Evidence of Performance
Thermal transmittance

Test Report
No. 16-000936-PR02
(PB-H01-06-en-01)

ROSENHEIM

Client

Luoyang Landglass Technology
CO. LTD-Guangjian Building
No. 12 Wangcheng Road
471000 Luoyang-Henan
China

Product

Low-E Vacuum insulating glass unit

Designation: LandVac (Landglass Vacuum Insulating Glass)

Performance-relevant product details: Insulating glass unit; Overall dimensions, width x height in mm 1000 x 1000; Configuration in mm 5TL / 0.3 Vacuum / 4T; Coating, type Low-E; Coating, position Pos. 2; Coating, emissivity ε_n = 0.05 (Nominal value); Vacuum < 0,1 Pa (Declared vacuum level); Spacer / Edge seals Material Metal; Dimension, width in mm 12; Metal Distance pieces; Distance in mm 45; Diameter in mm 0.5; Height in mm 0.3; Material Steel; Evacuation port; Diameter in mm 10; Material Metal

Special features: --

Results

Thermal transmittance

$U_{g,before}$ = 0.4 W/(m² · K) *
$U_{g,after}$ = 0.4 W/(m² · K) *

* The thermal transmittance $U_{g,before}$ and $U_{g,after}$ was determined before and after the mechanical and climate load. The thermal transmittance $U_{g,before}$ and $U_{g,after}$ was determined in the center of the glazing and does not include the influence of the edge sealing to the heat transfer. Due to the dimensions of the test specimens the tests were not carried out according to the standard test for glazing.

ift Rosenheim
20.12.2016

Manuel Demel
Deputy Head of Testing Department
Building Physics

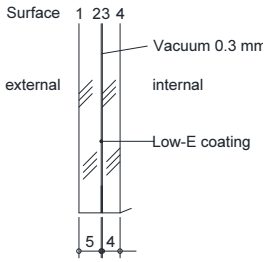
Konrad Huber, Dipl.-Ing. (FH)
Operating Testing Officer
Building Physics

Basis *)

Following
EN 12211:2000-06
prEN 12494:1996-08

*) Correspond/s to the national standard/s (e.g. DIN EN)

Representation



Instructions for use

This test report serves to demonstrate the thermal transmittance $U_{g,before}$ before the mechanical and climate load and the thermal transmittance $U_{g,after}$ after the mechanical and climate load. This test report can be used to evaluate the influence of the mechanical and climate load on the thermal transmittance. Due to the dimensions of the test specimens the tests were not carried out according to the standard test for glazing. The national regulations have to be observed for the national technical approval.

Validity

The data and results given relate solely to the described and tested object. Testing the thermal transmittance does not allow any statement to be made on further characteristics of the present structure which could define performance and quality.

Notes on publication

The ift-Guidance Sheet "Conditions and Guidance for the Use of ift Test Documents" applies. The document may only be published in full.

Contents

The report contains a total of 21 page/s and annexe (3 pages)

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Client: Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luo-yang-Henan (China)

1 Object

1.1 Description of test specimen

Product	Low-E Vacuum insulating glass unit
Manufacturer	Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luoyang-Henan (China)
Date of manufacture	July 1, 2016 / July 4, 2016
Product designation	LandVac (Landglass Vacuum Insulating Glass)
External dimension (W x H)	1000 mm x 1000 mm
Total thickness at edge	9.3 mm
Total thickness in pane centre	--
Configuration	5 TL / 0.3 Vacuum / 4 T mm *
Spacer / edge seals	
Material / Manufacturer	Metall *
Corner configuration	--
Dimension, width in mm	12
Coating	
Type / Manufacturer	Low-E *
Coating level	Pos. 2
Normal emissivity ε_n	
Declared value	0,05 *
Measured value	--
Vacuum in cavity	
Pressure in Pa	< 0.1 Pa (Declared vacuum level) *
Distance piece in cavity (pillar)	
Type, Manufacturer	Shape: Sphere
Construction	Distance 45 mm, diameter 0.5 mm, height 0.3 mm *
Material	Steel *
Evacuation port	
Type, Manufacturer	See attachment 1, Fig. 3
Diameter in mm	10
Material	Metal *
Extra equipment	Façade element, installed in frame made of ply wood
Dimension (W x H) in mm	See schematic view of the façade element in attachment 1, Fig. 4
Dimension façade profile (W x H) in mm	60 x 257
Installation depth of VIG in façade profile in mm	18
Special features	--

* Information provided by the client

The description is based on specifications provided by the client and on inspection of the test specimen at the **ift.** (Item designations/ numbers as well as material specifications were provided by the client, unless designated as *„**ift**-tested“*.)

Test specimen is described in the annex "Product/Sample description".

1.2 Sampling

The following data for sampling have been presented to **ift**:

Sampler: Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luoyang-Henan (China)

Documentation: ift Rosenheim did receive a sampling report.

Date of delivery: 11.07.2016

ift-test specimen-No.: 16-000936-PK02 / WE: 41768-001, 41768-002

2 Procedure

2.1 Basic documents *) of the procedures

Following

prEN 12494: 1996-08
Building components and elements – In – situ measurement of the surface - to - surface thermal resistance

EN ISO 6946: 2007-12
Building components and building elements – Thermal resistance and thermal transmittance – Calculation method

EN 12211:2000-06
Windows and doors - Resistance to wind load - Test method

*) correspond/s to the national standard/s, e.g. DIN EN

2.2 Short description of the procedures

Thermal transmittance and thermal resistance (before and after mechanical and climate load)
The test was performed following to the regular hot box method. The thermal transmittance was determined in steady state.

The specimen was located in a testing wall of insulation by covering the edge of the glazing using thermal insulation pieces with a width of 100 mm / 50 mm. The testing wall was surrounded by two half shells and the interior and exterior space. Air and surface temperatures as well as the heating power have been measured.

The heat flow density was determined by a heat flow meter. The thermal resistance was determined with the heat flow density and the measured surface temperatures. The thermal transmittance was calculated with the thermal resistance and the heat transfer coefficients for the internal and external side.

Thermal load / climate load
The specimen was installed in a façade element and located in a testing wall. The testing wall was surrounded on the external side by a conditioned box and the exterior space. The temperature on the external side was regulated to a temperature of +80°C or –15°C. The internal side of the specimen was conditioned by the indoor temperature. Air and surface temperatures have been measured.

Mechanical load
The specimen was installed in a façade element and located in a test rig. The testing wall was surrounded on the external side by a conditioned box and the exterior space. The wind pressure on the external side was regulated according to the standard. The internal side of the specimen was subjected to by the indoor pressure. The deflections of the specimen have been measured.

3 Detailed results

3.1 Detailed results for the thermal transmittance before mechanical and climate load

Thermal resistance and thermal transmittance

1508

Project-No.	16-000936-PR02	**Task No.**	16-000936
Basis of testing	prEN 12494: 1996-08 Building components and elements – In – situ measurement of the surface - to - surface thermal resistance EN ISO 6946: 2007-12 Building components and building elements – Thermal resistance and thermal transmit-tance – Calculation method		
Test equipment used	Pst/022762 - Hot Box U-Wert PstZ/022764 - Wand 1 (Hot Box) Heat flux meter (22823)		
Test specimen	VIG 1000 mm x 1000 mm		
Number of test specimen	41768-001, 41768-002		
Date of testing	27.08.2016 to 05.09.2016		
Testing personnel in charge	Konrad Huber		

Informationen regarding test arrangement / test method

Test method	There have been the following deviations from the test methods according to standard/basis. The thermal resistance was determined by measurement following prEN 12494. The test was carried out in the state of delivery.

Implementation of tests / Test results

Designation	Symbol	Specimen 1	Specimen 2	Average	Unit
Results and measured value R					
Surface temperature internal side	θ_{si}	21,6	21,7	21,7	°C
Surface temperature external side	θ_{se}	2,8	2,6	2,7	°C
Mean temperature	θ_{m}	12,2	12,2	12,2	°C
Mean temperature difference	$\Delta\theta_{si,se}$	18,8	19,1	18,9	°C
Heat flow density specimen (heat flux meter)	q_{sp}	8,8	8,7	8,8	W / m²
Thermal resistance test specimen	R_{sp}	2,12	2,19	2,16	(m² K) / W

Calculated value $U_{g,before}$					
normal emissivity internal surface	ε_n	0,89	0,89	0,89	-
corrected emissivity internal surface	ε	0,837	0,837	0,837	-
Surface resistance internal side (EN ISO 6946)	R_{si}	0,13	0,13	0,13	(m² K) / W
Surface resistance external side (EN ISO 6946)	R_{se}	0,04	0,04	0,04	(m² K) / W
Thermal transmittance	U	0,44	0,43	0,43	W / (m² K)
Thermal transmittance	$U_{g,before}$	0,4	0,4	0,4	W / (m² K)
Uncertainty of measurement (absolute)	ΔU_g	0,04	0,04	0,04	W / (m² K)

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Client: Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luo-yang-Henan (China)

3.2 Detailed results of mechanical and climate load

3.2.1 Thermal load with temperature of 80°C on the external side

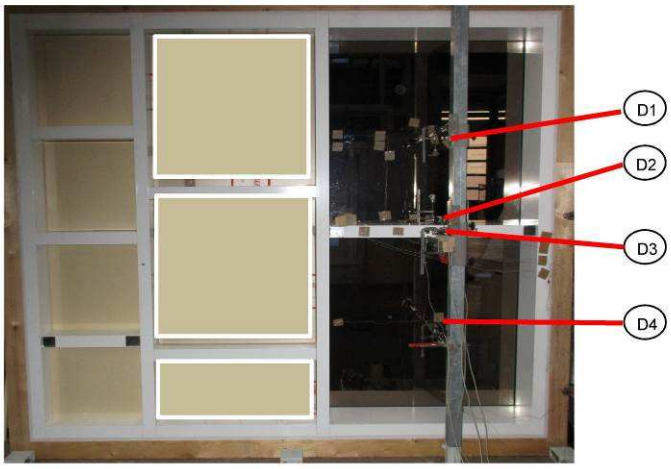
Thermal load with temperature of 80°C on the external side - VIG deflection

Project-No.	16-000936-PR02	**Task No.**	16-000936
Basis	--		
Test equipment	Pst/020828 - Klimaflex -40...80 °C		
Specimen	Facade element with VIG 1000 mm x 1000 mm		
Specimen No.	41768-001, 41768-002		
Date of test	31. October to 01. November 2016		
Responsible test engineer	Konrad Huber		
Test engineer	Konrad Huber		

Information to test assembly and testing method

Testing method	There were no deviations from test method or test conditions.	
Ambient conditions	Temperature internal side	+ 22 °C
	Temperature external side	+ 79 °C
	The ambient conditions were as specified by standard requirements.	

Testing procedure



Key

D(i) Measurement points deflection

Table: Measured results of frontal dislodgement in mm before thermal load

Deflection VIG top right	
D1 in mm	+ 0,3
Deflection VIG down right	
D4 in mm	-0,5

Table: Measured results of frontal deflection in mm by thermal load (start = 0 mm)

Deflection VIG top right	
D1 in mm	-5,0
D2 in mm	-0,9
f_{rel} in mm	-4,1
Deflection VIG down right	
D4 in mm	-4,8
D2 in mm	-0,9
f_{rel} in mm	-3,9
Deflection transom	
D3 in mm	-0,1

Key

D1, D2, D3	frontal dislodgement at measurement points D1, D2, D3 …
f	frontal deflection
leading sign	"+" deflection towards internal side (22°C); "-" deflection towards external side (80°C)

No malfunctions were detected.

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Thermal load with temperature of 80°C on the external side - VIG surface termperature

Project-No.	16-000936-PR02	**Task No.**	16-000936
Basis	--		
Test equipment	Pst/020828 - Klimaflex -40...80 °C		
Specimen	Facade element with VIG 1000 mm x 1000 mm		
Specimen No.	41768-001, 41768-002		
Date of test	31. October to 01. November 2016		
Responsible test engineer	Konrad Huber		
Test engineer	Konrad Huber		

Information to test assembly and testing method

Testing method	There were no deviations from test method or test conditions.	
Ambient conditions	Temperature internal side	+ 22 °C
	Temperature external side	+ 79 °C
	The ambient conditions were as specified by standard requirements.	

Testing procedure

Key

T(i) Measurement points temperature (see schematic view)

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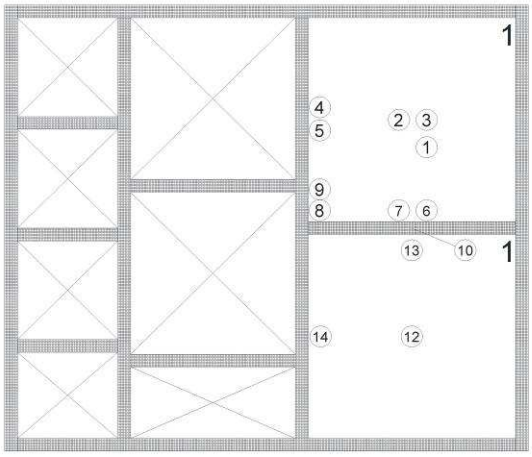
Client: Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luo-yang-Henan (China)



1: VIG 1000 mm x 1000 mm

1. Temperature in center of VIG, on distance piece
2. Temperature in center of VIG, between distance pieces
3. Temperature in center of VIG, between distance pieces
4. Temperature at left edge of VIG, near to distance piece
5. Temperature at left edge of VIG, between distance pieces
6. Temperature at bottom edge of VIG, near to distance piece
7. Temperature at bottom edge of VIG, between distance pieces
8. Temperature at corner of VIG, near to distance piece
9. Temperature at corner of VIG
10. Temperature in center of transom
12. Temperature in center of VIG, between distance piece
13. Temperature at top edge of VIG, between distance pieces
14. Temperature at left edge of VIG, between distance piece

Table: Measured values of surface temperatures in °C by thermal load with +80°C (external side)

Surface temperature on VIG top right

T1 in °C	+ 27,3
T2 in °C	-
T3 in °C	+ 26,6
T4 in °C	+ 42,6
T5 in °C	+ 42,7
T6 in °C	+ 42,4
T7 in °C	+ 41,9
T8 in °C	+ 41,4
T9 in °C	+ 44,0

Surface temperature on VIG down right

T12 in °C	+ 26,4
T13 in °C	+ 39,8
T14 in °C	+ 39,7

Surface temperature on transom

T10 in °C	+ 30,4

Key
T1, T2, T3 Surface temperature at measurement points T1, T2, T3 … (on the internal surface)

No malfunctions were detected.

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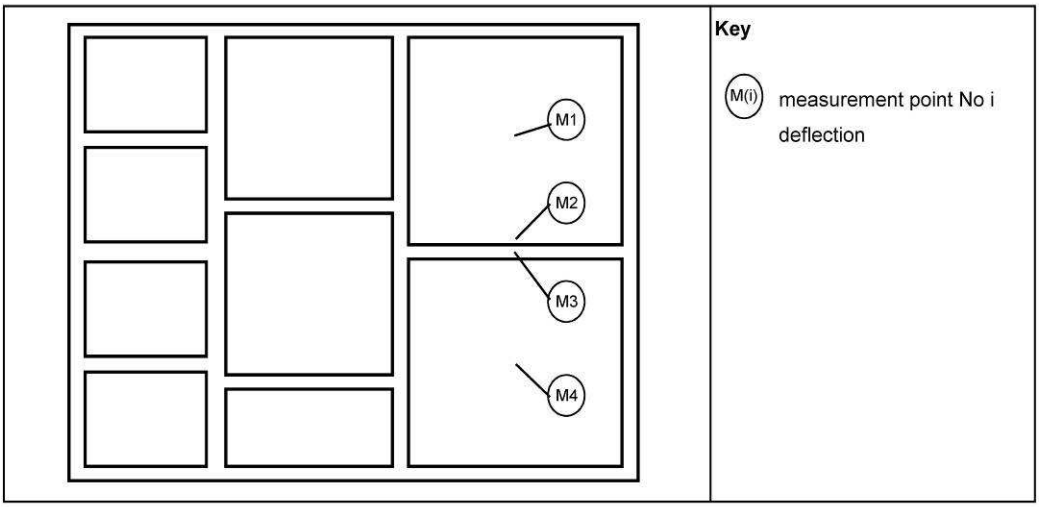
Client: Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luo-yang-Henan (China)

3.2.2 Mechanical load

Resistance to wind load, deflection and dynamic wind load - Test according to EN 12211

Project-No.	16-000936-PR02
Basis	EN 12211:2016-03 Windows and doors - Resistance to wind load - Test method
Test equipment	Pst/020920 - LWW-Prüfstand Fensterprüfstand 1
Test specimen	Facade element with VIG 1.000 mm x 1.000 mm
Test specimen No.	41768-001, 41768-002
Date of test	02.11.2016
Test engineer in charge	Stephan Bertagnolli
Test engineer	Stephan Bertagnolli
Implementation of tests Deviations	There have been the following deviations from the test method specified in the standard/basis: The test was done with 100 cycles.
Ambient conditions	Temperature 20.0 °C Air humidity 48 % Air pressure 963 hPa The ambient conditions are in accordance with the standard/basis requirements.

Measurement data/Results



Maximum test pressure: ± 2000 Pa 3 pressure pulses of 2200 Pa

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Client: Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luo-yang-Henan (China)

Table: Measured results of frontal deflection in mm at negative / positive wind pressures for VIG in the top

		Positive wind pressure					Negative wind pressure				
Measured results of frontal deflection in mm	**p_1 in Pa**	400	800	1200	1600	2000	-400	-800	-1200	-1600	-2000
	M1 in mm	-	-	-	-	+ 5,5	-	-	-	-	- 5,3
	M2 in mm	-	-	-	-	+ 3,2	-	-	-	-	- 2,6
	f_{rel} in mm	-	-	-	-	+ 2,3	-	-	-	-	- 2,7

Table: Measured results of frontal deflection in mm at negative / positive wind pressures for VIG in the bottom

		Positive wind pressure					Negative wind pressure				
Measured results of frontal deflection in mm	**p_1 in Pa**	400	800	1200	1600	2000	-400	-800	-1200	-1600	-2000
	M4 in mm	-	-	-	-	+ 5,6	-	-	-	-	- 5,2
	M2 in mm	-	-	-	-	+ 3,2	-	-	-	-	- 2,6
	f_{rel} in mm	-	-	-	-	+ 2,4	-	-	-	-	- 2,6

Table: Measured results of frontal deflection in mm at negative / positive wind pressures for the transom

		Positive wind pressure					Negative wind pressure				
Measured results of frontal deflection in mm	**p_1 in Pa**	400	800	1200	1600	2000	-400	-800	-1200	-1600	-2000
	M3 in mm	-	-	-	-	+ 3,0	-	-	-	-	- 2,3
	f_{rel} in mm	-	-	-	-	-	-	-	-	-	-

Key

p_1, p_2	Test pressure
M1, M2, M3,..	Frontal dislodgement at measurement points M1, M2, M3, ..
f_{rel}	Frontal deflection
leading sign	"+" deflection towards internal side; "-" deflection towards external side

Dynamic wind loads (negative / positive pressures)

Table: pressure pulses

p_2 in Pa	200	400	600	800	1000
passed					✓

100 cycles at p_2 ± 1000 Pa

Malfunctions at test specimen

At the test specimen were no malfunctions detected.

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Client: Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luo-yang-Henan (China)

Resistance to wind load, Safety test - Test according to EN 12211

Project-No.	16-000936-PR02
Basis	EN 12211:2016-03 Windows and doors - Resistance to wind load - Test method
Test equipment	Pst/020920 - LWW-Prüfstand Fensterprüfstand 1
Test specimen	Facade element with VIG 1.000 mm x 1.000 mm
Test specimen No.	41768-001, 41768-002
Date of test	02.11.2016
Test engineer in charge	Stephan Bertagnolli
Test engineer	Stephan Bertagnolli

Implementation of tests
Deviations: There have been no deviations from the test method as specified in the standard/basis.

Ambient conditions: Temperature 20.0 °C | Air humidity 48 % | Atmospheric pressure 963 hPa

The ambient conditions are in accordance with the standard/basis requirements.

Measurement data/Results

Safety test

Table: Pressure steps

		Positive wind pressure					Negative wind pressure				
p_3	Pa	600	1200	1800	2400	3000	-600	-1200	-1800	-2400	-3000
passed						✓					✓

Safety test passed at up to p3 ± 3000 Pa.

Malfunctions at test specimen

At the test specimen were no malfunctions detected.

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3.2.3 Thermal load with temperature of -15°C on the external side

Thermal load with temperature of -15°C on the external side - VIG deflection

Project-No.	16-000936-PR02	**Task No.**	16-000936
Basis	--		
Test equipment	Pst/020828 - Klimaflex -40...80 °C		
Specimen	Facade element with VIG 1000 mm x 1000 mm		
Specimen No.	41768-001, 41768-002		
Date of test	05. November to 06. November 2016		
Responsible test engineer	Konrad Huber		
Test engineer	Konrad Huber		

Information to test assembly and testing method

Testing method	There were no deviations from test method or test conditions.	
Ambient conditions	Temperature internal side	+ 18 °C
	Temperature external side	-15 °C
	The ambient conditions were as specified by standard requirements.	

Testing procedure

Key

D(i) Measurement points deflection

Table: Measured results of frontal dislodgement in mm before thermal load

Deflection VIG top right	
D1 in mm	+ 2,4
Deflection VIG down right	
D4 in mm	+ 1,8

Table: Measured results of frontal deflection in mm by thermal load (start = 0 mm)

Deflection VIG top right	
D1 in mm	+ 3,2
D2 in mm	+ 0,5
f_{rel} in mm	+ 2,7
Deflection VIG down right	
D4 in mm	+ 3,2
D2 in mm	+ 0,5
f_{rel} in mm	+ 2,7
Deflection transom	
D3 in mm	0,0

Key

D1, D2, D3	frontal dislodgement at measurement points D1, D2, D3 …
f	frontal deflection
leading sign	"+" deflection towards internal side (18°C); "-" deflection towards external side (-15°C)

No malfunctions were detected.

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Client: Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luo-yang-Henan (China)

Thermal load with temperature of -15°C on the external side - VIG surface termperature

Project-No.	16-000936-PR02	**Task No.**	16-000936
Basis	--		
Test equipment	Pst/020828 - Klimaflex -40...80 °C		
Specimen	Facade element with VIG 1000 mm x 1000 mm		
Specimen No.	41768-001, 41768-002		
Date of test	05. November to 06. November 2016		
Responsible test engineer	Konrad Huber		
Test engineer	Konrad Huber		

Information to test assembly and testing method

Testing method There were no deviations from test method or test conditions.

Ambient conditions

Temperature internal side	+ 18 °C
Temperature external side	-15 °C

The ambient conditions were as specified by standard requirements.

Testing procedure

Key

T(i) Measurement points temperature (see schematic view)

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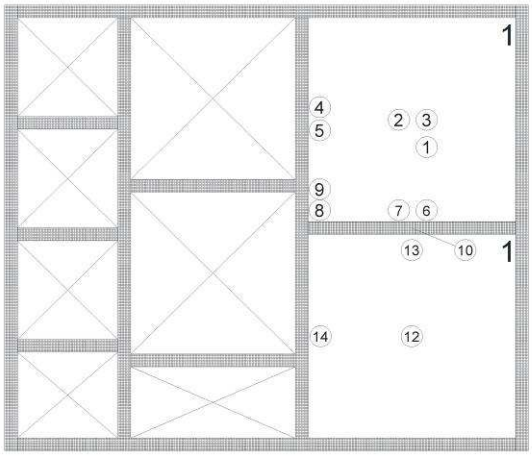

1: VIG 1000 mm x 1000 mm

1. Temperature in center of VIG, on distance piece
2. Temperature in center of VIG, between distance pieces
3. Temperature in center of VIG, between distance pieces
4. Temperature at left edge of VIG, near to distance piece
5. Temperature at left edge of VIG, between distance pieces
6. Temperature at bottom edge of VIG, near to distance piece
7. Temperature at bottom edge of VIG, between distance pieces
8. Temperature at corner of VIG, near to distance piece
9. Temperature at corner of VIG
10. Temperature in center of transom
12. Temperature in center of VIG, between distance piece
13. Temperature at top edge of VIG, between distance pieces
14. Temperature at left edge of VIG, between distance piece

Table: Measured values of surface temperatures in °C by thermal load with +80°C (external side)

Surface temperature on VIG top right

T1 in °C	+ 15,9
T2 in °C	+ 18,2
T3 in °C	+ 16,0
T4 in °C	+ 7,1
T5 in °C	+ 6,9
T6 in °C	+ 6,0
T7 in °C	+ 6,5
T8 in °C	+ 5,8
T9 in °C	+ 4,1

Surface temperature on VIG down right

T12 in °C	+ 15,9
T13 in °C	+ 7,6
T14 in °C	+ 7,2

Surface temperature on transom

T10 in °C	+ 12,7

Key
T1, T2, T3 Surface temperature at measurement points T1, T2, T3 … (on the internal surface)

Malfunctions: Condensation and ice at the edge of the VIG on the internal side (see attachement 2).

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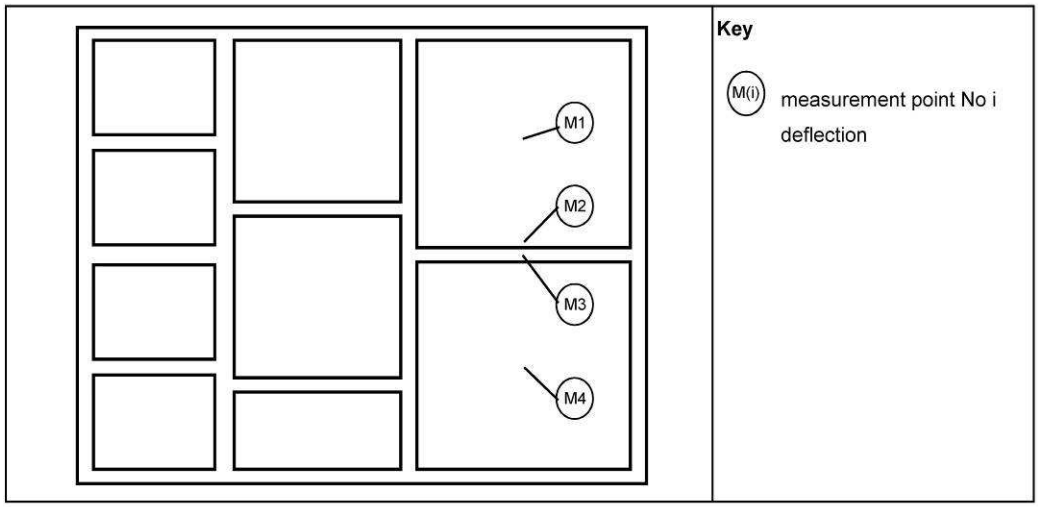
Client: Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luo-yang-Henan (China)

3.2.4 Mechanical load

Resistance to wind load, deflection and dynamic wind load - Test according to EN 12211

Project-No.	16-000936-PR02
Basis	EN 12211:2016-03 Windows and doors - Resistance to wind load - Test method
Test equipment	Pst/020920 - LWW-Prüfstand Fensterprüfstand 1
Test specimen	Facade element with VIG 1.000 mm x 1.000 mm
Test specimen No.	41768-001, 41768-002
Date of test	07.11.2016
Test engineer in charge	Daniel Gromotka
Test engineer	Daniel Gromotka
Implementation of tests Deviations	There have been the following deviations from the test method specified in the standard/basis:
Ambient conditions	Temperature 19.0 °C Air humidity 44 % Air pressure 956 hPa The ambient conditions are in accordance with the standard/basis requirements.

Measurement data/Results



Maximum test pressure: ± 2000 Pa 3 pressure pulses of 2200 Pa

Table: Measured results of frontal deflection in mm at negative / positive wind pressures for VIG in the top

		Positive wind pressure					Negative wind pressure				
Measured results of frontal deflection in mm	**p_1 in Pa**	400	800	1200	1600	2000	-400	-800	-1200	-1600	-2000
	M1 in mm	-	-	-	-	+ 6,0	-	-	-	-	- 5,9
	M2 in mm	-	-	-	-	+ 3,9	-	-	-	-	- 3,3
	f_{rel} in mm	-	-	-	-	+ 2,1	-	-	-	-	- 2,6

Table: Measured results of frontal deflection in mm at negative / positive wind pressures for VIG in the bottom

		Positive wind pressure					Negative wind pressure				
Measured results of frontal deflection in mm	**p_1 in Pa**	400	800	1200	1600	2000	-400	-800	-1200	-1600	-2000
	M4 in mm	-	-	-	-	+ 6,0	-	-	-	-	- 5,6
	M2 in mm	-	-	-	-	+ 3,9	-	-	-	-	- 3,3
	f_{rel} in mm	-	-	-	-	+ 2,1	-	-	-	-	- 2,3

Table: Measured results of frontal deflection in mm at negative / positive wind pressures for the transom

		Positive wind pressure					Negative wind pressure				
Measured results of frontal deflection in mm	**p_1 in Pa**	400	800	1200	1600	2000	-400	-800	-1200	-1600	-2000
	M3 in mm	-	-	-	-	+ 3,5	-	-	-	-	- 2,8
	f_{rel} in mm	-	-	-	-	-	-	-	-	-	-

Key

p_1, p_2	Test pressure
M1, M2, M3, …	Frontal dislodgement at measurement points M1, M2, M3, …
f_{rel}	Frontal deflection
leading sign	"+" deflection towards internal side; "-" deflection towards external side

Dynamic wind loads (negative / positive pressures)

Table: pressure pulses

p_2 in Pa	200	400	600	800	1000
passed					✓

100 cycles at p_2 ± 1000 Pa

Malfunctions at test specimen

At the test specimen were no malfunctions detected.

Test Report No. 16-000936-PR02 (PB-H01-06-en-01) dated 20.12.2016

Client: Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luo-yang-Henan (China)

Resistance to wind load, Safety test - Test according to EN 12211

Project-No.	16-000936-PR02
Basis	EN 12211:2016-03 Windows and doors - Resistance to wind load - Test method
Test equipment	Pst/020920 - LWW-Prüfstand Fensterprüfstand 1
Test specimen	Facade element with VIG 1.000 mm x 1.000 mm
Test specimen No.	41768-001, 41768-002
Date of test	07.11.2016
Test engineer in charge	Daniel Gromotka
Test engineer	Daniel Gromotka

Implementation of tests
Deviations: There have been no deviations from the test method as specified in the standard/basis.

Ambient conditions: Temperature 19.0 °C | Air humidity 44 % | Atmospheric pressure 956 hPa

The ambient conditions are in accordance with the standard/basis requirements.

Measurement data/Results

Safety test

Table: Pressure steps

		Positive wind pressure					Negative wind pressure				
p_3	Pa	600	1200	1800	2400	3000	-600	-1200	-1800	-2400	-3000
passed						✓					✓

Safety test passed at up to p3 ± 3000 Pa.

Malfunctions at test specimen

At the test specimen were no malfunctions detected.

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Client: Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luo-yang-Henan (China)

3.3 Detailed results for thermal transmittance after mechanical and climate load

Thermal resistance and thermal transmittance

1508

Project-No.	16-000936-PR02 **Task No.** 16-000936
Basis of testing	prEN 12494: 1996-08 Building components and elements – In – situ measurement of the surface - to - surface thermal resistance EN ISO 6946: 2007-12 Building components and building elements – Thermal resistance and thermal transmit-tance – Calculation method
Test equipment used	Pst/022762 - Hot Box U-Wert PstZ/022764 - Wand 1 (Hot Box) Heat flux meter (22823)
Test specimen	VIG 1000 mm x 1000 mm
Number of test specimen	41768-001, 41768-002
Date of testing	10.11.2016 to 16.11.2016
Testing personnel in charge	Konrad Huber

Informationen regarding test arrangement / test method

Test method	There have been the following deviations from the test methods according to standard/basis. The thermal resistance was determined by measurement following prEN 12494. The test was carried out after the mechanical and climate load.

Implementation of tests / Test results

Designation	Symbol	Specimen 1	Specimen 2	Average	Unit
Results and measured value *R*					
Surface temperature internal side	θ_{si}	21,6	21,5	21,6	°C
Surface temperature external side	θ_{se}	2,4	2,4	2,4	°C
Mean temperature	θ_{m}	12,0	11,9	12,0	°C
Mean temperature difference	$\Delta\theta_{si,se}$	19,2	19,2	19,2	°C
Heat flow density specimen (heat flux meter)	q_{sp}	9,2	9,2	9,2	W / m²
Thermal resistance test specimen	R_{sp}	2,10	2,09	2,09	(m² K) / W

Calculated value $U_{g,after}$					
normal emissivity internal surface	ε_n	0,89	0,89	0,89	-
corrected emissivity internal surface	ε	0,837	0,837	0,837	-
Surface resistance internal side (EN ISO 6946)	R_{si}	0,13	0,13	0,13	(m² K) / W
Surface resistance external side (EN ISO 6946)	R_{se}	0,04	0,04	0,04	(m² K) / W
Thermal transmittance	U	0,44	0,44	0,44	W / (m² K)
Thermal transmittance	$U_{g,after}$	0,4	0,4	0,4	W / (m² K)
Uncertainty of measurement (absolute)	ΔU_g	0,04	0,04	0,04	W / (m² K)

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Client: Luoyang Landglass Technology CO. LTD-Guangjian Building, 471000 Luo-yang-Henan (China)

3.4 Summary of test results and visual control

Thermal transmittance, mechanical und climate load, visual control

1508

Project-No.	16-000936-PR01	**Task No.**	16-000936
Basis of testing	See data sheet of the individual measurement		
Test equipment used	See data sheet of the individual measurement		
Test specimen	VIG 1000 mm x 1000 mm		
Number of test specimen	41768-001, 41768-002		
Date of testing	27.08.2016 to 16.11.2016		
Testing personnel in charge	Konrad Huber		

Informationen regarding test arrangement / test method

Test method	There have been the following deviations from the test methods according to standard/basis. See data sheet of the individual measurement

Implementation of tests / Test results

Summary of test results: Thermal transmittance

Designation	Symbol	$U_{g,average}$ * 1000 x 1000	$U_{g,average}$ * 500 x 500	$U_{g,average}$ **	Unit
Calculated value U_g					
Thermal transmittance (before)	$U_{g,before}$	0,43	-	**0,4** (0,43)	W / (m² K)
Thermal transmittance (after)	$U_{g,after}$	0,44	-	**0,4** (0,44)	W / (m² K)
Thermal transmittance (difference)	$\Delta U_{g,after-before}$	0,01	-	0,0 (0,01)	W / (m² K)

* Average value of two measurements
** Average value of two measurements

Summary of test results: Mechanical and climate load

Designation	Symbol	Value 1000 x 1000	Value 500 x 500	Value average	Unit
Thermal load +80 °C - deflection (center)	f_{rel}	-4,1	-	-	mm
Thermal load +80 °C - surface temperature (center)	$T_{average}$	+ 26,8	-	+ 26,8	°C
Thermal load +80 °C - surface temperature (edge/corner)	T_{max}	+ 44,0	-	-	°C
Mechanical load ±2000 Pa	$f_{rel,max}$	- 2,7	-	-	mm
Thermal load -15 °C - deflection (center)	f_{rel}	+ 2,7	-	-	mm
Thermal load -15 °C - surface temperature (center)	$T_{average}$	+ 16,7	-	+ 16,7	°C
Thermal load -15 °C - surface temperature (edge/corner)	T_{min}	+ 4,1	-	-	°C
Mechanical load ±2000 Pa	$f_{rel,max}$	- 2,6	-	-	mm

Visual control after complete test cycle

No malfunctions were detected.

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CO. LTD-Guangjian Building, 471000 Luoyang-Henan (China)

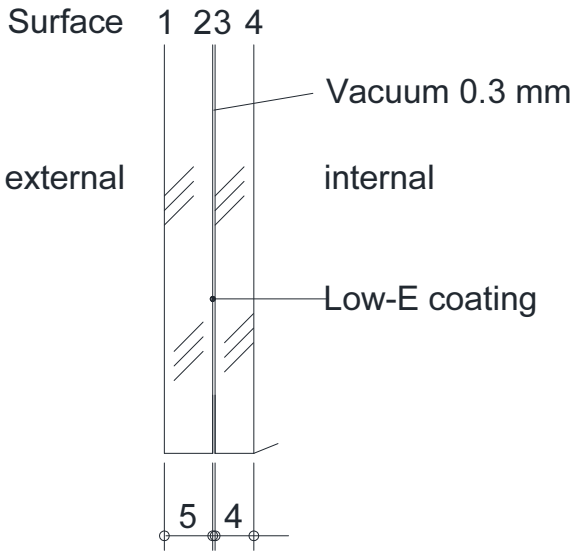

Fig. 1 Representation (Schematic view of the test specimen, drawing created by the ift).

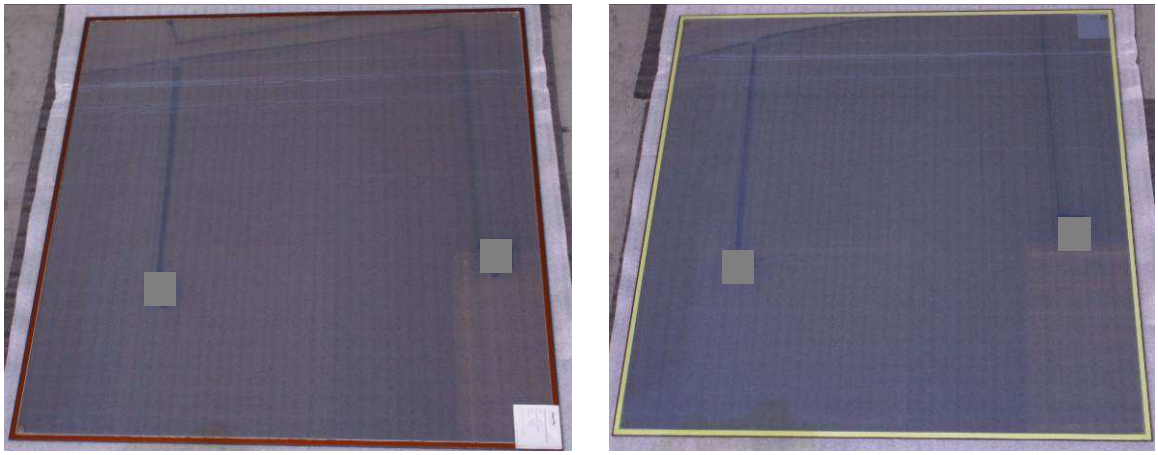

Fig. 2 Representation (Photos of the test specimen 1000 mm x 1000 mm, recorded by the ift).

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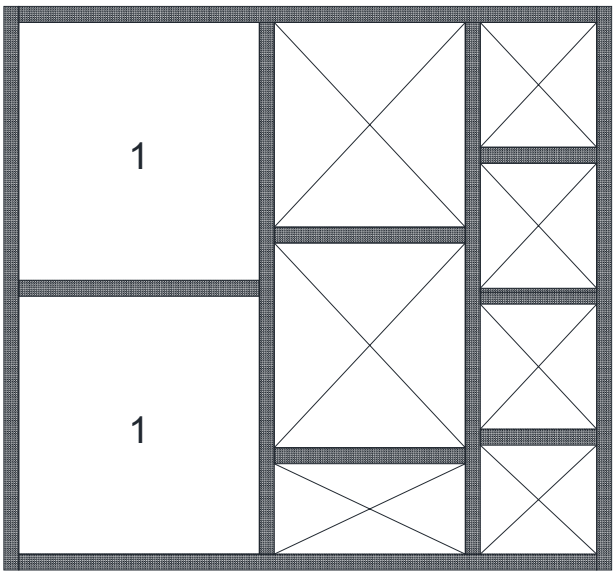
Fig. 3 Photo of the evacuation port (created by the ift).



1: VIG with 1000 mm x 1000 mm

Fig. 4 Representation (Schematic view of the façade element from the external side, drawing created by the ift).

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CO. LTD-Guangjian Building, 471000 Luoyang-Henan (China)

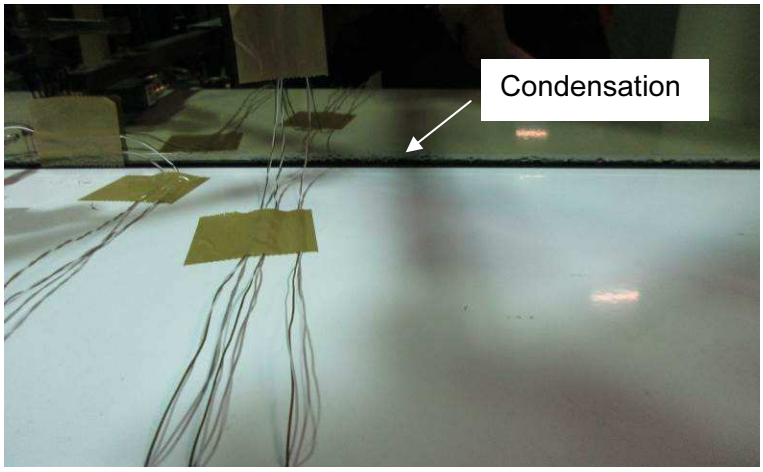

Fig 5 Condensation at the top edge, left edge and bottom edge during the climate test (external side: -15°C, internal side: 18°C / about 49% relative humidity). Width of the condensation area about 5 – 10 mm

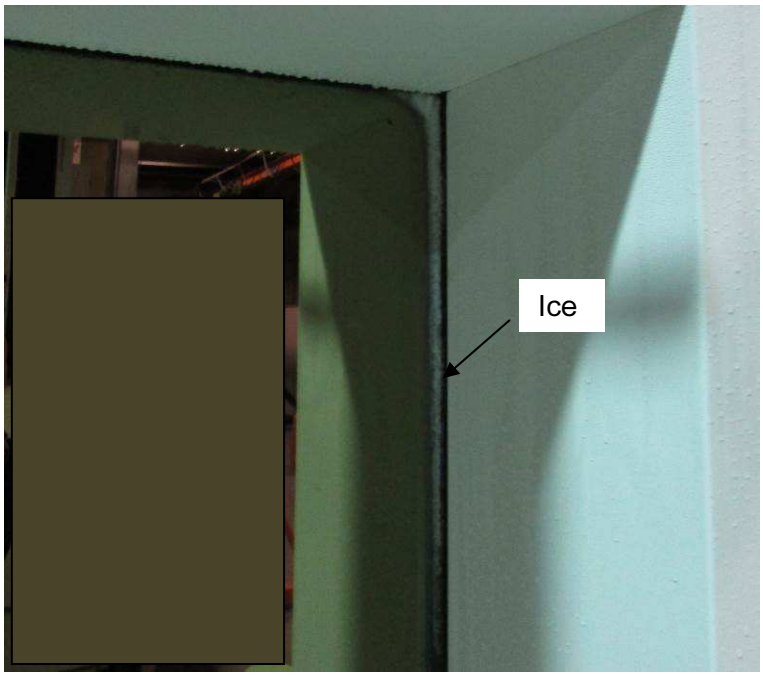

Fig 6 Ice at the right edge during the climate test (external side: -15°C, internal side: 18°C / about 49% relative humidity). Width of the ice area about 5 – 10 mm