Test report

Test report relating to a glass product according to European standard EN 1279-4; MVTR, gas permeation rate and tensile strength testing concerning the product marked as: PS 998 R Polysulfide, manufactured by: Glas Ockels BV

Report number	89202496-40
Date	12 December 2012
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Client	Nedex Chemie Deutschland GmbH Konrad- Zuse- Strasse 33 D 47445 Moers Germany
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Project name	Nedex
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Contents

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1 Introduction

1.1 Purpose

The tests have been performed in order to determine the properties of a sealant according to European standard EN 1279-4 [1].

1.2 Description of the samples

General

Name of the assignor	Nedex Chemie Deutschland GmbH
Address of the assignor	Konrad- Zuse- Strasse 33 D 47445 Moers Germany
Production plant of the samples	Glas Ockels BV Steenhouwer 29 9502 EV Stadskanaal The Netherlands
Line ID where the samples are made	-
Production date	20-09-2012
Sampling date	20-09-2012
The product was marked as	PS 998 R Polysulfide

Specific

Sample dimensions	
Dimensions of the H-samples	H-samples (28x) Sealant: 50x12x12mm Glass: 70x12x6mm (2x)
Dimensions of the permeation samples	sheet 2.0±0.1 mm
Sealant material	
Type	polysulfide
Charge Nr. A	912050348
Charge Nr. B	91207240579
Colour	A; grey; B: black
Glass Specification	
Type of glass (coating)	Clear float glass

1.3 Sampling procedure

The samples have been submitted by the assignor. The test house, acting as notified test body, has had no influence on the selection of the samples.

1.4 Application

The request for testing was submitted by the assignor on 24 September 2012. Assignment Form number: 11.A470_rev2.

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1.5 Method of testing

All applicable tests have been performed according to the European standard EN 1279-4 [1].

1.6 Put out to contract

No tests were performed at third parties.

1.7 Privacy statement

Due to privacy reasons, the names of involved personnel that executed the tests are not disclosed in the report. However, this information is available on internal work sheets, test forms etc. in the project file.

1.8 Remark concerning this ITT report

For any other manufacturer this initial type test (ITT) report is not automatically valid. The manufacturer for this ITT report is defined under 1.2.

Reference to test report for moisture penetration index according to EN 1279-2 [2]: not known.

1.9 Notifications and accreditations

TÜV Rheinland Nederland B.V. has been notified by the Dutch Ministry of Infrastructure and the Environment as Notified Test Body (number 1750) and Notified Certification Body (number 0336) for the European Construction Products Directive 89/106/EEC.

TÜV Rheinland Nederland B.V. has been accredited by the Dutch Accreditation Council (RvA) as ISO 17025 Test Laboratory (accreditation number L 484) and EN 45011 Certification Body (accreditation number C058).

TÜV Rheinland Nederland B.V. has been accredited as Technical Service (Laboratory) by RDW competent Administrative Department (Approval Authority) for the Netherlands to grant approvals as mentioned in Directive 70/156/etc. and the 1958 Agreement of the Economic Commission for Europe of the United Nations (UN-ECE) for glass as used in the automotive sector: ECE Regulation 43, safety glazing; EC Directive 92/22, Safety glass; EC Directive 2009/144, Glazing cat. T (accreditation number RDW-99050043 01).

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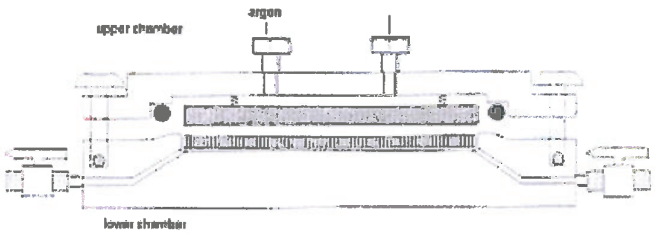
2 Test results

Moisture vapour transmission rate
Part 4 of the EN1279 describes the determination of the moisture vapour transmission rate (MVTR) of an adhesive used for sealing of IGU's. The applied method is based on the measurement of the gravimetric increase in weight of test samples during the exposure in a controlled environment. The conditions of the environment used for this determination are (23 ± 2) °C at a relative humidity [R.H.] of > 90%. The thickness of the sample material must be as close as possible to 2 mm and have a diameter of 250 mm. A sample with a diameter of about 80 mm is cut out of the foils. A metal dish is filled with a known amount of silica gel and covered by the foil. The space between foil and edge of the dish is filled with liquid wax. The wax coagulates and seals the dish. At regular intervals the increase in weight of the dish is measured on a Mettler AE160 analytical balance with an accuracy of 0.0001 g. The increase of weight [g] and exposure time are used for the calculation of the MVTR per day. The results are expressed as: MVTR in [g/(m^2·day)] at 23 °C and a relative humidity of > 90%.

Gas permeation rate
Part 4 of the EN 1279 [1] describes the argon or krypton gas permeation measurement. The argon and krypton transmission is measured by means of a gas cell and gas chromatography. The samples are placed between an upper and lower chamber of a gas cell. The upper chamber is flushed with argon or krypton and the lower chamber is flushed with helium. After several hours of flushing the lower chamber is closed. This chamber is of a known volume. After several hours a gas sample is taken from the lower chamber and analyzed by means of gas chromatography for the argon or the krypton percentage. From the percentage of argon or krypton in the helium, the elapsed time, the volume of the lower chamber and the test area (100 cm^2) the argon or krypton transmission is calculated. Of each type of material two samples were measured at (23 ± 2) °C.



Physical properties of the sealants
This part covers evaluation of the edge seal strength. The requirement is that all edge seals shall have such sufficient adhesive and cohesive strength that during extension of the samples in an extensometer, failure outside the area OAB as given in Annex B of the EN1279-4 will occur. Breakage of the glass during testing will not constitute failure, providing that sufficient successful bonds are tested in order that the average result can be obtained. Besides this requirement the crossing point on the line AB will be calculated. A sealant manufacturer should realize that this value has a significant meaning according to the rules of the EN 1279-4 [1]. This significant meaning is that when a repeat test is conducted (on another batch, date or for other reasons) and there is more than 20% deviation recorded towards the original crossing point AB of the official reference ITT the sealant is to be considered as a 'different sealant'. Part 4 describes the physical attributes of the bond made by the primary sealant before and after shortened accelerated ageing cycles. This is not directly related to the durability of the bond but about the effects of these cycles on the changes of the sealants physical response. For each of the following shortened accelerated ageing cycles 7 samples are exposed.

Heat exposure
After initial cure and conditioning seven test specimens are aged in a closed oven at (60 ± 2) °C for (168 ± 5) hours.

Water immersion
After initial cure and conditioning seven test specimens are immersed in one to two liters distilled or deionised water for (168 ± 5) hours.

UV exposure
After initial cure and conditioning seven test specimens are exposed to UV irradiation for (96 ± 4) hours, exposed perpendicular to the glass at an intensity in the UVA range of (40 ± 5) W/m^2.

After the ageing, the samples undergo testing under tensile load. The test specimens are measured accurately for width, depth and height prior to being placed in an extensometer. The accuracy of the extensometer is equal to or less than 2%. The speed of separation is (5 ± 0.25) mm/min. The laboratory conditions are (23 ± 1) °C and (50 ± 5) % R.H.

The breaking tension and tension at crossing the line AB were calculated from the mean of the contact areas between the sealant and the glass of the test specimens. The highest and lowest values were ignored so that the average values are calculated on the five remaining measured stress and strain values.

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Test results after performing all applicable tests according to European standard EN 1279-4 [1].

Requirements and end result

Required	Value of the test	Pass / fail
4.1 Edge seal strength		
"All edge seals shall have sufficient adhesive and cohesive strength to allow the joints as specified to be extended such that any failure occurs outside the area OAB of figure 1."	All ruptures outside area OAB	pass

Detailed test results

Moisture vapour transmission rate on foils (23°C, > 85% R.H. across the foil)

Test specimen	Thickness [mm]	Surface [cm^2]	MVTR [g/m^2*24h]
1	2.1 ± 0.1	50	5.7
2	2.0 ± 0.1	50	6.8
		Average:	6.3

Argon permeation rate measurement on foils (23°C)

Test specimen	Thickness [mm]	Surface [cm^2]	Argon gas [g/m^2*h]
1	2.1 ± 0.1	100	< 0.002
2	2.1 ± 0.1	100	< 0.002
		Average:	< 0.002

Physical properties of the sealant

In total 28 H-samples were delivered. These samples were divided in four groups of samples. One group was for initial values and the other three groups were used for ageing under water, heat and UV environments. The following table shows the values at AB line crossing. The results are as follows:

Seal strength test	At intersection with line AB		Type of failure observed (if any) c = cohesive ,a = adhesive				
Adhesion:	Average stress σ_{av} [MPa]	Average extension ε_{av} [%]	1	2	3	4	5
initial	0.33	18	c	c	c	c	c
after H_2O immersion	0.34	16	c	c	c	c	c
after heating at 60°C	0.31	19	c	c	c	c	c
after UV radiation	0.32	18	c	c	c	c	c
	average without min/max values						

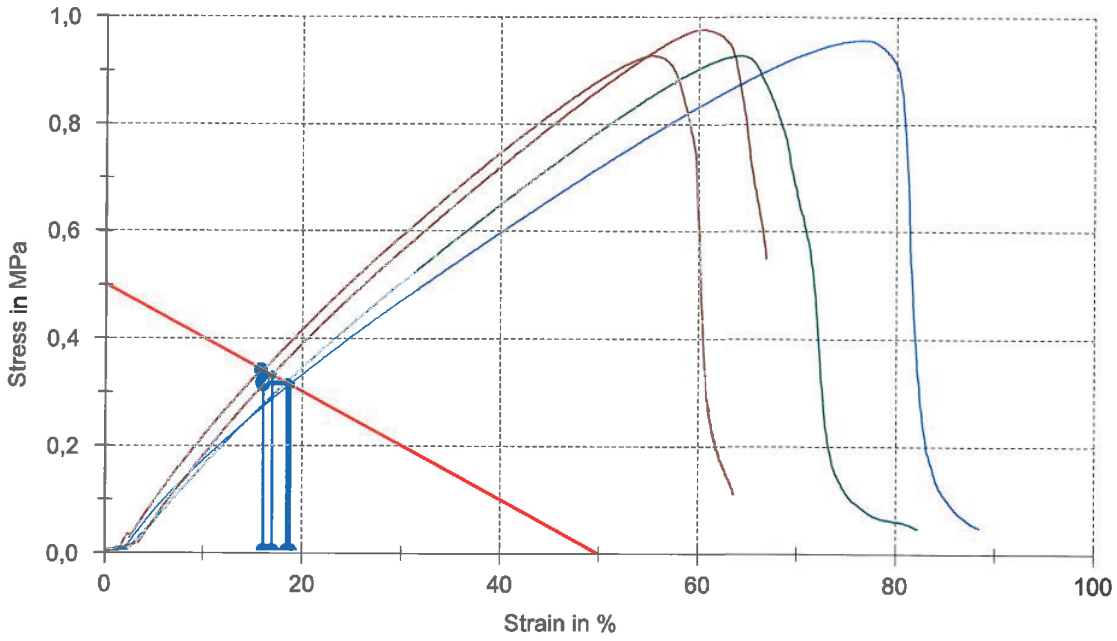

Figure 1: Stress/strain curves, initial

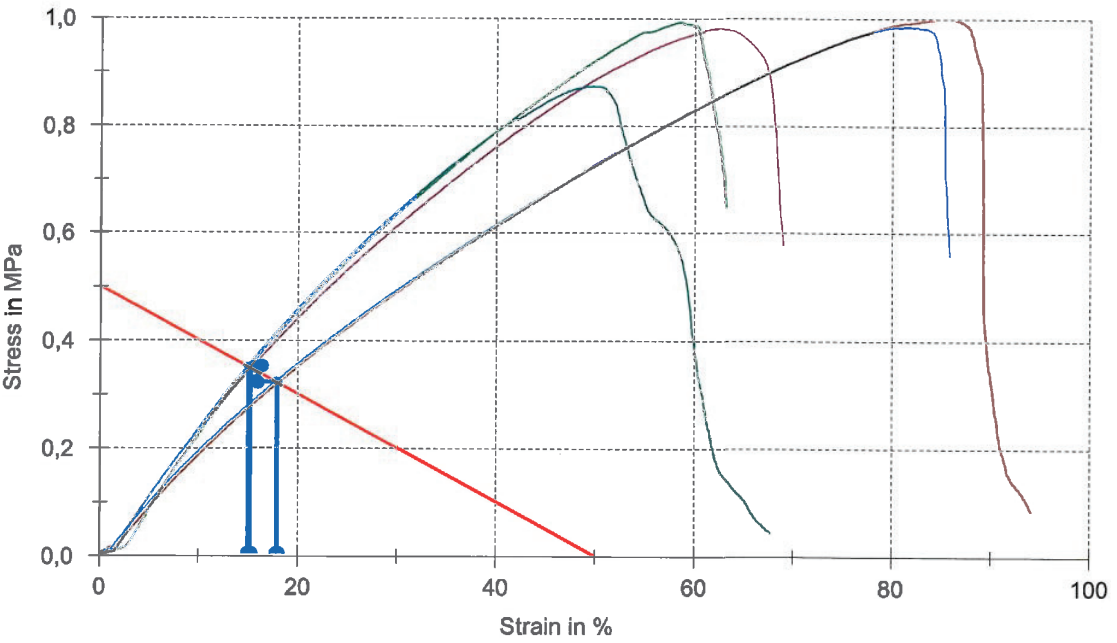

Figure 2: Stress/strain curves, after immersion in H_2O for (168 ± 5) hours

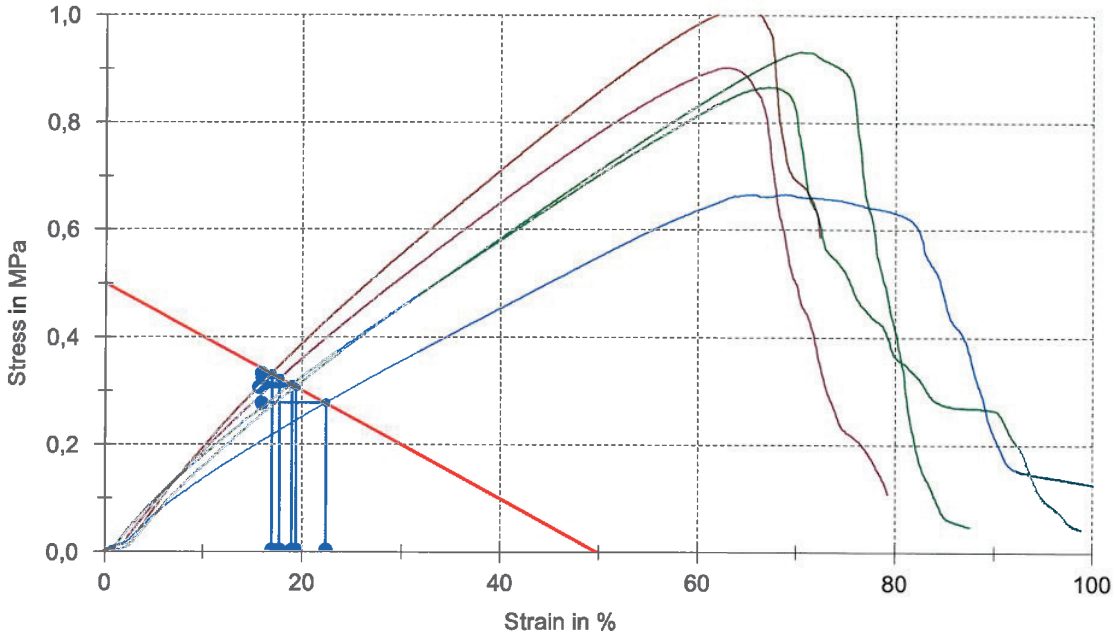

Figure 3: Stress/strain curves, after 60°C exposure for (168 ± 5) hours

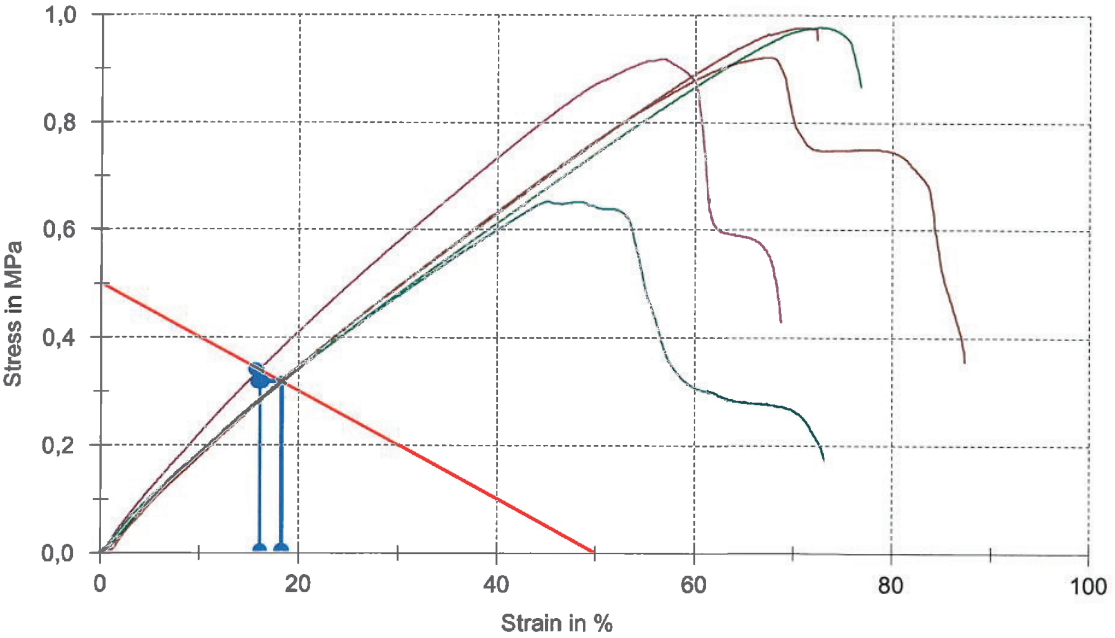

Figure 4: Stress/strain curves, after UV exposure for (96 ± 4) hours

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3 Conclusion

The edge seal, marked by the client or manufacturer as: PS 998 R Polysulfide, manufactured by: Glas Ockels BV, meets the applicable requirements as stated in the European standard EN 1279-4 [1].

The test results exclusively relate to the tested objects.

Remark 1
When and if changes are made in production method and/or equipment, assessment according to this standard shall be reconsidered and re-tests shall be performed when the changes can lead to different specifications of the sealant. The decision and responsibility lies at the manufacturer.

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4 References

1 European standard EN 1279-4:2002 (E),
Glass in building – Insulating glass units – Part 4: Methods of test for the physical attributes of edge seals,
European Committee for Standardization, March 2002.

2 European standard EN 1279-2:2002 (E),
Glass in building – Insulating glass units – Part 2: Long term test method and requirements for moisture penetration,
European Committee for Standardization, November 2002.

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5 Signatures

Author	Signature
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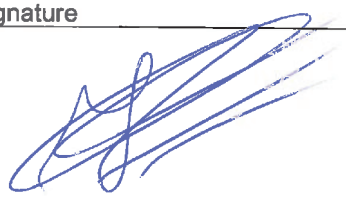
Peer review	Signature
Mr. M.J.R. Luppens Specialist	
Approved by	Signature
Mr. H. van Ginkel Business field manager	

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Summary of report n°: 89202496-40

Date: 12 December 2012

Insulating glass units – Seal properties results according to EN 1279-4

For details, see the test report

Company: Name: Nedex Chemie Deutschland GmbH
Address: Konrad- Zuse- Strasse 33
D 47445 Moers
Germany

Sealant manufacturer: Name: Nedex Chemie Deutschland GmbH
Address: Konrad- Zuse- Strasse 33
D 47445 Moers
Germany

Sealant specification: PS 998 R polysulfide

Sealant in IGU positively tested according to EN 1279-2, report: -

Glass specification when not float glass is used: n.a.

Seal strength test Adhesion:	At intersection with line AB (EN 1279-4, figure 1) Average Stress σ_{av} [Mpa]	Average extension ε_{av} [%]	Type of failure observed C = cohesive, A = Adhesive 1	2	3	4	5
Initial cure	0.33	18	c	c	c	c	c
After water immersion	0.34	16	c	c	c	c	c
After heating 60°C	0.31	19	c	c	c	c	c
After UV radiation	0.32	18	c	c	c	c	c

Average: without min and max values

Moisture vapour transmission rate:

Film thickness, avg [mm]:	2.1
ΔP_{H2O} [%]:	> 85
Test temperature: [°C]:	23 ± 1
MVTR [grams $H_2O \cdot m^2 \cdot (24h)$]:	6.3

Gas permeation rate:

Film thickness, avg [mm]:	2.1
Surface (shape: circulair) [cm^2]:	100
Test temperature: [°C]:	23 ± 1
Permeation rate [grams Argon/$m^2 \cdot h$]:	< 0.002

Overal comments: -

Conclusion of the seal strength test:
Sealant conforms to the test criteria: **YES**

Signature: M.A.A.M. Schets, B.Sc
Project leader

Signature: H. van Ginkel
Business field manager

(This is the end of this report).