

Test report no.: 126578/18-II

Customer: Schlegel Germany GmbH
Bredowstraße 33
22113 Hamburg
GERMANY

Order: Testing the suitability of PU foam sealings as foamed gaskets for plastic windows and doors

Letter of: 2018-01-19

Ref: Mr. Rune Strauch

Sample receipt: 2018-03-22

Test period: 2018-04-03 to 2019-01-08

The test report comprises 12 pages and 2 annexes.

Würzburg, 2019-03-22
Sc/Lg/km

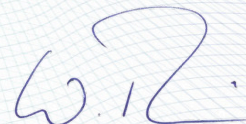
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The original language of the report is German. In case of doubt, the German version is obligatory.

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The results refer to the products tested. The scope of accreditation is available on the Internet at www.skz.de.

Content

1.	Order	3
2.	Test material	3
3.	Test procedure.....	5
3.1	Identification (item C. 4.1)	6
3.1.1	Colour (item C. 4.1.1).....	6
3.1.2	Solid-state infrared spectrum (item C. 4.1.2)	6
3.1.3	Tensile test (item C. 4.1.3)	6
3.1.4	Compression set (item C. 4.1.4)	7
3.2	Behaviour after heat ageing (item C. 4.2)	7
3.2.1	Changes in appearance and delivery condition (item C. 4.2.1).....	7
3.2.2	Change in elongation at break and tensile strength at break (item C. 4.2.2 and item C. 4.2.3).....	8
3.3	Behaviour after artificial weathering (item C. 4.3)	8
3.3.1	Visual assessment and colour change after artificial weathering (items C. 4.3.1 and C. 4.3.2)	9
3.3.2	Elongation at break after artificial weathering (item C. 4.3.3)	9
3.3.3	DVR after artificial weathering (item C. 4.3.4)	9
4.	Test results.....	10
5.	Summary of the results	12

1. Order

The company Schlegel Germany GmbH, Bredowstraße 33, 22113 Hamburg, GERMANY ordered SKZ - Testing GmbH by letter dated 19 January 2018 to test the suitability of PU foam sealings as foamed gaskets for plastic windows and doors. The test was carried out according to technical appendix to RAL-GZ 716, Quality and test specifications for components and processes, section C, "Foamed gaskets and the sealing materials used for these" (2018-07).

2. Test material

SKZ - Testing GmbH received the following test material for testing on 22 March 2018:

Manufacturer information:

- 12 x 1.3 m foamed profile pattern (sample 1)

Seal designation	Q-LON 9154
Formulation basis (foam core)	Polyurethane
Formulation basis (cover film)	Polyethylene
Manufacturer of gasket	Schlegel Germany GmbH, Germany
Production site	Schlegel Ltd., Henlow, England
Colour designation	black
Nominal value of colour:	---

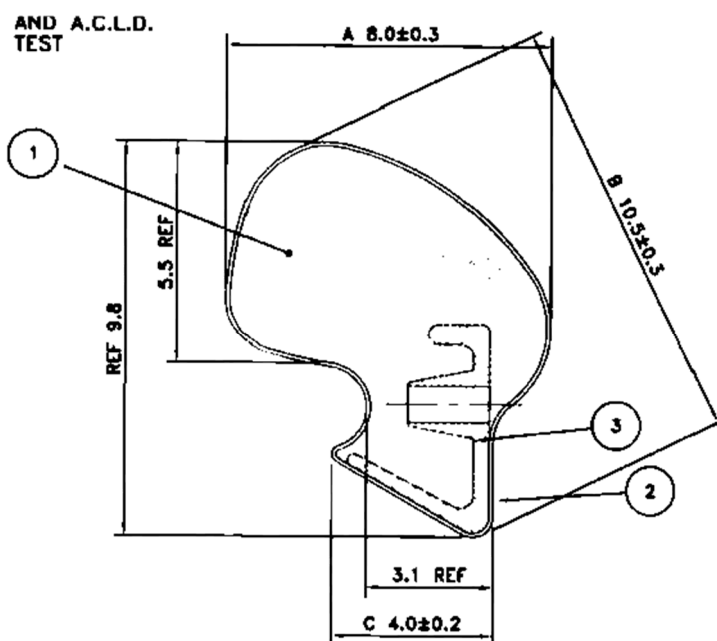


Figure 1: Structure of the profile pattern: 1) PU foam; 2) PE film; 3) PP insert

- 20 m cover film, w = 25 mm, d = 0.15 mm (sample 2)

Cover film designation	Q-LON 9154
Formula base	PE
Mixture manufacturer	Schlegel Germany GmbH, Germany
Production site	Schlegel Ltd., Henlow, England
Colour designation	black
Nominal colour values	---

3. Test procedure

The tests listed below were carried out in accordance with the Technical Annex to RAL-GZ 716, Section C, Quality and test specifications for foamed gaskets and the sealing materials used for these (item C.4: "Requirements for the sealing material"), July 2018 edition.

In deviation from the Technical Annex to RAL-GZ 716, Section C, Quality and test specifications for foamed gaskets and sealing materials used for these (item C.4: "Requirements for the sealing material"), July 2018 edition, the resilience test was carried out according to DIN EN 12365-3: 2003-12 for three different temperatures.

Unless otherwise specified, the pre-storage and test were carried out at normal climate 23/50, class 1 in accordance with DIN EN ISO 291: 2008-08.

Usually, we carry out tests according to standards for which we have an accreditation. The list of all standards for which we are accredited can be viewed as an annex to the accreditation certificate on the homepage at <https://www.skz.de/en/testing/products>. In case of non-accredited procedures, they are marked with *. If it is only a matter of deviating test conditions of an accredited standard, this is marked with #.

In case that a conformity assessment is issued, the general decision rule is as follows: The measurement uncertainty and the standard deviation are not taken into account. Deviations from this rule are only made at the customer's request, in the case of standard specifications or other specifications about which the customer is informed in each individual case.

3.1 Identification (item C. 4.1)

3.1.1 Colour (item C. 4.1.1)

The coordinates of the $L^*a^*b^*$ colour space and calculation of the colour distance ΔE^* were determined in accordance with DIN EN ISO 11664-4*:2012-06.

Requirement of RAL-GZ 716:

The colour distance ΔE^* to the manufacturer's specification must not exceed 1.7.

3.1.2 Solid-state infrared spectrum (item C. 4.1.2)

The infrared spectroscopic analysis was carried out according to item C.4.1.2 of the Technical Annex to RAL-GZ 716 Section C (Foamed gaskets and sealing materials used for them), July 2018 edition.

Requirement of RAL-GZ 716:

Documentation of the characteristic bands with regard to position and intensity as part of the proof of suitability.

3.1.3 Tensile test (item C. 4.1.3)

The test was carried out in accordance with DIN EN ISO 527-3: 2019-02 on 5 test specimens of type 2. The test speed was 200 mm/min.

Requirement of RAL-GZ 716:

- The tensile strength must be $\geq 1 \text{ N/mm}^2$.
- The elongation at break must be at least 200 %.

3.1.4 Compression set (item C. 4.1.4)

In deviation from the Technical Annex to RAL-GZ 716, Section C, the resilience was determined in accordance with DIN EN 12365-3: 2003-12 on the foamed profile sample and not as compression set in accordance with DIN ISO 815-1 and DIN ISO 815-2. The test specimens were fixed to a compression block and compressed to a minimum dimension. The specimens were then stored for 22 h at -10 °C, 23 °C and 70 °C in accordance with the storage conditions in the technical appendix to RAL-GZ 716, point C. 4.1.4, 23 °C and 70 °C for 22 h.

At the end of the storage period, the specimens were relaxed and stored on a wooden board (30 ± 3 min) at normal climate class 1 to allow the deformation to return. The thickness was then measured again.

RAL-GZ 716 requirement for resilience:

- > 30 % at -10 °C
- > 50 % at 23 °C
- > 30 % at 70 °C

3.2 Behaviour after heat ageing (item C. 4.2)

Artificial heat ageing was carried out according to DIN 53508: 2000-03 in a heating cabinet with forced ventilation at 70 °C for 7 days.

The values obtained are used for comparison with the properties in new condition according to item 3.1 "Identification".

3.2.1 Changes in appearance and delivery condition (item C. 4.2.1)

The changes to the surface after ageing in hot air and cooling compared to the new condition must be documented.

3.2.2 Change in elongation at break and tensile strength at break (item C. 4.2.2 and item C. 4.2.3)

The test was carried out analogously to item 3.1.3 on the cover film according to DIN EN ISO 527-3:2003-06 on 5 type 2 test specimens after heat ageing.

Requirement of RAL-GZ 716:

- The value of the elongation at break after heat ageing must be > 60 % of the value before heat storage.
- The tensile strength at break after heat ageing must be $\geq 1 \text{ N/mm}^2$.

3.3 Behaviour after artificial weathering (item C. 4.3)

Artificial weathering for the determination of weather fastness and weather resistance was carried out according to RAL-GZ 716.

The artificial weathering method corresponds to the specifications of DIN EN 513: 1999-10, method 1, simulation of a moderate climate zone (M), but with a higher BST of $(65 \pm 3) ^\circ\text{C}$.

Parameters of weathering device:

Type:	XENOTEST® BETA LM
Radiation source:	Xenon arc radiation (according to DIN EN ISO 4892-2)
Filter system:	outdoor sun light simulation
Black standard temperature:	$65 \pm 3 ^\circ\text{C}$
White standard temperature:	$40 - 45 ^\circ\text{C}$
Relative humidity:	$65 \pm 5 \%$
Spray cycle:	18 min. water spray, 102 min. dry period
Irradiation energy E_{UV} (300 - 400) nm:	$60 \pm 2 \text{ W/m}^2$
Total irradiation dose equivalent in the wave length range (300 - 800) nm:	8 GJ/m^2
Exposure period:	4090 h
Start:	2018-04-17
End:	2018-12-11

3.3.1 Visual assessment and colour change after artificial weathering (items C. 4.3.1 and C. 4.3.2)

After artificial weathering with a total irradiation dose equivalent of 3 GJ/m² and 8 GJ/m² in the wavelength range 300 to 800 nm, the weathered sample surface was visually assessed for changes (e.g. blistering or cracking).

The assessment was carried out without visual aids on a 30° bent sealing strip and with a microscope at 10x magnification on the flat sealing strip.

The colour change was determined by comparing the non-weathered sample with the weathered sample visually using the grey scale in accordance with DIN EN 20105-A02:1994-10 and colourimetrically.

Requirement of RAL-GZ 716:

No recognizable cracks or blisters. Changes must not lead to the formation of stains, blisters, streaks or cracks or any other significant impairment of appearance.

At the end of artificial weathering, the colour change must not be greater than level 3 of the grey scale according to DIN EN 20105-A02:1994-10.

3.3.2 Elongation at break after artificial weathering (item C. 4.3.3)

After completion of the artificial weathering, the type 2 test specimen was punched out of the artificially weathered flat strips and the elongation at break was determined in the tensile test analogous to item 3.1.3 and item 3.2.2 in accordance with DIN EN ISO 527-3:2003-06 at a speed of 200 mm/min.

Requirement of RAL-GZ 716:

After completion of artificial weathering, the value of the elongation at break must be must be > 50 % of the initial value.

3.3.3 DVR after artificial weathering (item C. 4.3.4)

After completion of the artificial weathering, the resilience at 23 °C was determined in %, analogous to item 3.1.4.

Requirement of RAL-GZ:

None

4. Test results

Table 1: Identification, behaviour after heat ageing and after artificial weathering

4.1	Identification (item C. 4.1)			
	<i>Test</i>	<i>Unit</i>	<i>Requirement</i>	<i>Result</i>
4.1.1	Colour	ΔE^*	$\leq 1,7$	see table 2
4.1.2	Solid-state IR spectrum	see annex 1		
4.1.3	Tensile test			
	Tensile strength	N/mm ²	$\geq 1,0$	16.3
	Elongation at break	%	≥ 200	238
4.1.4	Compression set ¹			
	-10 °C	%	> 30	100
	23 °C	%	> 50	98
	70 °C	%	> 50	71
4.2	Behaviour after heat ageing (item C. 4.2)			
4.2.1	Changes in appearance and delivery condition		Without complaint ²	Without complaint ²
4.2.2	Change in tensile strength			
	Tensile strength	N/mm ²	≥ 1	15.7
	Elongation at break	%	$> 60^3$	102 ³
4.3	Behaviour after artificial weathering (item C. 4.3)			
4.3.1	Visual assessment and colour change after artificial weathering	see table 2		
4.3.2	Elongation at break after artificial weathering			
	Tensile strength	N/mm ²	---	14.3
	Elongation at break	%	> 50	83.9
4.3.3	DVR after artificial weathering	%	---	93

¹ Determination according to EN 12365-3

² Without complaint

³ In relation to the initial value before warm storage

Table 2: Weathering fastness

Delivery condition			Artificial weathering			
	Actual value		3 GJ		8 GJ	
	Cover film	Gasket profile	Cover film	Gasket profile	Cover film	Gasket profile
L*	25.2	25.9	25.4	25.4	25.8	26.0
a*	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1
b*	-0.3	-0.4	-0.3	-0.2	-0.3	-0.1
ΔL^*			0.2	-0.5	0.6	0.1
Δa^*			0.1	0.0	0.1	0.0
Δb^*			0.0	0.2	0.0	0.3
Colour distance ΔE^*			0.2	0.6	0.6	0.4
Grey scale (GM) A02 ¹			4 - 5	4 - 5	4 - 5	4 - 5
Visual assessment for changes	1-fold		Without complaint	Without complaint	Without complaint	Without complaint
	10-fold		Without complaint	Without complaint	Without complaint	Without complaint

¹ Grey scale according to DIN EN 20105-A02:1994-10

5. Summary of the results

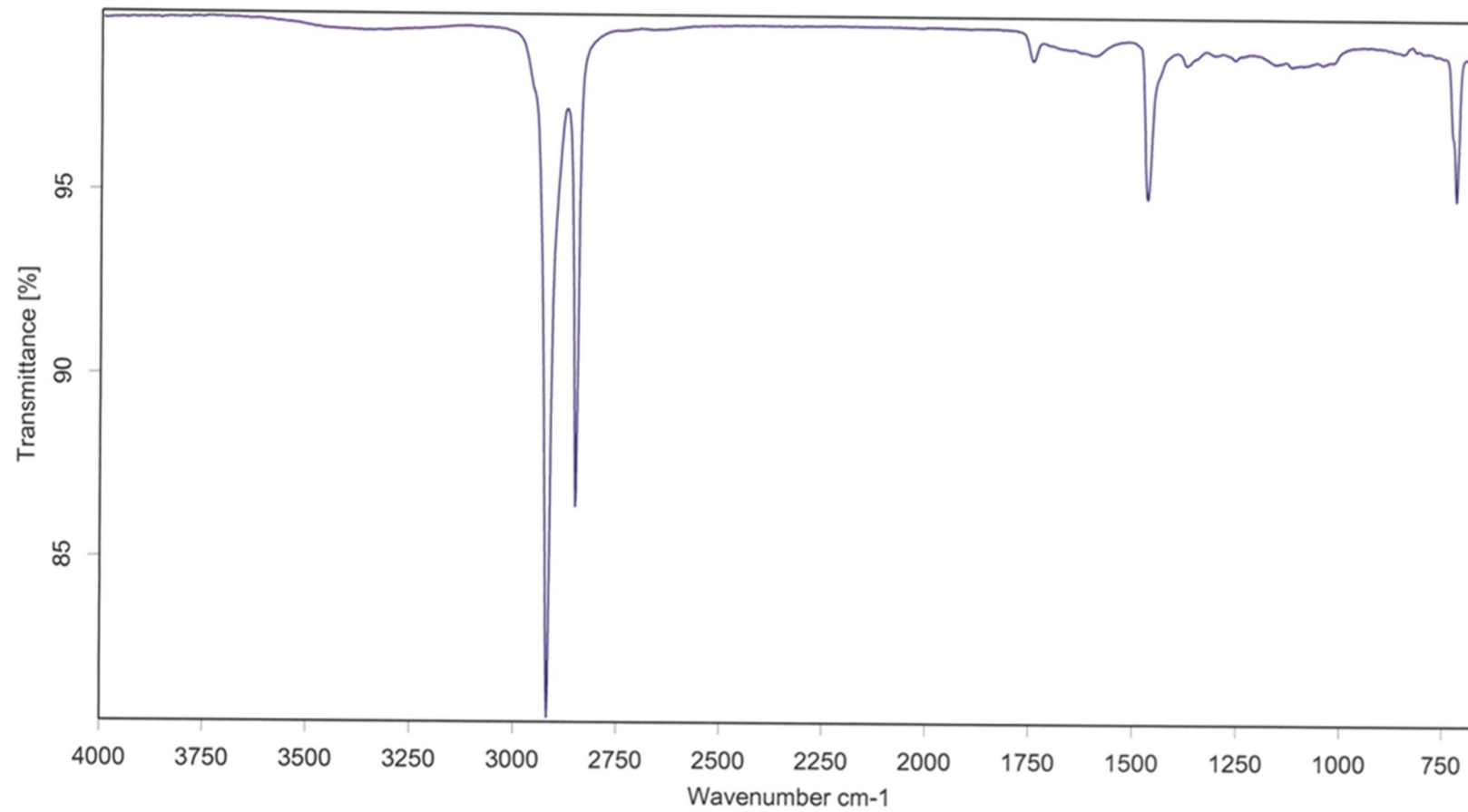
The requirements for the foamed gasket and the sealing material for suitability for use in PVC window and door systems in accordance with RAL-GZ 716, Quality and test specifications for components and processes, Section C "Foamed gaskets for components and processes" are fulfilled in all tested items.

The resilience test was carried out in deviation from RAL-GZ 716, Section C according to DIN EN 12365-3: 2003-12. The requirements of level 8 (for -10 °C and 23 °C) and level 6 (for 70 °C) were achieved.

Proof of suitability applies to the gasket with the manufacturer's designation: en

Gasket designation	Q-LON 9154
Formulation basis (foam)	Polyurethane
Formulation basis (cover film)	Polyethylene
Manufacturer of gasket	Schlegel Germany GmbH, Germany
Production site	Schlegel Ltd., Henlow, England
Colour designation	black
Nominal values of colour (cover film)	---
Nominal values Tensile strength / Elongation at break (cover film)	15.7 N/mm ² / 238 %
IR spectrum (cover film)	Appendix 1
Nominal values Resilience (-10°C/23°C/70°C)	100 % / 98 % / 71 %
IR spectrum (foam core)	Appendix 2

Annex 1
Test report no. 126578/18-II



Auftrag 126578 / Fa. Schlegel / Deckfolie schwarz / ATR / Germaniumkristall 07.05.2018

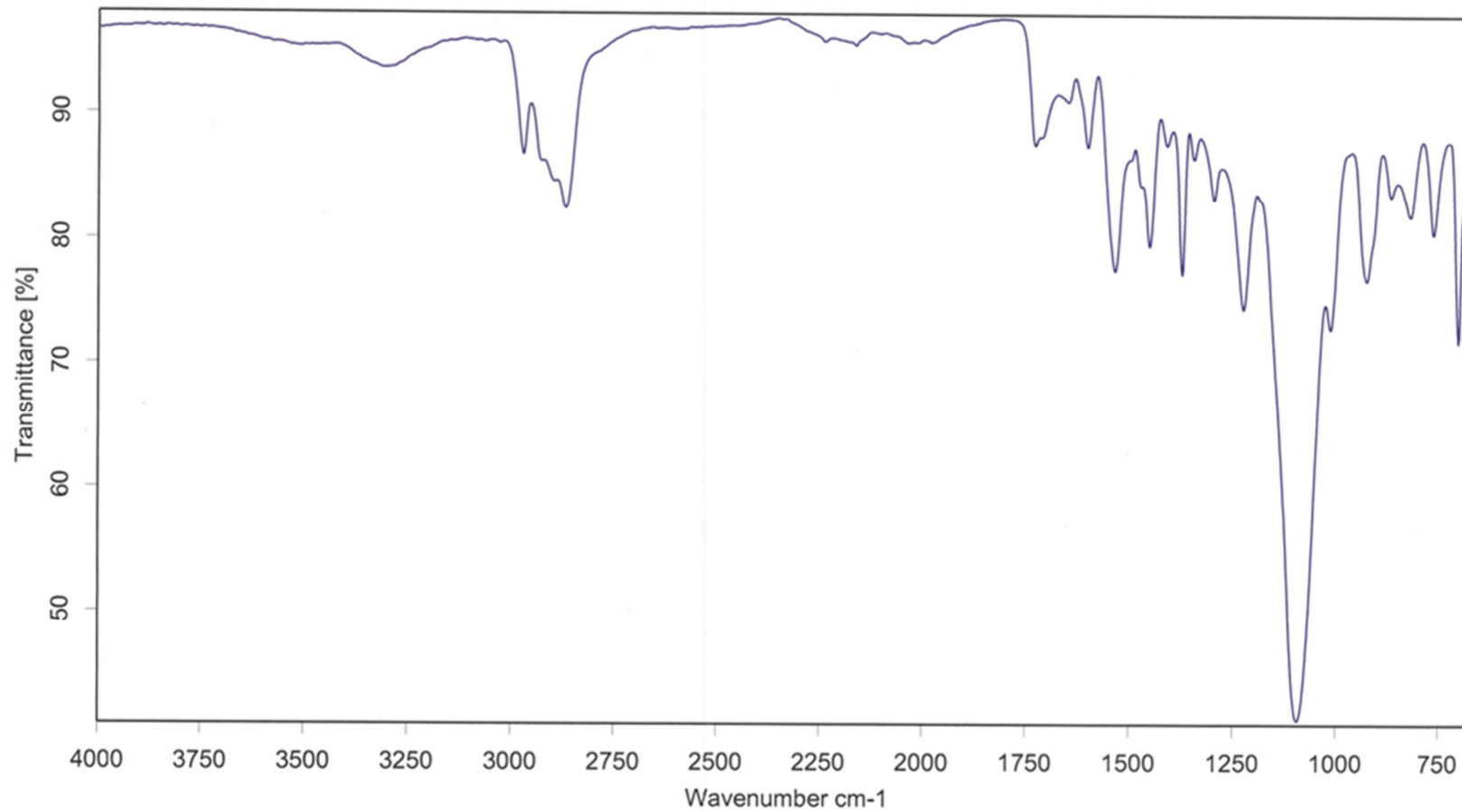
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Annex 2
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Auftrag 126578 / Fa. Schlegel / geschäumtes Profil / ATR / Diamantkristall 07.05.2018

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