



TESTING CERT # 1136.03

Chemitox

TEST REPORT

Report Number: 201047R

Date of Issue: March 18, 2024

Amendment to report serial number 201047 due to the request of Hanwha Techwin's company name change. The changes are identified with underlines.

Report to:

Hanwha Vision Co., Ltd.

6, Pangyo-ro 319 Beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, 13488, Korea

Prepared by:

Chemitox, Inc., Yamanashi Testing Center KAI

18349, Egusa, Sutama-cho, Hokuto-shi, Yamanashi-ken 408-0103, Japan

A handwritten signature in black ink, appearing to read 'K. Sakamoto'.

Responsible Officer
Kiyohiko Sakamoto
Vice President, Director
Chief Technology Officer

A handwritten signature in black ink, appearing to read 'Makoto Horimizu'.

Authorized
Makoto Horimizu
Manager

- (1) Chemitox is accredited by the following agency to ISO/IEC 17025.
American Association for Laboratory Accreditation (A2LA) — Certificated No: 1136.03
- (2) This TEST REPORT refers only to the sample tested, unless stated otherwise.

Hanwha Vision Co., Ltd.
6, Pangyo-ro 319 Beon-gil, Bundang-gu,
Seongnam-si, Gyeonggi-do, 13488, Korea

Oxygen Index Measurement Test Report

1. Objective

As per client’s request, oxygen index test is conducted in accordance with ISO 4589-2:2017 "Plastics -- Determination of burning behaviour by oxygen index -- Part 2: Ambient-temperature test".

2. Test Date

September 14, 2020

3. Test Specimen(s)

The description of the specimens given in Table 1 has been prepared from information provided by Hanwha Vision Co., LTD. This information has not been independently verified by Chemitox. All values quoted are nominal, unless specified.:

Table 1 Description of test specimens

Material Composition	Product Name	Color	Nominal Dimension (mm)	Received on
Polycarbonate	NH-1035	Gray	125 x 6.5 x 3.0	September 7, 2020

4. Conditioning

Test Method and Conditioning is indicated in Table 2.

Table 2 Test Method and Conditioning

Test	Oxygen Index Measurement
Applicable Standard	ISO 4589-2 : 2017
Test Mode	Procedure A (Top surface ignition)
Conditioning	Specimens are conditioned to be stabilized constant mass or at least 88h at 23±3°C/50±10 %RH

5. The Method

A small test specimen is supported vertically in a mixture of oxygen and nitrogen flowing upwards through a transparent chimney. The upper end of the specimen is ignited and the subsequent burning behavior of the specimen is observed to compare the period for which burning continues, or the length of specimen burned, with specified limits for such burning. By testing a series of specimens in different volume fractions of oxygen, the OI is estimated. For the purposes of calculation of estimated standard deviation σ , the OI is calculated to two decimal places when OI is expressed as a percentage. For the purposes of reporting OI results, express OI values to the nearest 0.1 when OI is expressed as a percentage, with exactly intermediate results being rounded downwards.

6. Test Results

The following Table 3 shows the summary of obtained test results. See Appendix for details.

Table 3: Test Results

Product Name	NH-1035
OI (%)	30.3

Note: The test results relate only to the behavior of the test specimens under the conditions of this test and that these results shall not be used to infer the fire hazards of the materials in other forms or under other fire conditions.

7. Test Location

Chemitox, Inc., Yamanashi Testing Center KAI
18349 Egusa, Sutama-cho, Hokuto-shi, Yamanashi-ken 408-0103

8. Performed by



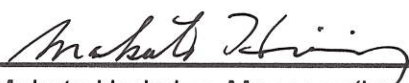
Masaru Sakamoto, Engineer (Level 2)

9. Reported by



Masaru Sakamoto, Engineer (Level 2)

10. Reviewed by



Makoto Horimizu, Manager (Level 3)

Note: This report shall not be reproduced except in full.

Appendix

(1 Pages)

- Detailed test results

Oxygen Index Test Result

TP-48-R3
Issued: 2005-07-29
Revised: 2019-06-03

Test Date: 2020/9/14
Product Name: NH-1035 Material: Polycarbonate
Specimen form: IV L: 125 mm / W: 6.5 mm T: 3 mm / Color: -)
Color: Gray
Test chimney Diameter: 75 mm
Room Temperature: 23 °C
Relative Humidity: 81 %
Ignition Procedure: Procedure A (Top Surface Ignition)
Chimney Inside Temp.: 23 °C
Ox. Conc. Change Interval (d): 0.2 %
Test method: ☐ JIS K6269 ☐ JIS K7201-2 ☐ ASTM D2863 ☒ ISO4589-2 ☐ other

A. Determination of preliminary volume fraction of oxygen

Oxygen volume fraction (%)	28.0	32.0	30.0	31.0
Burning period (s)	26.1	79.0	51.4	82.0
Length burnt (mm)	12.0	51.0	27.0	51.0
Response (○ or ×)	○	×	○	×

B. Determination of Oxygen Index

Found that differ by $d = 0.2\%$ and of which one gave an "○" response and the other an "×" response.

Measurement of N T Series									
Measurement of N L Series					Last Five Specimens				Cf
Oxygen Concentration (%)	30.0	30.2			30.2	30.0	30.2	30.4	30.2
Burning Time (s)	66.9	107.4			107.4	113.0	82.6	93.7	74.7
Burned Length (mm)	24.0	51.0			51.0	40.0	41.0	51.0	35.0
Response (○ or ×)	○	×			×	○	○	×	○
* COLUMN (2, 3, 4 or 5): 2					* ROW (1 to 16): 3				
					$k = 0.37$				

$$OI = Cf + kd = 30.2 + (0.37 \times 0.2) = 30.3\% \text{ (To Report; one decimal place)}$$

$$= 30.27\% \text{ (To Calculate Standard Deviation; two decimal places)}$$

C. Verification of step size d% oxygen volume fraction

Last Six Specimens' Results		Oxygen Concentration (%)			
		C_i	OI	$C_i - OI$	$(C_i - OI)^2$
C_f	1	30.2	30.27	-0.07	0.0055
	2	30.4	30.27	0.13	0.0159
	3	30.2	30.27	-0.07	0.0055
	4	30.0	30.27	-0.27	0.0751
	5	30.2	30.27	-0.07	0.0055
n	6	30.0	30.27	-0.27	0.0751
		$\sum (C_i - OI)^2 = 0.1825$			

Estimation of Standard Deviation

$$\hat{\sigma} = \left[\frac{\sum (C_i - OI)^2}{n-1} \right]^{1/2} = 0.1910$$

$$\frac{2\hat{\sigma}}{3} = 0.1274 \quad d = 0.2 \quad \frac{3\hat{\sigma}}{2} = 0.2866$$

D. Uncertainty estimation

$$\sigma_{OI} = \sqrt{\left(\frac{0.5}{\sqrt{3}}\right)^2 + \left(\frac{\hat{\sigma}}{\sqrt{6}}\right)^2} = 0.299$$

$$\Delta OI = \sqrt{3} \times \sigma_{OI} = 0.52$$

E. Observation

N/A

Performed by: Masaru Sakamoto