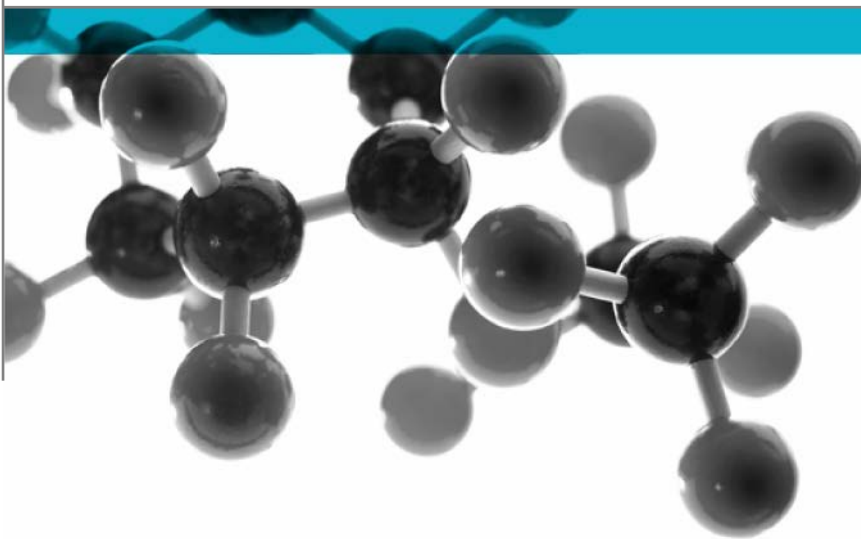


ISO 5659-2:2012



Smoke Assessment

ISO 5659-2: 2012; Plastics – Smoke Generation. Part 2 Determination of Optical Density by a Single Chamber Method

A Report To: Shore Auto Rubber Exports Pvt. Ltd.

Document Reference: 397435

Date: 18th May 2018

Issue No.: 1

Page 1

Testing
Advising
Assuring

Executive Summary

Objective To determine the optical density produced from the following product when tested in accordance with ISO 5659-2: 2012. The sole test mode used was an irradiance level of 25kW/m² with a pilot flame.

Generic Description	Product reference	Thickness	Density / specific gravity / weight per unit area
Silicone hose with three layers of fabric reinforcement	No specific reference assigned	7.24mm *	1.25g/cm ³ *
Individual components used to manufacture composite:			
Rubber	"58170C"	Unwilling to provide	1.25
Polyester fabric (Embedded in rubber)	"145 +/- 5 grams per square meter"	3 x 0.6mm	Unwilling to provide
* Determined by Exova Warringtonfire			
Please see page 6 of this test report for the full description of the product tested			



Test Sponsor Shore Auto Rubber Exports Pvt. Ltd., Gat 7, Post- Chimbli, Tal Khed, Dist, Pune – 410501, India

Summary of Test Results: **The average Ds(max) value determined within 10 minutes was 302.**

The average Ds(max) value determined within 20 minutes was 393.

Date of Test 30th April 2018

Signatories

	
Responsible Officer C. Henry * Technical Officer	Authorised B. Dean * Technical Leader

* For and on behalf of **Exova Warringtonfire**.

Report Issued: 18th May 2018

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CONTENTS	PAGE NO.
EXECUTIVE SUMMARY	2
SIGNATORIES.....	2
TEST DETAILS.....	4
DESCRIPTION OF TEST SPECIMENS.....	6
TEST RESULTS	7
APPENDIX I	9
APPENDIX II.....	10
REVISION HISTORY	11

Test Details

Scope of test

To determine the performance of specimens of a product when they are subjected to the conditions of the test specified in ISO 5659-2: 2012, Plastics – Smoke Generation – Part 2: Determination of optical density by a single chamber test.

The test was performed in accordance with the procedures specified in ISO 5659-2 and this report should be read in conjunction with this and other related standards.

Test procedure

The tests were performed in accordance with the procedure specified in EN ISO 5659-2: 2012 and it is advised that this report is read in conjunction with that Standard.

A 75mm x 75mm specimen was mounted horizontally inside a smoke chamber of the design specified in EN ISO 5659-2: 2012, 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.

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 method

Specimens were tested in a horizontal position by exposure to the heating arrangement specified in ISO 5659-2. As per LUL S1180, LUL S1085 and EN 45545-2, the test was only performed in one mode. The mode required for these tests heat flux 25kW/m². The change in optical density of the smoke produced when dispersed within a fixed volume of air is recorded throughout the period of test utilising the Concept software in order to determine information relating to the smoke density.

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.

**Fire test study
group/EGOLF**

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.

Instruction to test

The test was conducted on the 30th April 2018 at the request of Shore Auto Rubber Exports Pvt. Ltd., the sponsor of the test.

**Provision of test
specimens**

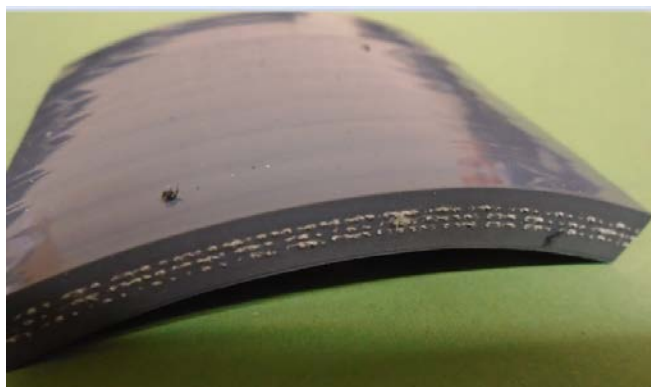
The specimens were supplied by the sponsor of the test. **Exova Warringtonfire** was not involved in any selection or sampling procedure.

Test face

The outer face of the specimens was exposed to the heating conditions.

**Condition of
specimen edges**

Layered product, with no layer covering the edges

**Photograph of
specimen****Conditioning of
specimens**

The specimens were received on the 14th March 2018.

The specimens were conditioned at temperatures of $23 \pm 2^\circ\text{C}$ and a relative humidity of $50 \pm 5\% \text{ RH}$, for a minimum period of 24 hours prior to testing.

Description of Test Specimens

The description of the system given below has been prepared from information provided by the sponsor of the test. This information has not been independently verified by **Exova Warringtonfire**. All values quoted are nominal, unless tolerances are given.

General description		Silicone hose with three layers of fabric reinforcement
Product reference of overall composite		No specific reference assigned
Name of manufacturer of overall composite		Shore Auto Rubber Exports Pvt. Ltd.
Thickness of overall composite		6 ± 1mm (up to 7.5mm at the overlap) (stated by sponsor) 7.24mm (determined by Exova Warringtonfire)
Specific gravity		1.25 (stated by sponsor)
Density overall composite		1.25g/cm ³ (determined by Exova Warringtonfire)
Rubber	Generic type	Silicone
	Product reference	"58170C"
	Name of manufacturer/ further details	Shore Auto Rubber Exports Pvt. Ltd. is compounding the rubber in house. The raw material is bought out along with the pigment, accelerators and fillers.
	Thickness	See Note 1 Below
	Specific gravity	1.25
	Colour reference	"Grey"
	Flame retardant details	See Note 2 Below
Polyester fabric (Embedded in rubber)	Generic type	Polyester fabric
	Product reference	"145 +/- 5 grams per square meter"
	Name of manufacturer	See Note 1 Below
	Colour reference	"White"
	Number of layers	3
	Thickness per layer	0.6 ± 0.1mm
	Density / weight per unit area per layer	See Note 1 Below
	Type of weave / cell dimensions	See Note 1 Below
Flame retardant details	See Note 3 Below	
Brief description of manufacturing process		The Inner Rubber Liner, Fabric Plies and Outer Layer, all 3 are calendared and wrapped on the tool. Following this, they are cured, extracted from the mandrel, and then post-cured.

Note 1: The sponsor was unwilling to provide this information.

Note 2: The sponsor was unable to provide this information as they are not the manufacturer of the raw material. The base raw material used is FR 8775U from Bluestar Silicones. Bluestar Silicones adds the flame retardants and the sponsor is not aware of the flame retardants contained within the base raw material purchased. The sponsor does the compounding inhouse by adding pigments, accelerators and other fillers.

Note 3: The sponsor of the test has confirmed that no flame retardant additives were utilised in the production of the component.

Test Results

Applicability of 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 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.

Smoke Density

EN 45545-2, test method referenced "T10.03" requires the Ds(max) to be calculated. That is the maximum specific optical density within the first 10 minutes test duration.

The maximum specific optical density within the first 20 minute test duration is also reported in case this is required by an alternative specification (e.g. LUL S1085 & LUL S1180).

	Specimen 1	Specimen 2	Specimen 3	Mean Average
Ds(max) within 10 minutes	298	287	320	302
Ds(max) within 20 minutes	435	349	396	393

Additional Test Data

Additional smoke density data along with observations obtained throughout the duration of the test is tabulated in Appendix I of this test report.

A graph of the results obtained is illustrated in Appendix II of this test report.

Summary of results

The average Ds(max) value determined within 10 minutes was 302.

The average Ds(max) value determined within 20 minutes was 393.

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.

These 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 hazard of the product in use.

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Appendix I

	SPECIMEN NUMBER			Mean
	1	2	3	
Clear Beam Correction Factor (D_c)	53	51	51	
Specific Optical Density at 10 minutes (D_{s10})	297	287	320	301
Specimen thickness	7.40	7.44	7.49	7.44
Initial specimen weight (g)	53.0	53.0	50.7	52.2
Final specimen weight (g)	46.2	44.81	44.09	45.0
Mass Loss (g)	6.8	8.2	6.6	7.2
Wire Grid (if applicable)	N/A	N/A	N/A	N/A
Neutral-density correction factor (C_f) (if applicable)	N/A	N/A	N/A	N/A
Test Duration (s)	1200	1200	1200	1200
Chamber back wall temperature	37	37	37	N/A
Test Operator	Hollie Mitchell			N/A

Observations:

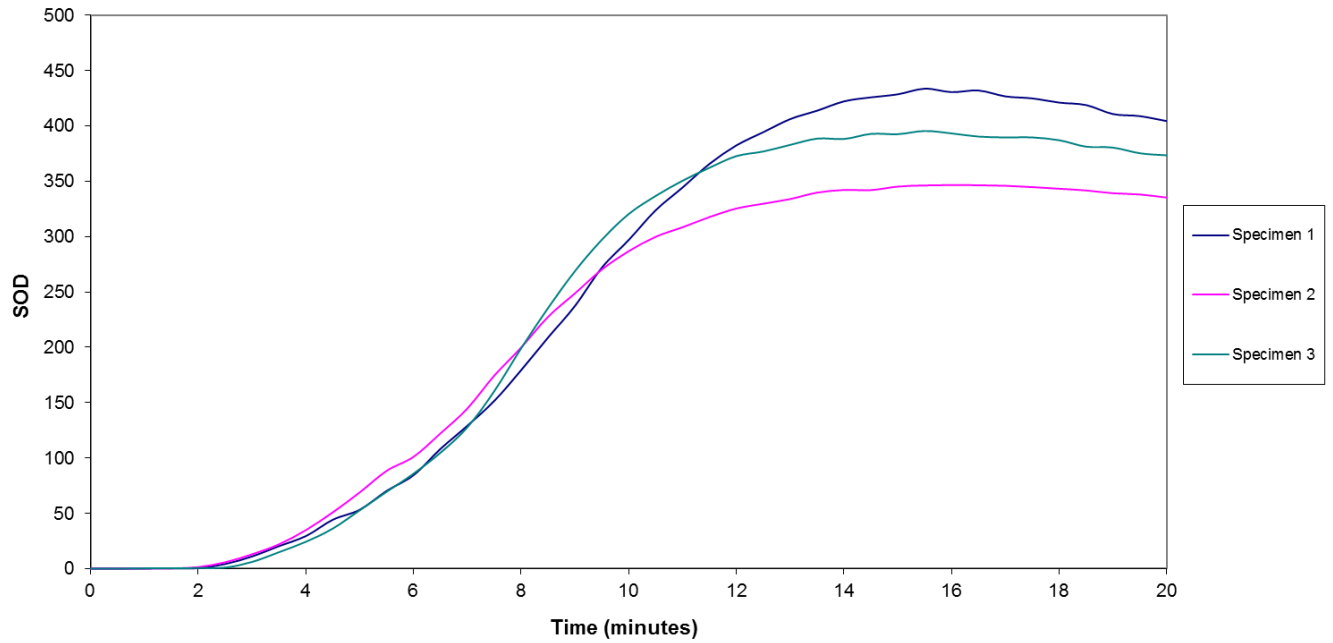
Specimen No.	25kW/m ² In The Presence Of A Pilot Flame		
	1	2	3
Colour of smoke produced	Dark	Dark	Dark
Expansion distance towards heater (mm)	10	15	15
Type of Expansion	*	*	*
Specimen to heater distance (mm)	25	25	25
Ignition time in seconds (if applicable)	135	119	195
Extinction time in seconds (if applicable)	End	End	End
Unusual or unexpected behavior?	N/A	N/A	N/A
Any difficulties during test?	N/A	N/A	N/A

N/A = Not Applicable

Where * indicates that the mode of expansion was a combination of delamination and intumescence, where the intumescence was < 10mm.

Appendix II

25kW/m² in the presence of a pilot flame



Revision History

Issue No :	Re - Issue Date:
Revised By:	Approved By:
Reason for Revision:	

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Revised By:	Approved By:
Reason for Revision:	