DEKRA Automobil GmbH
Industrie, Bau und Immobilien
Werkstofftechnik und Schadensanalytik
Untertürkheimer Str. 25, 66117 Saarbrücken

07092023
Page 1 of 7

Test Report

Client:	**DS GmbH** **Innsbrucker Bundesstr. 75** **5020 Salzburg** **Österreich**
Contact:	**Mr Florian Nitschke** **Phone N°: +43.662.2616010** **Email: office@doberstein-group.com**
Order date:	**22.05.2023**
Test Report N°:	**07092023**
SAP N°:	**1897232904**
Scope:	**Analyses of acrylic glass**
Testing period:	**22.05. – 17.07.2023**
Copy:	**1.**

This test report consists of 7 pages and exclusively refers to the scope.

Measurement uncertainties are not taken into account for statements on conformity. The requirement is considered fulfilled if the result is within or on the tolerance limit. If the result is a mean value, conformity is only granted when every single result is within the tolerance limit.

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07092023
Page 2 of 7

1. SCOPE

On 22.05.2023, DS GmbH in Salzburg (Austria), represented by Mr. Florian Nitschke, ordered DEKRA Automobil GmbH, Werkstofftechnik und Schadensanalytik, Saarbrücken to characterize acrylic glass.

The following analyses were carried out:

- Materials identification by means of FTIR-ATR,
- Density,
- Shore D hardness,
- Flexural and tensile strength,
- Tensile strength of glued acrylic glass and
- Transparency/haze.

The samples were delivered by post and the tests were performed in the condition as supplied.

2. TEST METHODOLOGY AND RESULTS

2.1. FT INFRARED SPECTROSCOPY IN ACCORDANCE WITH QMA-105:2018-09*

Analyses by means of Fourier transformation infrared spectroscopy (FT-IR) with attenuated total reflection (ATR) in accordance with QMA-105 were performed to provide the characterisation of the materials. A PerkinElmer Frontier Spectrometer (machine N°6303) with Universal ATR Accessory and diamond crystal was used for the analysis. The measurement was performed in the spectral region of 4000 bis 650 cm^{-1}.

The infrared spectrum shows adsorption bands which are typical of Poly(methyl methacrylate) (**PMMA**; acrylic glass).

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2.2. DETERMINATION OF DENSITY ACCORDING TO DIN EN ISO 1183-1:2013-04*

For a determination of the density, a measurement was performed in accordance with DIN EN ISO 1183-1 Method A (Immersion Method). De-ionized water was used as immersion liquid. The test temperature was 23 °C.

The results of the measurement can be found in the table below:

Designation	Density [g/cm^3]			
	SV 1	SV 2	SV 3	MV
Acrylic Glass	1.176	1.178	1.176	**1.177**

SV: Single value   MV: Mean value

Correction for buoyancy in air was not carried out.

2.3. DETERMINATION OF SHORE HARDNESS ACCORDING TO DIN EN ISO 868:2003-10*

A Shore D hardness test was performed in accordance with DIN EN ISO 868. The test temperature was 23 °C.

The results are detailed in the table below:

Designation	Shore D hardness / 15					
	SV 1	SV 2	SV 3	SV 4	SV 5	MV
Acrylic Glass	86	86	86	85	86	**86**

SV: Single value   MV: Mean value

2.4. FLEXURAL STRENGTH ACCORDING TO DIN EN ISO 178:2013-08

Five individual test samples in the dimensions of 4x10x80 mm were retained from the specimen. Before the test, the samples were stored for 24 h at standard atmosphere (23 °C $\pm$ 2 °C / 50 % $\pm$ 5 % relative air humidity).

The tests were performed with a software-assisted Zwick universal testing machine type SMZ050/TH3A (machine N°: 148852 – F_{max} 50 kN) in accordance with DIN EN ISO 7500-1:2018-06, class 1) with the following test parameters:

- Support distance: 64 mm
- preload: 3 N
- testing speed: 2 mm/min

The results are listed afterwards:

Sample	F at breakage [mm]	Flexural Strength MPa
1	206	125
2	199	123
3	206	123
4	204	125
5	204	123
MV	**204**	**124**

MV: Mean value

2.5. TENSILE STRENGTH ACCORDING TO DIN EN ISO 527-1:2012-06*

Five test samples of the form 1A in accordance with DIN EN ISO 527-2:2012-06 were mechanically retained from the provided specimens by punching. Afterwards, the test samples were stored in standard atmosphere (23 °C $\pm$ 2 °C / 50 % $\pm$ 5 % relative air humidity) for more than 24 hours.

The tensile tests were performed in standard atmosphere with a software-assisted Zwick universal testing machine type SMZ050/TH3A (Machine N°: 148852 – F_{max} 50 kN) with the following test parameters in accordance with DIN EN ISO 527-2:

- Speed tensile modulus: 1 mm/min
- Test speed: 5 mm/min
- Preload: 01.01.2000

The results of the tensile tests in accordance with DIN EN ISO 527-1 have been summarized in the table below:

Sample Identification	Tensile modulus E_t [MPa]*	Tensile strength σ_m [MPa]*	Nominal Elongation ε_B [%]
1	3160	80.9	6.0
2	3540	81.1	5.6
3	3170	78.7	4.6
4	3690	82.4	5.5
5	3270	79.7	4.4
MV	**33663290**	**80.6**	**5.2**

MV: Mean value

2.6. TENSILE STRENGTH OF GLUED ACRYLIC GLASS FOLLOWING DIN EN ISO 527-1:2012-06

Five test samples were mechanically retained from the provided specimens by punching. Afterwards, the test samples were stored in standard atmosphere (23 °C ± 2 °C / 50 % ± 5 % relative air humidity) for more than 24 hours.

The tensile tests were performed in standard atmosphere with a software-assisted Zwick universal testing machine type SMZ050/TH3A (Machine N°: 148852 – F_{max} 50 kN) with the following test parameters in accordance with DIN EN ISO 527-2:

- Speed tensile modulus: 1 mm/min
- Test speed: 5 mm/min
- Preload: 01.01.2000

The results of the tensile tests have been summarised in the table below:

Sample Identification	Tensile modulus E_t [MPa]*	Tensile strength σ_m [MPa]*	Nominal Elongation ε_B [%]
1	3110	59.1	2.5
2	3090	53.9	2.1
3	3050	49.3	1.9
4	3030	46.9	1.8
5	2670	47.7	1.8
MV	**2990**	**51.4**	**2.0**

MV: Mean value

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2.7. TRANSPARENCY/HAZE ACCORDING TO ASTM D 1003:2013-11

Transparency was determined with a spectral photometer according to ASTM D 1003 method B.

The results are listed afterwards:

Sample	Transparency [%]			
	Min	Max	MV	s
Acrylglas	99,2	99,3	**99,2**	0,0

MV: Mean value; s: Standard deviation

Saarbrücken, 17.07.2023

DEKRA Automobil GmbH

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