

Test report no.:	89216314 001 V3	Order No.:	89216314 10	Page 1 of 13
Client Reference No.:	-	Order date:	2019-12-08	
Client:	Profloating B.V., Honderdland 226, 2676 LE, Maasdijk			
Test item:	Plastic panels from final product			
Identification/ Type No.:	-			
Order content:	Accelerated Weathering followed by tensile testing at 23 °C and -20 °C			
Test specification:	EOTA-TR010-Severe climate ISO 527-2/1BA/50			
Date of sample receipt:	2020-01-29			
Test sample No.:	20.0008			
Testing period:	2020-01-29 – 2021-03-04			
Place of testing:	Arnhem			
Testing laboratory:	TÜV Rheinland Nederland B.V.			
Test result*:	See Other			
tested by:	X 	authorized by:	X 	
Date:	2021-04-21	Issue Date:	2021-04-21	
	<small>Ondertekend door: Marco Hubers</small>		<small>Ondertekend door: Jaring de Wolff</small>	
Position:	Expert	Position:	Expert	
Others:	See individual test results in report.			
Condition of the test item at delivery:	Test item complete and undamaged			
<small>* Legend:</small>	<small>P(ass) = passed a.m. test specification(s)</small>	<small>F(ail) = failed a.m. test specification(s)</small>	<small>N/A = not applicable</small>	<small>N/T = not tested</small>
This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.				

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Test report no.: 89216314 001 V3

Page 2 of 13

Remarks

1	<p>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request. For the influence of the measuring uncertainties on the results, reference is made to the validation of the respective methods.</p>
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1 Introduction

On November 1, 2019 WEP Circular B.V. (WEP) requested TÜV Rheinland Nederland BV (TRN) to perform accelerated weather and tensile testing of two plastic materials.

WEP assigned the order to TRN by returning a signed copy of TRN quotation 89003246 dated November 11, 2019.

2 Samples

TRN received sample material from WEP on January 29, 2020. The sample materials were given TRN sample codes. The TRN sample codes and descriptions are given in Table 1. Photographs are given in appendix A.

Table 1: TRN sample codes and description.

TRN sample code	Description
20.0008-1	Grey plastic panels taken from final product
20.0008-2	Black plastic panels taken from final product

3 Investigation

3.1 Preparation of tensile testing test specimen

Test specimen ISO 527-2/1BA were die cutting from the sample materials as received.

3.2 Artificial accelerated weathering

The artificial accelerated weathering was performed using a Weather-Ometer Ci4000 apparatus according to ISO 4892, parts 1 and 2. The conditions used are in accordance with EOTA TR010 "Severe climate". In table 2.2 the weathering conditions are given.

Table 2: Weathering method used the Weather-Ometer Ci4000.

Apparatus	Weather-Ometer Ci 4000 (Atlas Electric Devices Company)
Light source	6500 Watt cooled Xenon Arc Lamp
Filter combinations	Inner and outer filter glass type "S" Borosilicate
Replacement schedule lamps and filters	As recommended by the manufacturer
Light intensity (controlled)	0.50 W/m ² at 340 nm
Test chamber temperature (controlled)	43 °C
Black standard temperature (controlled)	70 °C
White standard temperature	53 °C
Relative air humidity (controlled)	65 %
Spray cycle	Duration of spraying 18 minutes, dry interval between spraying 102 minutes
Mounting of test specimens	Specimen holder type WPCT-3T, no backing
Carrier	Continuous exposure to light
Exposure time	6000 hours (The solar radiation exposure equivalent of app. 15 years in The Netherlands and app. 5 years in southern European countries.)

Prior to the evaluation the specimens were conditioned for a period of at least 24 hours at a temperature of 23 ± 2 °C and a relative air humidity of 50 ± 5%.

Test report no.: 89216314 001 V3

Page 4 of 13

3.3 Tensile testing

Tensile testing was performed in accordance with ISO 527-2/1BA/50. The parameters are summarized in table 3.

Table 3: Tensile testing parameters.

Standard:	ISO 527-1 and -2
Test specimen:	ISO 527-2/1BA
Test speed:	50 mm/min
Loadcell:	1 kN
Specimen grips:	Mechanical clamps
Length of narrow parallel part:	30 mm
Grip to grip separation:	55 mm
Extensometer:	Crosshead displacement
Preload:	10 N
Precision of tensile tester: (ISO 7500-1)	Loadcell: Class 0.5 Crosshead: Class 0.5 (range 1.6 to 50 mm)
Test climate:	23°C / 50% RH and -20°C (cabinet)

4 Results

The individual values, averaged values and standard deviation of the results of the tensile tests of samples 20.0008-1 and 20.0008-2 before and after 6000 hours accelerated weathering are summarized in tables 4, 5, 6 and 7. The stress-strain diagrams are given in appendices B. Photographs of the test specimen after testing are given in appendix C.

Legend for tables 4, 5, 6, 7 and 8:

- L0 : Test length
- σ -y : Stress at yield
- σ -m : Maximum stress
- ϵ -m : Strain at maximum stress
- σ -b : Stress at break
- ϵ -b : Strain at break
- Avg. : Average
- St.Dev. : Standard deviation
- : No value measured because elongation at break is higher than the test setup range (>924%)

Table 4: Results of tensile tests of sample 20.0008-1 before and after 6000 hours accelerated weathering @23°C.

20.0080-1	Specimen	Width	Thickness	Area	L0	σ -y	σ -m	ϵ -m	σ -b	ϵ -b
	Nr	(mm)	(mm)	(mm ²)	(mm)	(MPa)	(MPa)	(%)	(MPa)	(%)
As received	1	4.95	3.05	15.10	30.00	23.54	23.54	14	-	-
	2	4.95	2.80	13.86	30.00	23.53	23.53	13	-	-
	3	4.95	3.18	15.74	30.00	23.59	23.59	13	-	-
	4	4.95	3.20	15.84	30.00	24.27	24.27	14	-	-
	5	4.95	2.52	12.47	30.00	22.82	22.82	14	-	-
	6	4.95	3.40	16.83	30.00	22.54	22.54	14	-	-
	Avg.	4.95	3.03	14.97	30.00	23.38	23.38	14	-	-
	St.Dev.	0.00	0.32	1.57	0.00	0.62	0.62	0	-	-
After 6000 h WOM	1	4.95	3.00	14.85	30.00	24.16	24.16	14	-	-
	2	4.95	3.25	16.09	30.00	23.87	23.87	15	-	-
	3	4.95	3.22	15.94	30.00	23.78	23.78	14	-	-
	4	4.95	2.92	14.45	30.00	23.28	23.28	15	-	-
	5	4.95	3.49	17.28	30.00	22.63	22.63	14	-	-
	6	4.95	3.35	16.58	30.00	23.73	23.73	15	-	-
	Avg.	4.95	3.21	15.86	30.00	23.58	23.58	14	-	-
	St.Dev.	0.00	0.21	1.06	0.00	0.54	0.54	0	-	-

Table 5: Results of tensile tests of sample 20.0008-1 before and after 6000 hours accelerated weathering @-20°C.

20.0080-1	Specimen	Width	Thickness	Area	L0	σ -y	σ -m	ϵ -m	σ -b	ϵ -b
	Nr	(mm)	(mm)	(mm ²)	(mm)	(MPa)	(MPa)	(%)	(MPa)	(%)
As received	1	4.95	3.30	16.34	30.00	36.28	36.30	860	34.33	862
	2	4.95	3.75	18.56	30.00	36.41	36.41	11	7.11	51
	3	4.95	3.27	16.19	30.00	37.57	40.54	907	35.48	922
	4	4.95	3.02	14.95	30.00	36.39	38.55	924	35.38	933
	5	4.95	3.32	16.43	30.00	37.96	37.96	11	22.66	736
	6	4.95	2.62	12.97	30.00	37.05	38.21	863	33.04	869
	Avg.	4.95	3.21	15.91	30.00	36.94	37.99	596	28.00	729
	St.Dev.	0.00	0.37	1.85	0.00	0.70	1.56	454	11.32	339
After 6000 h WOM	1	4.95	3.13	15.49	30.00	36.83	36.83	11	7.26	66
	2	4.95	3.24	16.04	30.00	37.27	37.27	12	19.48	634
	3	4.95	2.84	14.06	30.00	36.79	36.79	11	10.13	75
	4	4.95	3.14	15.54	30.00	37.55	37.55	11	14.10	186
	5	4.95	3.32	16.43	30.00	37.44	37.44	11	15.94	351
	6	4.95	3.25	16.09	30.00	37.51	37.51	10	15.60	261
	Avg.	4.95	3.15	15.61	30.00	37.23	37.23	11	13.75	262
	St.Dev.	0.00	0.17	0.84	0.00	0.34	0.34	1	4.39	212

Table 6: Results of tensile tests of sample 20.0008-2 before and after 6000 hours accelerated weathering @23°C.

20.0080-2	Specimen	Width	Thickness	Area	L0	σ -y	σ -m	ϵ -m	σ -b	ϵ -b
	Nr	(mm)	(mm)	(mm ²)	(mm)	(MPa)	(MPa)	(%)	(MPa)	(%)
As received	1	5.03	2.90	14.59	30.00	23.36	23.36	11	22.09	14
	2	4.99	2.94	14.67	30.00	23.41	23.41	11	18.66	15
	3	5.01	3.06	15.33	30.00	23.62	23.62	11	19.05	16
	4	5.02	3.06	15.36	30.00	22.92	22.92	10	18.86	13
	5	5.02	3.20	16.06	30.00	23.85	23.85	11	20.02	13
	6	4.92	4.32	21.25	30.00	23.43	23.43	11	21.60	15
	Avg.	5.00	3.25	16.21	30.00	23.43	23.43	11	20.05	15
	St.Dev.	0.04	0.54	2.53	0.00	0.31	0.31	0	1.48	1
After 6000 h WOM	1	4.98	2.80	13.94	30.00	-	24.73	11	24.52	12
	2	4.98	2.95	14.69	30.00	23.64	23.64	10	22.74	11
	3	4.99	3.23	16.12	30.00	23.92	23.92	11	21.52	14
	4	5.00	3.62	18.10	30.00	23.83	23.83	11	22.86	14
	5	4.98	3.14	15.64	30.00	24.12	24.12	11	22.79	13
	6	4.99	3.35	16.72	30.00	-	23.59	11	23.33	12
	Avg.	4.99	3.18	15.87	30.00	23.88	23.97	11	22.96	13
	St.Dev.	0.01	0.29	1.48	0.00	0.20	0.42	0	0.97	1

Table 7: Results of tensile tests of sample 20.0008-2 before and after 6000 hours accelerated weathering @-20°C.

20.0080-2	Specimen	Width	Thickness	Area	L0	σ -y	σ -m	ϵ -m	σ -b	ϵ -b
	Nr	(mm)	(mm)	(mm ²)	(mm)	(MPa)	(MPa)	(%)	(MPa)	(%)
As received	1	5.00	2.80	14.00	30.00	37.98	37.98	9	35.54	11
	2	5.02	2.85	14.31	30.00	37.53	37.53	9	33.32	11
	3	5.06	2.86	14.47	30.00	36.79	36.79	9	34.01	10
	4	5.06	2.91	14.72	30.00	37.88	37.88	8	35.07	11
	5	5.06	3.18	16.09	30.00	36.89	36.89	8	35.19	10
	6	5.01	3.56	17.84	30.00	36.29	36.29	9	33.12	11
	Avg.	5.04	3.03	15.24	30.00	37.23	37.23	8	34.37	11
	St.Dev.	0.03	0.29	1.46	0.00	0.67	0.67	0	1.03	1
After 6000 h WOM	1	5.06	3.22	16.29	30.00	-	36.46	8	36.46	8
	2	5.02	2.90	14.56	30.00	-	37.98	8	37.98	8
	3	5.01	3.40	17.03	30.00	37.01	37.01	9	33.85	10
	4	5.00	3.20	16.00	30.00	-	36.01	9	35.50	9
	5	4.99	3.04	15.17	30.00	37.24	37.24	9	36.26	10
	6	5.02	2.99	15.01	30.00	37.06	37.06	8	33.89	9
	Avg.	5.02	3.13	15.68	30.00	37.10	36.96	9	35.66	9
	St.Dev.	0.02	0.18	0.93	0.00	0.12	0.68	1	1.60	1

5 Summary

In table 8 the averaged values and standard deviations of the tensile test of sample 20.0008-1 and 20.0008-2 are summarized.

Table 8: Summary of results of tensile tests of samples 20.0008-1 and -2.

20.0008-		σ -y (MPa)	σ -m (MPa)	ϵ -m (%)	σ -b (MPa)	ϵ -b (%)
		Avg / StDev	Avg / StDev	Avg / StDev	Avg / StDev	Avg / StDev
1	23 °C	As received	23.58 / 0.54	23.58 / 0.54	14 / 0	- / -
		After 6000 h WOM	23.58 / 0.54	23.58 / 0.54	14 / 0	- / -
	-20 °C	As received	36.94 / 0.70	37.99 / 1.56	596 / 454	28.00 / 11.32
		After 6000 h WOM	37.23 / 0.34	37.23 / 0.34	11 / 1	13.75 / 4.39
2	23 °C	As received	23.43 / 0.31	23.43 / 0.31	11 / 0	20.05 / 1.48
		After 6000 h WOM	23.88 / 0.20	23.97 / 0.42	11 / 0	22.96 / 0.97
	-20 °C	As received	37.23 / 0.67	37.23 / 0.67	8 / 0	34.37 / 1.03
		After 6000 h WOM	37.10 / 0.12	36.96 / 0.68	9 / 1	35.66 / 1.60

Remark: "- / -" indicates no value is measured because elongation at break is higher than the test setup range (>924%).

6 Conclusions

Based on the investigation in this report the following can be concluded:

- The tensile strength of samples 20.0008-1 and 20.0008-2 are similar, at -20 °C and 23 °C;
- The tensile strength of samples 20.0008-1 and 20.0008-2 at -20 °C (app. 37 MPa) are higher than at 23 °C (app. 24 MPa);
- After 6000 hours of accelerated artificial weathering (in accordance with EOTA-TR010-Severe conditions) no significant effect is observed in the tensile strength of samples 20.0008-1 and 20.0008-2;
- Strain at break of sample 20.0008-1 at 23 °C, before and after accelerated artificial weathering, is greater than 924%;
- Strain at break of sample 20.0008-2 at 23 °C, before and after accelerated artificial weathering, is approximately 11%;
- Strain at break of sample 20.0008-1 at -20 °C, before accelerated artificial weathering, is approximately 596% with a high standard deviation. After accelerated artificial weathering, it is reduced to 11%;
- Strain at break of sample 20.0008-1 at -20 °C, before and after accelerated artificial weathering, is approximately 9%.

Appendix A: sample photographs

Sample 20.0008-1



Front



Back

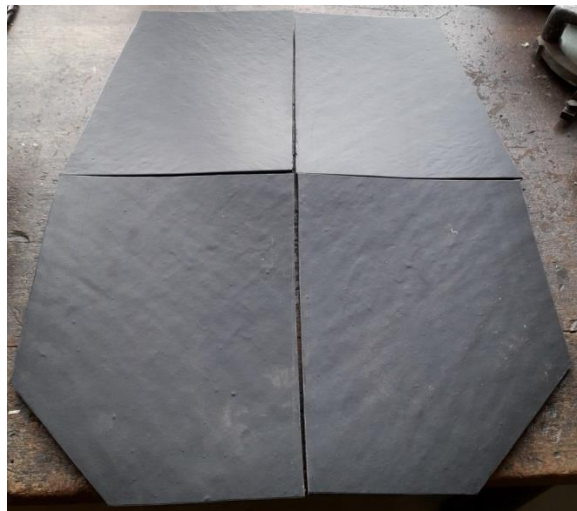


Detail

Sample 20.0008-2



Front

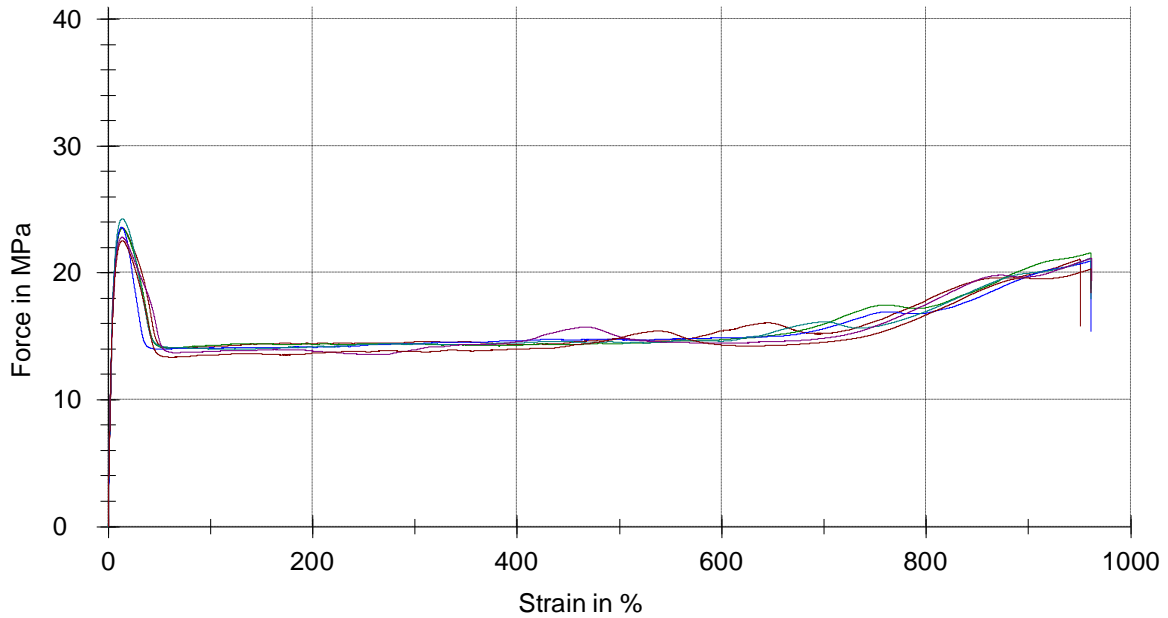


Back

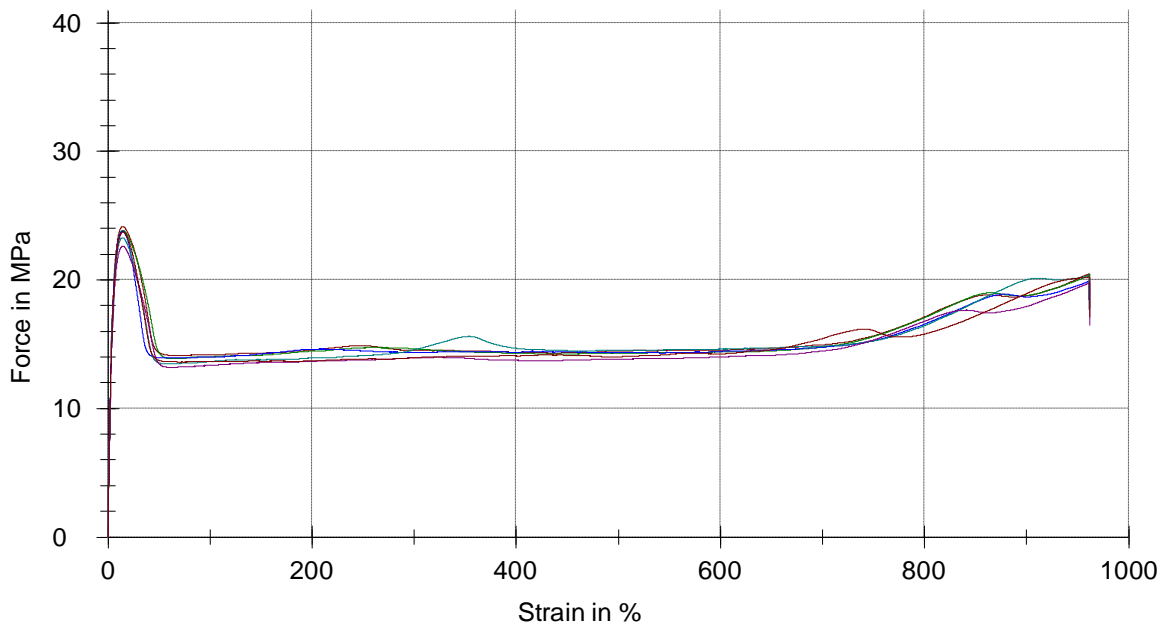


Detail

Appendix B.1: Stress-strain diagrams 20.0008-1 @ 23 °C

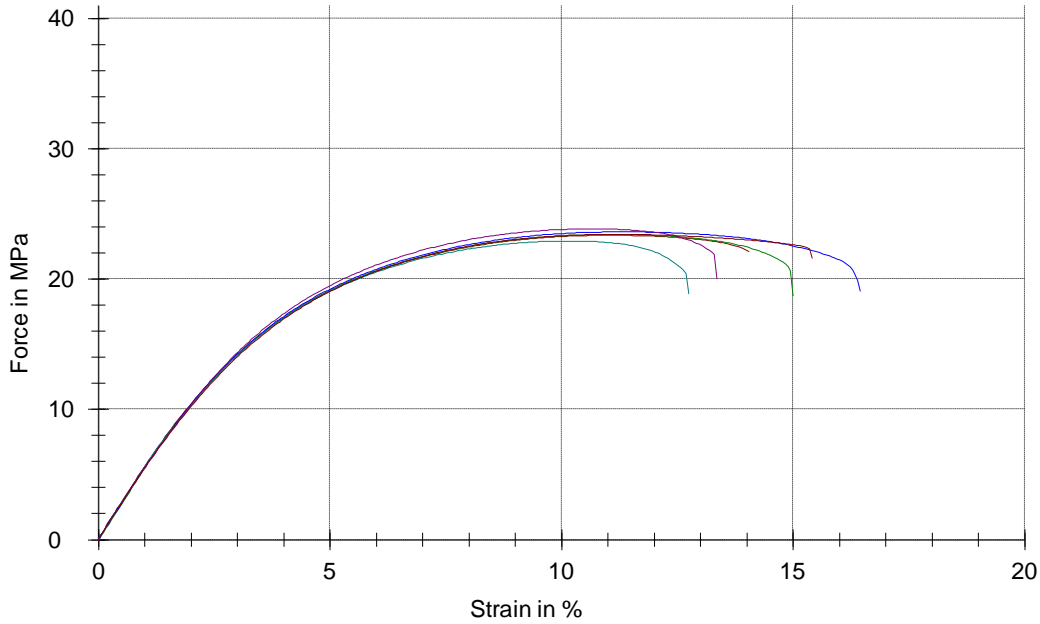


20.0008-1 grey as received

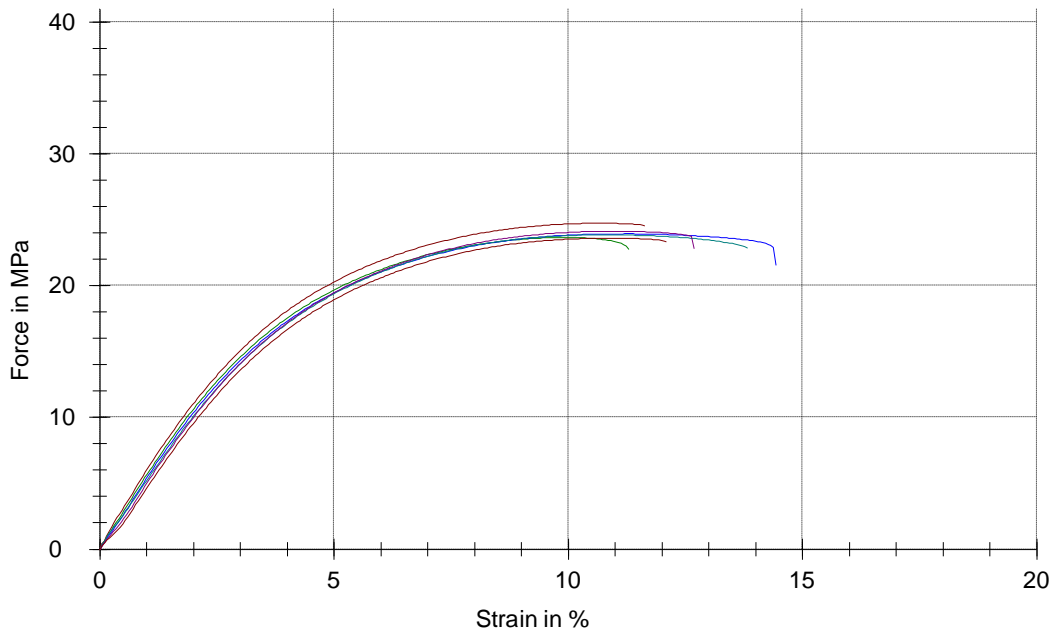


20.0008-1 grey - 6000 h WOM - EOTA-TR010-S

Appendix B.2: Stress-strain diagrams 20.0008-2 @ 23 °C

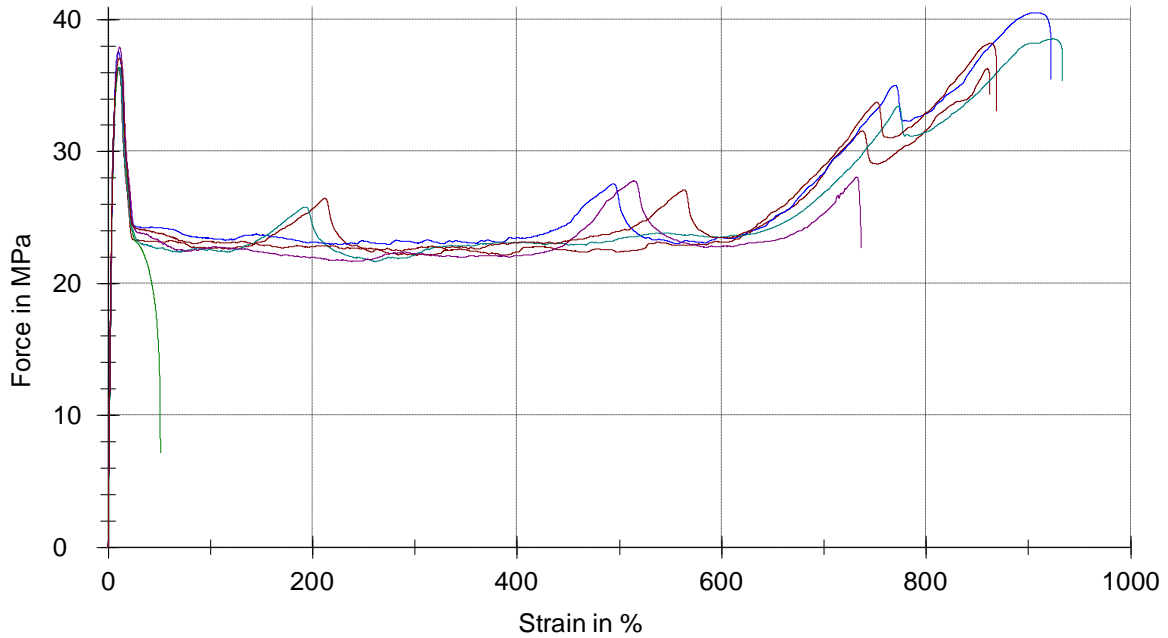


20.0008-2 black as received

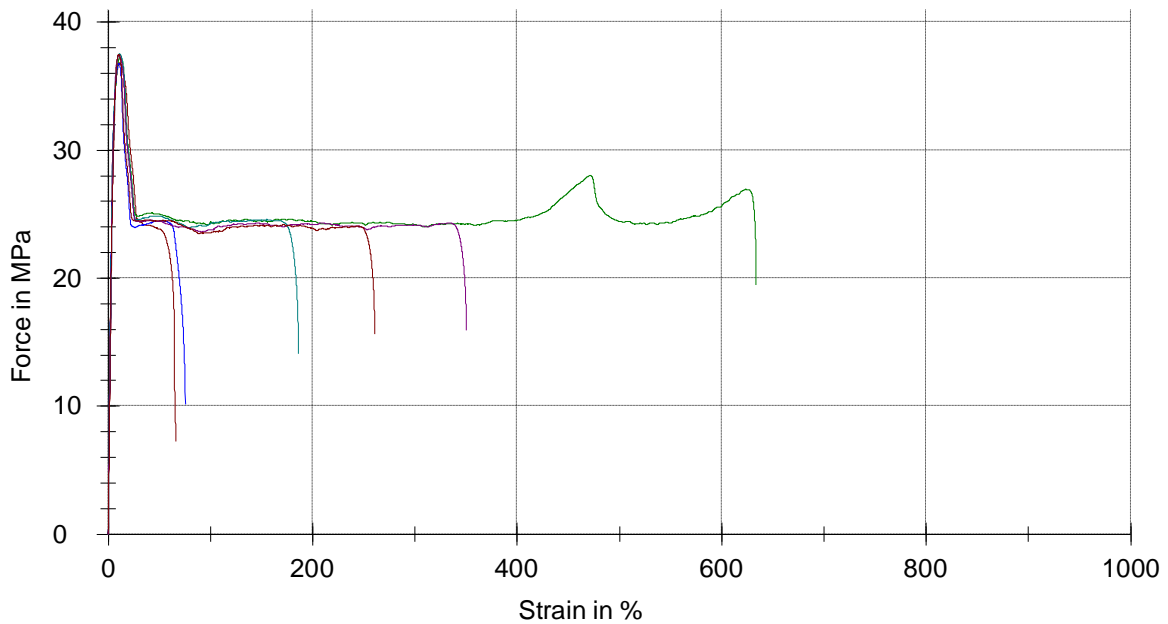


20.0008-2 black - 6000 h WOM EOTA-TR010-S

Appendix B.3: Stress-strain diagrams 20.0008-1 @ -20 °C

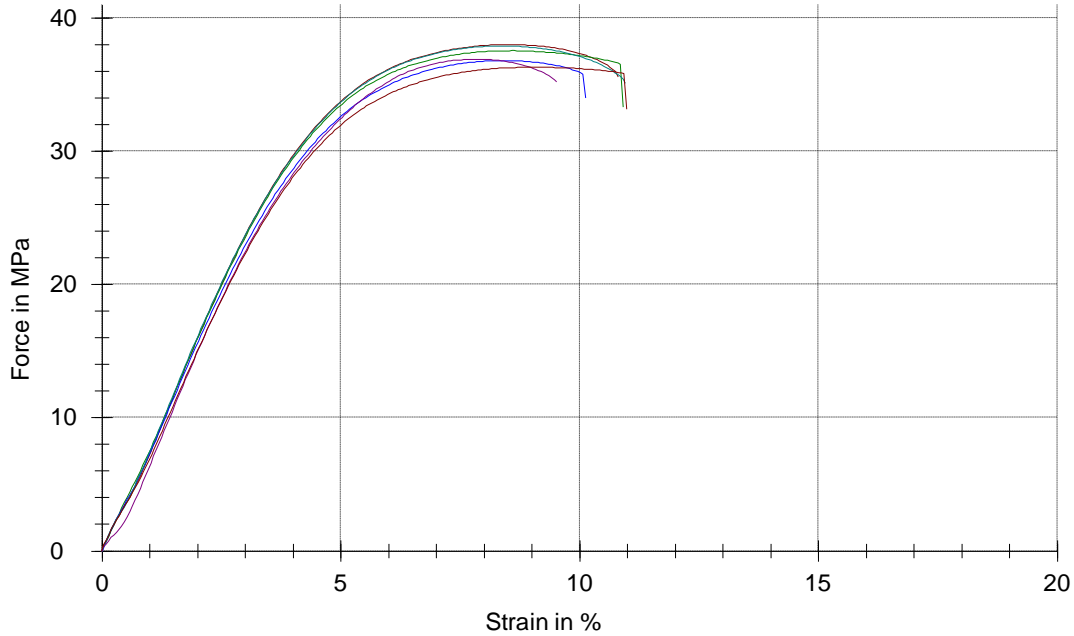


20.0008-1 grey as received

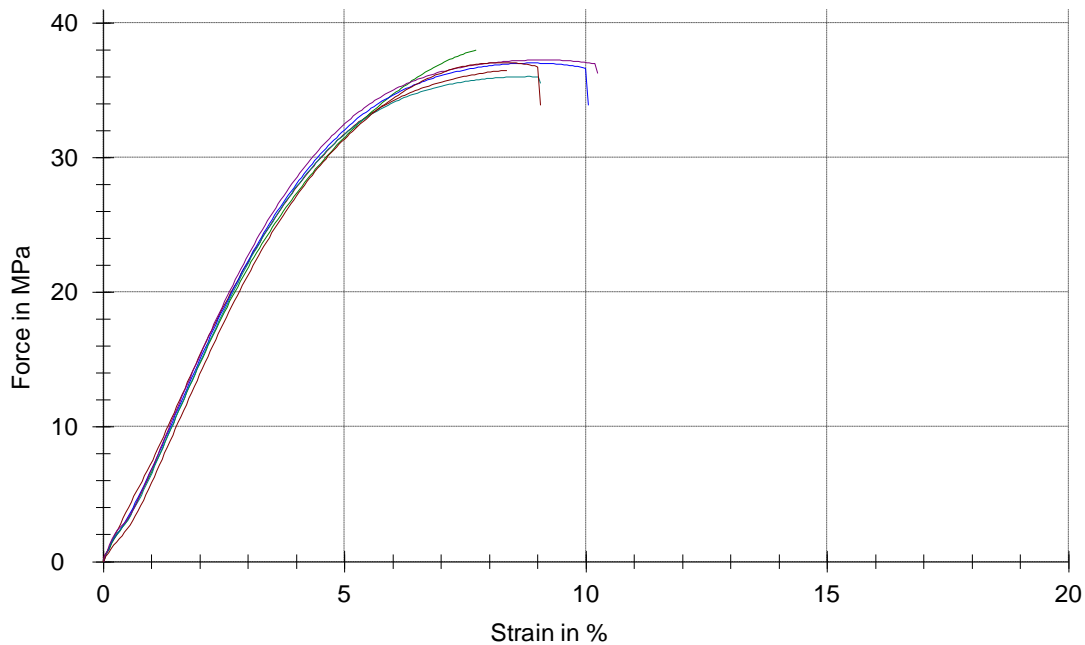


20.0008-1 grey - 6000 h WOM - EOTA-TR010-S

Appendix B.4: Stress-strain diagrams 20.0008-2 @ -20 °C



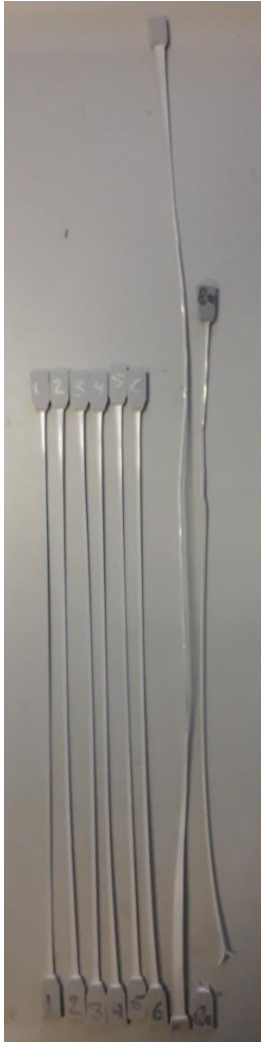
20.0008-2 black as received



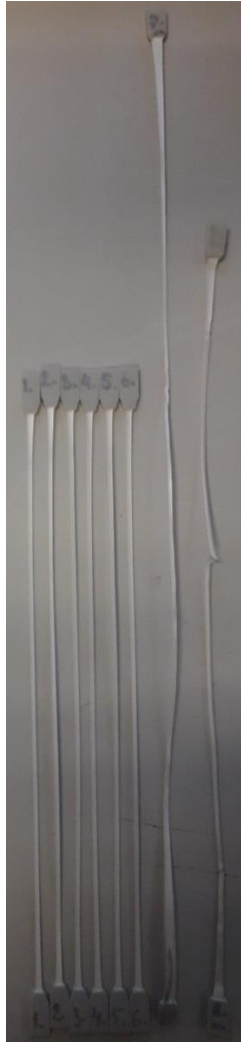
20.0008-2 black - 6000 h WOM EOTA-TR010-S

Appendix C: Photographs of test specimen after tensile testing

@ 23 °C



20.0008-1 grey as received



20.0008-1 grey - 6000 h
WOM EOTA-TR010-S

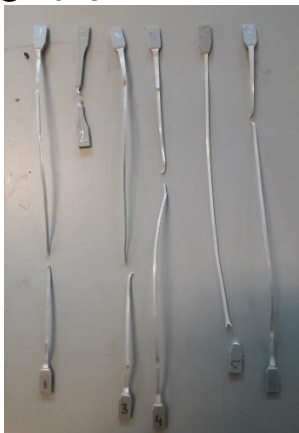


20.0008-2 black as received



20.0008-2 black - 6000 h
WOM EOTA-TR010-S

@ -20 °C



20.0008-1 grey as received



20.0008-1 grey - 6000 h
WOM EOTA-TR010-S



20.0008-2 black as received



20.0008-2 black - 6000 h
WOM EOTA-TR010-S

End of report.