

TÜV Rheinland LGA Products GmbH * 90431 Nürnberg

Karl Otto Braun GmbH
Herrn Dr. Michael Lill
Lauterstraße 50
D-67752 Wolfstein
Germany

Test Report
No.: 5421028/1b_en

Orderer: see consignee

Order Date: 16.03.2012
Order number: 4541781419

Scope: Testing of the chemical resistance of the interior surfaces of plastics and linings according to DIN 858-1, clause 8.1.4.2 on an epoxy resin

Samples Received: 25.03.2012

Testing Period: 29.03. till 21.05.2012

Attachments: ---

Vorbehaltlich einer abweichenden Genehmigung / Lizenzvereinbarung darf dieser Prüfbericht nur im ungekürzten Originalwortlaut und in Originalgestaltung veröffentlicht und verwendet werden. Das Gutachten (Bericht) enthält das Ergebnis einer Einzelprüfung und stellt kein allgemeingültiges Urteil über die Eigenschaften aller Produkte aus der Serienfertigung dar. Sollte der Inhalt des Prüfberichtes einer Auslegung bedürfen, so ist der deutsche Text maßgebend. / *Except when otherwise approved / licensed by TÜV Rheinland LGA Products GmbH this test report may only be published and used in unabbreviated original phrasing and form. The test report contains the result of one single examination of the individual test sample and does not represent any universally valid evaluation of the qualities of all products from serial production. Should the content of the test report need any interpretation the German text shall be leading.*

P:\Datad\QZPS\PZGK\2012\Berichte\ 5421028_1b_en page 1 of 4

TÜV Rheinland LGA Products GmbH
Tillystraße 2 • 90431 Nürnberg
Tel (09 11) 6 55-5641 • Fax (09 11) 6 55-5739
E-Mail: norbert.kurr@de.tuv.com • www.tuv.com/safety

Amtsgericht Nürnberg HRB Nr. 26013
Geschäftsführer: Dipl. Ing. Jörg Mähler
Dipl.-Kfm. Dr. Jörg Schlösser
Steuer-Nr. 216/5715/1213 Ust-IdNr. DE 811835490

1. Task

Per mailing of March 16, 2012 the TÜV Rheinland LGA Products GmbH was instructed to perform tests of the chemical resistance of the interior surfaces of plastics and linings according to DIN 858-1, clause 8.1.4.2 on an epoxy resin.

2. Description of samples

10 green sheets with the dimensions of ca. 290 mm x 200 mm x 4 mm were made available. The sheets were marked with III-1 to III-10.

According to the given information the material is the type Brawoliner III, an epoxy resin designed for liners and the corresponding support material. The layers correspond with the composition in liners.

3. Performance of the tests

3.1 Media storage

Ever 2 of the above mentioned sheets were stored in the following media according to ISO 858-1, section 8.1.4.1 1000 h

- Demineralized water, at (40 ± 2) °C;
- Fuel oil according to ISO 8217, named ISO-F-DMA, at (23 ± 2) °C;
- Unleaded fuel according to EN 228, at (23 ± 2) °C;
- A mixture of different substances, as specified in DIN 858-1, at (40 ± 2) °C.

After the storage the sheets were removed from the media and tested according to DIN 858-1, clause 8.1.4.2:

3.2 Tensile Test

The tensile strength and modulus was determined according to DIN EN ISO 527-4 (supersedes EN 61).

Parameters: Test speed: 100 mm/min, sample type 1A, measuring distance: 50 mm, testing climate: 23 °C / 50 % RH.

3.3 Flexural strength

The flexural strength and flexural modulus were determined according to DIN EN ISO 14125 (supersedes EN 63).

Parameters: Test speed: 5 mm / min, test specimen dimensions: 80 mm x 10 mm x thickness, climate: 23 °C / 50 % RH.

3.4 Izod impact strength

The Izod impact strength was measured according to ISO 180 / U.

Parameters: Test equipment: Zwick type 5113, specimen dimensions: 80 mm x 10 mm x thickness, pendulum used: 5.5 J, sample temperature: + 23 °C. Test conditions: climate 23/50-2 according to DIN 50 014.

4. Results

The correlation of the testing media for the chemical resistance is to be seen in the following table.

Table 1. Correlation of the testing medium for the chemical resistance

No. of medium	Medium	According to standard	Storage temperature, °C
1	Zero samples, stored at room conditions	---	23
2	Demineralized water	EN 858-1	40
3	Fuel according to ISO 8217	EN 858-1	23
4	Unleaded fuel according to EN 228	EN 858-1	23
5	A mixture of different substances with demineralized water as specified in DIN 858-1	EN 858-1	40

Table 2. Tensile test and E-Modulus according to DIN EN ISO 527-4

Medium	Tensile strength, MPa			Modulus, MPa		
	actual	nominal	passed	actual	nominal	passed
1	32,0	---	---	3160	---	
2	31,2	≥ 25,6 ¹⁾	yes	3080	≥ 2528 ¹⁾	yes
3	33,7	≥ 25,6 ¹⁾	yes	3220	≥ 2528 ¹⁾	yes
4	30,7	≥ 25,6 ¹⁾	yes	3220	≥ 2528 ¹⁾	yes
5	30,9	≥ 25,6 ¹⁾	yes	3120	≥ 2528 ¹⁾	yes

1) ≥ 80 % of the actual value of no. 1 (zero sample)

Table 3. Flexural strength and flexural modulus according to DIN EN ISO 14125

Medium	Flexural strenght, MPa			flexural modulus, MPa		
	actual	nominal	passed	actual	nominal	passed
1	73,4	---	---	3210	---	
2	72,0	≥ 58,7 ¹⁾	yes	3040	≥ 2568 ¹⁾	yes
3	72,9	≥ 58,7 ¹⁾	yes	3150	≥ 2568 ¹⁾	yes
4	74,7	≥ 58,7 ¹⁾	yes	3260	≥ 2568 ¹⁾	yes
5	75,5	≥ 58,7 ¹⁾	yes	3140	≥ 2568 ¹⁾	yes

1) ≥ 80 % des Wertes von 1 (Nullprobe),

Table 4. Results of the mechanical tests according to ISO 180/U Izod

Medium	Izod notched impact test, kJ/m ²		
	actual	nominal	passed
1	14,6 (C)	---	---
2	14,39 (C)	≥ 11,7 ¹⁾	yes
3	16,5 (C)	≥ 11,7 ¹⁾	yes
4	15,7 (C)	≥ 11,7 ¹⁾	yes
5	17,2 (C)	≥ 11,7 ¹⁾	yes

1) ≥ 80 % des Wertes von 1 (Nullprobe)

5. Summary

Based on the performed tests and our experience, we confirm that the tested material meets the requirements regarding the chemical resistance of the interior surfaces according to DIN 858-1, section 8.1.4.2.

Nürnberg, May 21, 2012

TÜV Rheinland LGA Products GmbH
 Kunststoffprüfung



Dipl.-Ing. Norbert Kurr
 Head of Polymer Testing