Summaries of Test Reports, Studies and Applications of LUMON Products

Common features

Lumon 5 Balcony Glazing

Lumon 6 Balcony Glazing

Lumon 6T Terrace Galzing

Balustrades

Lumon Balustrade 30 x 70

CERTIFICATE
SOUND INSULATION, LUMON BALCONY GLAZINGS

Technical report number: 3371-2a, dated 18 December 2009

Test institute: Helimäki Akustikot

Client: Lumon OY
Kaitilankatu 11
FI-45130 KOUVOLA

Product: Balcony Glazing Lumon
Installed between the top of an aluminum balustrade and ceiling.
Infill in the balustrade 4 + 4 laminated safety glass.

Normalized sound level difference of facades: Normalized sound level difference of facades $D_{Is,2m,n,w} + C_{tr}$ was measured by using pink noise as measurement signal.
The measured results include the reflection from the facade that improves the result by 3 dB. This has been taken account by reducing the results with 3 dB.

Measured structures:

Structure1: Standard Balcony glazing;
no plastic seals between glasses

Structure 2: Standard Balcony glazing;
plastic seals between glasses

Structure3: Standard Balcony glazing;
plastic seals between glasses;
5 x Paroc AKU-rp 50 mm acoustic mineral wool in the ceiling

Results: $D_{Is,2m,n,w} + C_{tr}$ – 3 dB

Glazing/Measured structure	Structure 1	Structure 2	Structure 3
6mm TSG	12 dB	13 dB (1	14 dB (1
8mm TSG	14 dB (1	16 dB (1	18 dB (1
10mm TSG	16 dB	18 dB	20 dB

(1 interpolated, not measured

The complete test report is available on request.

RESEARCH
ENERGY SAVING EFFECTS OF THE BALCONY GLAZING

Research: **Energy Saving Effects of the Balcony Glazing**
Master of Science Thesis, August 2010

Research institute: Tampere University of Technology

Product: Lumon Balcony Glazing

Measured structure: Apartments of ~ 80 m^2 with glazed and unglazed balconies (based on field measurements and computer simulations)

Summary: Balcony glazing creates a buffer zone that is 2-8 ^{o} C warmer than the outside air. Warmer air on the balcony creates

- a decreased heat loss of the outer wall (18 %), the door (15 %) and the window (22 %)
- less draught in the apartment → increased indoor temperature (0.5-1.0 ^{o} C)

➔ decreased energy demand

- longer use of the balcony during the year (at best 2.5 months longer than in the unglazed balcony)

Energy savings of glazed balconies compared to unglazed balconies:

Territory / Saving %	Saving % min	Saving % max	Average %
Germany, Berlin	5.6	12.0	8.2
Finland	3.4	10.7	5.9

The most saving was measured at buildings of the 1970's with integral balconies which are directed to the south and in which the incoming air was taken through these glazed balconies.

The least saving was gained at buildings of the 2010's with outside balconies of which are directed to the east and in which the incoming air was taken from outside the balcony.

The three most important factors that affect the energy saving were the supply air solution, balcony type and orientation of the building.
The location, isolation level and air tightness of the balcony were of smaller significance.

The complete research report is available on request.

STUDY
CARBON FOOTPRINT FOR LUMON 5-TYPE BALCONY GLAZING AND LEED SURVEY OF LUMON PRODUCTS

Study report: Carbon footprint for Lumon 5-type balcony glazing and LEED survey of Lumon products. Dated 29 August 2012.

Study Institute: Ramboll Finland Oy

Client: Lumon Oy
Kaitilankatu 11
FI-45130 Kouvola

Products: Lumon 5 Balcony Glazing and Lumon Balustrades

Carbon Footprint: The carbon footprint was calculated for a Lumon 5 Balcony Glazing and Lumon Balustrades which have been installed to a single apartment. That apartment is situated in an apartment building that was built in 1970's. It is a typical installation place of the balcony glazing in Finland. The Carbon footprint was researched under the circumstances of Finland and Canada.

The carbon footprint calculation was made with the usage of the Business to Consumer (B2C) –life cycle. The whole life cycle of the balcony glazing, from mining of raw materials to the destruction or recycling of the end product, has been taken into consideration into the calculation. Variables of the calculation are the recycling rate and the distance from the factory to the installation place.

Results: Carbon dioxide emissions and payback of CO_2 emissions

Average Case	CO_2 emissions (kg CO2)	Payback of CO_2 emissions (years)
Finland, recycling rate of 60-97 %	162.9	2.6
Finland, reduced recycling rate	249.1	4.0
Canada, recycling rate of 60-97 %	174.0	2.8
Canada, reduced recycling rate	260.2	4.2

The reduced recycling rate is a third of the original recycling rate.

On average, the payback period for the emissions caused by the Lumon 5-type balcony glazing system during its life cycle is 3 years 4 months.

LEED Credits: Lumon products can be an integral part of your project's LEED certification. Lumon products can contribute to 51 out of 110 credits (contains ten bonus points) as specified in 2009 LEEDv3 for New Construction.

The complete study report is available on request.

RESEARCH
FIRE-RESISTANCE OF BALCONY GLAZINGS

Research:	Fire resistance of balcony glazings. Test Report No.: 404/2003/256. Dated 7 July 2003
Research institute:	Fire Laboratory, Tampere University of Technology
Client:	Lumon Oy Kaitilankatu 11 FI-45130 Kouvola
Product:	Lumon Balcony Glazing, 5 panels (610 mm x 1530 mm)
Exterior dimensions (w x h):	3200 mm x 2800 mm
Frame material:	Steel
Experimental method:	SFS-EN 1634-1, Fire resistance test for door and shutter assemblies. Part 1: Fire doors and shutters.
Results:	One glass got the first crack after 16 minutes. After 18 minutes a small piece of glass fell down. The same glass broke down totally after 21,5 minutes. The average temperature after 15 minutes was 556 °C and the maximum temperature was 582 °C. After 20 minutes the average temperature was 598 °C and the maximum temperature was 632 °C.
Summary:	The balcony glazing was tested according to SFS-EN 1634-1. The temperature rose according to the standard temperature-time curve ISO 834. Based on the experiment, a corresponding tempered glass with a size up to 610 mm x 1530 mm (width x height) meets the fire requirements of class E 15 in the Building Code of Finland.

The complete test report is available on request.

RESEARCH
Balcony Glazing – a Threat or a Defense in Fire

Research: Balcony Glazing – a Threat or a Defence in Fire
Timo Korhonen and Olavi Keski-Rahkonen

Research institute: VTT Technical Research Centre of Finland

Client: Lumon Oy
Kaitilankatu 11
FI-45130 Kouvola

Study: This study presents a fire risk analysis of installation of balcony glazing to a suburb residential multistory concrete-framed building. In the chosen example the balconies were arranged in columns with two adjacent balconies.
To establish the statistical basis a survey was carried out on the material recorded in the Finnish National Accident Database PRONTO, concerning residential fires and the role of balconies on these fires.

Fault tree analysis was used to estimate the effect of balcony glazing and the partition on the risk of fire spread. Both fires igniting at balconies and inside apartments were investigated. The results of the analysis are showed in Fig.1.

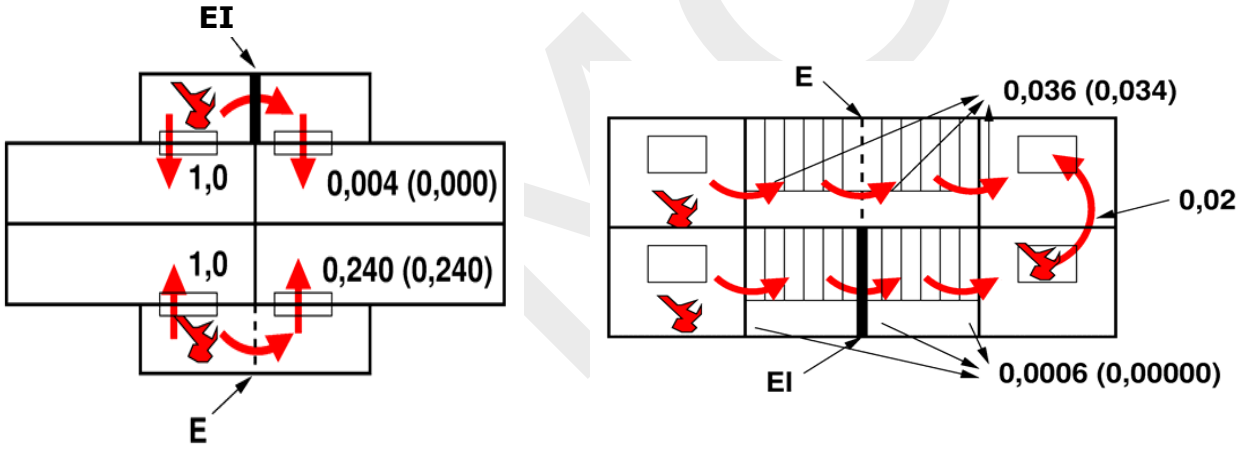

Figure 1. Probabilities of fire spread involving balconies. The numbers corresponding to fires spreading through the partition separating the adjacent balconies refer to 'E15' and 'EI15' structures and the numbers in parenthesis refer to 'E30' and 'EI30' structures.

According to the statistical analysis covering six years, the number of fires ignited on balconies seems to be stayed on a constant level, even though the number of balconies with glazing has increased during this period by 35000 annually, i.e., in six years this counts up to 20% of the total number of balconies.

Summary: The risk of fire spread upwards is not larger than the risk of fire spread from an unglazed balcony. When the partition separating two adjacent balconies is at least class EI15, the risk of fire spread sideways trough the balconies to the neighboring apartment is negligible. If the glazing is totally closed, the fire ignited on balcony will become ventilation controlled and the heat rate remains lower.

The complete report is available on request

DNV BUSINESS ASSURANCE

MANAGEMENT SYSTEM CERTIFICATE

Certificate No. 69329-2010-AQ-FIN-FINAS

This is to certify that

LUMON OY

Kaitilankatu 11, 45130 Kouvola; Finland

has been found to conform to the Management System Standard:

ISO 9001:2008

This Certificate is valid for the following product or service ranges:

DEVELOPMENT PROCESS OF BALCONY AND TERRACE FRONTAGES, SALES PROCEDURE, PRODUCT ENGINEERING AND PRODUCTION AND INSTALLATION AND SUPPORT SERVICES.

Initial Certification date:
12 January 2010

This Certificate is valid until:
30 November 2015

The audit has been performed under the supervision of

Miia Vironen
Lead Auditor

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT
IAF
FINAS
Finnish Accreditation Service
S001 (EN ISO/IEC 17021)

Place and date:
Espoo, *22 November 2012*

for the Accredited Unit:
DNV CERTIFICATION OY/AB, FINLAND

Kimmo Haarala
Management Representative

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.

DNV BUSINESS ASSURANCE

MANAGEMENT SYSTEM CERTIFICATE

Certificate No. 69330-2010-AHSO-FIN-FINAS

This is to certify that

LUMON OY

Kaitilankatu 11, 45130 Kouvola; Finland

has been found to conform to the Management System Standard:

OHSAS 18001:2007

This Certificate is valid for the following product or service ranges:

DEVELOPMENT PROCESS OF BALCONY AND TERRACE FRONTAGES, SALES PROCEDURE, PRODUCT ENGINEERING AND PRODUCTION AND INSTALLATION AND SUPPORT SERVICES.

Initial Certification date:
12 January 2010

This Certificate is valid until:
30 November 2015

The audit has been performed under the supervision of

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Lead Auditor

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Kimmo Haarala
Management Representative

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RESEARCH
Thermally toughened building glass EN 12150-2: Pendulum-impact test and classification EN 12 600 and determination of the bending strength, EN 1288-3

Research: Thermally toughened building glass EN 12150-2. Pendulum-impact test and classification EN 12 600. Determination of the bending strength EN 1288-3. Test report No:.VTT-S-03768-07. Dated 20 April 2007.

Research institute: VTT Technical Research Centre of Finland

Client: Lumon Oy
Kaitilankatu 11
FI-45130 Kouvola

Product: Thermally toughened building glasses manufactured by Lumon Oy.

Pendulum impact test: The impact test was carried out according to the standard method SFS EN 12 600 "Glass in building-Pendulum test-Impact test method and classification for flat glass".

Product	Classification
Thermally toughened building glass, 4 mm, clear	1(C)2
Thermally toughened building glass, 5 mm, clear	1(C)2
Thermally toughened building glass, 6 mm, clear	1(C)1
Thermally toughened building glass, 8 mm, clear	1(C)1
Thermally toughened building glass, 10 mm, clear	1(C)1

Determination of bending strength: Bending strength of glasses was determinated according to the standard EN 1288-3, Glass in building. Determination of the bending strength of glass Part 3: Test with specimen supported at two points (four point bending).

Product	Bending strength [N/mm^2] Sample 1	Bending strength [N/mm^2] Sample 2
4 mm clear	170,0	166,5
5 mm clear	147,0	140,6
6 mm tinted brown	163,2	188,6
6 mm clear	182,4	175,9
8 mm clear	167,9	138,2
8 mm tinted grey	189,2	192,3
10 mm clear	171,5	174,0

The complete test report is available on request.

RESEARCH
FIRE-RESISTANCE OF LAMINATED GLASS INFILL OF BALCONY BALUSTRADE

Research:	Fire resistance of laminated glass infill of balcony balustrade. Test Report No.: 404/2003/259. Dated 18 September 2003
Research institute:	Fire Laboratory, Tampere University of Technology
Client:	Lumon Oy Kaitilankatu 11 FI-45130 Kouvola
Product:	Lumon Balcony Balustrade 3080 mm x 1010 mm. 3 infill panels 4 Float + 0,38 + 4 Float, height 972 mm.
Exterior dimensions (w x h):	3200 mm x 2800 mm (frame).
Frame material:	Steel
Experimental method:	SFS-EN 1634-1, Fire resistance test for door and shutter assemblies. Part 1: Fire doors and shutters.
Results:	One glass got the first crack after 6 minutes. The same glass broke down totally after 7,5 minutes. The average temperature in glass after 5 minutes was 131 ˚C and the maximum temperature in glass was 164 ˚C. After 7,5 minutes the average temperature in glass was 191 ˚C and the maximum temperature in glass was 271 ˚C.
Summary:	The balcony balustrade was tested according to SFS-EN 1634-1. The temperature rose according to the standard temperature-time curve ISO 834. The first glass got the first crack after 6 minutes. 6 minutes can be taken as the time limit for a single, similar size, laminated glass infill in the balustrade to keep its tightness in fire, as it is defined in the Building Code of Finland.

The complete test report is available on request.

CE

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Kaitilankatu 11
FI-45130 Kouvola

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ETA-10/0395

Lumon 5 Balcony Glazing system

Purpose of use: Balcony and Terrace glazing systems

Characteristic	**Assessment of the characteristic**
Safety in case of fire	NPD
Hygiene, health and environment	
• Dangerous substances	No dangerous materials used
• Ventilation of balcony as dampness control	Gaps between glasses assures ventilation, which reduces the risk of dampness or condensation
Safety in use:	
• Wind load resistance EN 12211	**2000 Pa** (6 x 677 x 1470 mm glass panes) **1000 Pa** (8 x 837 x 2080 mm glass panes) **2500 Pa** (8 x 840 x 1680 mm glass panes) **1300 Pa** (10 x 798 x 2673 mm glass panes) **3900 Pa** (10 x 798 x 1673 mm glass panes)
• Impact resistance of the system EN 12600 Impact from indoors and outdoors	**450 mm** (10 x 876 x 1938 mm glass panes) **190 mm** (8 x 876 x 1938 mm glass panes) (glass panes nor any other part did break in the tests)
Sound insulation	NPD
Durability UV-ageing and heat testing 1000 h, ISO 4892-2	No influence on performance
Corrosion resistance of the metallic parts of the glazing system.	Protected from rain. NPD

RESEARCH
RESISTANCE TO WIND LOAD. LUMON 5. GLASS 6 MM.

Research:	Resistance to wind load. Lumon 5. Glass 6 mm. Test report No.: VTT-S-00727. Dated 27 January 2011.
Research institute:	VTT Expert services Ltd
Client:	Lumon Ltd Kaitilankatu 11 FI-45130 Kouvola
Product:	Lumon 5 Balcony glazing
Tests:	Static Wind load test of Lumon 5. Determination of deflection and relative deflection of a straight three-pane balcony glazing of 6 mm submitted to the positive and negative test pressures.

Results:

	Specimen 1 (triple leaf) Positive test pressure	Specimen 1 (triple leaf) Negative test pressure
Overall dimensions (W x H) mm	2040 x 1470	2040 x 1470
Casement dimensions (W x H) mm	677 x 1343	677 x 1343
Glazing	TSG, 6 mm	TSG, 6 mm
	Resistance under static wind load no malfunction at up to	Resistance under static wind load no malfunction at up to
Positive wind pressure [Pa = N/m^2]	2000 Pa [1)]	
Negative wind pressure [Pa = N/m^2]		2000 Pa [1)]
	Deflection	Deflection
Deflection at max. pressure (2000 Pa)	76,5 mm	74,3 mm

[1)] maximum pressure of the test equipment

The complete test report is available on request.

RESEARCH
RESISTANCE TO WIND LOAD. LUMON 5. GLASS 8 MM.

Research:	Resistance to wind load. Lumon 5. Glass 8 mm. Test report No.: 106 41371e. Dated 16 September 2009.
Research institute:	ift Rosenheim
Client:	Lumon Oy Kaitilankatu 11 FI-45130 Kouvola
Product:	Lumon 5 Balcony glazing
Tests:	Wind load test static – specimens 1 and 2 Wind load test dynamic – specimen 1

Results:

	Specimen 1 (double leaf)	Specimen 2 (single leaf)
Overall dimensions (W x H) mm	1710 x 2200	870 x 1800
Casement dimensions (W x H) mm	837 x 2080	840 x 1680
Glazing	TSG, 8 mm	TSG, 8 mm
	Resistance under static wind load no malfunction at up to	Resistance under static wind load no malfunction at up to
Positive wind pressure [Pa = N/m^2]	1000 Pa	2500 Pa
Negative wind pressure [Pa = N/m^2]	1200 Pa	2700 Pa
	Resistance under dynamic wind load no malfunction at up to	Resistance under dynamic wind load no malfunction at up to
Positive wind pressure [m/s]	40 m/s [1)] (approx. 144 km/h)	not tested

[1)] maximum wind speed of the test equipment

The complete test report is available on request.

RESEARCH
RESISTANCE TO WIND LOAD. LUMON 5. GLASS 10 MM.

Research:	Resistance to wind load. Lumon 5. Glass 10 mm. Test report No.: 106 42572e. Dated 26 April 2010.
Research institute:	ift Rosenheim
Client:	Lumon Oy Kaitilankatu 11 FI-45130 Kouvola
Product:	Lumon 5 Balcony glazing
Tests:	Wind load test static – specimens 1 and 2 Wind load test dynamic – specimen 2

Results:

	Specimen 1 (double leaf)	Specimen 2 (double leaf)
Overall dimensions (W x H) mm	1630 x 1800	1630 x 2800
Casement dimensions (W x H) mm	798 x 1673	798 x 2673
Glazing	TSG, 10 mm	TSG, 10 mm
	Resistance under static wind load no malfunction at up to	Resistance under static wind load no malfunction at up to
Positive wind pressure [Pa = N/m^2]	3900 Pa	1300 Pa
Negative wind pressure [Pa = N/m^2]	4500 Pa	1500 Pa
	Resistance under dynamic wind load no malfunction at up to	Resistance under dynamic wind load no malfunction at up to
Positive wind pressure [m/s]	not tested	40 m/s [1)] (approx. 144 km/h)

[1)] maximum wind speed of the test equipment

The complete test report is available on request.

RESEARCH
Pendulum-impact, EN 12 600, Lumon 5 Balcony Glazing

Research:	Determination of the pendulum-impact resistance according to EN 12600 of Lumon 5 Balcony Class Curtain System for ETA approval. Test report VTT-S-05029-10. Dated 14 June 2010.
Research institute:	VTT Expert services Ltd
Client:	Lumon Oy Kaitilankatu 11 FI-45130 Kouvola
Product:	Lumon 5 Balcony Glazing: - sliding panes (type 1) of 8 mm glass - turn panes (type 2) of 8 mm glass - sliding panes (type 1) of 10 mm glass - turn panes (type 2) of 10 mm glass Dimensions of the panes: breadth of 876 mm and height of 1938 mm.
Tests:	The impact test was carried out according to the standard EN 12 600 by the impactor of 50 kg, air pressure of the tyres of the impactor was 0,35 MPa. The specimens of balcony glazing were impacted in the middle of glass pane on the both sides using different pane samples. Drop height level was 190 mm when using 8 mm thick glass panes. With 10 mm thick glass panes the tests were carried out from the drop height of 450 mm.
Results:	**Lumon 5 with 8 mm glass panes.** Both sliding glass (type 1) and turn glass (type 2) passed the test from the drop height level of 190 mm without any structural or functional failures. **Lumon 5 with 10 mm glass panes.** Both sliding glass (type 1) and turn glass (type 2) passed the test from the drop height level of 450 mm. There was only some insignificant structural damages noticed which did not affect the function of the panes.

The complete test report is available on request.

RESEARCH
Artificial weathering of plastic components of Lumon 5 and Lumon 4 (Lumon 6 and Lumon 6T)

Research: Artificial weathering of plastic components of Lumon 5 and Lumon 4 Balcony Glass Curtain Systems by Xenon Arc + water spray.
Test report VTT-S-06723-10/EN. Dated 26 September 2010.

Research institute: VTT Expert Services Ltd.

Client: Lumon Oy
Kaitilankatu 11
FI-45130 Kouvola

Products: Plastic components of Lumon 5 and Lumon 4. Most of Lumon 4 components are also used in the lumon 6 and Lumon 6T which are updated versions from Lumon 4.

Tests: Samples (three of each type) were exposed to the Xenon Arc radiaton according to the standard ISO 4892-2 method A. Specimens were exposed to 102 min dry and 18 min water spray period repeated 1000 hours.
The spectral irradiance on the band bass 300 to 400 nm was 60+/-2 W/m2 and the black standard temperature 65 +/- 3 °C.

Results:

Name of the component	Comp. number	Material	Change dim.	Change weight	Change colour
Upper hinge L5 (wheel 1) Wheel 2 (other supplier)	50200020	PA 6.6 steel/ POM	+0,04% +0,20%	+0,4% -0,5%	Light change to white Rust on the bearings Some flakin on the axle V.light change to white
Follower L5, light grey L	53220052	PA 6.6	+0,20%	+1,8%	V.light change to yellow
Follower L5, dark grey L	53220054	PA 6.6	+0,04%	+1,2%	Light change to white
Lower seal L5, light grey	54220001	Silicone	-0,90%	-2,5%	Light change to yellow
Lower seal L5, dark grey	54220002	Silicone	-0,50%	-2,4%	No changes
Lower profile seal L5, lg	54220004	TPE	-0,10%	-0,4%	Clear change to yellow
Lower profile seal L5, dg	54220005	TPE	-0,60%	-0,6%	No changes
Edge sealing 20 mm	54042014	Silicone	-0,60%	-0,8%	V.light change to yellow
Fastening bead 8, L5, L6, L6T	54043024	PVC	-0,30%		Clear change to yellow
Inclined Bruch seal	54220006		-0,60%	-0,8%	Brittleness occurred on outer edge of b.m.
Handle L4	53200009	ABS-PVC	-0,10%	+0,2%	V.light change to yellow
Lower profile seal L4, L6T, lg	54200105	Silicone	-0,60%	-1,3%	V.light change to white
Lower profile seal L4, L6T, dg	54200205	Silicone	-0,40%	-1,8%	Light change to white
Lower rail guide L4, L6T (wheel)	50200002	PA 6.6 Steinless steel/POM	+0,20%	+0,7%	Light change to white Stuck as dry, worked when wetted
Seal 1	Seal	PVC	-0,04%		V.light change to blue
Seal 2	Seal	Acryl	-0,06%	+0,7%	V.light change to yellow

The complete test report is available on request

RESEARCH
Seismic Displacement Testing Lumon 5 and Lumon Guard

Research: Seismic displacement testing. Lumon 5 Balcony Glazing; glass 10 mm and Lumon Guard; infill 6 mm tempered glass.
Test Report No.: B5173.01-119-16. Dated 11 May 2012.

Research institute: Architectural Testing

Client: Lumon International
Kaitilankatu 11
FI-45130 Kouvola, Finland

Product: Lumon 5 Balcony glazing and Lumon Guard.
Unit size: 1666 mm wide by 2850 high.
Balcony glazing: 1666 mm x 1780 mm with 2 tempered 10 mm glass units with dimensions 818 mm x 1646 mm.
Lumon Guard: 1666 mm wide x 1070 mm high; infill two 6 mm tempered glass unit with dimensions 830 mm wide x 1009 mm high.

Tests: Seismic displacement testing in accordance with AAMA 501.4-09.
Test method**: Seismic Interstory Drift:**
AAMA 501.4-09 Recommended Static Test Method for Evaluating Curtain Wall and Storefront System Subject to Seismic and Wind Interstory Drifts.

Test Results:

Test No. 1	Design Drift: 0 mm – 30 mm		
Test No.	Glass Fallout / Breakage	Non-Glass Fallout	Additional Observations
1	None	None	All functions of the unit remained unimpaired with no visible damage at completion of the test.
All units had reached 30 mm of static racking displacement without any glass fallout or breakage. In addition no components fell off or became disengaged during the test.			

Test No. 1	1,5 x Design Drift: 0 mm – 45 mm		
Test No.	Glass Fallout / Breakage	Non-Glass Fallout	Additional Observations
1	None	None	All functions of the unit remained unimpaired with no visible damage at completion of the test.
All units had reached 30 mm of static racking displacement without any glass fallout or breakage. In addition no components fell off or became disengaged during the test.			

Summary and Conclusions: Based on the results of seismic displacement tests, the Lumon Balcony Glazing System achieved the 1,5 x design drift of 45 mm without failure, thus **validating the seismic performance requirements of AAMA 501.4.**

The complete test report is available on request.

RESEARCH
Dynamic Seismic Drift Testing Lumon 5 and Lumon Guard

Research: Dynamic seismic drift testing. Lumon 5 Balcony Glazing; glass 10 mm and Lumon Guard; infill 6 mm tempered glass.
Test Report No.: B5174.01-119-16. Dated 14 May 2012.

Research institute: Architectural Testing

Client: Lumon International
Kaitilankatu 11
FI-45130 Kouvola, Finland

Product: Lumon 5 Balcony Glazing and Lumon Guard.
Unit size: 1666 mm wide by 2850 high.
Balcony Glazing: 1666 mm x 1780 mm with 2 tempered 10 mm glass units with dimensions 818 mm x 1646 mm.
Lumon Guard: 1666 mm wide x 1070 mm high; infill two 6 mm tempered glass unit with dimensions 830 mm wide x 1009 mm high.

Tests: Dynamic seismic drift testing in accordance with AAMA 501.6-09.
Test method**: Dynamic Seismic Drift:**
AAMA 501.6-09 Recommended Dynamic Test Method for Determining the Seismic Drift Causing Glass Fallout from a Wall System.

Test Results:

Test Nos. 1 - 3			
Test No.	Glass Fallout	Non-Glass Fallout	Additional Observations
1	None	End caps	No glass fallout or cracking of the glass occurred from 0 mm - 31 mm of displacement.
2	None	End caps	
3	The top left lite fell out at 93 mm	End caps	
All units had reached 30 mm of static racking displacement without any glass fallout or breakage. In addition no components fell off or became disengaged during the test.			

Summary and Conclusions: Based on the results of the dynamic testing for the three units, the overall $\Delta_{fallout}$ for the Lumon Balcony Glazing System is 93 mm. Therefore the $\Delta_{fallout}$ for the mocup was greater than the 30 mm design drift specified for the Lumon Balcony Glazing System.

The complete test report is available on request

RESEARCH
Resistance to Wind Load. Lumon 5 Balcony Glazing together with Lumon Guard.

Research: Evaluation of the "Lumon Glazing System 5" Balcony Glazing System. Wind Load Resistance. Report No.: 10-06-M0578. Dated 7 June 2012.

Research institute: Exova

Client: Lumon Oy
Kaitilankatu 11
FI-45130 Kouvola

Product: Lumon 5 Balcony Glazing and Lumon Guard.
Overall Specimen Size: 1666 mm (width) x 2850 mm (height).
Lumon 5 Balcony Glazing Size: 1666 mm (width) x 1780 mm (height).
Glazing panel size (2 panels): 818 mm (width) x 1650 mm (height).
Glazing: 10 mm TSG (Tempered).
Guard Size: 1646 mm (width) x 1070 mm (height).
Infill: Two 6 mm tempered glass unit 830 mm (width) x 1009 mm (height).

Test Details: Sustained Pressures P_1 and P'_1: P_1 and P'_1 were maintained for 1-hour.
Cyclic Loads P_2 and P'_2: 1000 cycles from 0 to P_2 and 1000 cycles from 0 to P'_2.
Gust Loads P_3 and P'_3: P_3 and P'_3 (1810 Pa) were hold for 3 seconds.
Deformation Test: P and P' (1810 Pa) were hold for 10 seconds.

Test Results:

Table 1. Summarized Testing Results

Pressures	Max. Deflection	Max. Residual Deflection
Sustained Pressure P_1 = +1000 Pa	31,6 mm	5,6 mm
Sustained pressure P'_1 = -1000 Pa	34,9 mm	15,8 mm
Cyclic Load P_2 = 0 to +1340 Pa	39,3 mm	0,9 mm
Cyclic Load P'_2 = 0 to -1340 Pa	49,1 mm	3,4 mm
Gust Load P_3 = 0 to +1810 Pa	56,3 mm	4,8 mm
Gust Load P'_3 = 0 to -1810 Pa	63,1 mm	10,6 mm
Deformation Test P = 0 to +1810 Pa	56,3 mm	4,8 mm
Deformation Test P' = 0 to -1810 Pa	63,1 mm	10,6 mm

Conclusions: There was no breaking, significant permanent deformation or component fallout when tested to wind design values below:
- P_1: Q_{50} < 0,45 at a building height of 60 m, 1000 Pa
- P_2: Q_{50} < 0,45 at a building height of 40 m, 1340 Pa
- P_3: Q_{50} < 0,75 at a building height of 20 m, 1810 Pa
- Deformation test: Q_{50} < 0,75 of 1630 Pa (1810 Pa exceeds this value)

The maximum performance level is Q_{50} < 0,75 at a building height of 20 m.

A more complete test report is available on request.

RESEARCH
Resistance to Wind Load. Lumon 5 Balcony Glazing using a Fixed Rail.

Research: Evaluation of the Wind Load Performance Characteristics of the "Lumon Glazing System 5 Series" using a Fixed Rail System.
Report No.: 11-06-M0513. Dated 6 June 2012.

Research institute: Exova

Client: Lumon North America
65 Reive Boulevard
Cookstown, Ontario
LOL 1LO

Product: Lumon 5 Balcony Glazing. Installed to a fixed / rigid rail.
Overall Specimen Size: 1666 mm (width) x 1780 mm (height)
Glazing panel size (2 panels): 818 mm (width) x 1650 mm (height)
Glazing: 10 mm TSG (Tempered)

Test Details: Sustained Pressures P_1 and P'_1: P_1 and P'_1 were maintained for 1-hour.
Cyclic Loads P_2 and P'_2: 1000 cycles from 0 to P_2 and 1000 cycles from 0 to P'_2.
Gust Loads P_3 and P'_3: P_3 and P'_3 (2440 Pa) were hold for 3 seconds.
Deformation Test: P and P' (2440 Pa) were hold for 10 seconds.
Wind Loading to Failure: Increasing positive pressure to failure.

Test Results:

Table 1. Summarized Testing Results

Pressures	Max. Deflection	Max. Residual Deflection
Sustained Pressure P_1 = +1120 Pa	22,9 mm	2,1 mm
Sustained pressure P'_1 = -1120 Pa	29,5 mm	3,9 mm
Cyclic Load P_2 = 0 to +1640 Pa	32,7 mm	2,3 mm
Cyclic Load P'_2 = 0 to -1640 Pa	34,4 mm	2,5 mm
Gust Load P_3 = 0 to +2440 Pa	46,4 mm	2,8 mm
Gust Load P'_3 = 0 to -2440 Pa	51,7 mm	3,4 mm
Deformation Test P = 0 to +2440 Pa	46,4 mm	2,8 mm
Deformation Test P' = 0 to -2440 Pa	51,7 mm	3,4 mm
Wind Load to Failure = 0 to +4214 Pa	Not measured	Not measured

Conclusions:
- Lumon 5 Balcony Glazing sustained a wind design value of **Q_{50} < 0,55 at a building height of 40 m.**
- Deformation was measured by loading system for 10 sec with wind pressure
- +/-2440 Pa which exceed the **Q_{50} < 1,00 of 2180 Pa.**
- Lumon 5 Balcony Glazing sustained a **maximum wind load +4214 Pa.**

The complete test report is available on request.

RESEARCH
CAN/ULC-S102 Surface Burning Characteristics of "Lumon Glazing System"

Research: CAN/ULC-S102 Surface Burning Characteristics of "Lumon Glazing System". Test Report No.: 11-002-273. Dated 31 May 2011.

Research institute: Exova

Client: Lumon Oy
Kaitilankatu 11
FI-45130 Kouvola

Product: Lumon 5 Balcony glazing and Lumon Guard
Unit size: 5 sections of glazing system 533 mm wide by total 7315 high.
The sections were butted together to create the test specimen length.

Tests: Determine the Flame Spread and Smoke Development Classifications based upon triplicate testing conducted in accordance with CAN/ULC-S102-10. Results for individual specimens are expressed in terms of Flame Spread Value FSV and Smoke Developed Value SDV.
Results of three or more replicate tests on identical samples produce average values expressed as Flame Spread Rating FSR and Smoke Developed Classification SDC.

Test Results: Requirements: Flame Spread Rating FSR ≤ 150.

Table 1. Test results

	FSV	SDV
Test 1	3	23
Test 2	2	25
Test 2	3	15
Average	3	21
Rounded Average Flame Spread Rating FSR	**5**	
Rounded Average Smoke Developed Classification SDC		**20**

Summary: Rounded Average Flame Spread Rating FSR = **5** ≤ 150; meets the requirement.
Rounded Average Smoke Development Classification = **20**.

The complete test report is available on request.

RESEARCH
Cycling Test on Glass Panel Sample Lumon 5; AAMA 906

Research:	Cycling test on glass panel sample Lumon 5; AAMA 906. Test Report No.: 11-15-C0150. Dated 17 June 2011.
Research institute:	Exova
Client:	Lumon Oy Kaitilankatu 11 FI-45130 Kouvola
Product:	Lumon 5 Balcony glazing. Glazing panel 818 mm (width) x 1650 mm (height) x 10 mm (thick), tempered.
Tests:	Cycling test on glass panel sample was conducted in accordance with Section 10.6.2.2 from AAMA 906-07 Voluntary Test Method and Specifications for Sliding Glass Door Roller Assemblies. The cycling motion was applied between the end strokes of the actuator (36 in. in one direction and then reverse) at an approximate speed 12 in/sec. A complete cycle is defined as complete motion between fully closed-fully open-fully closed positions (total of 72 in. travel). The test was conducted to failure or until maximum number of **10 000 cycles** was achieved, whichever occurs first. Visual inspection was periodically performed during testing.
Results:	The sample completed 10 000 cycles without visible failures. A detailed functional inspection was performed on the sample assembly at the test completion and no breakage, deformation of any roller assembly or other components was found. **The sample passed the test requirements.**

The complete test report is available on request.

RESEARCH
Performance Properties of Lumon 5 Balcony Glazing System. Ease of operation; Shock load; Deglazing.

Research: Performance Properties of Lumon 5 Balcony Glazing System.
Ease of operation; Shock load; Deglazing.
Test Report No.: 10-06-M0578. Dated 7 June 2012.

Research institute: Exova

Client: Lumon Oy
Kaitilankatu 11
FI-45130 Kouvola

Product: Lumon 5 Balcony glazing.
Glazing Panel size: 818 mm (width) x 1650 mm (height) x 10 mm thick, tempered.

Test Results:

Description	Requirements	Results
Ease of Operation / ASTM E 2068 Force to initiate and maintain motion from closed and open position for a sliding panel.	Force ≤ 135 N to initial motion ≤ 90 N to maintain motion	Initiate from Closed: 23,9 N Maintain from Closed: 29,2 N Initiate from Open: 15,6 N Maintain from Closed: 27,8 N **Meets Requirements**
Shock Load / AMMA 906 Roll the panel with supplied rollers over a 90-degree edge of 6,4 mm (0,25”), and free allow to free-fall.	No breakage, failure or permanent deformation of any roller assembly part that would cause any malfunction or impair operation.	**Meets Requirements**
Deglazing /ASTM E 387 Load 320 N Both glazing beads were tested.	No damage observed to the glazing that would inhibit normal operation of the glazing unit; no glazing breakage.	Top Sash: - deflection 0,090 mm - deglazing 0,5 % Bottom Sash: - deflection 0,385 mm - deglazing 2,0 % **Meets Requirements**

A more complete test report is available on request.

RESEARCH
RESISTANCE TO HEAT STRESS. LUMON 5 BALCONY GLAZING.

Research:	Resistance to heat stress. Lumon 5 Balcony Glazing Test report No:.P 4.1/09-197. Dated 11 June 2009.
Research institute:	MFPA Leipzig GmbH
Client:	Lumon Deutschland GmbH Fanny-Zobel-Straβe 5 D-12435 Berlin
Product:	Lumon 5 Balcony Glazing
Tests:	A test to exclude that extreme temperature changes don't cause any glass breakage because of the contact between glass and glazing bead. In TRLV 1998 ("Technische Regeln für die Verwendung von linienförmig gelagerten Verglasungen") is a demand that there shall be no direct contact between glass and hard materials. This demand is set to avoid that the divergent coefficients of thermal expansion of glass and e.g. aluminum don't cause any glass breagake. In Lumon 5 Balcony Glazing there is a direct contact between glass and aluminum. A glazing panel 1000 mm (width) x 2000 mm (height) was tested in maximal in Europe expected thermal stress for a balcony glazing.

Table 1: Test climate

Summer cycle (5x)	
Fast heating of upper surface	about 1 h
Keeping in high temperature T = 70 ^{0}C	2 h
Fast cooling to T = 12 ^{0}C	about 1 h
Keeping in the temperature T = 12 ^{0}C	20 h
Winter cycle (5x)	
Heating to T = 30 ^{0}C and keeping T = 30 ^{0}C	8 h
Cooling to T = -20 ^{0}C and keeping T = -20 ^{0}C	16 h

Results: Lumon 5 Balcony Glazing panel did not show any sign of unsustainable stress. The demand in TRLV that there shall be no contact between glass and hard material is therefore not justified for Lumon 5 Balcony Glazing.

The complete test report is available on request.

RESEARCH
Research of uniformity of Lumon 5 Balcony Glazing in accordance with "Technischen Regeln für die Verwendung von linienförmig gelagerten Verglasungen" (TRLV).

Research:	Research of uniformity of Lumon 5 Balcony Glazing in accordance with "Technischen Regeln für die Verwendung von linienförmig gelagerten Verglasungen" (TRLV). Test report No:.S 2.2/09-251. Dated 31 August 2009.
Research institute:	MFPA Leipzig GmbH
Client:	Lumon Deutschland GmbH Fanny-Zobel-Straβe 5 D-12435 Berlin
Product:	Lumon 5 Balcony Glazing
Uniformity to TRLV:	The scope of TRLV is vertical glazings, which are completely linearly supported at least on 2 opposite sides. In Lumon 5 the glass panes are on top and bottom sides compressed with an aluminum profile. As a result it was noticed that Lumon 5 corresponds with TRLV except with the general demand, that there shall not be any direct contact between glass and hard materials. In Lumon 5 there is a direct contact between glass and aluminum profile. Because of that many tests were done to proof, with engineering technical backgrounds, that this direct contact glass/aluminum does not cause any problems.
Tests:	- Compression in Aluminiumprofile. - Bending test and shear stress test. - Heat stress. A glazing panel was tested in maximal in Europa expected thermal stress for a balcony glazing. Test report No:. P 4.1/09-197.
Results:	As a result of the research and tests there was not detected any disadvantages, compared with the traditional structure with an elastic material in between, because of this special connection between glass and aluminum profile.

The complete test report is available on request.

CCMC Evaluation for Lumon Glazing System

CCMC number: **CCMC 13640-R**

Evaluation: Evaluation Report **CCMC 13640-R**. Masterformat: 08 57 00.
Issued: 2012-12-11. Re-evaluation due: 2015-12-11.

Evaluation institute: Canadian Construction Material Centre, a program of NRC Construction at the National Research council of Canada, 1200 Montreal Road, Ottawa, Ontario K1A 0R6.

Report holder: Lumon Oy
Kaitilankatu 11
FI-45130 Kouvola

Plant(s): Cookstown, ON

Products: Lumon 5 Balcony Glazing and Lumon Guard System.

Opinion: When used as a balcony enclosure glazing system in accordance with the conditions and limitations stated in the Report, complies with the National Building Code 2010:

- Clause 1.2.1.1.(1)(a), Division A, using the following acceptable solutions from Division B:
  - Article 4.1.5.14 Loads on guards
  - Article 4.1.7.1 Specified Wind Load
  - Sentence 4.1.8.3.(5) General Requirements (earthquake load and effects)
  - Article 4.3.5.1 Design Basis for Aluminum
  - Section 9.6. Glass
  - Article 9.8.8.3 Height of Guards
  - Article 9.8.8.6 Design of Guards to Not Facilitate Climbing
  - Article 9.8.8.7 Glass in Guards
  - Article 9.10.17.1 Flame Spread Rating of Interior Surfaces
  - Article 9.20.16.1 Corrosion Resistance of Connectors

Test Results: Wind Load Resistance; Lumon 5 Balcony Glazing and Lumon Guard System.
The test specimen was 1 666 mm wide * 2 850 mm high.

Table 1. Chosen test loads

Sustained load	P1	1 000 Pa
Cyclic load	P2	1 340 Pa
Gust load	P3	1 810 Pa

Wind Load Resistance; Lumon 5 Balcony Glazing using a fixed rail system.
The test specimen was 1 666 mm wide * 1 780 mm high.

Table 2. Chosen test loads and test to failure

Sustained load	P1	1 120 Pa
Cyclic load	P2	1 640 Pa
Gust load	P3	2 440 Pa
Test to failure		4 214 pa

The complete Evaluation Report is available on request

Airborne Sound Insulation of Lumon 5 Balcony Glazings

Technical report No: 12-000515-PR01 (PB 1-A03-04-en-01), dated 14 May 2013

Test institute: ift Rosenheim

Client: Lumon OY
Kaitilankatu 11
FI-45130 KOUVOLA

Product: Balcony Glazing Lumon 5
Installed in an opening. Overall dimensions (W x H) 1250 mm x 1500 mm
2 panels (side-hung and sliding / side-hung.
Single pane / toughened safety glass (TSG)
Test of 2 glass variants, TSG 8 and TSG 10
Seal on glass sides: PVC/silicone. Seal between glass panes: PVC.

Test method: Weighted sound reduction index $\mathbf{R_w}$ and spectrum adaptation terms **C** and $\mathbf{C_{tr}}$ was measured by using pink noise as measurement signal and one-third octave band filter.
The measured frequency range was from 100 Hz to 3150 Hz.

The test method based on:
- EN ISO 10140-1:2010 + A1:2012 Acoustics; Laboratory measurement of sound insulation of building elements - Part 1
- EN ISO 10140-2:2010 Acoustics; Laboratory measurement of sound insulation of building elements - Part 2
- EN ISO 717-1:1996 + A1:2006 Acoustics; Rating of of sound insulation in building elements - Part 1: Airborne sound insulation

Results: The weighted sound reduction index $\mathbf{R_w}$ and the spectrum adaptation terms **C** and $\mathbf{C_{tr}}$ for the frequency range 100 Hz to 3150 Hz.

Glazing / Measured structure	Measured result $\mathbf{R_w}$ **(C;$\mathbf{C_{tr}}$)** in dB
8 mm TSG	**19 (-1;-2)**
10 mm TSG	**18 (0;-2)**

The complete test report is available on request.

CE

Lumon Oy
Kaitilankatu 11
FI-45130 Kouvola

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ETA-12/0315

Lumon 6 and 6T Balcony and Terrace Glazing systems

Purpose of use: Balcony and Terrace glazing systems

Characteristic	**Assessment of the characteristic**
Safety in case of fire	NPD
Hygiene, health and environment	
• Dangerous substances	No dangerous materials used
• Ventilation of balcony as dampness control	Gaps between glasses assures ventilation, which reduces the risk of dampness or condensation.
Safety in use:	
• Wind load resistance EN 12211	**Lumon 6** 1000 Pa (8x677x1470) mm^3 900 Pa (10x1000x2876) mm^3 4500 Pa (12x1000x1876) mm^3 1600 Pa (12x830x2876) mm^3
	Lumon 6T 900 Pa (8x1000x2406) mm^3 800 Pa (10x1000x2906) mm^3 3300 Pa (12x1000x1906) mm^3 1300 Pa (12x830x2906) mm^3
• Impact resistance of the system EN 12600 Impact from indoors and outdoors	**Lumon 6** 450 mm (8x876x1938) mm^3 450 mm (10x876x1938) mm^3 900 mm (12x876x1938) mm^3
	Lumon 6T 190 mm (8x876x1938) mm^3 190 mm (10x876x1938) mm^3 450 mm (12x876x1938) mm^3
Durability UV-ageing and heat testing 1000 h, ISO 4892-2	No influence on performance
Corrosion resistance of the metallic parts of the glazing system	Protected from rain. NPD

RESEARCH
RESISTANCE TO WIND LOAD. LUMON 6. GLASS 8, 10 and 12 MM.

Research:	Resistance to wind load. Lumon 6. Glass 8, 10 and 12 mm. Test report 11-002640-PR01. Dated 10 January 2012.
Research institute:	ift Rosenheim
Client:	Lumon Oy Kaitilankatu 11 FI-45130 Kouvola
Product:	Lumon 6 Balcony glazing
Tests:	Wind load test static – specimens 1 to 4 Wind load test dynamic – specimen 4

Results:

	Specimen 1 (double leaf)	Specimen 2 (double leaf)	Specimen 3 (double leaf)	Specimen 4 (double leaf)
Overall dimensions (W x H) mm	2040 x 2000	1700 x 3000	2040 x 2500	2040 x 3000
Casement dimensions (W x H) mm	1000 x 1876	830 x 2876	1000 x 2376	1000 x 2876
Glazing	TSG, 12 mm	TSG, 12 mm	TSG, 8 mm	TSG, 10 mm
	Resistance under static wind load no failure at up to	Resistance under static wind load no failure at up to	Resistance under static wind load no failure at up to	Resistance under static wind load no failure at up to
Positive wind pressure [Pa = N/m^2]	4500 Pa	1600 Pa	1000 Pa	900 Pa
Negative wind pressure [Pa = N/m^2]	5400 Pa	2000 Pa	1100 Pa	1000 Pa
	Resistance under dynamic wind load no failure at up to	Resistance under dynamic wind load no failure at up to	Resistance under dynamic wind load no failure at up to	Resistance under dynamic wind load no failure at up to
Positive wind pressure [m/s]	not tested	not tested	not tested	35 m/s [1)] (app. 126 km/h)

[1)] maximum wind speed of the test equipment

The complete test report is available on request.

RESEARCH
Pendulum-impact, EN 12 600, Lumon 6 Balcony Glazing

Research:	Determination of the pendulum-impact resistance according to EN 12600 of Lumon 6 Balcony Class Curtain System for ETA approval. Test report VTT-S-01915-12. Dated 20 March 2012.
Research institute:	VTT Expert services Ltd
Client:	Lumon Oy Kaitilankatu 11 FI-45130 Kouvola
Product:	Lumon 6 Balcony Glazing: - sliding panes (type 1) of 8 mm glass - turn panes (type 2) of 8 mm glass - sliding panes (type 1) of 10 mm glass - turn panes (type 2) of 10 mm glass - sliding panes (type 1) of 12 mm glass - turn panes (type 2) of 12 mm glass Dimensions of the panes: breadth of 876 mm and height of 1938 mm.
Tests:	The impact test was carried out according to the standard EN 12 600 by the impactor of 50 kg, the air pressure of the tyres of the impactor was 0,35 MPa. The specimens of balcony glazing were impacted in the middle of glass pane on the both sides using different pane samples. Drop height levels were 190 mm and 450 mm when using 8 mm thick glass panes. With 10 mm thick glass panes the drop height was 450 mm and with 12 mm thick glass panes drop heights were 450 mm and 900 mm.
Results:	**Lumon 6 with 8 mm glass panes.** Both Sliding glass (type 1) and turning glass (type 2) passed the test from the both drop heights of 190 mm and 450 mm without any structural or functional failures. **Lumon 6 with 10 mm glass panes.** Both Sliding glass (type 1) and turning glass (type 2) passed the test from the drop height 450 mm without any structural or functional failures. **Lumon 6 with 12 mm glass panes.** Both sliding glass (type 1) and turning glass (type 2) passed the test from the drop heights of 450 mm and 900 mm without any structural or functional failures.

The complete test report is available on request.

RESEARCH
Artificial weathering of the plastic components of Lumon 4 (Lumon 6 and Lumon 6T)

Research: Artificial weathering of plastic components of Lumon 4 Balcony Glass Curtain Systems by Xenon Arc + water spray, ISO 4892-2.
Test report VTT-S-07127-07. Dated 21 August 2007.

Research institute: VTT technical Research Centre of Finland

Client: Lumon Oy
Kaitilankatu 11
FI-45130 Kouvola

Products: Plastic components of Lumon 4. Most of Lumon 4 components are also used in the lumon 6 and Lumon 6T whith are updated versions from Lumon 4.

Tests: Samples (three of each type) were exposed to the Xenon Arc radiaton according to the standard ISO 4892-2 method A. Specimens were exposed to 102 min dry and 18 min water spray period repeated 1000 hours. The spectral irradiance on the band bass 300 to 400 nm was 60+/- 2 W/m^2 and the black standard temperature 65 +/- 3 ^{o}C.

Results:

Name of the component	Comp. number	Material	Change dim.	Change weight	Change colour
Lower hinge L4, L6T	50200004	PA 66	+0,5 %	+0,4 %	Clear change to yellow
One-sided-latch L4	50200006	ABS-PC	-0,3 %	-1,5 %	Clear change to yellow
Upper Rail Guide L4, L6, L6T	50200022	PA 66		-0,08 %	No visible change Inner roller was stuck
Upper seal L4, L6, L6T	54200001	Silicone	-4,1% h +0,3% l	-2,0 %	Light change to yellow
Lower seal L4	54200002	PVC/Acryl		-0,5 %	Clear change to yellow
Bruch seal L4, L6, L6T	54220007	PVC	-2,7% b	-2,6 %	Clear change to yellow Base material perished
Ceiling seal L4		TPE	-1,7% l	+2,5 %	Clear change to white
Corner seal L4	54220003	Silicone	-0,8% l	-4,2 %	Light change to yellow
Edge sealing 20 L4, L6, L6T	54042024	Silicone	-0,5% l	-1,8 %	Light change to yellow
Fastening bead 8, L4, L6, L6T	54043024	PVC		+0,2 %	Clear change to bright
h-seal 8, L5, L6, L6T	54043044	PVC	-0,1% l	+0,01%	Clear change to bright
Extension profile seal L4, 6, 6T	54200204	TPE	-0,7% l	+0,4 %	Clear change to yellow
End plugs of glazing beads: upper straight grey L4 lower straight grey L4 upper corner white L4 lower corner white L4	 53201019 50200011 53200043 50200026	 PA 66 PA 66 PA 66 PA 66	 +0,4% b -0,8% h +0,5% l +0,3% h	 - +1,3 % +3,0 % +2,3 %	 very light visible change very light visible change Clear change to yellow Clear change to yellow
Double edge seal 6/20 L3		PVC	-0,7 %	-3,3 %	Clear change to yellow

The complete test report is available on request

RESEARCH
RESISTANCE TO WIND LOAD. LUMON 6T. GLASS 8, 10 and 12 MM.

Research:	Resistance to wind load. Lumon 6T. Glass 8, 10 and 12 mm. Test report 11-002640-PR02. Dated 10 January 2012.
Research institute:	ift Rosenheim
Client:	Lumon Oy Kaitilankatu 11 FI-45130 Kouvola
Product:	Lumon 6T Balcony glazing
Tests:	Wind load test static – specimens 1 to 4 Wind load test dynamic – specimen 4

Results:

	Specimen 1 (double leaf)	Specimen 2 (double leaf)	Specimen 3 (double leaf)	Specimen 4 (double leaf)
Overall dimensions (W x H) mm	2040 x 2000	2040 x 2500	1700 x 3000	2040 x 3000
Casement dimensions (W x H) mm	1000 x 1906	1000 x 2406	830 x 2906	1000 x 2906
Glazing	TSG, 12 mm	TSG, 8 mm	TSG, 12 mm	TSG, 10 mm
	Resistance under static wind load no failure at up to	Resistance under static wind load no failure at up to	Resistance under static wind load no failure at up to	Resistance under static wind load no failure at up to
Positive wind pressure [Pa = N/m^2]	3200 Pa	900 Pa	1300 Pa	800 Pa
Negative wind pressure [Pa = N/m^2]	4500 Pa	1000 Pa	1700 Pa	1100 Pa
	Resistance under dynamic wind load no failure at up to	Resistance under dynamic wind load no failure at up to	Resistance under dynamic wind load no failure at up to	Resistance under dynamic wind load no failure at up to
Positive wind pressure [m/s]	not tested	not tested	not tested	37 m/s [1)] (app. 133 km/h)

[1)] maximum wind speed of the test equipment

The complete test report is available on request.

RESEARCH
Pendulum-impact, EN 12 600, Lumon 6T Balcony Glass Curtain System

Research:	Determination of the pendulum-impact resistance according to EN 12600 of Lumon 6T Balcony Class Curtain System for ETA approval. Test report VTT-S-01914-12. Dated 20 March 2012.
Research institute:	VTT Expert services Ltd
Client:	Lumon Oy Kaitilankatu 11 FI-45130 Kouvola
Product:	Lumon 6T Balcony Glass Curtain System: - sliding panes (type 1) of 8 mm glass - turn panes (type 2) of 8 mm glass - sliding panes (type 1) of 10 mm glass - turn panes (type 2) of 10 mm glass - sliding panes (type 1) of 12 mm glass - turn panes (type 2) of 12 mm glass Dimensions of the panes: breadth of 876 mm and height of 1938 mm.
Tests:	The impact test was carried out according to the standard EN 12 600 by the impactor of 50 kg, the air pressure of the tyres of the impactor was 0,35 MPa. The specimens of balcony glazing were impacted in the middle of glass pane on the both sides using different pane samples. Drop height levels were 190 mm and 450 mm when using 8 mm and 10 mm thick glass panes. With 12 mm thick glass panes the tests were carried out from the drop heights of 450 mm and 900 mm.
Results:	**Lumon 6T with 8 mm glass panes.** Sliding glass (type 1) passed the test from the drop height level of 450 mm without any structural or functional failures. The turning glass part (type 2) passed the test from the drop height of 190 mm without any structural or functional failures. **Lumon 6T with 10 mm glass panes.** Sliding glass (type 1) passed the test from the drop height level of 450 mm without any structural or functional failures. The turning glass part (type 2) passed the test from the drop height of 190 mm without any structural or functional failures. **Lumon 6T with 12 mm glass panes.** Both sliding glass (type 1) and turning glass (type 2) passed the test from the drop height level of 450 mm without any structural or functional failures. The sliding glass part (type 1) passed also the test from the drop height of 900 mm without any structural failures, which would have affected on the usability or functionality of the system.

The complete test report is available on request.

Airborne Sound Insulation of Lumon 6T Terrace Glazings

Technical report No: 12-000515-PR01 (PB 2-A03-04-en-01), dated 14 May 2013

Test institute: ift Rosenheim

Client: Lumon OY
Kaitilankatu 11
FI-45130 KOUVOLA

Product: Terrace Glazing Lumon 6T
Installed in an opening. Overall dimensions (W x H) 1250 mm x 1500 mm
2 panels (side-hung and sliding / side-hung.
Single pane / toughened safety glass (TSG)
Test of 3 glass variants, TSG 8, TSG 10 and TSG 12
Seal on glass sides: PVC/silicone. Seal between glass panes: PVC.

Test method: Weighted sound reduction index $\mathbf{R_w}$ and spectrum adaptation terms **C** and $\mathbf{C_{tr}}$ was measured by using pink noise as measurement signal and one-third octave band filter.
The measured frequency range was from 100 Hz to 3150 Hz.

The test method based on:
- EN ISO 10140-1:2010 + A1:2012 Acoustics; Laboratory measurement of sound insulation of building elements - Part 1
- EN ISO 10140-2:2010 Acoustics; Laboratory measurement of sound insulation of building elements - Part 2
- EN ISO 717-1:1996 + A1:2006 Acoustics; Rating of of sound insulation in building elements - Part 1: Airborne sound insulation

Results: The weighted sound reduction index $\mathbf{R_w}$ and the spectrum adaptation terms **C** and $\mathbf{C_{tr}}$ for the frequency range 100 Hz to 3150 Hz.

Glazing / Measured structure	Measured result $\mathbf{R_w}$ **(C;$\mathbf{C_{tr}}$)** in dB
8 mm TSG	**22 (0;-1)**
10 mm TSG	**24 (0;-2)**
12 mm TSG	**23 (0;-1)**

The complete test report is available on request.

RESEARCH
Load tests, Posts and Fixings of Balcony Balustrades

Research:	Load tests of posts and fixings of balcony balustrades. Test report P505042. Dated 6 February 2006.
Research institute:	SP Technical Research Institute of Sweden
Client:	Balkongföreningen i Norden (**bf**) Minkvägen 4 SE-352 45 Växjö
Products:	6 member companies of **bf** let **SP** test their posts and fixings of their aluminium balcony balustrades. All together 14 different posts and fixings of balcony balustrades were tested by **SP**.
Tests (Lumon):	The fixings and posts were fastened in a 200 mm thick concrete slab. Lumon had two different types of fixings: - on the front of the concrete slab with a hat bracket - on the top of the concrete slab with a steel pedestal The hat bracket and the steel pedestal was fastened to the concrete with two chemical anchor; M12 x 140; A2/70. The load was brought to the posts 1100 mm above the concrete slab. Displacement was also measured 1100 mm above the concrete slab. Each test was repeated 10 times.
Explanations:	The selected values and dimension are based on regulations in Sweden: - 1100 mm is the requirement for the height of a railing. - 0,4 kN/m is the horizontal load requirement for handrail in apartments - 0,8 kN/m is the requirement for handrail in public areas - 30 mm is the maximum allowable deflection for handrail in serviceability limit state
Results of Lumon posts and fixings:	Results are shown in table 1.

Table 1. Deflections [mm]

Fixing type / Load direction	Load 0,4 kN				Load 0,8 kN				Deflection 30 mm		Load 2,2 kN
	Deflection		Residual deflection		Deflection		Residual deflection		Load [kN]	Residual deflection	Deflection 1 specimen
	average	max.	average	max.	average	max.	average	max.			
on the front / load outward	9,29	9,43	0,17	0,33	22,58	27,07	0,36	0,65	1,00	0,88	
on the top / load outward	10,21	11,15	0,92	1,50	24,25	25,45	2,57	2,94	1,01		95
on the top / load inward	9,96	10,45	0,73	1,04	22,00	22,25	1,85	2,58	1,01	1,71	

The part of the test report, concerning Lumon products, is available on request.

RESEARCH
Impact tests, EN 12 600, Lumon Balcony Balustrades

Research:	Impact tests of Lumon balcony balustrades applying the standard SFS-EN 12600. Test report VTT-S-07039-09. Dated 5 October 2009.
Research institute:	VTT Technical Research Centre of Finland
Client:	Lumon Oy Kaitilankatu 11 FI-45130 Kouvola
Product:	Lumon Balcony Balustrades: - glass balustrades of different glass sizes [mm]: o LSG 4+4 + PVB 0,38; 1000 x 763 and 1500 x 763. Distance between posts 1200 mm. o LSG 5+5 + PVB 0,38; 1000 x 1062 and 1500 x 1062. Distance between posts 1200 mm. o LSG 4TSG+4FG + PVB 0,76; 500 x 762, 800 x 1062. Distance between posts 500 mm. o LSG 4TSG+4FG + PVB 0,76; 1500 x 1062. Distance between posts 1200 mm. LSG = laminated safety glass; TSG = Thermally toughened safety glass Each of the glass balustrades was tested with four similar specimens. - bar balustrades of different sizes (width 1500 mm x height 900 mm or 1300 mm) with three different type of aluminium bars. 8 Specimens. - one balustrade (width 1500 mm x height 1200 mm) with a sheet steel (perforated sheet steel 1240 mm x 1300 mm x 0,6 mm). - one balustrade (width 1070 mm x height 1200 mm) with a building board (Ikilevy Formica 1040 mm x 1269 mm x 8 mm).
Tests:	The impact test was carried out according to the standard method SFS-EN 12 600 “Glass in building. Pendulum test”. The used drop height was 450 mm. The hitting points were the middle point of the balustrade, glass, sheet steel and building board.
Summary of results:	In the impact tests made from the drop height 450 mm all the glass part of balustrades stayed unbroken with exception of two glasses: - one LSG 4+4 + PVB 0,38; 1500 x 763; distance between posts 1200 - one LSG 5+5 + PVB 0,38; 1500 x 1062; distance between posts 1200 Bowing of the glazing fixing rails were observed mainly in the cases in which the posts were spaced wider than in practice. The balustrades with sheet steel or building board stayed unbroken in the impact test with drop height of 450 mm. In impact tests with drop height 450 mm all the aluminium bar balustrades showed different failures depending on the height of the balustrade, of the profile type and stapling.

The complete test report is available on request.

RESEARCH
Impact tests, TRAV, Lumon Balcony Balustrades, Posts 70x30

Research: Impact tests of Lumon balcony balustrades according to TRAV (Technischen Regeln für die Verwendung von abstürzsichernden Verglasungen) requirements applying the standard SFS-EN 12 600.
Test report No:.VTT-S-09122-09. Dated 10 December 2009.

Research institute: VTT Technical Research Centre of Finland

Client: Lumon Oy
Kaitilankatu 11
FI-45130 Kouvola

Product: Lumon Balcony Balustrades. Posts 70 x 30:
- glass balustrades of two glass sizes [mm]:
  - LSG 5TSG+5FG + PVB 0,76; 500 x 1128
  - LSG 5TSG+5FG + PVB 0,76; 2020 x 1128

LSG = Laminated safety glass; TSG = Thermally toughened safety glass

Tests: The impact test was carried out according to the standard method SFS-EN 12 600 "Glass in building. Pendulum test". In accordance with TRAV requirements the impact height 450 mm was used. The air pressure in the tyres was 3,5 kPa. The impact points are presented in Table Impact points.

Table. Impact points

Test No.	1. impact	2. impact	3. impact
1 a	in the middle 500 mm from bottom	250 mm from left and 250 mm from top	in the middle of glass pane
4 a	250 mm from left and 500 mm from bottom	250 mm from left and 250 mm from top	in the middle 250 mm from top

Test results: The whole glass part of the balustrades stayed unbroken in the impact tests made from height 450 mm. In both tests the bottom fixing rail bowed slightly after first impact. However, additional impact from the drop height 100 mm was not carried out.

According to the tests these two specimens fulfill the requirements of C1 presented in TRAV.

The complete test report is available on request.

RESEARCH
Impact tests, TRAV, Lumon Balcony Balustrades, Posts 70x30-2

Research: Impact tests of Lumon balcony balustrades according to TRAV (Technischen Regeln für die Verwendung von abstürzsichernden Verglasungen) requirements applying the standard SFS-EN 12 600.
Test report No:. VTT-S-07710-11. Dated 14 November 2011.

Research institute: VTT Expert Services Ltd.

Client: Lumon Oy
Kaitilankatu 11
FI-45130 Kouvola

Product: Lumon Balcony Balustrades. Posts 70 x 30 - 2:
- glass balustrades of two glass sizes [mm]:
  - LSG 5TSG+5FG + PVB 0,76; 500 x 1350
  - LSG 5TSG+5FG + PVB 0,76; 2020 x 1350

LSG = Laminated safety glass; TSG = Thermally toughened safety glass

Tests: The impact test was carried out according to the standard method SFS-EN 12 600 "Glass in building. Pendulum test". In accordance with TRAV requirements the impact height 450 mm was used. The air pressure in the tyres was 3,5 kPa. The impact points are presented in Table Impact points.

Table. Impact points

Test No.	1. impact	2. impact	3. impact
1 and 2	250 mm from left and 500 mm from bottom	250 mm from left and 250 mm from top	in the middle of glass pane

Test results: The whole glass part of the balustrades stayed unbroken in all impact tests made from drop height of 450 mm. Neither other failures were detected.

According to the tests these two specimens fulfill the requirements of C1 presented in TRAV.

The complete test report is available on request.

RESEARCH
Performance evaluation of Lumon NA's "Lumon Guardrail System" in accordance with the NBCC 2010/OBC 2006 guard requirements

Research: Performance evaluation of Lumon North America's "Lumon Guardrail System" in accordance with the NBCC 2010 / OBC guard requirements.
Report No.: 12-06-M0021. Dated 24 January 2012.

Research institute: Exova

Client: Lumon North America
65 Reive Boulevard
Cookstown, Ontario
LOL 1LO

Product: Lumon Guardrail System; two posts; Infill tempered glass.
Unit size: 1930 mm wide by 1092 high.
Posts: 70 mm (deep) x 30 mm (wide). Spacing between posts 1530 mm.
Infill: Tempered 6 mm. 1930 mm wide, 864 mm high.
Post fixings: steel pedestal + 2 x M12 L140 A2 Rods + Hilti Hy150.

Test Results:

Table 1. Summarized Guard Testing Results

Loading Description	Specified Load	Minimum Design Load Required	1,5 x Factored Load Required	Test Result (Pass / Fail)
OBC 2006 Section 4.1.5.15.1(c) / NBCC 2010 4.1.5.15.1(c) – 0.75 kN/m or 1.0 kN Applied at Any Point				
Concentrated horizontal load applied at the midpoint of the rail	1,0 kN (225 lfb)	1,0 kN (225 lfb)	1,5 kN (338 lbf)	Pass
Concentrated horizontal load applied at the end of the rail	1,0 kN (225 lfb)	1,0 kN (225 lfb)	1,5 kN (338 lbf)	Pass
Concentrated vertical load (downward) applied at the midpoint of the rail	1,0 kN (225 lfb)	1,0 kN (225 lfb)	1,5 kN (338 lbf)	Pass
Concentrated vertical load (downward) applied at the end of the rail	1,0 kN (225 lfb)	1,0 kN (225 lfb)	1,5 kN (338 lbf)	Pass
Concentrated vertical load (upward) applied at the midpoint of the rail	1,0 kN (225 lfb)	1,0 kN (225 lfb)	1,5 kN (338 lbf)	Pass
Concentrated vertical load (upward) applied at the end of the rail	1,0 kN (225 lfb)	1,0 kN (225 lfb)	1,5 kN (338 lbf)	Pass
OBC 2006 Section 4.1.5.15.2 / NBCC 2010 4.1.5.15.2 – 0.5 kN/100 mm^2 or 1.0 kN Applied to elements				
Concentrated load applied to individual spindles (balusters)	0,5 kN (113 lfb)	0,5 kN (113 lfb)	0,75 kN (225 lfb)	Pass
OBC 2006 Section 4.1.10.1.4 / NBCC 2010 4.1.5.15.4 – 1.5 kN/m Applied Vertically at the Top				
Uniformly distributed vertical load applied downward	1,5 kN/m (103 lfb/ft)	2,9 kN (652 lfb)	4,35 kN (978 lfb)	Pass
Uniformly distributed vertical load applied upward	1,5 kN/m (103) lfb/ft	2,9 kN (652 lfb)	4,35 kN (978 lfb)	Pass

Conclusions: Based on the results of the testing summarized in Table 1, the "Lumon Guardrail System" met the following requirements:
- National Building Code of Canada Section 4.1.5.14.1(c), 4.1.5.14.2, 4.1.10.1.4
- Ontario Building Code Section 4.1.5.15.1(c), 4.1.5.15.2, 4.1.10.1.4

The complete test report is available on request.