Test report

Test report relating to a glass product according to European standard EN 1279-4: 2018; physical attributes of edge seal components and inserts:
sealant marked as: MF840,
manufactured by: Zhengzhou Zhongyuan Silande High Technology Co., Ltd.

Report number	89217423-05
Date	26 February 2021
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Client	Zhengzhou Zhongyuan Silande High Technology Co., Ltd. No. 28 Dongqing W St. Zhengzhou Hi-Tech Development zone, 450001 China
Project number	89217423
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Contents

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 test specimen

General

Name of the Manufacturer	Zhengzhou Zhongyuan Silande High Technology Co., Ltd.
Address of the manufacturer	No. 28 Dongqing W St. Zhengzhou Hi-Tech Development zone, 450001, China
Production plant of the samples	Donngqing street plant
Line ID where the samples are made	-
Production date	-
The product was marked as	Silande MF840

Specific

Sample dimensions	
Dimensions of the H-samples	Sealant 50x12x12 mm Glass 70x12x6 mm
Dimensions film sample	2 mm thick, 150 mm diameter (permeation) 2.3 mm thick, 70 mm diameter (volatile)
Component	2 jars of component A and B
Sample making date	2020-09-04
Sealant material	
Type	polysulfide 2 component
Batch no. comp. A	20200630110 white
Batch no. comp. B	20200407107 black
Mix ratio	A:B 10:1 (m/m and v/v)
Colour	black
Function	secondary/outer sealant
Glass Specification	
Type of glass (coating)	Clear float glass
Type of coating (if present)	N/A

1.3 Sampling procedure

TÜV Rheinland B.V., acting as Notified Test Laboratory, has had no influence on the selection of the sample. All test specimens within the sample were test-worthy and were received on 11 December 2020 .

1.4 Application

The request for testing was submitted by the client on 17 August 2020 order or reference number or name: -/-. TRN quotation and/or assignment form number: 20.A226.

1.5 Method of testing

All applicable tests have been performed according to the European standard EN 1279-4 : 2018 [1].

1.6 Period of testing

The tests took place in the period week 51, 2020 till week 6, 2021.

1.7 Test location

TÜV Rheinland Nederland, Westervoorstedijk 73, Arnhem, the Netherlands.

1.8 Put out to contract

No tests were performed at third parties.

1.9 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.

1.10 Notifications, accreditations, designations

TÜV Rheinland Nederland B.V. has been notified by the Dutch Ministry of Infrastructure and the Environment as Notified Laboratory and Notified (Factory Production Control) Certification Body (number 0336) for the European Construction Products Regulation 305/2011 (EU).

TÜV Rheinland Nederland B.V. has been accredited by the Dutch Accreditation Council (RvA) as ISO 17025 Test Laboratory (nr. L 484) and ISO 17065 Certification Body (nr. C078).

TÜV Rheinland Nederland B.V. has been recognised by the German Institute for building technics (DIBt) under number NL005 as test, control and certification body.

Remark

The reported tests with an [a] are performed under ISO 17025 accreditation.

2 Methods

The requirements for sealants consist of a physicochemical characterisation and seal strength, water vapour transmission and gas permeation data. Additional also the volatile content was determined.

2.1 Physicochemical characterisation

The following properties of the cured sealant are determined according to table 2 of EN1279-4 [1]

2.1.1 Change in volume EN ISO 10563 [a]

The volume change or shrinkage is determined of 3 round specimens made by the test house from the separate components sent in by the client. The specimens were conditioned for 28 days at laboratory conditions followed by 7 days at 70 °C.

Table 1: Change in volume

Specimen	1	2	3	average
ΔV [%]	1.98	1.81	1.79	1.9

2.1.2 Infrared spectrum (IR)

The IR spectrum is taken from a freshly cut piece from the cured sealant made by the client.

2.1.3 Thermogravimetric analysis (TGA) EN ISO 11358-1:2014

The TGA is determined in twofold from a piece of the cured sealant made by the client.
In deviation from the TGA method of the standard pure oxygen gas is used instead of synthetic air.

2.1.4 Density /specific gravity EN ISO 1183-1, procedure A [a]

The density is determined from pieces of the film sealant made by the client.

Table 2: Density

Specimen	1	2	3	average
Density [g/cm^3]	1.773	1.777	1.776	1.78

2.2 Outer sealant strength [a]

This part covers evaluation of the edge seal strength. The requirement is that outer sealant shall show sufficient adhesive and cohesive strength before and after aging. The maximum tension or the point of failure or the end of the tensile curve shall lie outside the triangle area AOB as given in figure 1 of EN1279-4 [1]. Besides this requirement the cross over stress on the line AB is determined (σ_c).

For the test 3 series of specimens are tested, series 1 for the initial values and two series after aging. The aging process is as follows:

- **UV exposure and high temperature moisture series 2**

After initial cure and conditioning seven test specimens are exposed to UV irradiation for (504 ±8) hours, exposed perpendicular to the glass at an intensity in the UVA range of (40 ±5) W/m^2.
After the exposure to UV the test specimens are aged in a climate chamber at (58 ±1) °C and a relative humidity of at least 95 % for (168 ±5) hours.

- **Water immersion series 3**

After initial cure and conditioning seven test specimens are immersed in one to two litres of distilled or deionized water for (168 ±5) hours at (23 ±2) °C.

The test specimens are measured for width, depth and height prior to aging. After the ageing, the samples undergo testing under tensile load at a speed of (5 ±0.25) mm/min after conditioning for at least 24 hr at laboratory conditions. The laboratory conditions are (23 ±2) °C and (50 ±5) % R.H.

The maximum stress (σ_s) and stress at crossing the line AB (σ_c) were calculated from the mean of the 2 contact areas between the sealant and the glass of the test specimens. The highest and lowest σ_s values were ignored so that the average values are calculated on the five remaining measured stress and strain values.

For detail test results see appendix A.

2.3 Water vapour transmission rate [a]

Annex D1 of the EN1279-4 [1] describes the determination of the water vapour transmission rate (WVTR) of a polymeric sealant. For materials which have a WVTR less than the substitution limit given in EN 1279-1:2018 table D.2 and D3 the method is used only for confirmation that the WVTR is less than this limit (for inner and single sealant WVTR < 0.5 $g.m^{-2}.d^{-1}$).
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 ±1) °C at a relative humidity [R.H.] of > 90%. The thickness of the sample material must be as close as possible to 2 mm. A specimen with a diameter of about 90 mm is punched out of the film sample. A metal dish is filled with a known amount of desiccant, with a RH< 5% and covered by the film. The dish is closed by clamping a lid with an opening of 50 cm² on top of the film. At regular intervals the increase in weight of the dish is measured on an analytical balance with a resolution of 0.0001 g. The increase of weight [g] (with possible corrections for the increase in mass of a dummy sample) and exposure time and exposed area are used for the calculation of the WVTR per day per m².
The results are expressed for 2 mm thick specimen as: WVTR in [g/(m².day)], at 23 °C and a relative humidity of > 85%. In the calculations an inverse relationship between transmission and thickness is assumed for samples that are thicker or smaller than 2 mm.
Of three measured specimens the lowest value is reported to two significant digits.

Table 3: Water vapour transmission at 23°C/ >90% RH

Specimen	1	2	3
Thickness [mm]	2.00	2.02	1.99
WVTR [$g.m^{-2}.d^{-1}$]	5.65	5.66	5.55
WVTR [g.2 mm. $m^{-2}.d^{-1}$]	5.6	5.7	5.5

2.4 Gas permeation rate [a]

Annex D2 of the EN 1279-4 [1] describes the gas permeation rate (GPR) measurement for polymeric sealant. For materials which have a GPR less than the substitution limit given in EN 1279-1:2018 table D.2 and D3 the method is used only for confirmation that the GPR is less than this limit (for inner and single sealant GPR < 0.060 $g.m^{-2}.d^{-1}$).
The GPR is measured by means of a gas cell and gas chromatography. The sealant samples are placed between the upper and lower chamber of a gas cell. The upper chamber is flushed with argon and the lower chamber is flushed with nitrogen (resulting in a partial pressure difference of one atmosphere over

the sample). After several hours of flushing the lower chamber is closed (steady state condition is received). This chamber is of a known volume. After a certain time (minutes to hours, depending of the gas permeability) a gas sample is taken from the lower chamber and analysed by means of gas chromatography for the argon amount. From the concentration of argon in the gas sample, the elapsed time, the volume of the lower chamber and the test area (100 cm²) the argon permeation is calculated.
The results are expressed for a 2 mm thick specimen as: argon mass permeation rate Pm in [g./(m²•day)], at 23 °C and a relative humidity of <5% with 1 bar pressure difference. In the calculations an inverse relationship between permeation and thickness is assumed for samples that are thicker or smaller than 2 mm.
Of three measured specimens the lowest value is reported to two significant digits.

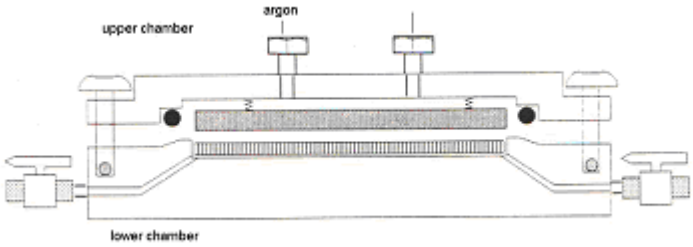


Table 4: Gas permeation rate at 23°C

Specimen	1	2	3
Thickness [mm]	2.00	2.00	1.98
GPR [g.2 mm. $m^{-2}.d^{-1}$]	0.086 ±0.003	0.091 ±0.001	0.088 ±0.002

2.5 Volatile content

The volatile test was carried out on three pieces of 2.3 mm thick and 70 mm diameter cured sealant film according to Annex H of EN1279-4 at (70±3) °C for 212 hours. Reported is the average weight loss as volatile content.

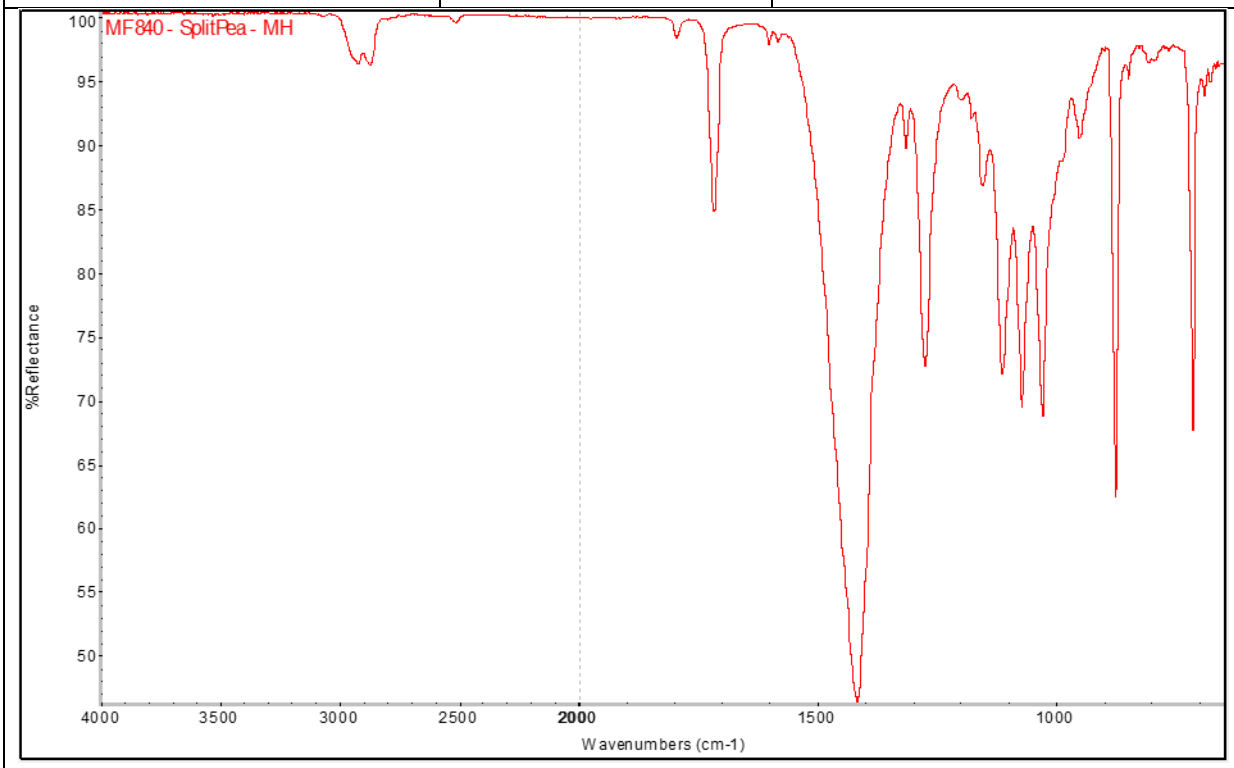
Table 5: Volatile content

Specimen	1	2	3
Initial mass [g]	22.6399	19.7109	17.2368
Final mass [g]	22.4861	19.5733	17.1338
Difference [g]	0.1538	0.1376	0.103
Volatile content [%]	0.68	0.70	0.60
Average [%]	0.66 ±0.05		
Date of test	(12-21)-1-2021		

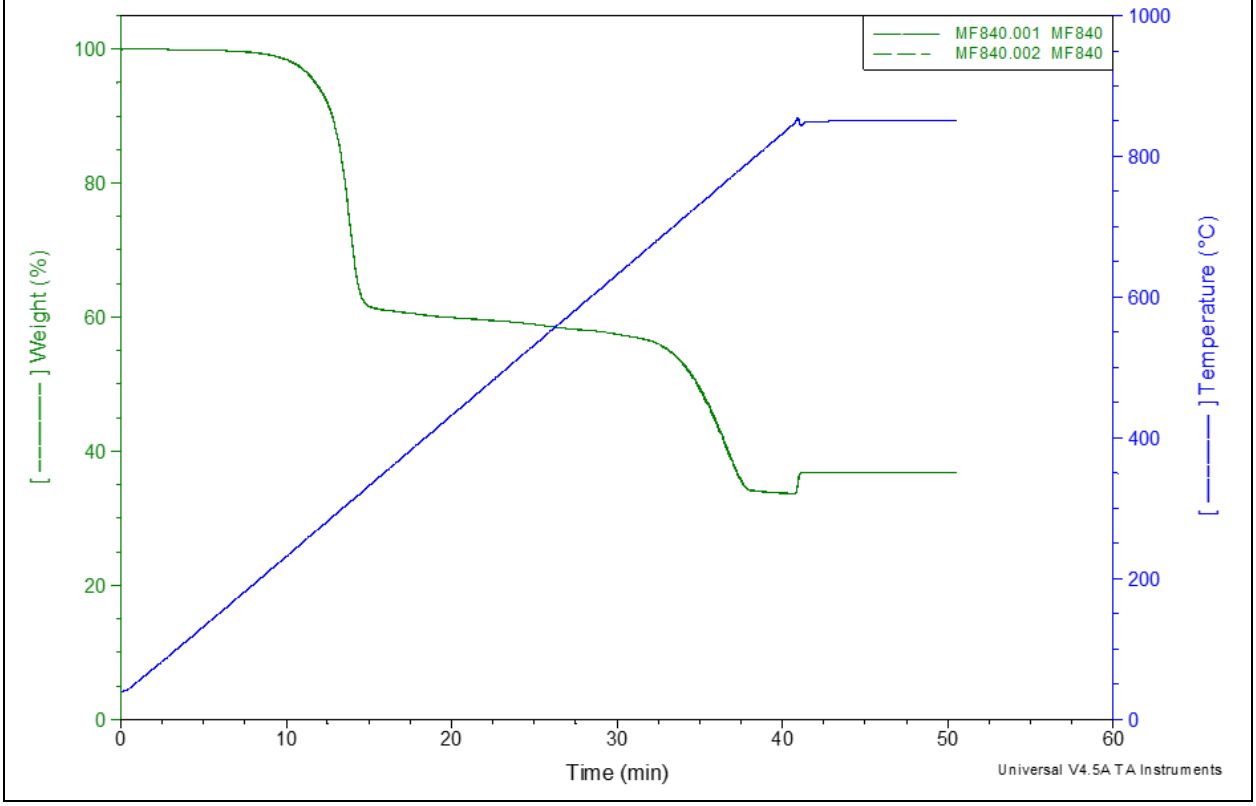
3 Test results

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

Physicochemical characterisation (EN1279-4:2018, 5.2)		
Volume shrinkage	Sealant	ΔV = (1.9 ±0.1) %
Density / Specific gravity	Cured sealant	ρ = (1.78 ±0.01) g/cm^3
Infrared spectrum	Cured sealant	



Thermogravimetric analysis	Cured sealant (duplicate)	for details see appendix B



Outer sealant strength (EN1279-4:2018, 5.3)		
Initial test (series 1)	Adhesive bond (float glass-sealant-float glass)	pass σ_c = (0.400 ±0.002) MPa
After exposure to UV, temperature and moisture (series 2)	Adhesive bond (float glass-sealant-float glass)	pass σ_c = (0.391 ±0.005) MPa
After immersion in water (series 3)	Adhesive bond (float glass-sealant-float glass)	pass σ_c = (0.400 ±0.003) MPa
Charateristics for the substitution of sealants (EN1279-4:2018, 5.5)		
Cross-over stress (series 1)	Adhesive bond (float glass-sealant-float glass)	σ_c = (0.40 ±0.01) MPa
Water vapour transmission rate	sealant sheet (2 mm thickness)	WVTR = 5.5 $g.m^{-2}.d^{-1}$
Gas permeation rate (Argon)	sealant sheet (2 mm thickness)	GPR = 0.086 $g.m^{-2}.d^{-1}$
Additional results		
Volatile content	(0.66 ±0.05) %	

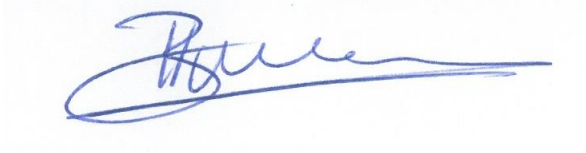
The test results exclusively relate to the tested objects.

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.

4 References

1 European standard EN 1279-4: 2018 (E),
Glass in building – Insulating glass units – Part 4: Methods of test for the physical attributes of edge seal components and inserts,
European Committee for Standardization, July 2018.

5 Signatures

Author	Signature
Mr. M.A.A.M. Schets, B.Sc. Senior Expert	
Authorised by	Signature
Mr. R. Brandhorst Senior Expert	

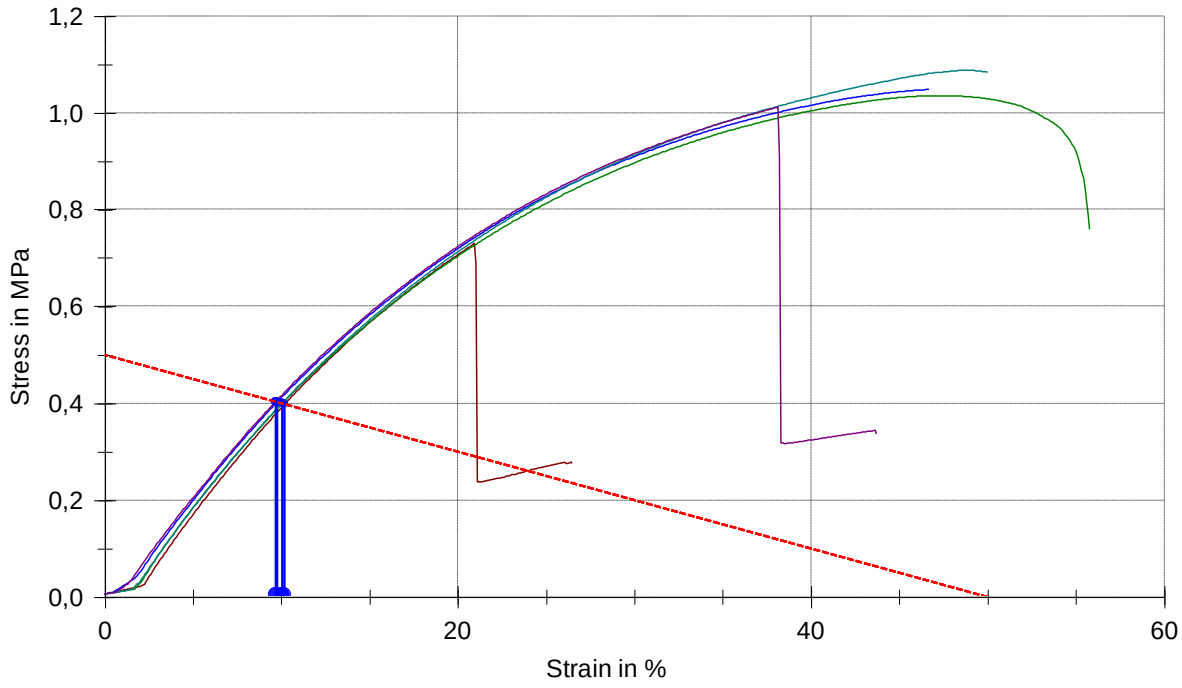
Appendix A, Details seal strength tests

Series 1: Initial

Legends	Nr	width b0 mm	thickness a0 mm	A mm²	Kit height mm	σ c MPa	ε c %	σ-max MPa	Failure
"	1	50,5	11,9	601,0	12,0	0,398	10,2	0,73	glass breakage
"	2	50,5	11,9	601,0	12,0	0,399	10,1	1,03	Cohesive
"	3	50,5	12,0	606,0	12,0	0,402	9,8	1,05	glass breakage
"	4	50,5	11,9	601,0	12,0	0,399	10,1	1,09	glass breakage
"	5	50,5	11,7	590,9	12,0	0,403	9,7	1,01	glass breakage

Statistics:

Series	width b0	thickness a0	A	Kit height	σ c	ε c	σ-max
n = 5	mm	mm	mm²	mm	MPa	%	MPa
x	50,5	11,9	599,9	12,0	0,400	10,0	0,98
s	0,0	0,1	5,5	0,0	0,002	0,2	0,14
ν	0,00	0,92	0,92	0,00	0,54	2,18	14,67



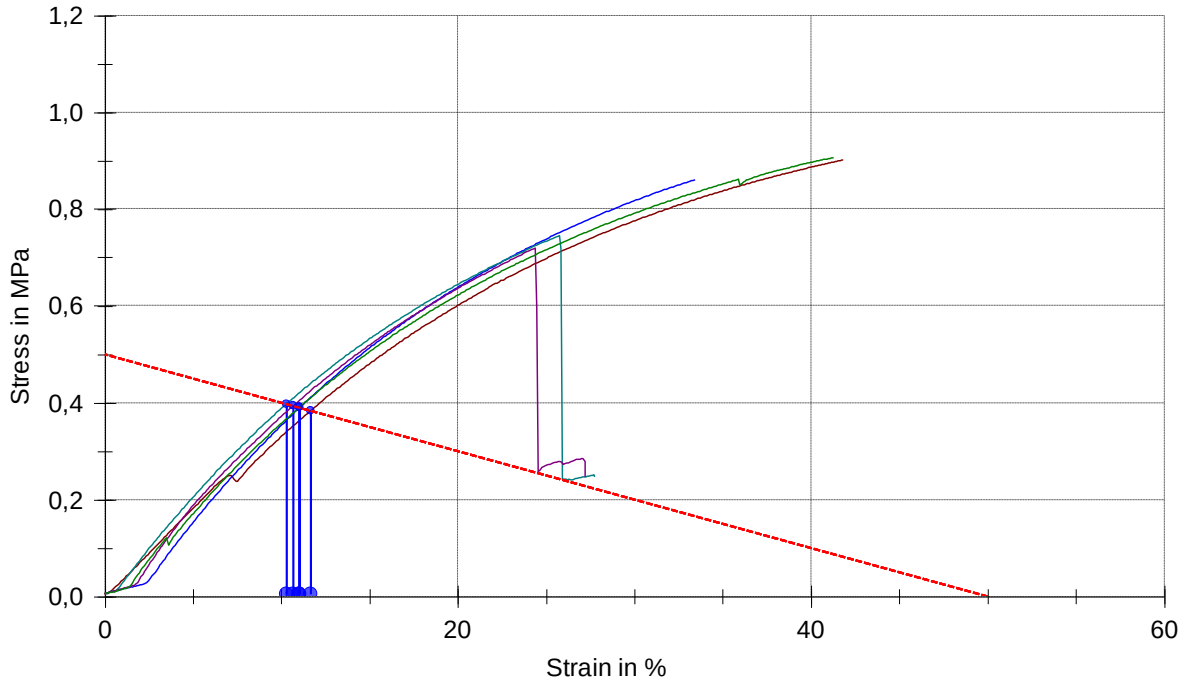
Series 2: UV and high temperature moisture

Results:

Legends	Nr	width b0 mm	thickness a0 mm	A mm²	Kit height mm	σ c MPa	ε c %	σ-max MPa	Failure
"	1	50,7	12,1	613,5	12,0	0,383	11,7	0,90	glass breakage
"	3	50,5	12,2	616,1	12,0	0,389	11,1	0,86	glass breakage
"	4	50,5	12,1	611,1	12,0	0,397	10,3	0,74	glass breakage
"	5	50,1	11,7	586,2	12,0	0,393	10,7	0,72	glass breakage
"	7	50,1	12,0	601,2	12,0	0,390	11,0	0,91	glass breakage

Statistics:

Series	width b0	thickness a0	A	Kit height	σ c	ε c	σ-max
n = 5	mm	mm	mm²	mm	MPa	%	MPa
x	50,4	12,0	605,6	12,0	0,391	10,9	0,83
s	0,3	0,2	12,2	0,0	0,005	0,5	0,09
ν	0,53	1,60	2,02	0,00	1,30	4,65	10,68



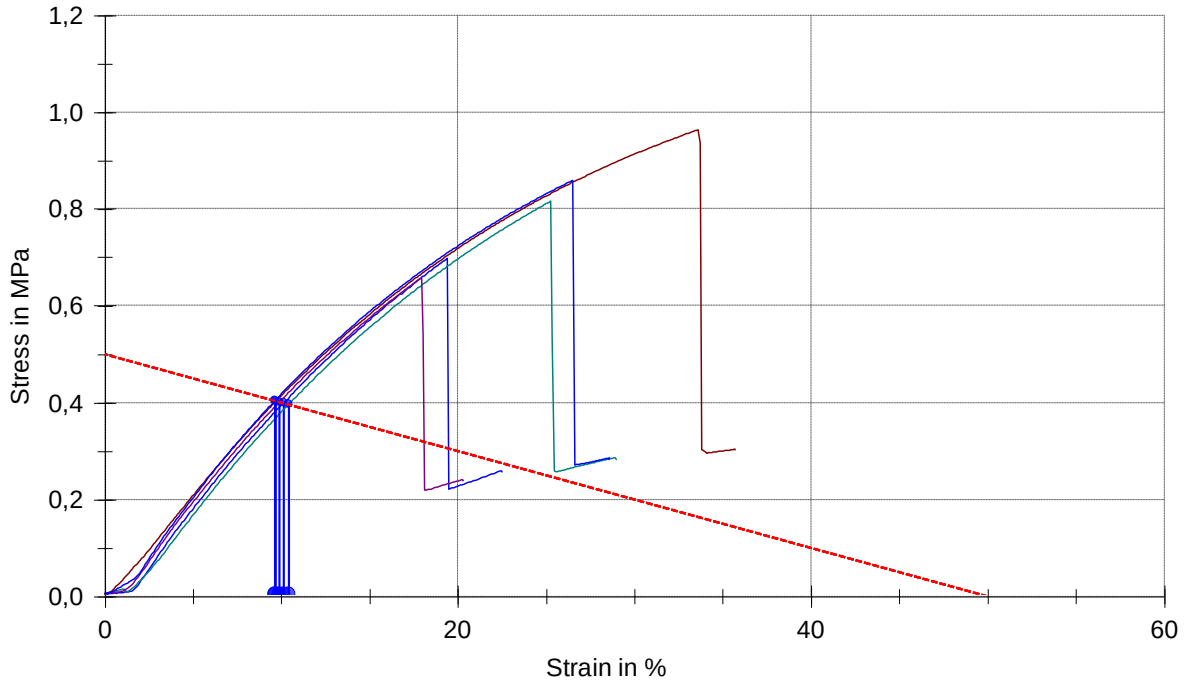
Series 3: Water immersion

Results:

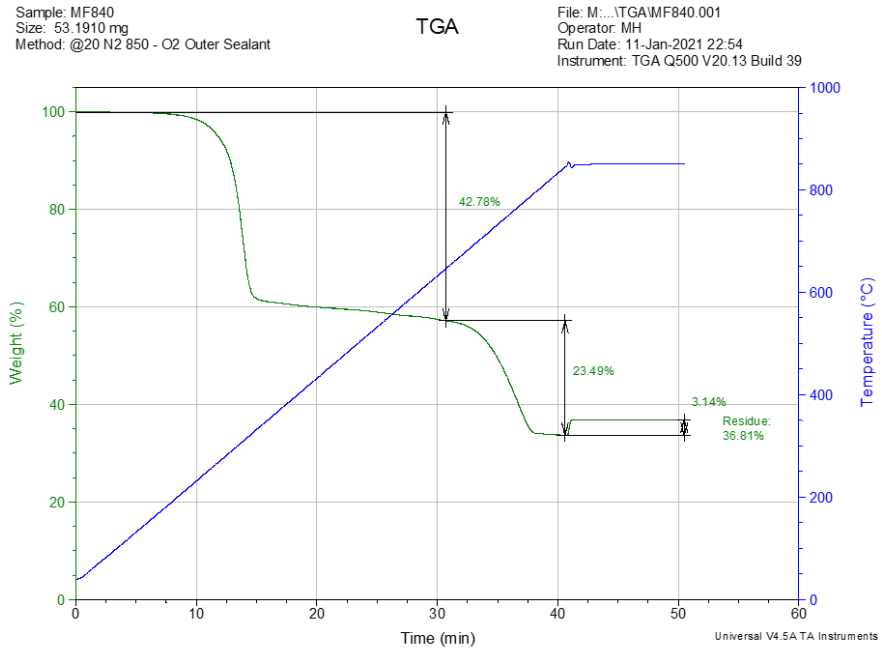
Legends	Nr	width b0 mm	thickness a0 mm	A mm²	Kit height mm	σ c MPa	ε c %	σ-max MPa	Failure
"	3	49,8	12,0	597,6	12,0	0,399	10,1	0,70	glass breakage
"	4	50,2	11,9	597,4	12,0	0,396	10,4	0,82	glass breakage
"	5	50,0	12,0	600,0	12,0	0,401	9,9	0,66	glass breakage
"	6	50,0	11,8	590,0	12,0	0,403	9,7	0,96	glass breakage
"	8	50,2	12,0	602,4	12,0	0,404	9,6	0,86	glass breakage

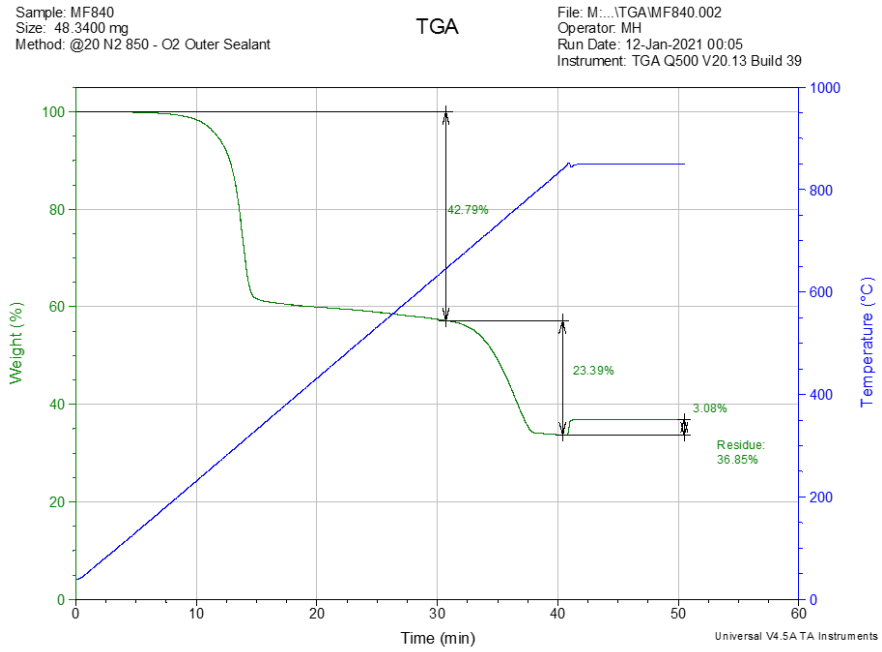
Statistics:

Series	width b0	thickness a0	A	Kit height	σ c	ε c	σ-max
n = 5	mm	mm	mm²	mm	MPa	%	MPa
x	50,0	11,9	597,5	12,0	0,400	10,0	0,80
s	0,2	0,1	4,7	0,0	0,003	0,3	0,12
ν	0,33	0,75	0,78	0,00	0,80	3,20	15,47



Appendix B, Details TGA





Weight Change MF840		.001	.002	avr
Start	Stop	Weight	Weight	Weight
°C	°C	%	%	%
40	646	42.78	42.79	42.8
646	845	23.49	23.39	23.4
845	850	-3.14	-3.08	-3.1
Residue		36.81	36.85	36.8

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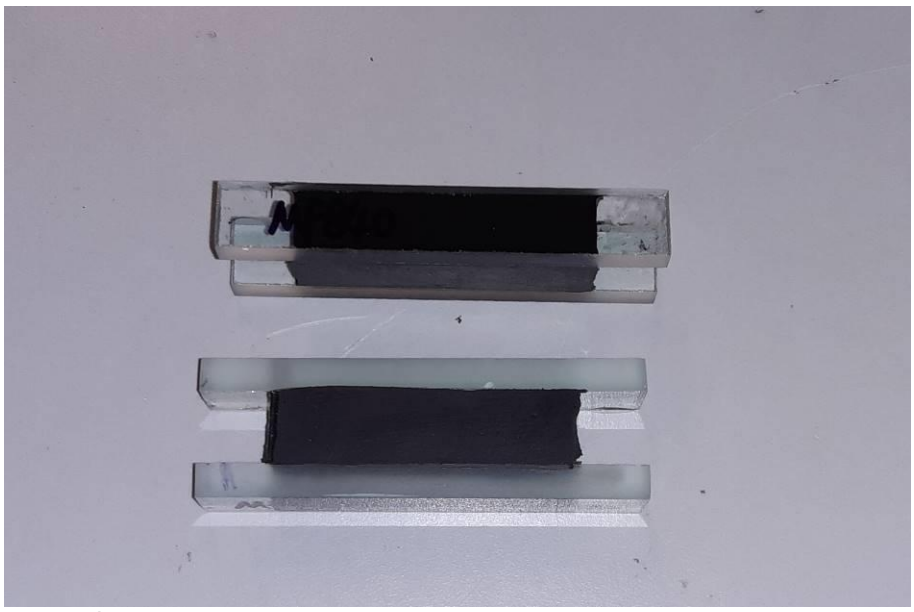
Appendix C, Pictures of the test specimen



H samples

Components

- End of test report -