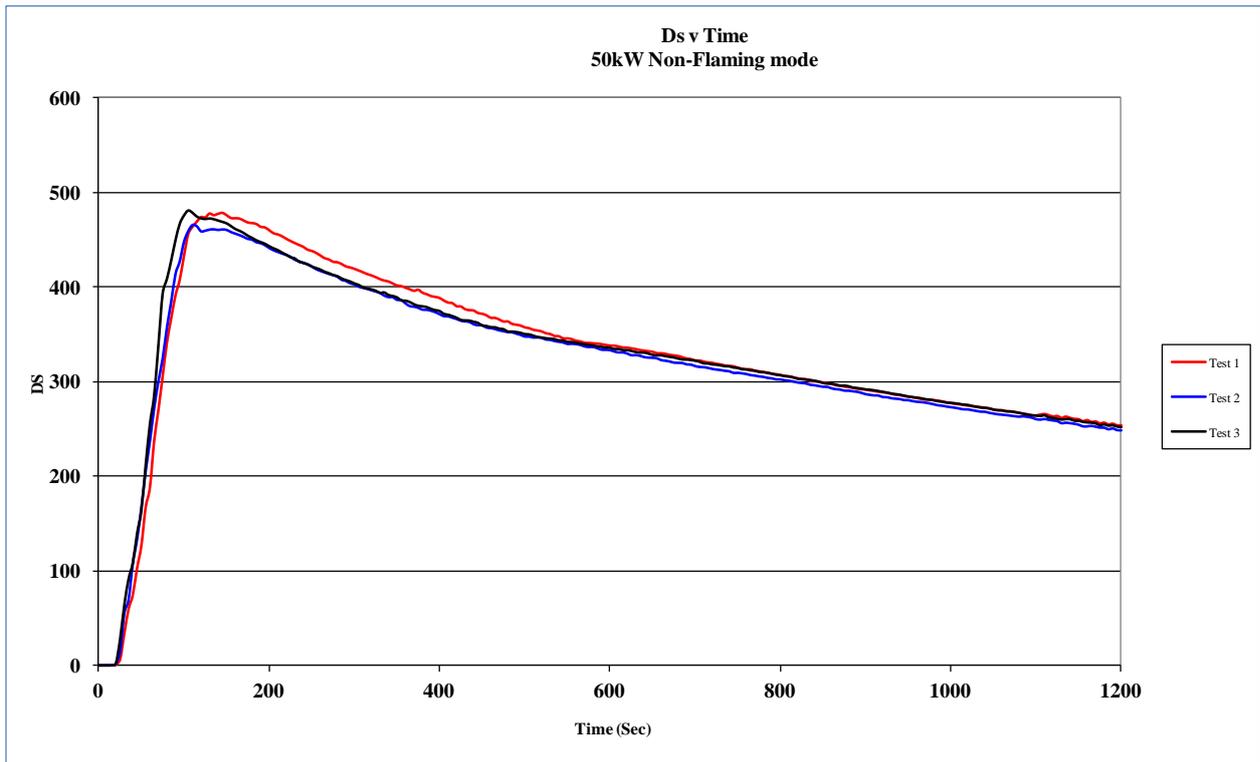


**Graph 1** – Optical Density v Time curve for 25 kWm<sup>-2</sup> without pilot flame



**Graph 2** – Optical Density v Time curve for 25 kWm<sup>-2</sup> with pilot flame

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Graph 3 – Optical Density v Time curve for 50 kWm<sup>-2</sup> without pilot flame

## Appendix 2

### Toxicity Data

#### 25kW/m2 without pilot

Gas species	Concentration (ppm)		
	Run 2	Run 3	Average
Carbon monoxide, CO	73	86	80
Oxides of Nitrogen, NOx	ND	ND	ND
Sulphur dioxide, SO2	ND	ND	ND
Hydrogen Chloride, HCl	53	52	53
Hydrogen Bromide, HBr	ND	ND	ND
Hydrogen Fluoride, HF	ND	ND	ND
Hydrogen Cyanide, HCN	ND	ND	ND

#### 25kW/m2 with pilot

Gas species	Concentration (ppm)		
	Run 2	Run 3	Average
Carbon monoxide, CO	46	49	48
Oxides of Nitrogen, NOx	ND	ND	ND
Sulphur dioxide, SO2	ND	ND	ND
Hydrogen Chloride, HCl	21	20	21
Hydrogen Bromide, HBr	ND	ND	ND
Hydrogen Fluoride, HF	ND	ND	ND
Hydrogen Cyanide, HCN			

#### 50kW/m2 without pilot

Gas species	Concentration (ppm)		
	Run 2	Run 3	Average
Carbon monoxide, CO	97	132	114
Oxides of Nitrogen, NOx	ND	ND	ND
Sulphur dioxide, SO2	16	17	17
Hydrogen Chloride, HCl	78	85	81
Hydrogen Bromide, HBr	ND	ND	ND
Hydrogen Fluoride, HF	ND	ND	ND
Hydrogen Cyanide, HCN	ND	ND	ND

ND = Not detected.

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**Photo: Specimen before test.**

## Annex 1

### Amtico Marine Product Reference Table

General description		Hetrogenous PVC based floor covering
Product reference of floor covering		Amtico Marine (01-14)
Floor covering thickness		2.0mm
Overall weight per unit area		2.55 kg/m <sup>2</sup>
Pattern reference		AN5W2504
Composition		Coating (Lacquer) Wear-layer Print Design Filled Core Layer Filled Backing Layer
Surface Coating	Product reference	(Option 3)
	Generic type	Urethane Acrylic
	Name of manufacturer	(Option 3)
	Application rate	12 g/m <sup>2</sup>
	Application method	Roller
	Curing process (duration and temperature)	UV
	Trade name of flame retardant	N/A
	Generic type of flame retardant	N/A
Clear Wear-Layer	Product reference	Marine Clear Wear-layer
	Generic type	Plasticised PVC
	Name of manufacturer	Amtico
	Thickness	520µm
	Trade name of flame retardant	N/A
	Generic type of flame retardant	N/A
	Amount of flame retardant	N/A
Print Film	Product reference	SW2504
	Generic type	PVC Print Film
	Name of manufacturer	(Option 3)
	Thickness	75µm
Filled Core Layer	Product reference	Marine Filled Core Layer
	Generic type	Filled Plasticised PVC
	Name of manufacturer	Amtico International
	Thickness	760µm
	Generic type of flame retardant	(Option 3)

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Filled Backing Layer	Product reference	Marine Filled Backing Layer
	Generic type	(Option 3)
	Name of Manufacturer	Amtico International
	Thickness	500µm
	Generic type of flame retardan	(Option3 )
Adhesive (floor covering to substrate)	Product Reference	Amtico Universal 2-part Adhesive
	Generic type	Polyurethane adhesive
	Name of Manufacturer	(Option 3)
	Application rate	2-2.5 m <sup>2</sup> /kg
	Application method	Notched trowel (A2 or 1.5mm x 5mm V notch)
	Amount of flame retardant	N/A
Substrate	Trade Name / Product Ref.	Superlux
	Generic Type	Calcium Silicate
	Thickness	12mm
	Density	950 kg/m <sup>3</sup>
	Amount of flame retardant	Product is inherently non-combustible

OPTION 1. - The sponsor was unwilling to provide this information.

OPTION 2. - The sponsor was unable to provide this information.

OPTION 3. - The sponsor of the test has provided this information but at the specific request of the sponsor, these details have been omitted from the report and are instead held on the confidential file relating to this investigation.