Evidence of Performance

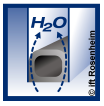
Of the physical attributes of the edge seals of insulating glass units according to DIN EN 1279-4

Test Report 17-002666-PR03 (PB-H01-09-en-02)

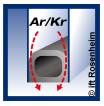
Client	ZHENGZHOU ZHONGYUAN SILAND HIGH TECHNOLOGY CO., LTD No. 28 Dongqing West St, Zhengzhou Hi-tech Development Zone 450001 Zhengzhou China
Product	Sealant for use in the edge seals of insulating glass units
System designation	2K-Silicone, MF881, made by original client (desposited at ift)
Order	Test according to DIN EN 1279-4

The sealant based on
2K-Silicone, MF881, made by original client (desposited at ift)
displays the following properties according to DIN EN 1279-4:

5.1 Adhesion — **The requirements of DIN EN 1279-4, chapter 5.1, stress-strain behaviour, are fulfilled**



5.2 Moisture vapour transmission rate — $MVTR = (17.7 \pm 1.1) \frac{\text{Gramm } H_2O}{m^2 \cdot 24h \cdot 2\,mm}$



5.3 Gas permeation rate — $(755 \pm 22) \times 10^{-3}\ g/(m^2\,h)$

ift Rosenheim
27.11.2017

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Prüfstellenleiter
Materialprüfung

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Basis

DIN EN 1279-4 : 2002-10;
Glass in building – Insulating glass units;
Part 4: Methods of test for the physical attributes of edge seals.

Chapter: 5.1 Adhesion

Chapter: 5.2 Moisture vapour transmission rate

Chapter: 5.3 Gas permeation rate

Replaced Test Report No. 17-002666-PR03 (PB-H01-09-en-01) dated 23.10.2017

Instructions for use

This test report serves to demonstrate the phsyical attributes of edge seals of insulating glass units.

It serves as a basis for substitution of sealants used in insulating glass units. according to EN 1279-1.

Validity

The data and results given relate solely to the tested and described specimen.

Notes on publication

The **ift**-Guidance Sheet 'Conditions and Guidance for the Use of **ift** Test Documents' applies.

The cover sheet can be used as an abstract.

Contents

The test report comprises a total of 11 pages.

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1 Object

1.1 Test specimen for the adhesion test

Subject	H-specimen consisting of float glass and sealant (Fig. 1)
Manufacturer	original client (desposited at ift)
Substrate A	Floatglas according to DIN EN 572-2
Dimensions (l x w x h) in mm	50 x 50 x 12
Substrate B	Aluminum, anodic oxidized
Dimensions (l x w x h) in mm	50 x 50 x 12
Sealant	
Product designation	2K-Silicone, MF881, made by original client (desposited at ift)
Type	2K- Silicone - based
Manufacturer	original client (desposited at ift)
Colour	black
Dimensions (l x w x h) in mm	50 x 12 x 12

Measures in Millimeter

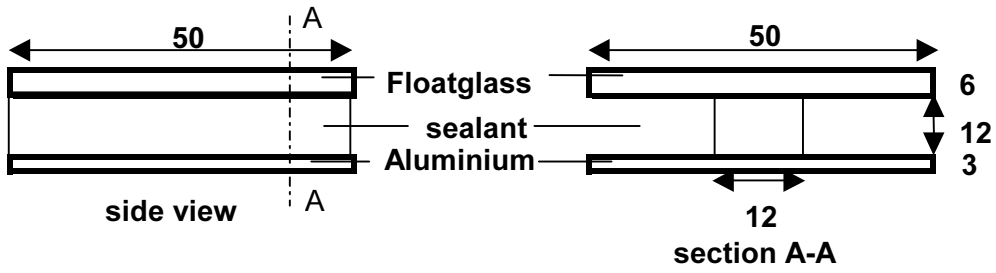

Fig. 1 Geometry of the test specimen

1.2 Test specimen for testing the moisture vapour transmission rate

Films as described in DIN EN 1279-4

Thickness	Film 1	d = 2.0 mm
	Film 2	d = 2.1 mm
	Film 3	d = 2.1 mm

Surface diameter approximately 20 cm.

1.3 Test specimens for testing the gas permeation rate

Films as described in DIN EN 1279-4, colour grey

Thickness	Film 1	d = 1.9 mm
	Film 2	d = 2.1 mm
	Film 3	d = 2.1 mm

Surface diameter approximately 20 cm.

The description is based on inspection of the test specimen at **ift.**
Item designations/numbers as well as material specifications were given by the original client (desposited at ift).

2 Procedure

2.1 Sampling

The samples were selected and produced by the original client (desposited at ift).

2.1.1 Test specimen for the adhesion test

Quantity	40 pieces as shown in Fig. 1
Delivered	April 11, 2007
Registration No.	21745

2.1.2 Test specimen for testing the moisture vapour transmission rate (MVTR)

Quantity	10 films
Delivered	April 11, 2007
Registration No.	21745

2.1.3 Test specimen for testing the gas permeation rate

Quantity	10 films
Delivered	April 11, 2007
Registration No.	21745

2.2 Process

Basis

DIN EN 1279-4 : 2002-10	Glass in building – Insulating glass units. Methods of test for the physical attributes of edge seals. Chapter 5.1 Adhesion Chapter 5.2 Moisture vapour transmission rate Chapter 5.3 Gas permeation test on film
Boundary conditions	According to the requirements of the standard
Deviations	There are following deviations from the test method and test conditions: The subtrate B is deviant from the standard.

2.3 Test equipment

2.3.1 Adhesion

Normal climate chamber	Appliance number: 22040
Airflow oven	Appliance number: 22159
UV source (Osram Vitalux)	Appliance number: 22604
Heatable water bath	Appliance number: 22509
Material testing machine acc. to DIN EN ISO 7500-1	Appliance number: 22933

2.3.2 Moisture vapour transmission rate

Normal climate chamber	Appliance number: 22040
Precision balance	Appliance number: 22431
Test chamber with	
hygrostat	Appliance number: 22589
moisture sensor	Appliance number: 22562

2.3.3 Gas permeation rate on film

Normal climate chamber	Appliance number: 22040
Gasleakage measurement device with gas chromatograph	Appliance number: 22503

2.4 Testing

Date/Period	May 07 until December 15, 2007
Testing personnel	Irina Hausstetter, Dipl.-Ing. (FH)
	Thomas Eder
	Robert Happach
	Katharina Simon

3 Detailed results

3.1 Adhesion test according to DIN EN 1279-4, Chapter 5.1

Tables 1 to 4 show the results of adhesive tensile strength tests following appropriate conditioning of the test specimens. Figs. 2 to 5 show the stress-strain diagrams for new condition and for the effects of the various types of exposure, with the triangle A0B shown in each case.

Table 1 Tensile strength test in new condition following curing

Test specimen number	Force F_{max} in N	Displacement s at F_{max} in mm	Stress in MPa	Strain in %	Intersection with section AB	
					Stress in MPa	Strain in %
New 1	711	10.1	1.19	84	0.32	18
New 4	728	10.8	1.21	90	0.32	18
New 5	694	9.9	1.16	83	0.32	18
New 6	710	10.1	1.18	84	0.32	18
New 7	789	12.3	1.32	102	0.32	18
				Average	0.32	18

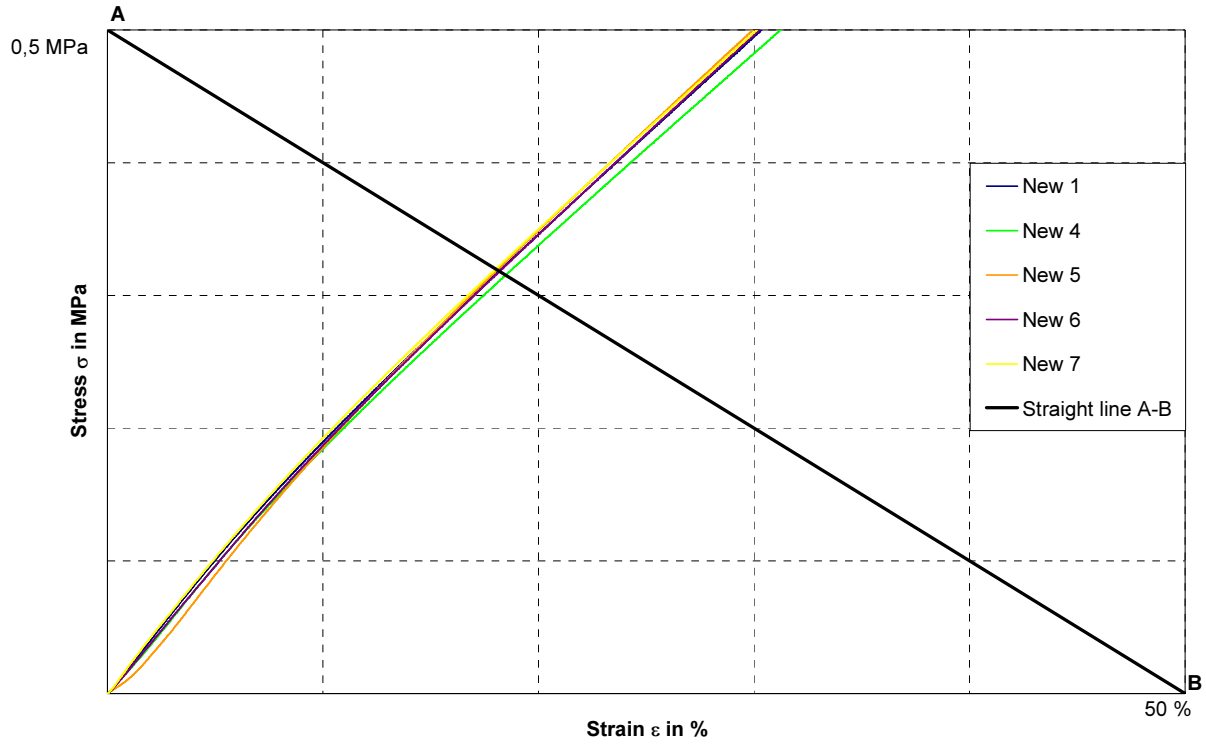

Fig. 2 Stress-strain diagram of test specimen in new condition following curing

Table 2 Tensile strength test following heat exposure 60 °C / 168 h

Test specimen number	Force F_{max} in N	Displacement s at F_{max} in mm	Stress in MPa	Strain in %	Intersection with section AB	
					Stress in MPa	Strain in %
Heat 1	641	9.0	1.07	75	0.32	18
Heat 2	736	10.0	1.23	84	0.33	17
Heat 3	685	9.4	1.14	78	0.32	18
Heat 5	710	10.0	1.18	83	0.32	18
Heat 6	710	9.5	1.18	79	0.32	18
				Average	0.32	18

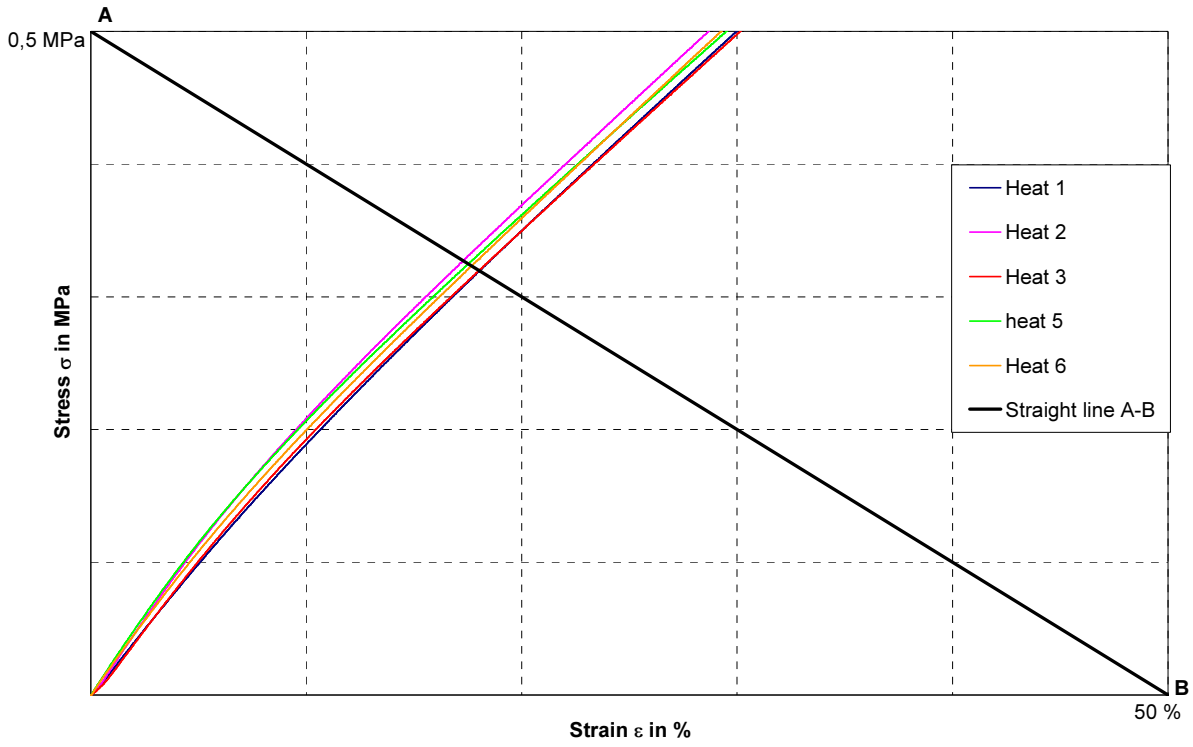

Fig. 3 Stress-strain diagram of test specimen following heat exposure

Table 3 Tensile strength test following water immersion

Test specimen number	Force F_{max} in N	Displacement s at F_{max} in mm	Stress in MPa	Strain in %	Intersection with section AB	
					Stress in MPa	Strain in %
Water 2	651	13.4	1.08	112	0.31	19
Water 3	709	12.4	1.18	103	0.32	18
Water 4	646	11.5	1.08	96	0.32	18
Water 6	689	13.0	1.15	108	0.31	19
Water 7	772	13.9	1.29	115	0.32	18
				Average	0.32	19

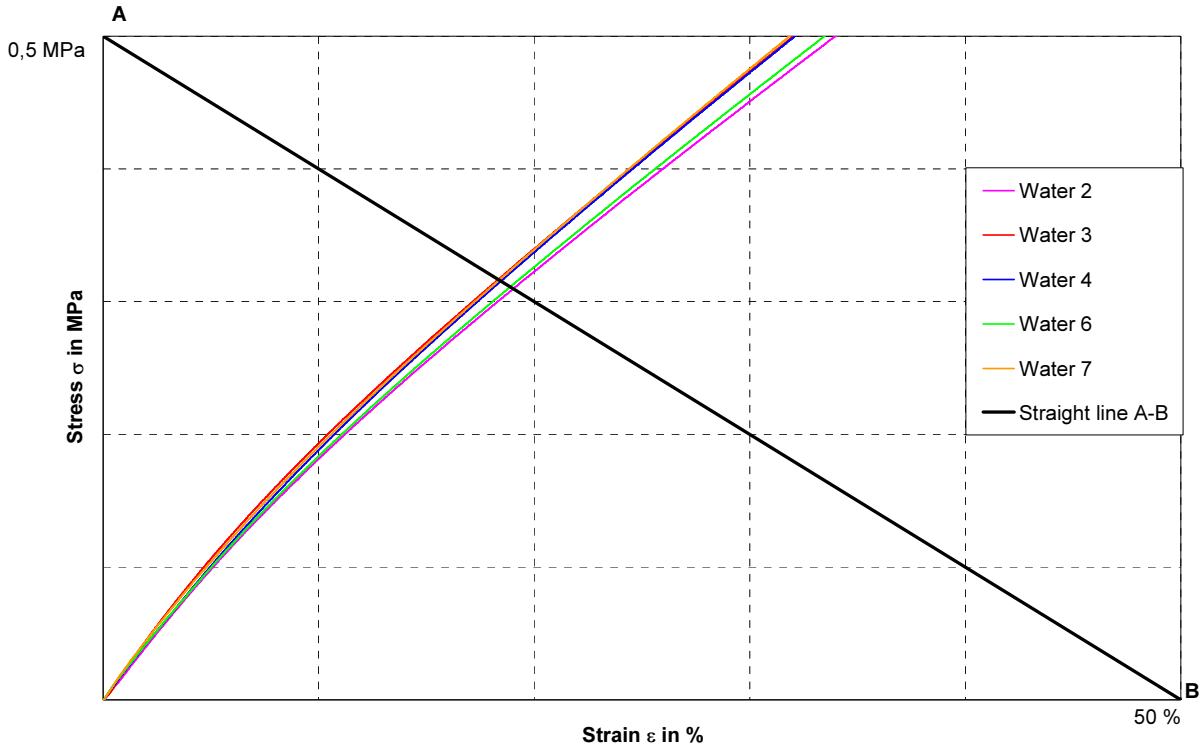

Fig. 4 Stress-strain diagram of test specimen following water immersion

Table 4 Tensile strength test following UV exposure

Test specimen number	Force F_{max} in N	Displacement s at F_{max} in mm	Stress in MPa	Strain in %	Intersection with section AB	
					Stress in MPa	Strain in %
UV 1	683	11.0	1.14	91	0.32	18
UV 3	668	9.3	1.11	78	0.32	18
UV 4	679	10.1	1.13	84	0.32	18
UV 5	650	9.2	1.08	76	0.32	18
UV 7	735	10.8	1.23	90	0.31	19
				Average	0.32	18

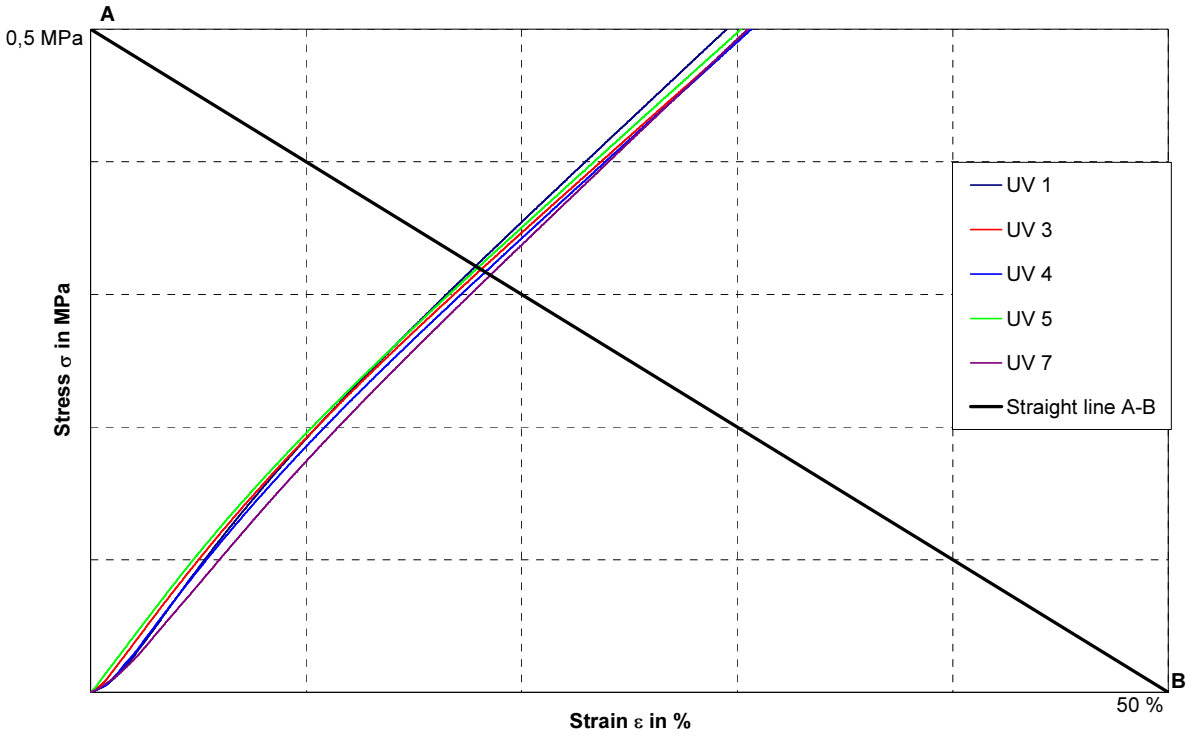

Fig. 5 Stress-strain diagram of test specimen following UV exposure

3.2 Moisture vapour transmission rate test according to DIN EN 1279-4. Chapter 5.2

Table 5 shows the moisture vapour transmission rate results for three test specimens. The moisture vapour transmission rate can be found from the gradient of the lines in the graph (Fig. 6).
The moisture vapour transmission rate is calculated according to the following formula:

$$MVTR = \frac{G}{tA} = \frac{G/t}{A}$$

G = *Mass change, grams of H_2O*
t = *Time in days (24 h)*
G/t = *Gradient of the lines, grams of H_2O x (24 h)$^{-1}$*
A = *Area tested in m^2*

Table 5 Testing moisture vapour transmission rate on films

	Sample 1	Sample 2	Sample 3
Slope of the regression line	0.1596	0.1497	0.1578
Membrane thickness in mm	2.0	2.1	2.1
Tested area in m²	0.00911	0.00948	0.00883
MVTR g_{H2O}/(m²*1d*2mm)	**17.672**	**16.582**	**18.776**
MVTR (average value)	**(17.7 ± 1.1) g_{H2O}/(m²*1d*2mm)**		

Error of measurement in the test procedure according to EN 1279-4, Annex C, is specified as 25 % standard deviation from the average value

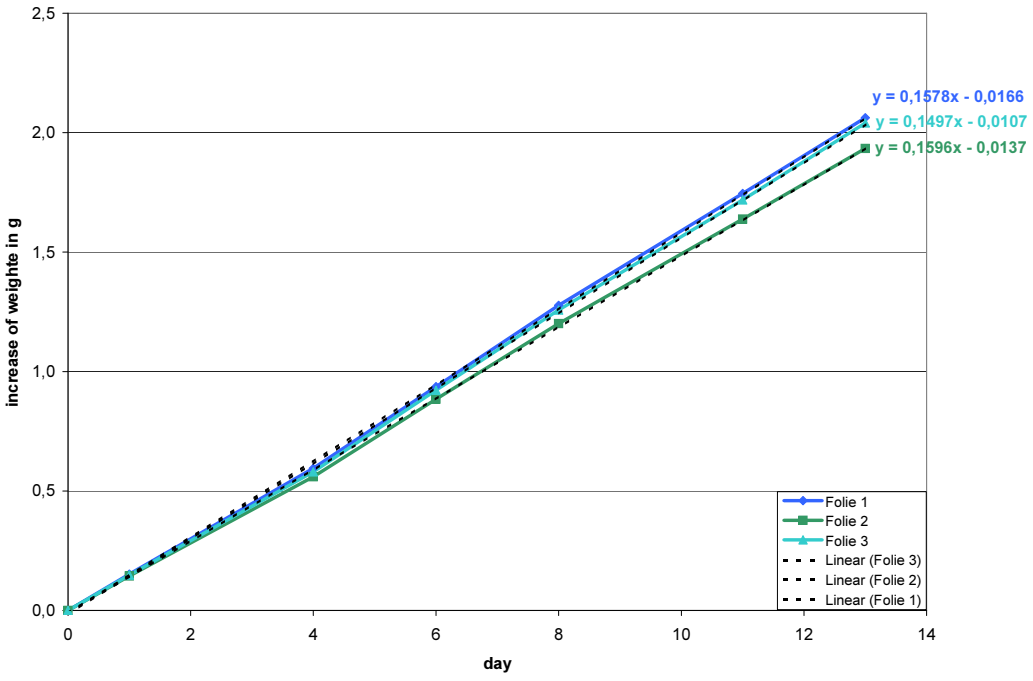

Fig. 6 Graph of the moisture vapour transmission rate of 3 test specimen

3.3 Gas permeation rate. test according to DIN EN 1279-4. Chapter 5.3

The gas permeation rate test was carried out on three test specimens. The testing area of the films was approx. 63 cm^2. Once a constant state had been reached, the value of the average gas permeation rate for each of the films was determined on the basis of four measurements. The results are presented in table 6.

Table 6 Gas permeation rate test on films

	Gas permeation rate in g/m^2 h		
	Test specimen 1	Test specimen 2	Test specimen 3
Membrane thickness in mm	1.93	2.13	2.12
Average value for the measured film	780×10^{-3}	689×10^{-3}	733×10^{-3}
Average value for film (relating to 2 mm membrane thickness)	753×10^{-3}	734×10^{-3}	777×10^{-3}
Average value of gas permeation rate calculated from the 3 individual values	**$(755 \pm 22) \times 10^{-3}$ g/(m^2 h)**		

Error of measurement in the test procedure according to EN 1279-3 is specified as 20 % standard deviation for all individual values.

4 Evaluation and summary according to the specifications of DIN EN 1279-4

Client: **ZHENGZHOU ZHONGYUAN SILAND HIGH TECHNOLOGY CO., LTD**
No. 28 Dongqing West St,
Zhengzhou Hi-tech Development Zone
450001 Zhengzhou
China

Sealant specification: 2K-Silicone, MF881, made by original client (desposited at ift)
Glass specification: Floatglas according to DIN EN 572-2

4.1 Adhesion test

Table 7 Summary of results

Tested strength of edge seal	at the intersection with line A-B (EN 1279-4. Fig. 1)		Failure pattern						
	Average stress σ_{av} in MPa	Average strain ε_{av} in %	k = cohesive oA = no evaluation						
Adhesion			1	2	3	4	5	6	7
After curing	0.32	18	k	oA	oA	k	k	k	k
After heat exposure 60 °C	0.32	18	k	k	k	oA	k	k	oA
After water immersion	0.32	19	oA	k	k	k	oA	k	k
After UV exposure	0.32	18	k	oA	k	k	k	oA	k

4.2 Moisture vapour transmission rate test

Film thickness	Based on a thickness of 2 mm
ΔP_{H2O}	Initial load on desiccant 2.4 %; Climatic chamber average 93 %rh; ΔP_{H2O} = 90.6 %
Temperature	(23±1) °C
Moisture vapour transmission rate	**(17.7 ± 1.1)** $\frac{\textbf{Gramm } H_2O}{m^2 \cdot 24h \cdot 2\ mm}$

4.3 Gas permeation rate test

Film thickness	Based on a thickness of 2 mm
Surface	Average approx. -/- m²
Gas permeation rate	**(755 ± 22)x 10^{-3} g/(m² h)**

Result of the testing of the strength of the edge seal:

The sealant 2K-Silicone, MF881, made by original client (desposited at ift)
fulfils the criteria: **YES**

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