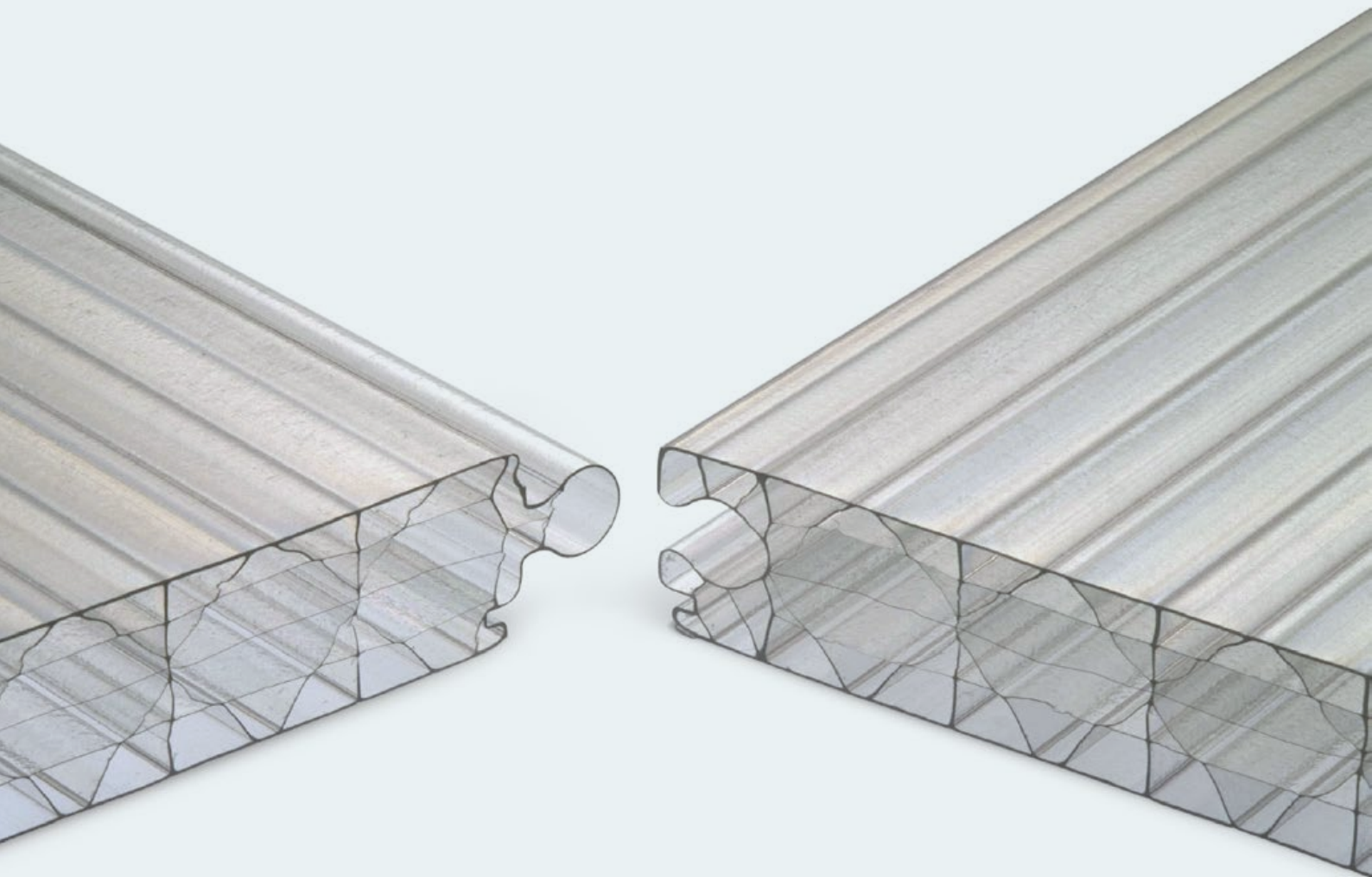


TECHNICAL MANUAL

LEXAN™ THERMOCLEAR™
MULTIWALL POLYCARBONATE SHEET





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LEXAN™ FILM & SHEET BUSINESS

POLYVANTIS Polycarbonate Film & Sheet business is a leading supplier of high performance engineering sheet products, serving customers around the world in a broad spectrum of applications.

Our virtually unbreakable, lightweight, fire resistant LEXAN™ sheet portfolio made with Polycarbonate (PC) technology includes many structures, ranging from solid and multiwall sheet. The company has integrated extrusion processes, surface texturing and coating technologies to provide value added solutions across a wide variety of industries. A well-established brand name for over 50 years, LEXAN™ THERMOCLEAR™ multiwall sheet is amongst the most extensive portfolio on the market today, offering hundreds of combinations of structures, coatings, colors and finishes.

At POLYVANTIS, we are dedicated to meet our customers' ever changing needs with our high performance LEXAN sheet portfolio. Our material solutions and services help our customers to reduce their system costs, create innovative designs and environmentally responsible materials. POLYVANTIS ongoing investment in world-class technologies demonstrates our commitment to helping our customer's technical requirements, application development needs and business goals. Our product portfolio is backed by advanced technical support and application development services around the world to meet our customers' global specification needs with local supply.

POLYVANTIS operates in more than 50 countries across the world with 1,500 plus employees worldwide. It has significant research resources with 4 dedicated technology and innovation facilities in the USA, the Netherlands, India and China. POLYVANTIS operates in more than 50 countries across the world with 35,000 employees worldwide. It has significant research resources with 18 dedicated technology and innovation facilities in the USA, the Netherlands, Spain, India and China.

LEXAN™ RESIN

LEXAN™ resin is a polycarbonate which is a unique engineering thermoplastic that combines a high level of mechanical, optical and thermal properties. The versatility of this material makes it a suitable candidate for many engineering applications. When extruded in sheet form, due to its excellent optical and impact properties, this material can be an excellent candidate for a wide range of glazing applications. POLYVANTIS has developed a multiwall polycarbonate sheet portfolio, called LEXAN™ THERMOCLEAR™ sheet, which can provide an outstanding balance of light weight, high impact strength and stiffness, excellent thermal insulation, UV and flame resistance and long-term light transmission for variety of applications.

TYPICAL APPLICATIONS INCLUDE:

- DIY / Home Construction
- Greenhouses
- Interior Applications
- Large Architectural Projects
- Pool Covers
- Rooflights & Skylights
- Soundwalls
- Storm Protection
- Verandas & Conservatories
- Vertical Glazing
- Wall Cladding

LEXAN™ THERMOCLEAR™ Multiwall Sheet Portfolio

LEXAN™ THERMOCLEAR-PLUS™ sheet (LT2UV)

LEXAN THERMOCLEAR-PLUS Sheet features a unique 2 side proprietary surface treatment designed to protect the sheet against the degrading effects of ultra-violet radiation in natural sunlight. Available from 4.5 mm thickness, easy to cut and install sheets are treated with proprietary UV protection on both sides to help ensure long-term optical quality and high light transmission against outdoor weathering and minimize installation mistake costs.

LEXAN THERMOCLEAR Dripgard sheet (LTD)

LEXAN THERMOCLEAR Dripgard sheet features a specially developed coating on the inner surface which reduces the formation of condensation droplets. This property is particularly important in helping to prevent crop spoilage in commercial greenhouses, by falling condensation droplets. It also helps prevent reduction of light transmission due to condensation water droplets. It can be an excellent material choice for roof glazing where water drops are unacceptable. For instance: greenhouses/verandas/sunrooms/ swimming pool enclosures/industrial roof glazing.

LEXAN THERMOCLEAR Solar Control IR sheet (2UVIR)

LEXAN THERMOCLEAR Solar Control IR sheet makes use of an innovative nano technology platform of solar energy absorption. The LEXAN THERMOCLEAR Solar Control IR sheets are transparent with a green (GN8B038T) tint, which blocks near-infrared light but lets in high levels of visible light. LEXAN Solar Control IR multiwall sheet offers: high light transmission combined with low solar transmission. Available in various structures (2/3/5/9 walls, RS, TS & X structures), this product comes with UV protection on both sides and can offer long-term weathering resistance and high impact strength.

LEXAN THERMOCLICK™ sheet

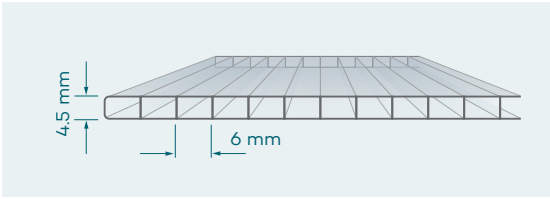
LEXAN THERMOCLICK sheet is an X-structured multiwall polycarbonate panel with an inter-connecting system which eliminates the need for vertical profiles, thereby saving costs and enhancing aesthetics. It is an excellent candidate to create flush profile-free facades in different colors and effects. Combined with the ease of installation, this product is highly suitable for facades and wall cladding. LEXAN THERMOCLICK sheet has a one side proprietary surface treatment designed to protect the sheet against the degrading effects of ultra-violet radiation in natural sunlight.

TYPICAL APPLICATIONS INCLUDE:

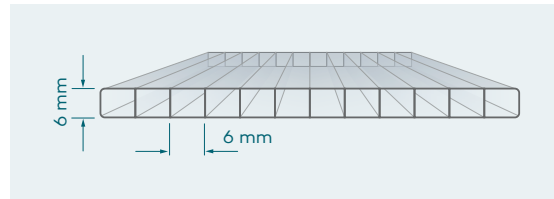
- Industrial sidewalls
- Commercial sidewalls greenhouses
- Railway/metro station
- Interior decoration



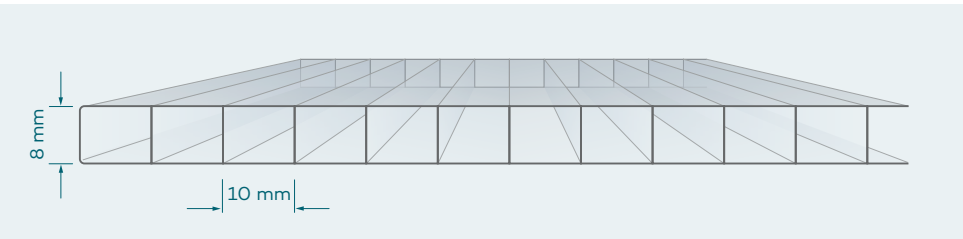
452RS10 structure



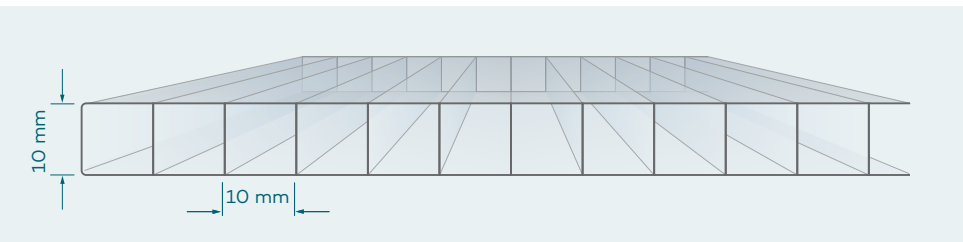
62RS13 structure



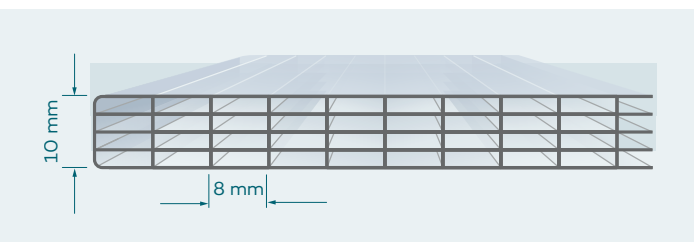
82RS15 structure



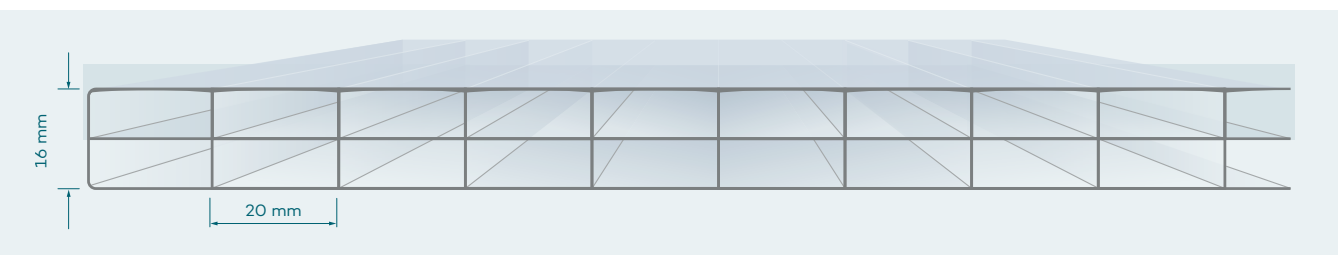
102RS17 structure



105R175 structure

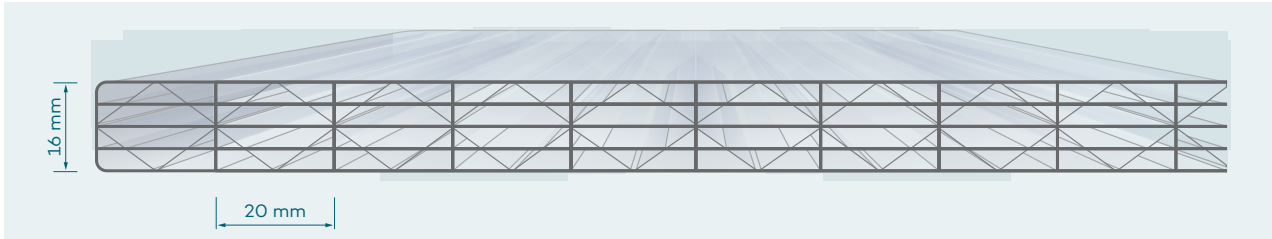


163TS27 structure

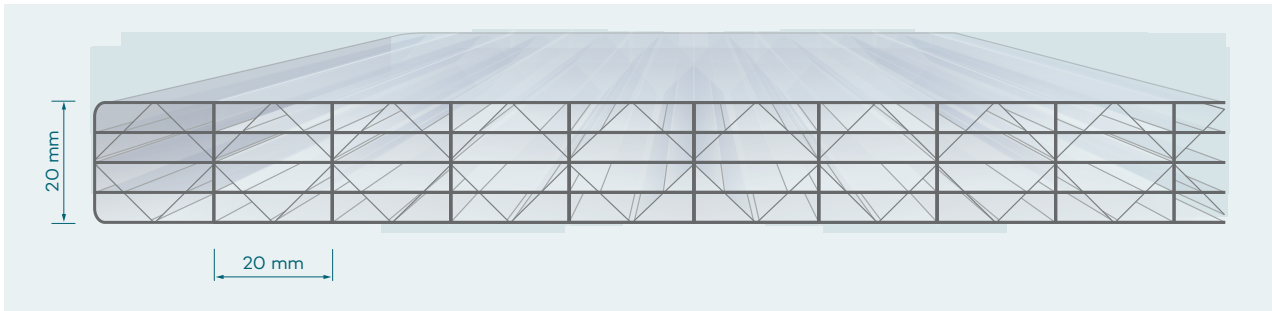


PRODUCT AVAILABILITY

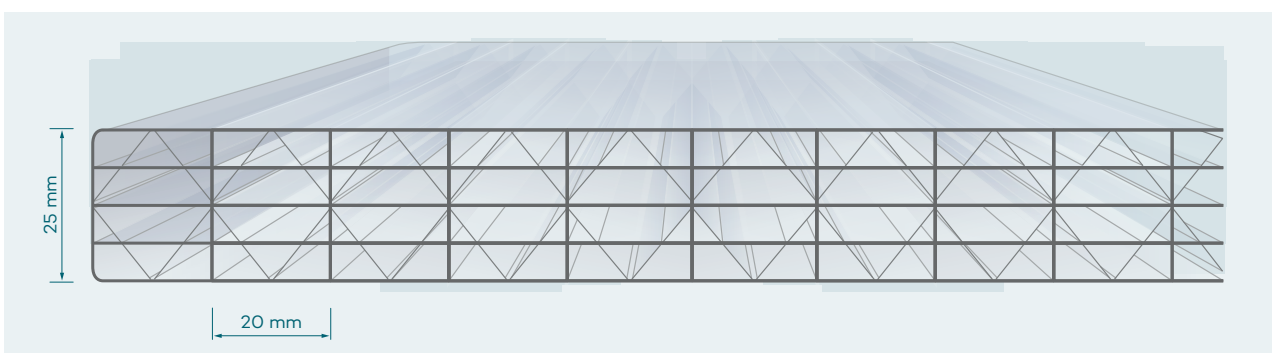
165X26 structure



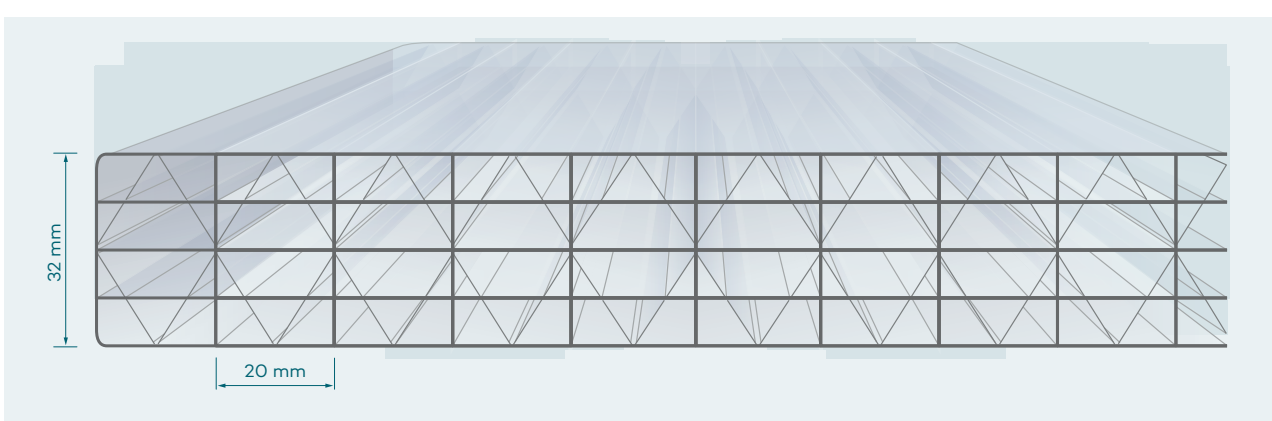
205X32 structure



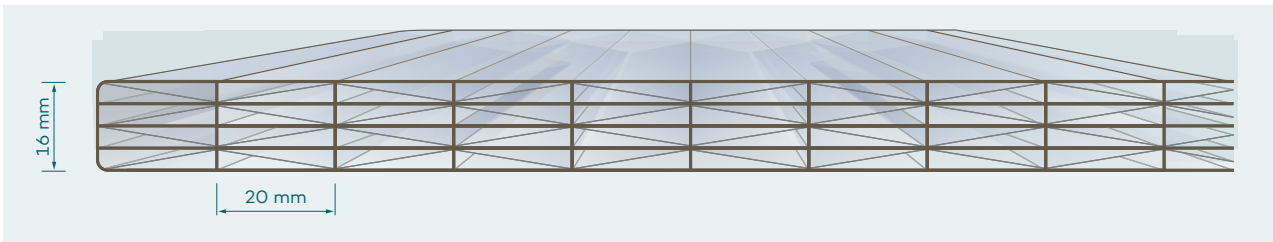
255X34 structure



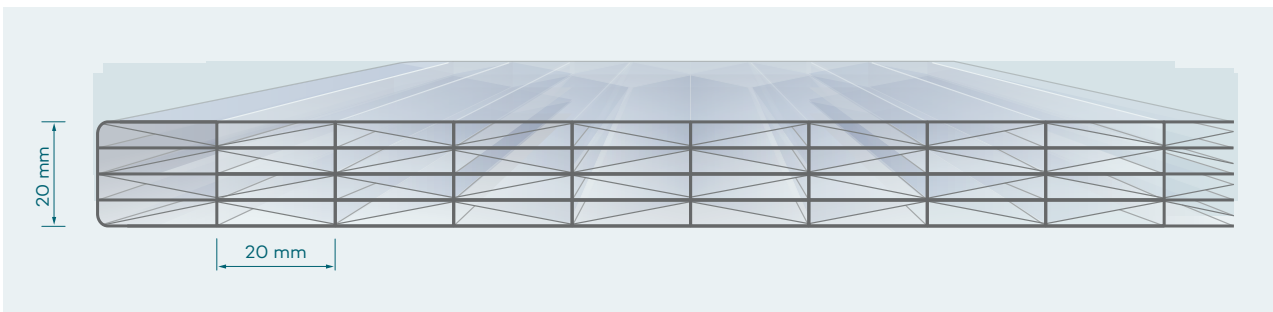
325X38 structure



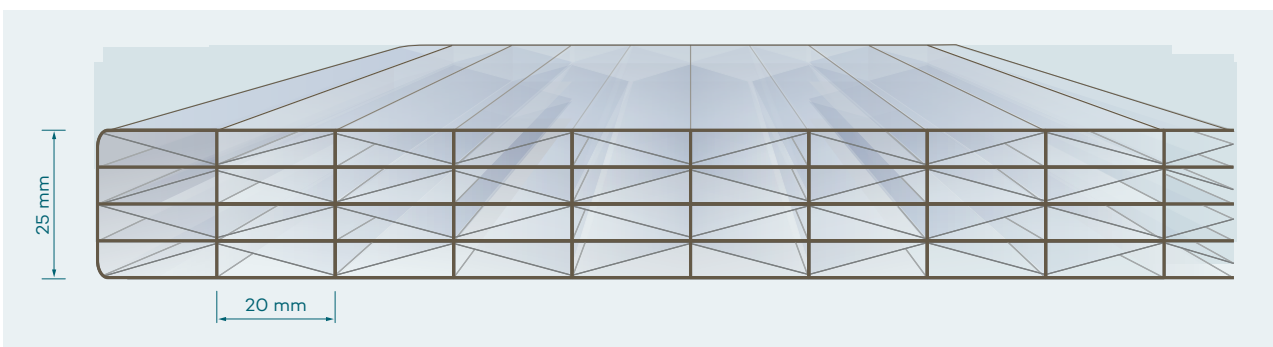
169X25 structure



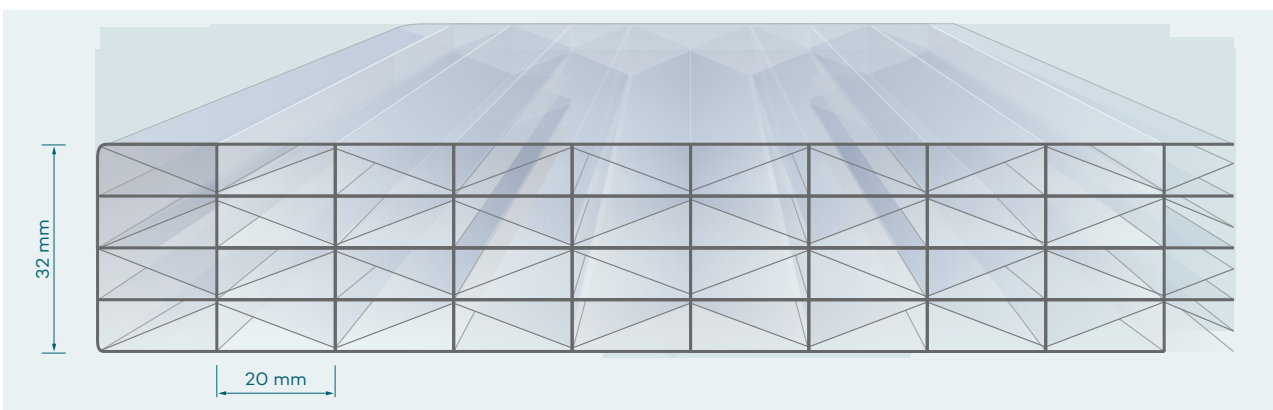
209X28 structure



259X30 structure



329X38 structure



PROPERTY PROFILE

Table 1: LEXAN THERMOCLEAR sheet Product Selector

PRODUCT	GRADE NAME	STRUCTURE	GAUGE (MM)	WEIGHT (KG/M ²)	U-VALUE # (W/M ² K)	RIB DISTANCE (MM)	STANDARD COLORS
LEXAN THERMOCLEAR LT2UV sheet (20 yr limited written warranty) 2 side UV PLUS coating Clear color = 112 Opal color = WH7A092X Bronze color = 515055	LT2UV452RS10	2-Wall Rectangular	4,5	1,00	3,86	6,30	112-WH7A092X-515055
	LT2UV62RS13	2-Wall Rectangular	6	1,30	3,56	6,30	112-WH7A092X-515055
	LT2UV82RS15	2-Wall Rectangular	8	1,50	3,26	10,70	112-WH7A092X-515055
	LT2UV102RS17	2-Wall Rectangular	10	1,70	3,02	10,70	112-WH7A092X-515055
	LT2UV105R175	5-Wall Rectangular	10	1,75	2,48	8,00	112-WH7A092X-515055
	LT2UV163TS27	3-Wall Tunnel	16	2,70	2,27	20,00	112-WH7A092X-515055
	LT2UV165X26	5-Wall X-structure	16	2,60	1,88	20,00	112-WH7A092X-515055
	LT2UV169X	9-Wall X-structure	16	2,50	1,77	20,00	112-WH7A092X-515055
	LT2UV209X	9-Wall X-structure	20	2,80	1,59	20,00	112-WH7A092X-515055
	LT2UV205X32	5-Wall X-structure	20	3,20	1,69	20,00	112-WH7A092X-515055
	LT2UV259X	9-Wall X-structure	25	3,00	1,40	20,00	112-WH7A092X-515055
	LT2UV255X34	5-Wall X-structure	25	3,40	1,51	20,00	112-WH7A092X-515055
	LT2UV325X38	5-Wall X-structure	32	3,80	1,32	20,00	112-WH7A092X-515055
	LT2UV329X	9-Wall X-structure	32	3,80	1,2	20,00	112-WH7A092X-515055

Please check with your POLYVANTIS representative when non standard combinations are required for alternatives.

U-values based on POLYVANTIS calculated values according ISO 10077

LT (Light transmission) and TST (Total Solar Transmission) measurements according ISO 9050
TST divided by 100 equals Solar Heat Gain Coefficient (SHGC) or g-value.

Shading Coefficient (SC): The ratio of the total solar radiation transmitted by a given material to that transmitted by normal 3 mm glass, whose light transmission is 87%. SC=%TST/87.

LEXAN multiwall sheet products

Typical property values for:

LEXAN THERMOCLEAR-PLUS sheet	(LT2UV) 20 yr limited written warranty
LEXAN SOLAR CONTROL IR	(2UVIR) 20yr limited written warranty
LEXAN THERMOCLEAR Drippard sheet	(LTD) 10 yr limited written warranty
LEXAN THERMOCLICK sheet	(LTC) 10 yr limited written warranty

	LT 112 (%)###	TST 112 (%)##	DST 112 (%)	SC 112 (%)###	LT WH7A092X (%)	TST WH7A092X (%)	DSTWH7A092X (%)	SCWH7A092X (%)	STANDARD WIDTH (MM)	AVAILABLE LENGTHS (MM)
	83	83		0,95	67	70		0,80	1200-2100	3000-13000
	82	82	76	0,94	66	69	63	0,79	1200-2100	3000-13000
	81	82	77	0,94	64	68	62	0,78	1200-2100	3000-13000
	81	80	76	0,92	64	68	62	0,78	1200-2100	3000-13000
	65	65	61	0,75	60	59	58	0,68	1250-2100	3000-13000
	74	78	70	0,90	63	69	60	0,79	980-1200-2100	3000-13000
	59	58		0,67	51	52			1200-2100	3000-13000
	54	54	51	0,62	47	49	45	0,56	980-1200-2095	3000-13000
	53	53	50	0,61	47	50	46	0,57	980-1200-2095	3000-13000
	58	66		0,76	50	51			1200-2100	3000-13000
	51	52	49	0,60	44	47	42	0,54	980-1200-2095	3000-13000
	57	65		0,75	49	54			1200-2100	3000-13000
	55	65	54	0,60	48	48	46	0,55	1200-2100	3000-13000
	51	53	48	0,61	44	48	43	0,55	980-1200-2095	3000-13000

Table 2: Typical properties for LEXAN Polycarbonate Resin

PROPERTY PHYSICAL	TEST METHOD	UNIT	VALUE
Density	ISO 1183	g/cm ³	1,20
Water absorption, 50% RH / 23°C	ISO62	%	0,15
Water absorption, saturation / 23°C	ISO 62	%	0,35
Mechanical			
Tensile stress at yield 50mm/min	ISO 527	MPa	60
Tensile stress at break 50mm/min	ISO 527	MPa	70
Tensile strain at yield 50mm/min	ISO 527	%	6
Tensile strain at break 50mm/min	ISO 527	%	120
Tensile modulus 2mm/min	ISO 527	MPa	2300
Flexural stress at yield 2mm/min	ISO 178	MPa	90
Flexural stress at break 2mm/min	ISO 178	MPa	2300
Hardness H358/30 95	ISO 2039/1	MPa	95
Thermal			
Vicat Softening Temperature, rate B/120	ISO 306	°C	145
HTD/Ae, 1.8 MPa edgew. 120*1*04/sp=100	ISO 75	°C	127
Thermal conductivity	ISO 8302	W/m.°C	0,2
Coeff. of lin. Therm. Exp.extr. 23-80°C	ISO 11359-2	1/°C	7,00 E-05
Electrical			
Volume resistivity	IEC 60093	Ohm.cm	10 E15

These property values have been derived from LEXAN resin data for the material used to produce this sheet product. Variation within normal tolerances are possible for various colors. These typical values are not intended for specification purposes.

If minimum certifiable properties are required please contact your local POLYVANTIS Film & Sheet representative. All values are measured at least after 48 hours storage at 23°C/50% relative humidity. All properties are measured on injection molded samples. All samples are prepared according ISO 294.

PROPERTY PROFILE

LEXAN THERMOCLICK sheet LTC404X4000 (4.0kg/m²)

LEXAN THERMOCLICK sheet 40mm is an impact resistant, energy-saving multiwall sheet with profiled tongue and groove connection, including a groove for double sided tie on the inside. This inter-connecting system eliminates the need for vertical profiles, thereby saving costs and enhancing aesthetics.

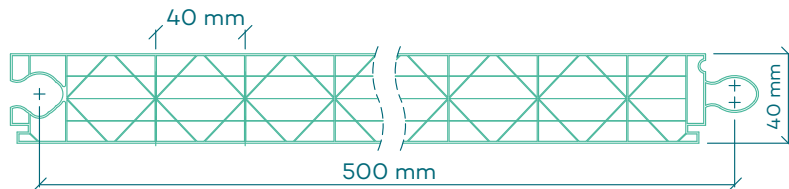


Table 3: LEXAN Thermoclick sheet Systems Product Selector

PRODUCT	GRADE NAME	STRUCTURE	GAUGE (MM)	WEIGHT (KG/M ²)	U-VALUE # (W/M ² K)	RIB DISTANCE (MM)	LT 112 (%) ##	LT WH7A092X (%) ##	AVAILABLE WIDTH (MM)	AVAILABLE LENGTHS (MM)
LEXAN THERMOCLICK LTC sheet <i>Top side UV co-extrusion (10 yr limited written warranty)</i>	LTC404x4000	4-Wall X-structure	40	4,00	1,27	20,00	59	50	500	3000- 13000

Standard colors:

Clear	: 112
Opal White	: WH7A092X
Blue	: BL6C024T
Green	: GN7C018T
Red	: RD7C005T
Orange	: OR6C012T
Yellow	: YW9C007T

Please check with your POLYVANTIS representative when non standard combinations are required for alternatives.

For more information concerning our THERMOCLICK please check out our dedicated technical manual.

MECHANICAL PROPERTIES

Impact Strength

LEXAN THERMOCLEAR sheet has outstanding impact performance over a wide temperature range, -40°C to $+120^{\circ}\text{C}$, and also after prolonged outdoor exposure.

Hail Resistance

As a roof glazing material LEXAN THERMOCLEAR sheet provides outstanding impact performance even in severe weather such as windstorm, hail-stones, snowstorms and ice formation. Virtually unbreakable LEXAN THERMOCLEAR sheet is able to withstand harsh weathering conditions as well as to the subsequent temperature change to sunny conditions without breaking or buckling.

An independent research organization, TNO Science & Industry, tested the properties of LEXAN THERMOCLEAR multiwall sheet for simulated hail-stone storm of varying diameters. As a result the material showed no significant damage.

A test sample is clamped into a metal frame and polyamide balls of varying diameters are fired at the surface of the sample using a pressurized airgun.

In practice, hail-stones with a diameter of 20 mm can reach a terminal velocity of 21 m/s. Under these conditions materials such as glass and acrylic fail.

While glass and the acrylic showed brittle characteristics when they failed the test, LEXAN THERMOCLEAR sheet showed ductile behavior. The ball left only indentations after impact and the THERMOCLEAR sheet showed no breakage (See figure 1).

POLYVANTIS offers a standard twenty years written limited warranty on LEXAN THERMOCLEAR sheet covering loss of strength or impact due to weathering. For more details please consult POLYVANTIS.

Figure 1: Represents material failure at this speed

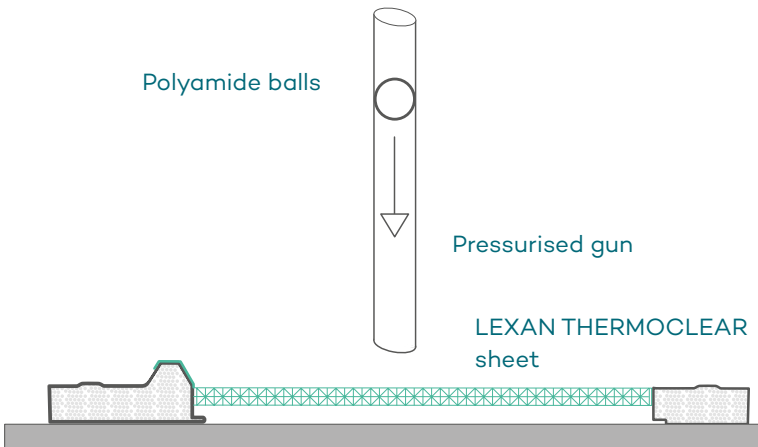


Table 4: Hail Simulation Test Results

MATERIAL	BALL DIAMETER 20MM
Equilibrium velocity of hail stones in practice	21 m/s
Acrylic multiwall sheet t=16 mm	7-14 m/s
Float glass t=4 mm	10 m/s
LEXAN THERMOCLEAR sheet t=10 mm	21 m/s
LEXAN THERMOCLEAR sheet t=16 mm	21 m/s

PHYSICAL PROPERTIES

Light Transmission

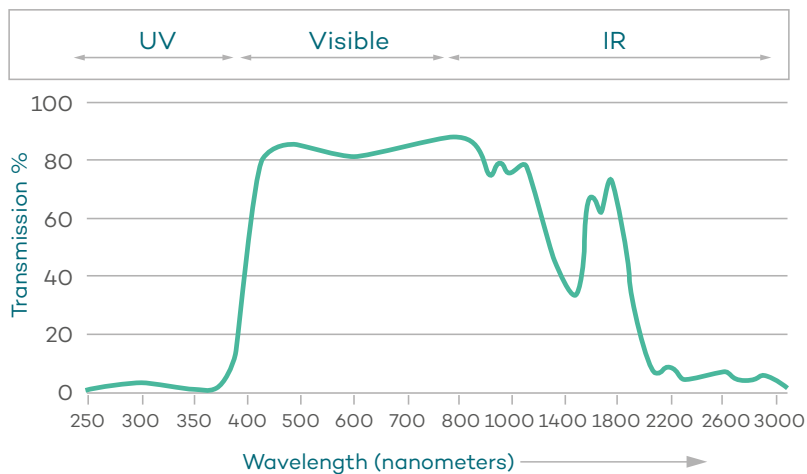
The wavelength of the sun affecting a thermoclear sheet material ranges from 280 up to 2140 nanometers. This optical window is divided into the following sections:

UV-B Middle ultraviolet region	280 – 315 nm
UV-A Near ultraviolet region	315 – 380 nm
Visible light region	380 – 780 nm
Near infra-red region	780 – 1400 nm
Middle infra-red region	1400 – 3000 nm

As shown in Graph 1, LEXAN THERMOCLEAR sheet has the highest transmission in the visible light.

Despite transmitting visible light very well, LEXAN™ THERMOCLEAR™ sheet is almost opaque to radiation in the UV and far infra-red region. This useful shielding property can prevent discolouration of sensitive materials such as fabrics or other organic materials placed under or behind LEXAN THERMOCLEAR sheet glazing in, for example, a factory warehouse, museum or shopping centre.

Graph 1: Light Transmission Spectrum of LEXAN THERMOCLEAR sheet



Conservatory with transparent LEXAN™ THERMOCLEAR™ sheet.

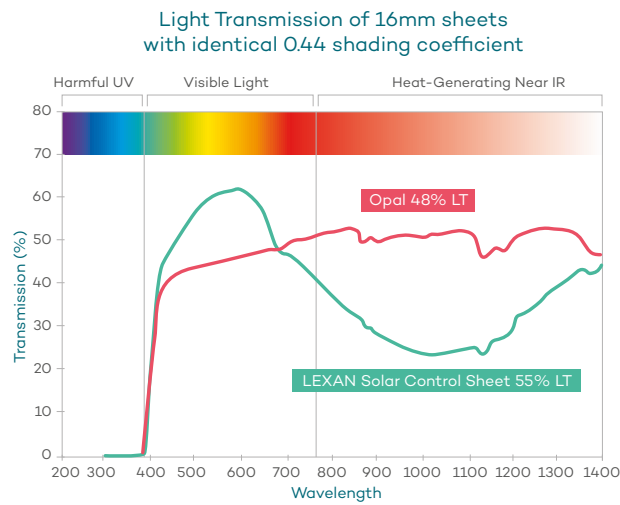


SOLAR CONTROL PROPERTIES

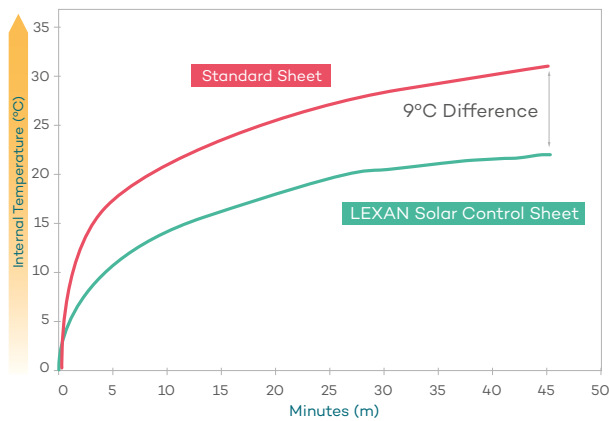
Temperature Increase Inside the Building

Sunlight entering the building heats the air both directly and through absorption by the framework, furniture, etc., and is released as infra-red energy. In combination with the insulating properties of LEXAN THERMOCLEAR sheet, this prevents heat escaping faster than it is created causing a temperature increase – the so-called 'greenhouse effect'. The temperature can be controlled by venting, often in combination with specially tinted LEXAN THERMOCLEAR sheet and LEXAN THERMOCLEAR Solar Control IR sheet.

Graph 2



Internal Temperature Reduction - Comparison



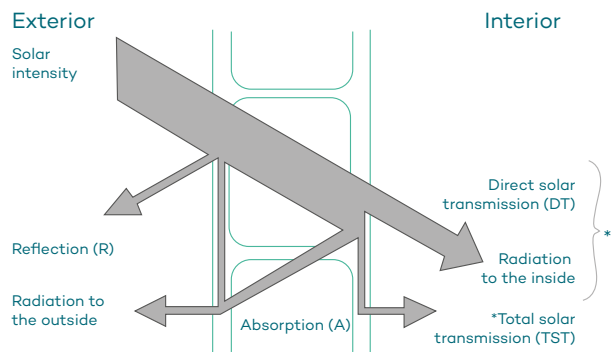
Solar Control

Unlike many other solar control products, LEXAN THERMOCLEAR Solar Control IR (SCIR) sheet does not block or reflect sun light but it absorbs the spectrum of the light which creates solar transmission. LEXAN THERMOCLEAR SCIR Sheet is an excellent candidate for those applications where there is a need for high light transmission together with a low solar transmission.

Solar Heat Gain

The solar radiation reaching the sheet is reflected, absorbed and transmitted, as shown in graph 2. The greatest proportion is transmitted and the total solar transmission (TST) is the sum of the direct transmission (DT) and the inwardly released part of the absorbed energy (A). Table 5 lists the solar control properties of the LEXAN THERMOCLEAR sheet product range.

Figure 2



SOLAR CONTROL PROPERTIES

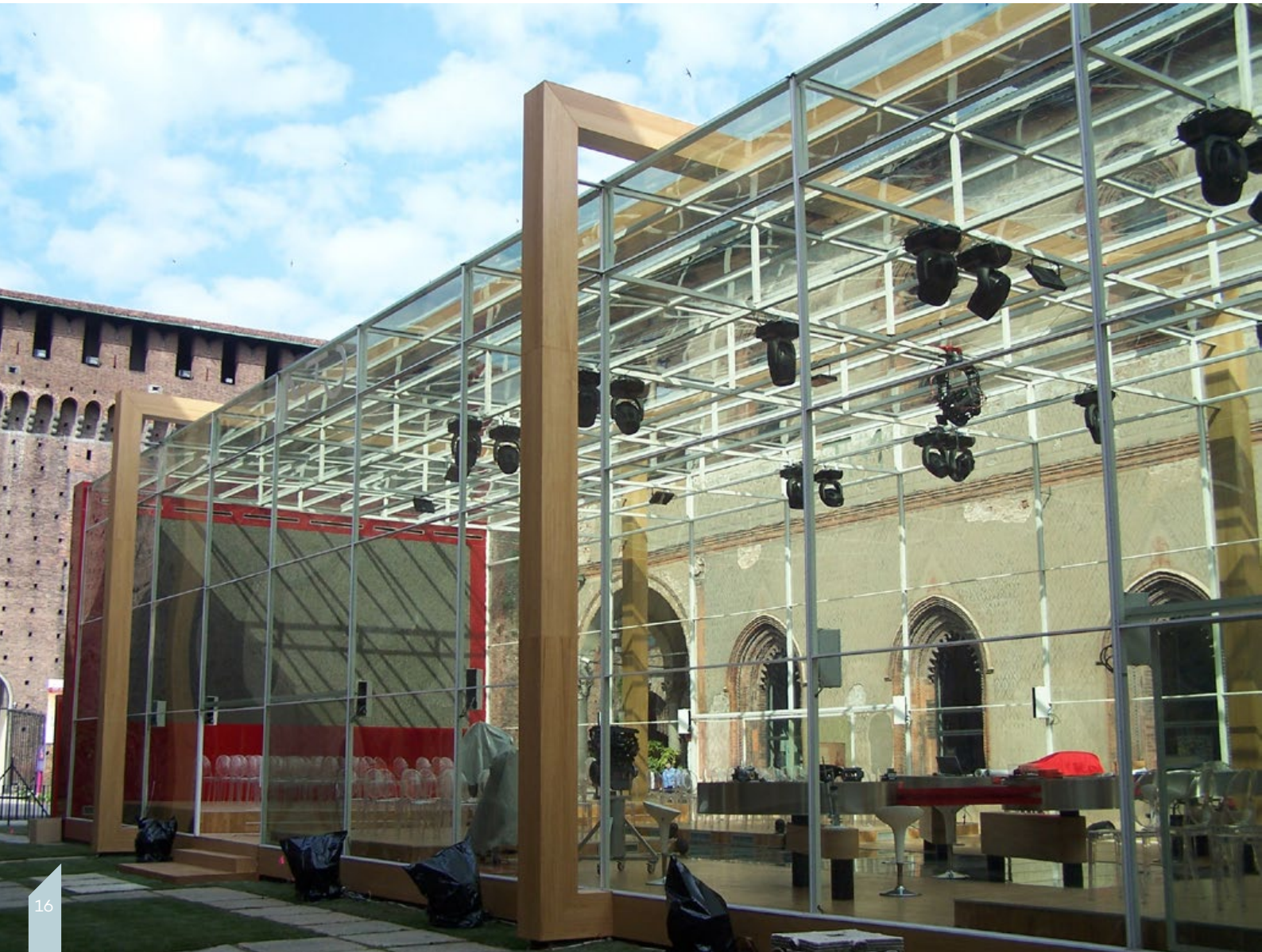
Table 5: Typical properties for LEXAN THERMOCLEAR Solar Control IR (2UVIR) sheet

PRODUCT	GRADE NAME	STRUCTURE	GAUGE (MM)	WEIGHT (KG/M ²)	U-VALUE # (W/M ² K)	GN8B038T LT (%)	GN8B038T DST (%)	GN8B038T TST ## (%)	SHADING COEFFICIENT GN (%)
LEXAN THERMOCLEAR sheet Solar Control Infra Red (20yr limited written warranty)	2UVIR62R13	2-Wall Rectangular	6	1,30	3,56	66	47	60	0,69
	2UVIR82R15	2-Wall Rectangular	8	1,50	3,26	65	47	61	0,70
	2UVIR102R17	2-Wall Rectangular	10	1,70	3,02	65	45	60	0,69
	2UVIR105R175	5-Wall Rectangular	10	1,75	2,48	48	34	48	0,56
	2UVIR163T27	3-Wall Tunnel	16	2,70	2,27	55	36	52	0,60
	2UVIR165X26	5-Wall X-structure	16	2,60	1,88			NPD	
	2UVIR169X25	9-Wall X-structure	16	2,50	1,77	38	25	39	0,45
	2UVIR209X28	9-Wall X-structure	20	2,80	1,59	37	25	39	0,45
	2UVIR205X32	5-Wall X-structure	20	3,20	1,69			NPD	
	2UVIR259X30	9-Wall X-structure	25	3,00	1,40	36	23	37	0,42
2UVIR255X34	5-Wall X-structure	25	3,40	1,51	38	25	44	0,51	
2UVIR325X38	5-Wall X-structure	32	3,80	1,32	36	23	42	0,49	

U-values based on POLYVANTIS calculated values according ISO 10077

LT (Light Transmission) and TST (Total Solar Transmission) measurements acc. ISO 9050.

DST measured according to EN410



OUTDOOR WEATHERING PERFORMANCES

UV Protection

Solar radiation has a particularly harmful effect upon polymeric materials initiating degradation by causing superficial surface crazing. These crazes become sites for further erosion from water, dust, chemicals, etc. The degree to which these conditions affect the polymer depend largely upon environmental parameters such as geographical location, altitude, seasonal variations, etc.

Standard LEXAN THERMOCLEAR sheet has on one or both sides a unique proprietary UV-protected surface, giving excellent resistance to outdoor weathering. This unique protection ensures long-term optical quality under intensive UV exposure, and maintains the superior toughness of the polycarbonate material in comparison to other thermoplastic glazing.

Typical Values of THERMOCLEAR sheet

Research into the long-term effects of weathering on glazing materials is basically focused upon measuring product performance through material property changes, typically mechanical strength, impact resistance, colour retention, transparency, etc.

Under ISO 4892, a test has been developed by using high intensity Xenon lamps to simulate natural sunlight. Together with UV filters and programmable rain and heat cycles, the test is able to simulate natural conditions.

Accelerated weathering tests have been carried out on LEXAN THERMOCLEAR sheet by POLYVANTIS. Using in-house Xenon 1200 apparatus, these tests were carried out according to ISO 4892. However, even tougher demands were placed on the material by removing the UV filter for 1/6 of the cycle. Placed within this environment, LEXAN THERMOCLEAR sheet was exposed to 12,000 hours. Experience with the Xenon test equipment indicates that this relates to 15 years' natural exposure in a moderate European climate. Following the test the optical properties of light transmission and yellowness index were measured and compared with an un-aged sample.

WARRANTY

POLYVANTIS offers a Twenty Year Written Limited Warranty on LEXAN THERMOCLEAR sheet covering discolouration, loss of light transmission and loss of impact strength due to weathering as more specifically defined in such warranty. Please consult your local distributor or POLYVANTIS Sales Office for more details.



The Europe's first stadium with a sliding roof, Amsterdam Arena in The Netherlands, was constructed from transparent LEXAN THERMOCLEAR sheet. An independent research organization, TNO Science & Industry, tested the properties of LEXAN THERMOCLEAR multiwall sheet from the roof of the Amsterdam ArenA stadium after 15 years and found no significant change. The minimal loss in light transmission of 1.5 percent and small increase in yellowness index of 1.1 point met the product warranty. This TNO report is available on request.

Temperature Resistance

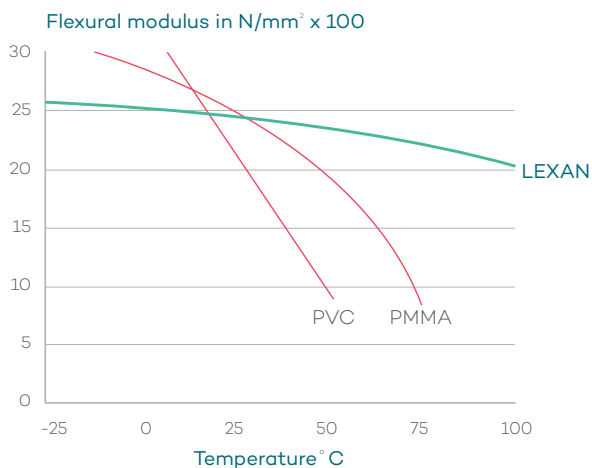
The heat build-up of glazing materials can be seen as a function of the solar energy absorption of the glazing material and the solar intensity.

In areas with intense sun radiation, and when high energy absorbing tinted glazing is installed, heat build-up of the glazing can be considerable. Calculations and actual measurements on installed LEXAN THERMOCLEAR sheet in several projects throughout Europe have shown that sheet surface temperatures of 100°C can exist.

Dimensional Stability

LEXAN THERMOCLEAR sheet is characterised by its excellent retention of impact strength and stiffness at elevated temperatures, even over an extended period. LEXAN THERMOCLEAR sheet retains 85% of its room temperature flexural modulus at 80°C.

Graph3: Dimensional stability. Flexural modulus in N/mm² x100



Continuous Use Temperature

UL Ratings

The U.S.A. Underwriters Laboratories continuous-use temperature rating can be considered as a reliable indicator of a thermoplastic's long-term high temperature performance. The most important properties of the thermoplastic are tested at various temperatures. Test results are extrapolated over a period of 10 years and no property may lose more than 50% of its original value. Table 6 outlines the UL-continuous use temperatures of typical thermoplastic glazing materials.

LEXAN THERMOCLEAR sheet has a continuous-use temperature of 100°C. At the other end of the scale the minimum continuous-use temperature has been set at -40°C. However, using LEXAN THERMOCLEAR sheet at lower temperatures is possible since the embrittlement temperature is as low as -110°C.

Fire Performance

LEXAN THERMOCLEAR sheet has good fire behaviour characteristics, and receives high ratings in several major European fire performance tests including EN13501. More detailed information is available from your local POLYVANTIS Service Centre or authorised dealer.

Table 6: UL Temperature Ratings UL746B

UNDERWRITERS LABORATORIES		
	Continuous-use Temperature Rating	Softening Temperature
LEXAN polycarbonate	100°C	145°C
Acrylic	50°C	100°C
PVC	50°C	70°C

Weight Factors

LEXAN THERMOCLEAR sheet is an excellent replacement for the more traditional glazing materials. It is safe and easy to handle, cut and install and is virtually unbreakable. Its light weight offers significant savings in terms of transportation, handling and installation. When compared with 6 mm wired glass, 10 mm LEXAN THERMOCLEAR sheet offers weight savings of more than 85%.

LEXAN THERMOCLEAR sheet has shown in many applications that its lightness and ease of handling have contributed to significant savings in overall installation costs.

Table 7: Weight

PRODUCT	THICKNESS (MM)	WEIGHT (KG/M ²)
LEXAN THERMOCLEAR sheet	4.5	1.00
	6	1.30
	8	1.50
	10	1.70 - 1.75
	16	2.50 - 2.70
	20	2.80 - 3.20
	25	3.00 - 3.40
	32	3.80
LEXAN THERMOCLICK sheet	40	4.00

VARIOUS PROPERTIES / THERMAL PROPERTIES

Sound Insulation

The sound insulation characteristics of a material are largely pre-determined by its stiffness, mass and physical construction. In accordance with EN ISO 10140-2:2010, the maximum obtainable sound transmission class for a particular thickness of LEXAN THERMOCLEAR sheet is listed in table 8.

Thermal Insulation

The multiwall structure of LEXAN THERMOCLEAR sheet offers significant advantages where thermal insulation is a major consideration. The hollow form provides excellent insulation characteristics with heat losses significantly lower than mono-wall glazing materials. Heat loss is normally referred to as the U-value, which is the amount of energy transmitted through a material per square metre of glazing area and per degree temperature difference. It is expressed in terms of $W/m^2 K$.

Table 8: Sound Reduction Values

PRODUCT	THICKNESS (MM)	WEIGHT	STRUCTURE	SOUND REDUCTION (DB)
LEXAN THERMOCLEAR sheet	4.5	1	2RS	15
	6	1,3	2RS	17
	8	1,5	2RS	17
	10	1,7	2RS	18
	10	1,75	5RS	19
	16	2,7	3TS	18
	20	2,8	9X	18
	25	3,4	5X	21
	32	3,8	5X	21
LEXAN THERMOCLICK sheet	40	4	4X	21

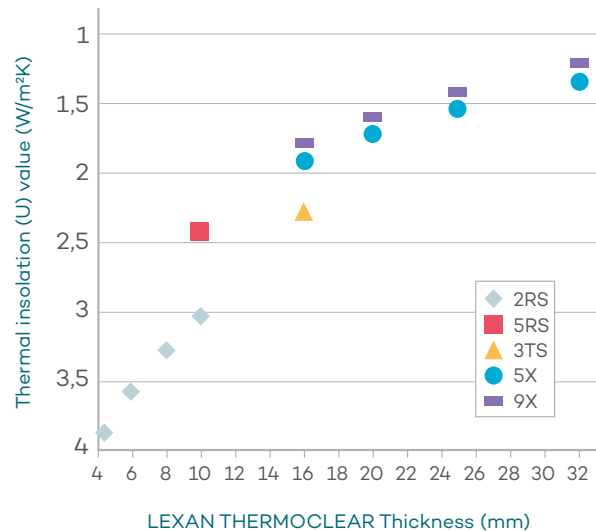
Sound reduction measurements against valid norm: EN ISO 10140-2:2010

Table 9: Material U-values ($W/m^2 K$)

PRODUCT	THICKNESS (MM)	U-VALUE ($W/M^2 K$)
LEXAN THERMOCLEAR sheet	4.5 (2RS)	3.86
	6 (2RS)	3.56
	8 (2RS)	3.26
	10 (2RS)	3.02
	10 (5RS)	2.48
	16 (3TS)	2.27
	16 (5X)	1.88
	16 (9X)	1.77
	20 (5X)	1.69
	20 (9X)	1.59
	25 (5X)	1.51
	25 (9X)	1.40
	32 (5X)	1.32
	32 (9X)	1.20
LEXAN THERMOCLICK sheet	40 (4X)	1.27

U-values based on POLYVANTIS calculated values according ISO 10077 (EN673)

Graph 4



Overglazing

Installing LEXAN™ THERMOCLEAR™ sheet in front or behind the existing glazed window provides additional energy savings. For effective insulation, the best results are obtained when leaving a 20-50 mm air gap between the existing glazing and the LEXAN multiwall sheet.

Double LEXAN multiwall sheet Units

Extremely low U-values can be obtained by double-glazed multiwall LEXAN sheet units. A combination of LEXAN THERMOCLEAR sheet outside and LEXAN THERMOCLEAR sheet inside, with an air gap of 20-50 mm will dramatically reduce the heat loss factor in applications such as curved and pitched roof lights.

Energy Loss Calculations

The need to reduce energy consumption, and therefore energy costs, is one of the highest priorities in any business today. Substantial savings of more than 50% are possible when installing LEXAN THERMOCLEAR sheet instead of mono-layer glass. When calculating according to the guidelines given in the DIN standard 4701, an average annual saving of between 0.9 - 1.3 litres of oil or 1.0 - 1.5 m³ of gas per m² of glazing area will be obtained by decreasing the U-value by 0.1 W/m² K.

Table 12 shows the minimum and maximum amount of savings of fuel consumption per m² glazing area when the U-value is decreased by varying amounts.

CALCULATION EXAMPLE

Annual fuel saving when glass is replaced by LEXAN THERMOCLEAR sheet.

Data:

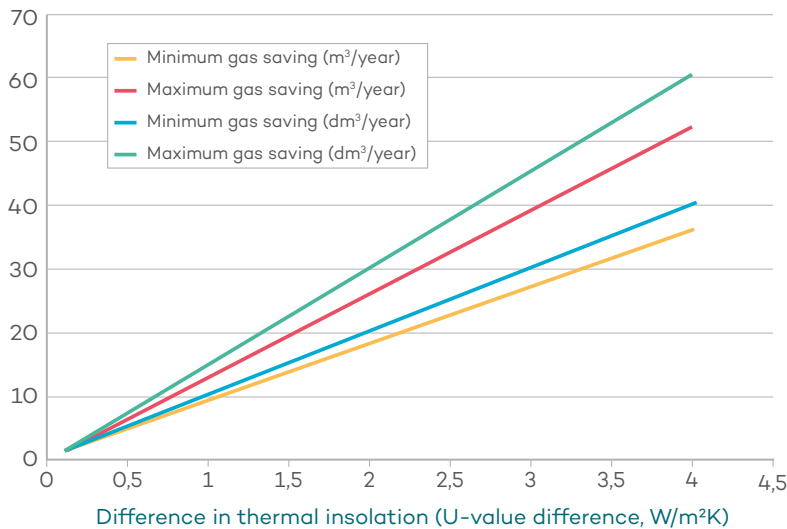
4 mm glass, U-value - 5.8 W/m² K
 10 mm LEXAN THERMOCLEAR sheet,
 U-value - 3.0 W/m² K

U-value difference: 5.8 - 3.0 = 2.8 W/m² K.

As shown in Table 12, the minimum and maximum amount of annual fuel savings per m² glazing area are:

25.2 - 36.4 litres of oil
 28 - 42 m³ of gas

Graph 5



THERMAL PROPERTIES

Table 10: Material U-values (W/m² K)

GLASS THICKNESS (MM)	AIR SPACE (MM)	THERMOCLEAR SHEET THICKNESS (MM)	U-VALUE (W/M ² K)
4	20-50	6(2RS)	2.17
4	20-50	8(2RS)	2.09
4	20-50	10(2RS)	1.97
4	20-50	16(3TS)	1.69

Installing LEXAN THERMOCLEAR sheet in front or behind the existing glazed window provides additional energy savings. For effective insulation, the best results are obtained when leaving a 20-50 mm air gap between the existing glazing and the LEXAN multiwall sheet.

Table 11: Overglazing

THERMOCLEAR SHEET OUTSIDE	AIR GAP (MM)	THERMOCLEAR SHEET INSIDE	U-VALUE (W/M ² K)
6(2RS)	20-50	4.5(2RS)	1.83
8(2RS)	20-50	4.5(2RS)	1.78
10(2RS)	20-50	6(2RS)	1.61
16(3TS)	20-50	6(2RS)	1.42
16(3TS)	20-50	8(2RS)	1.39

Table 12: Annual savings

U-VALUE DIFFERENCE (W/M ² K)	ANNUAL SAVING PER M ² GLAZING AREA	
	OIL (LITRES)	GAS (M ³)
0.1	0.9 - 1.3	1.00 - 1.50
0.2	1.8 - 2.6	2.0 - 3.0
0.3	2.7 - 3.9	3.0 - 4.5
0.4	3.6 - 5.2	4.0 - 6.0
0.5	4.5 - 6.5	5.0 - 7.5
0.6	5.4 - 7.8	6.0 - 9.0
0.7	6.3 - 9.1	7.0 - 10.5
0.8	7.2 - 10.4	8.0 - 12.0
0.9	8.1 - 11.7	9.0 - 13.5
1	9.0 - 13.0	10.0 - 15.0
1.2	10.8 - 15.6	12.0 - 18.0
1.4	12.6 - 18.2	14.0 - 21.0
1.6	14.4 - 20.8	16.0 - 24.0
1.8	16.2 - 23.4	18.0 - 27.0
2.0	18.0 - 26.0	20.0 - 30.0
2.2	19.8 - 28.6	22.0 - 33.0
2.4	21.6 - 31.2	24.0 - 36.0
2.6	23.4 - 33.8	26.0 - 39.0
2.8	25.2 - 36.4	28.0 - 42.0
3.0	27.0 - 39.0	30.0 - 45.0
3.2	28.8 - 41.6	32.0 - 48.0
3.4	30.6 - 44.2	34.0 - 51.0
3.6	32.4 - 46.8	36.0 - 54.0
3.8	34.2 - 49.4	38.0 - 57.0
4.0	36.0 - 52.0	40.0 - 60.0

Note:

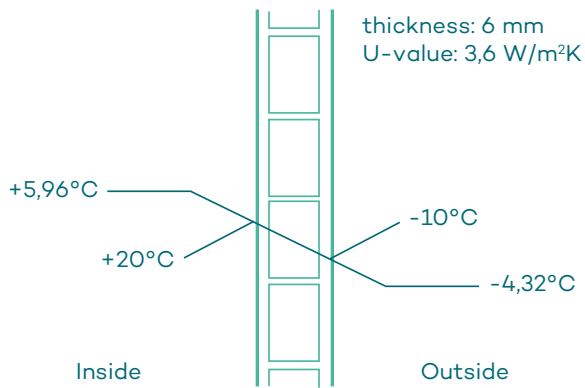
The exact amount of annual fuel savings is strongly dependent upon the building type, location and regional environmental conditions. Local authority engineering departments usually have official data relating to average temperature differences throughout the year.

Cold Radiation

The excellent insulation properties of LEXAN THERMOCLEAR sheet will also contribute to a reduction in the radiation of cold into the building. The lower the U-value, the higher the inner sheet surface temperature will be maintained during the winter season.

Figure 3 presents an example of the temperature profile through 6 mm LEXAN THERMOCLEAR sheet when the outside temperature is -10°C and the inside building temperature is $+20^{\circ}\text{C}$.

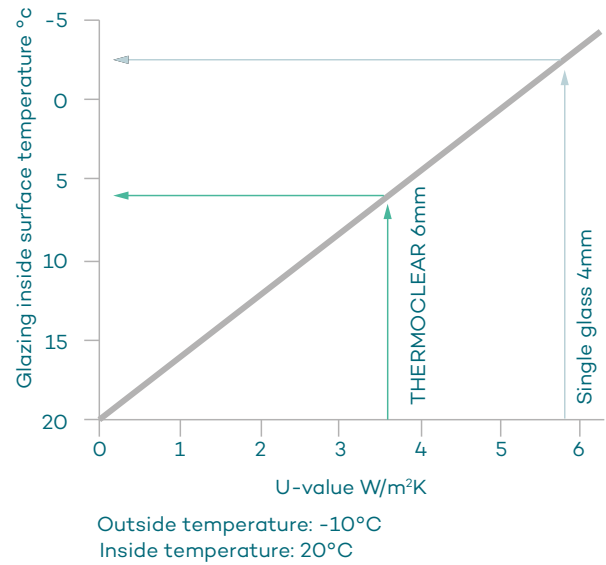
Figure 3: Temperature process through LEXAN THERMOCLEAR sheet at low outside temperature.



The multiwall construction creates an air space which results in a moderate sheet surface temperature. Under the conditions indicated, the inner sheet surface temperature remains far above zero so that there is no cold radiation to the inside of the building.

Graph 6 compares LEXAN THERMOCLEAR sheet with single glazed glass under the same conditions. The inside glass surface temperature is well below zero, which means that cold radiation will negatively influence the overall building temperature and will affect the comfort level near the windows.

Graph 6: Comparison of LEXAN THERMOCLEAR sheet with single glazed glass under the same conditions.



LEXAN™ SHEET CLEANING RECOMMENDATIONS

These cleaning recommendations apply to all LEXAN polycarbonate sheet products, including, but not limited to, LEXAN solid sheet and signs, LEXAN coated MARGARD™ sheet and LEXAN multiwall sheet.

Periodic cleaning using correct procedures can help to prolong service life. For cleaning, it is recommended that the following instructions be adhered to:

Cleaning Procedure for Small Areas – Manual

1. Gently wash sheet with a solution of mild soap and lukewarm water, using a soft, grid-free cloth or sponge to loosen any dirt or grime.
2. Fresh paint splashes, grease and smeared glazing compounds can be removed easily before drying by rubbing lightly with a soft cloth using petroleum ether (BP65), hexane or heptane. Afterwards, wash the sheet using mild soap and lukewarm water.
3. Scratches and minor abrasions can be minimized by using a mild automobile polish. We suggest that a test be made on a small area of LEXAN sheet with the polish selected and that the polish manufacturer's instructions be followed, prior to using the polish on the entire sheet.
4. Finally, thoroughly rinse with clean water to remove any cleaner residue and dry the surface with a soft cloth to prevent water spotting.

Cleaning Procedure for Large Areas - Automated

1. Clean the surface using a high-pressure water cleaner (max. 100bar or 1,450psi) and/or a steam cleaner. We suggest that a test be made on a small area, prior to cleaning the entire sheet.
2. Use of additives to the water and/or steam should be avoided.

Other Important Instructions for all LEXAN sheets:

- Never use abrasive or highly alkaline cleaner on LEXAN polycarbonate materials.
- Never use aromatic or halogenated solvents like toluene, benzene, gasoline, acetone or carbon tetrachloride on LEXAN polycarbonate materials.
- Use of incompatible cleaning materials with LEXAN sheet can cause structural and/or surface damage.
- Contact with harsh solvents such as methyl ethyl ketone (MEK) or hydrochloric acid can result in surface degradation and possible crazing of LEXAN sheet.
- Never scrub with brushes, steel wool or other abrasive materials.
- Never use squeegees, razorblades or other sharp instruments to remove deposits or spots.
- Do not clean LEXAN polycarbonate sheet in direct sunlight or at high temperatures as this can lead to staining.
- For all mentioned chemicals consult the manufacturer's Article Safety Data sheet (ASDS) for proper safety precautions.

Additional Important Considerations for multiwall, Corrugated and Sign sheet:

- Cleaners and solvents generally recommended for use on polycarbonate are not necessarily compatible with the UV-protected surfaces of LEXAN multiwall sheet and sign polycarbonate materials.
- Do not use alcohols on the UV-protected surfaces of LEXAN sheet.
- Never clean the Dripgard surface of LEXAN multiwall sheet.



Amsterdam Arena in Amsterdam, the Netherlands is Europe's first stadium with a sliding roof, made from LEXAN™ THERMOCLEAR™ transparent sheet. 20.000 m² - The sliding roof was necessary to allow events to be staged regardless of the weather.

CONDENSATION/CHEMICAL RESISTANCE

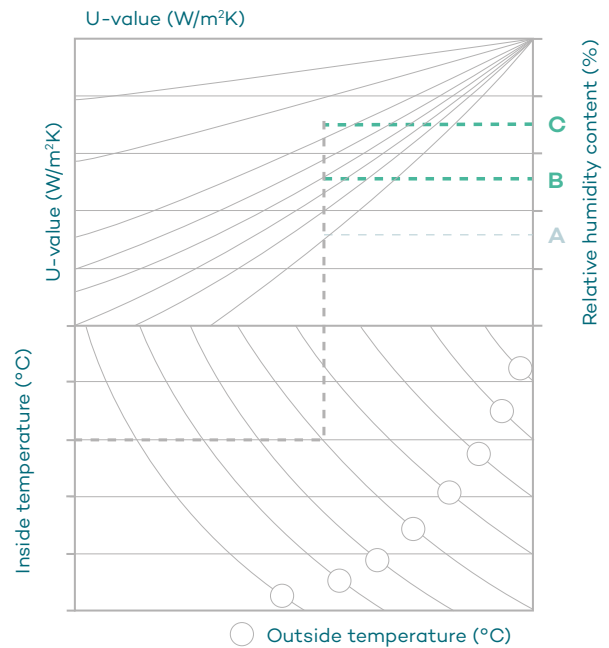
Condensation

Condensation is formed when moisture in the atmosphere changes back to water as it comes into contact with a surface at a temperature below the 'dewpoint' of the surrounding air.

Water droplets on the surface of the glazing reduce light transmission, and, if they fall, can spoil plants or damage sensitive goods and equipment underneath. LEXAN THERMOCLEAR Dripgard sheet has a special one-sided coating that inhibits the formation of condensation droplets. The coating lowers the surface tension and the droplets form a thin layer of water over the whole surface of the sheet. When the sheet is correctly installed, this thin, transparent water film runs off the sheet surface into the profile drainage system without falling to the ground and without affecting the light transmission values of the glazing.

Graph 7 shows a typical condensation prediction chart showing the relationships between internal and external temperatures, relative humidity and the U-value. The dotted lines on the chart illustrate clearly how glass with a high U-value is more prone to condensation than LEXAN THERMOCLEAR Dripgard sheet.

Graph 7:
Condensation Prediction Chart showing the relationships between internal and external temperatures, relative humidity and the U-value



Inside temperature: 20°C
Outside temperature: -10°C

Condensation will occur on:

- A Glass U-value 5.8 w/m² K at a humidity content of: 32%
- B LT2UV 6 mm U-value 3.56 W/m² K at a humidity content of: 50%
- C LT2UV 20 mm U-value 1.8 W/m² K at a humidity content of: 68%

Chemical Resistance

LEXAN THERMOCLEAR sheet has been successfully used in combination with many building materials and glazing compounds. Taking into account the complexity of chemical compatibility, all chemicals which come into contact with polycarbonate should always be tested in the particular application. For sheet products, the most common materials are sealants, gaskets and the various cleaning media. Chemical compatibility testing is an ongoing process at POLYVANTIS and many standard products have already been tested. A complete list of recommended cleaners, gaskets and sealants is available upon request. However, a shortened list of some of the more common compounds is shown below.

When using glazing compounds it is essential that the sealant system accepts a certain amount of movement to allow for thermal expansion, without loss of adhesion to the frame or sheet. Momentive Silicones' sealants are generally recommended for use with LEXAN THERMOCLEAR sheet, see table 13. It is strongly advised when using other sealing compounds to check compatibility before use.

Table 13: Recommended Sealants

SEALANT	SUPPLIER
Silpruf	Momentive
multiSil	Momentive

Compatible Neoprene, EPT or EPDM rubbers with an approximate Shore Hardness of the A65 are recommended, and compatibility reports for different rubber types are available upon request.

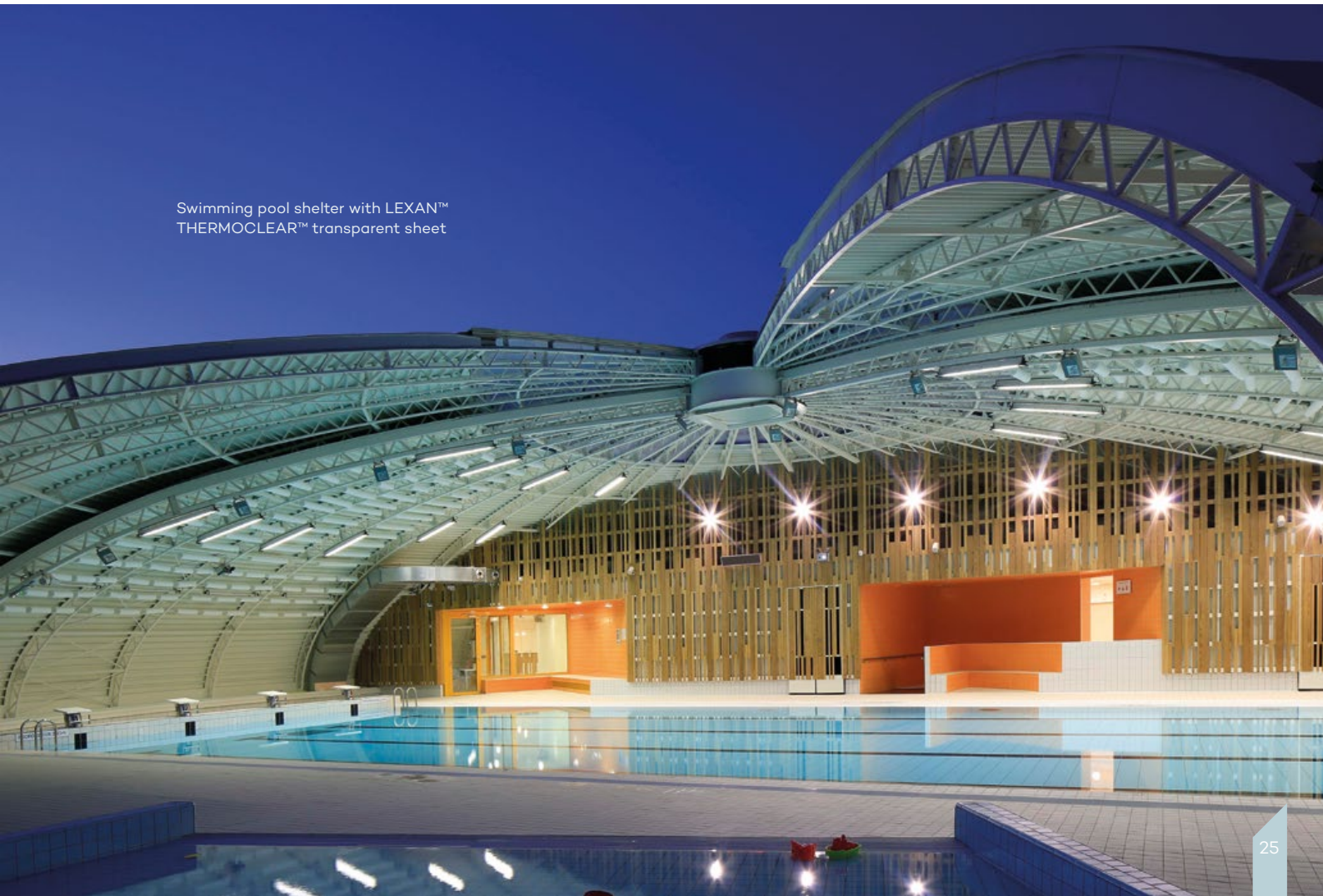
Table 14: Recommended Gasket Systems

GASKET TYPE*	SUPPLIER
EPDM Chloropene, RZ4-35-81	Helvoet
EPDM 4330, 4431, 5530, 5531	Vredestein
EPDM 3300/670, 64470	Phoenix

* more grades available

In case of doubt about any aspect of the chemical compatibility of the LEXAN THERMOCLEAR sheet range, always consult your nearest POLYVANTIS Sales Office for further advice.

Swimming pool shelter with LEXAN™ THERMOCLEAR™ transparent sheet



GENERAL GUIDELINES

Storage

LEXAN THERMOCLEAR sheet should be stored and protected against atmospheric influences like sun, rain, etc. LEXAN THERMOCLEAR sheets of the same length should be stacked together horizontally or, if different lengths, graded with the longest sheet at the bottom of the stack in order to avoid unsupported overhangs. The stacks should be supported on timber bearers and should not be placed where they can be walked on or driven into.

Handling

As with all glazing materials, care should be exercised when handling and transporting LEXAN THERMOCLEAR sheet in order to prevent scratches and damage to sheet edges. Each sheet is packaged as follows to minimise the risk of these problems:

- The top face is covered with printed masking. LEXAN THERMOCLEAR-PLUS (2UV) sheet has a red print and LEXAN Dripgard has a blue printed masking.
- The bottom face has a neutral masking.
- The edges of the sheets have transportation tape on them.
- The sheet should be kept in their packaging until immediately prior to installation.

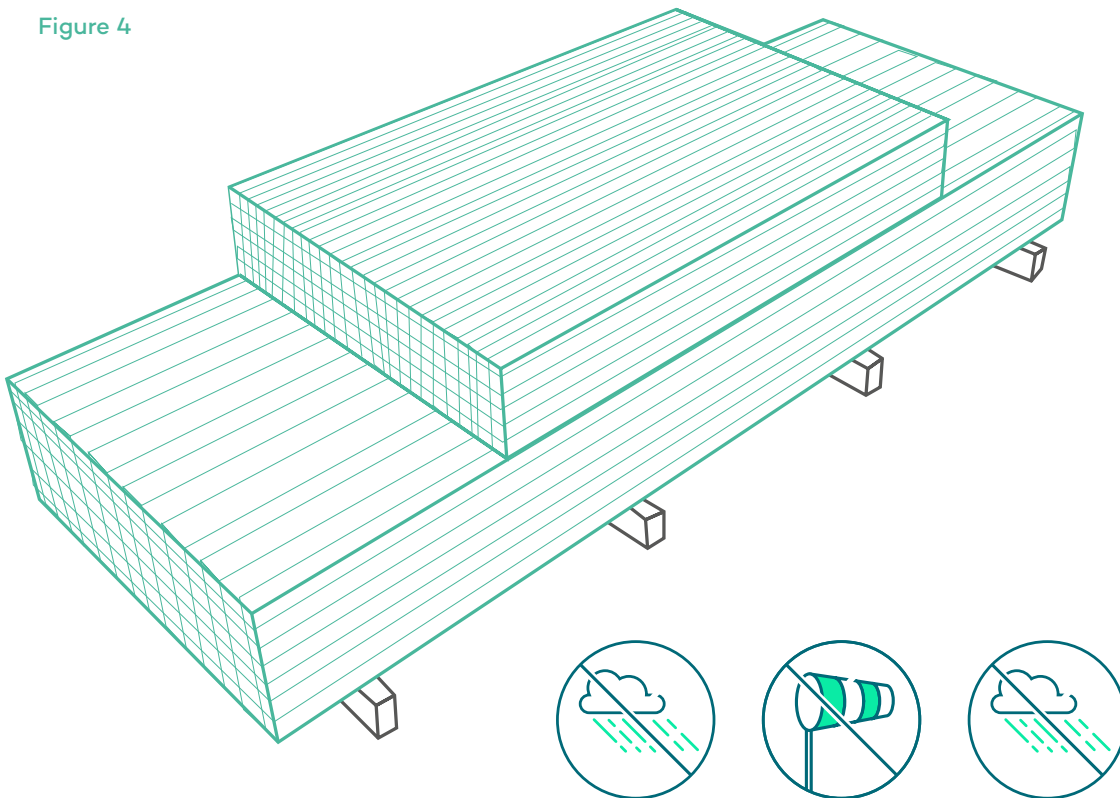
Sawing

LEXAN THERMOCLEAR sheet can be cut easily and accurately with standard workshop equipment. This includes common circular, hand and hacksaws. Saw dust should be blown out of the channels using dry compressed air. Circular saws should have fine-toothed panel blades. When hand or power hacksaws are used, the sheet should be clamped to the worktable to avoid undesirable vibration. To avoid scratching the surface do not remove the protective masking. When finished the edges of the LEXAN THERMOCLEAR sheet should be free of notches and swarf build-up. With the smaller wall section LEXAN THERMOCLEAR sheet (up to 10 mm), it is possible to cut the sheet with a knife. However, it is important that the knife is sharp.

Drilling

Holes can be drilled by a power drill using standard high speed steel twist drills or drills with an angular wedged bit. When drilling, support should be given immediately beneath the drill to avoid vibration. Very clean holes are easily obtained. The use of liquid cooling media is not recommended.

Figure 4



INSTALLATION

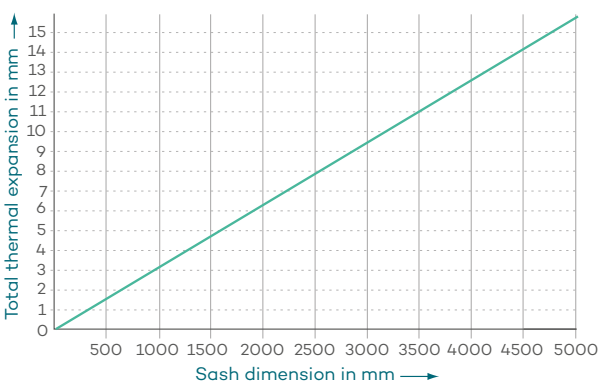
Installation

Glazing with LEXAN THERMOCLEAR sheet should be considered a finishing operation and seen as the final step in the completion of an application.

Thermal Expansion Allowance

Since LEXAN THERMOCLEAR sheet has a greater coefficient of linear thermal expansion than that of traditional glazing materials, care should be taken to allow for free expansion of the sheet to prevent bowing and internal thermal stress.

Graph 8: This shows Thermal Expansion Allowance at various sash dimensions



Allowance for thermal expansion must be made for both the length and the width of the LEXAN THERMOCLEAR sheet. The recommended allowances for various sheet dimensions are outlined in the graph.

The sheet must be trimmed to allow for at least as much as the indicated thermal expansion.

In general:

Thermal expansion of the sheet is approximately 3 mm per linear metre at a delta of 50°C.

Sheet Edge Clamping Conditions

The following recommendations apply to installations involving both flat glazing, i.e. vertical, horizontal or inclined, and curved glazing. It is extremely important when installing LEXAN THERMOCLEAR sheet that the edges are correctly clamped, whether the application involves wet or dry glazing conditions.

A cover plate, or glazing bead, with rubber gaskets or silicone sealant, hold the sheet in place and create a water-tight seal. In both cases there must be sufficient clearance to allow for thermal expansion of the sheet. It is also important that the edge of the sheet is engaged for a minimum of 20 mm into the glazing frame with at least one rib located in the clamping area (See figure 5 and 6).

Figure 5 and 6: Indicates correct installation when clamping the sheet in a profile

Figure 5

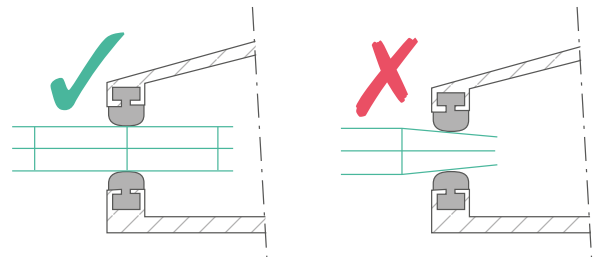
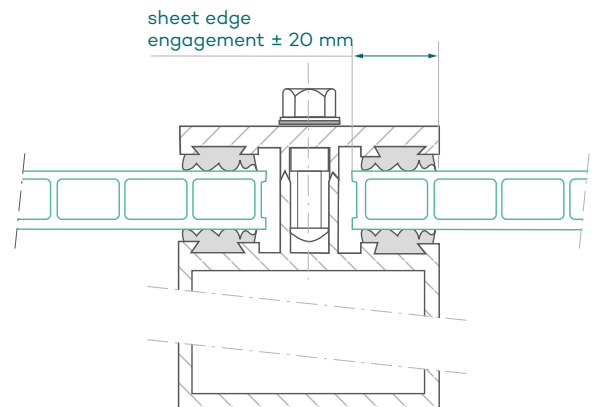


Figure 6



In general the total rebate depth for each profile should include a minimum of 20 mm sheet edge engagement and an allowance for thermal expansion.

Due to the rib geometry of LEXAN THERMOCLEAR sheet, at a thickness of ≥ 16 mm, additional precautions should be taken. In this case it is important that the sheet is cut such that at least one rib is located in the centre of the rebate.

Dry Glazing Systems

This section illustrates some glazing proposals using commercially available profiles which have proven to be successful in combination with LEXAN THERMOCLEAR sheet. Situations may occur where sheet expansion exceeds sealant limitations and, often for aesthetic reasons, this type of 'dry' glazing system provides an excellent solution.

The advantage of dry systems is that the rubber gaskets snap-fit into the glazing strips which then allow free movement of the sheet during expansion and contraction (See figure 7 and 8).

WARNING!
Do not use PVC gaskets.

Due to the migration of additives from soft PVC, the LEXAN THERMOCLEAR sheet can be chemically affected resulting in surface cracks or even sheet breakage.

A wide range of easy to use glazing bars and fixing accessories, designed specifically for glazing LEXAN THERMOCLEAR sheet, is available from most of the approved LEXAN THERMOCLEAR sheet distributors and specialised installers.

Wet Glazing Systems

This type of installation system is mainly used in small domestic type applications, car ports, warehouses, conservatories and other glass replacement situations.

With standard metal profiles or wooden sections, in combination with glazing tapes and glazing compounds, many different configurations are possible (See figure 9 and 10).

When using glazing compounds it is essential that the sealant system accepts a certain amount of movement, to allow for thermal expansion, without loss of adhesion to the frame or sheet. Silicone sealants are generally recommended for use with LEXAN THERMOCLEAR sheet, but it is strongly advised when using sealing compounds to check compatibility before use.

Care should be taken to not to use amine nor benzamide curing silicone sealants, which are not compatible with LEXAN sheet and result in crazing, particularly when stress is involved. See Table 13 for suitable sealant.



INSTALLATION

Figure 7, 8, 9 and 10:
Different installation profile examples

Figure 7

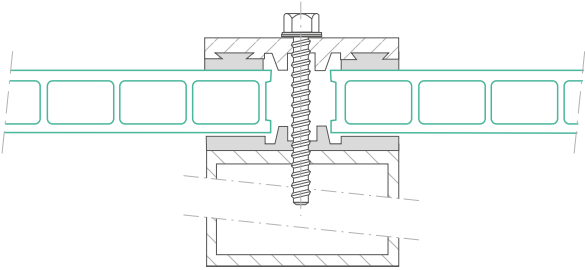


Figure 8

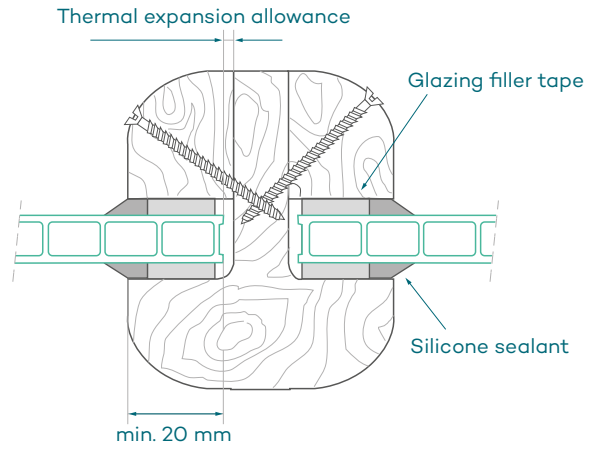


Figure 9

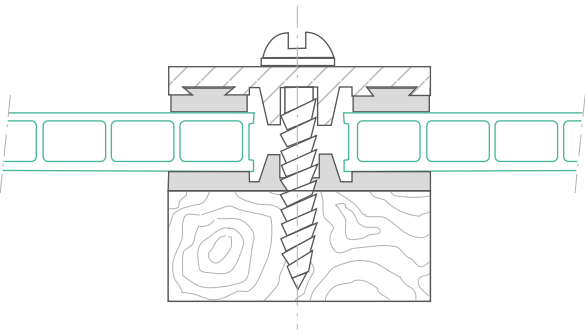
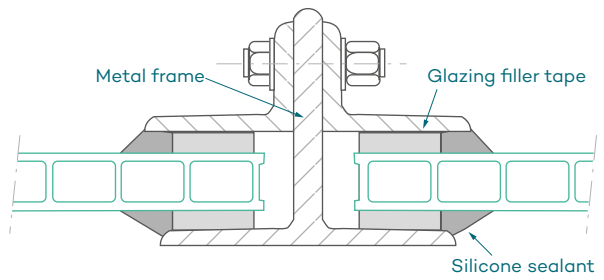


Figure 10



Edge sealing

In all cases LEXAN™ THERMOCLEAR™ sheet should be mounted with the ribs running downwards to assist condensation water drainage. Algae growth, in the form of a green deposit inside the sheet channels, may occasionally be a problem. It is the result of permanent condensation inside the channels due to particular temperature conditions.

Since moisture build-up and dust/insect contamination inside the channels can be a major problem, one of the most important aspects of installation is edge sealing, particularly of the open-ended channels. There are several techniques that can be adopted to significantly reduce contamination, the choice depending largely on the prevailing environmental conditions.

Sealing Tape

It should be noted that the tape delivered on THERMOCLEAR sheet is for protection, during transportation and storage, only and is not an impermeable sealing/ installation tape. This tape should be replaced prior to installation with a tape as described below.

Before taping, approximately 50 mm of the masking should be removed from all sheet edges. The remaining masking should be removed only when installation is completed.

- The tape should have good weathering resistance, without loss of long-term adhesion or mechanical strength.
- The tape should have good resistance to tearing and other damage during installation and handling.
- In close co-operation with the company multifoil, an anti-dust impermeable tape G3600 and an anti-dust venting tape AD3400/AD4500 have been developed. Multifoil will provide within Europe a 10 Year Guarantee on the operation of the tapes.

MULTIFOIL B.V.

Laanakkerweg 12
4131 PA Vianen
The Netherlands
tel. +31 347 366 717
email: info@multifoil.nl

Figure 11

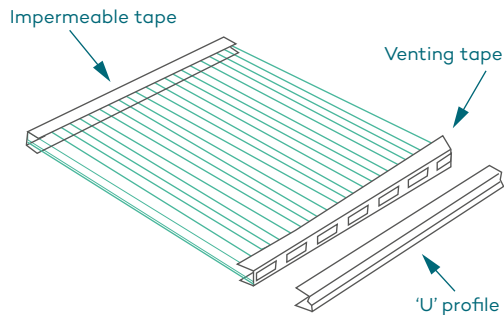


Figure 12

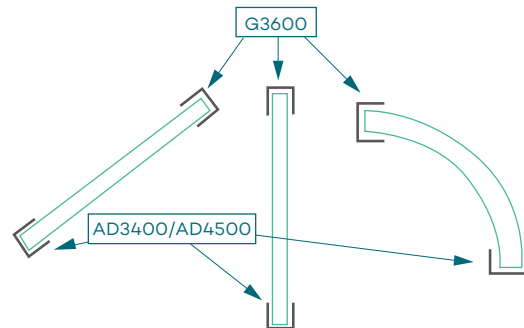


Figure 13

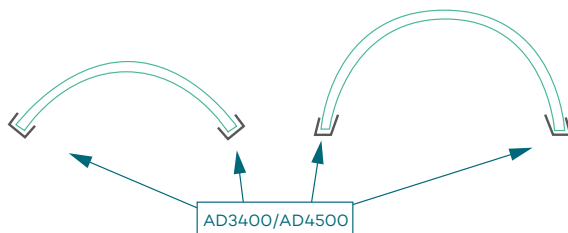
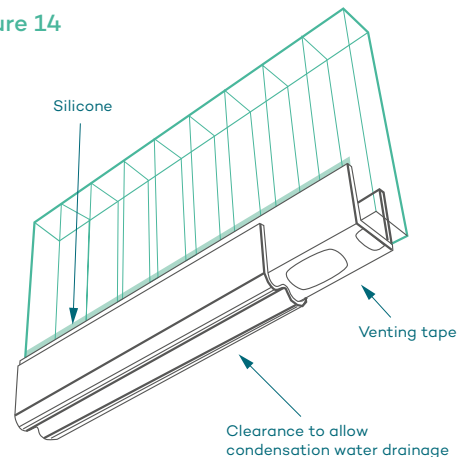


Figure 14



SEALING GUIDELINES

The following Guidelines are recommended to minimise sealing and contamination problems:

- Ensure that all sheet edges are smooth and rounded before applying the tape.
- All channels should be blown free of dust before sealing.
- Ensure tape is completely covered by glazing profiles, flashings, end closures, etc. No tape should be left exposed when installation is complete.
- Replace any damaged tape before final installation.
- Recommended sealing tapes for glazing LEXAN THERMOCLEAR sheet are available from most approved LEXAN THERMOCLEAR distributors and specialised installers.

Standard Glazing Conditions

In standard glazing conditions, the top end channels are sealed with an impermeable tape and the bottom end channels are sealed with a perforated filter tape (See fig. 11 and 12).

An additional 'U' profile can be installed to cover the perforated bottom tape and to facilitate condensation drainage (See fig. 15 and 16).

In semicircular barrel vaults both channel ends should be sealed with perforated filter tape e.g. multifoil AD 3400 (See fig. 13).

Care should be taken to provide a clearance between both the sheet edges and the sash platform to allow for condensation drainage (See fig. 14 and 15). In general the total rebate depth for each profile should include a minimum of 20 mm sheet edge engagement and an allowance for thermal expansion.

Specific Glazing Conditions

In certain environments, it is recommended that both channel ends are sealed with an impermeable tape (See fig. 16).

These environments include:

- Extremely dusty environments (sawmills – welding-stations, etc)
- Low humidity/dry conditons (shopping centres – warehouses, etc)
- Limited temperature difference between the interior and exterior (football stadium – metro/ railway station roofing, etc)

Figure 15

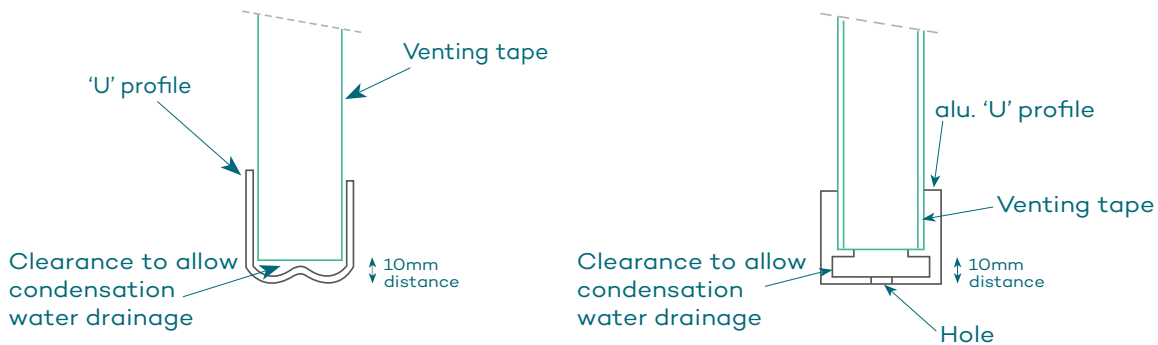
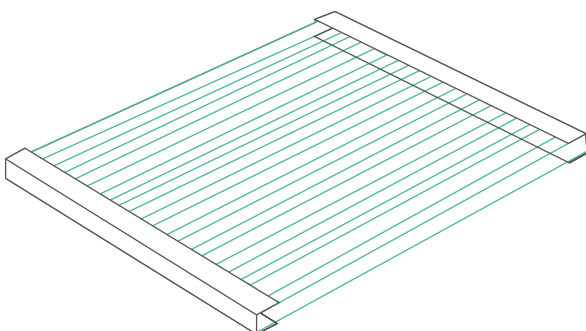


Figure 16: Impermeable tape on both sides



Dynamic Wind Pressure

The wind speed is used to determine the actual loading upon the glazing panels. In mathematical terms, the pressure loading is calculated by multiplying the square of the design wind speed by 0.613.

$$q = KV^2$$

where q = dynamic wind pressure in N/m^2
 $K = 0.613$
 V = design wind speed in metres/second

Table 15: Values of q in SI units (N/m^2)

WIND SPEED (M/S)	WIND (KM/H)	WIND PRESSURE (N/M^2)
10	36	61
15	54	138
20	72	245
25	90	383
30	108	552
35	126	751
40	144	981
45	162	1240
50	180	1530
55	198	1850
60	216	2210
65	234	2590

For glazing projects with an unusual loading condition, please contact your local POLYVANTIS Sales Office

The Beaufort scale transforms wind into static pressure:

WIND	LIGHT	MODERATE	STRONG	STORM
Speed (km/h)	20	40-60	80-100	120-140
Speed (m/sec)	6	11-17	22-28	33-39
Static pressure (N/m^2)	20	80-170	300-480	680-950

Table 16: The wind pressure created through the wind speed on a building surface

HEIGHT OF BUILDING (M)	WIND SPEED (M/S)	WIND PRESSURE (N/M^2)
0 – 8	28,3	500
8 – 20	35,8	800
20 – 100	42	1100
> 100	45,6	1300

Pressure Coefficient

To allow for local fluctuations in the acceleration/ deceleration of the wind by building or glazing geometry, it is necessary to include an appropriate pressure coefficient.

Determining pressure coefficients requires knowledge of:

- Form and type of building
- Height of glazing
- Shape of glazing e.g.
 - Flat vertical
 - Inclined roofing
 - Curved glazing

The wind loading is obtained by multiplying the dynamic wind pressure by the pressure coefficient. The total wind loading can be positive indicating a wind pressure force or negative indicating a wind suction load. Detailed pressure coefficient values can be found in the appropriate national building norms.

Snow Loading

Snow loading on roof glazing can be considered equivalent to a vertically, uniformly distributed load, acting per m^2 of the horizontal projection of the glazing.

A roof made of LEXAN THERMOCLEAR sheet does not permit immediate melting of the snow, due to its excellent thermal insulation, and therefore the load produced by the snow must be carefully taken into consideration.

Snow-indicative weights per centimetre of height

- fresh snowfall 0.8-1.9 kg/m^2 per cmh.
- wet snowfall 2.0-8.0 kg/m^2 per cmh.

Snow loading factors can be obtained from the appropriate local building norm.

Computer Aided Sheet Engineering

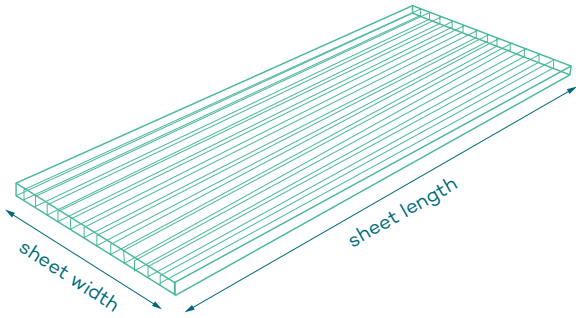
A computer aided design programme has been developed especially for large glazing projects, or projects with an uncommon shape or unusual loading conditions. The programme creates the finite element model of a particular glazing design, applies the specified loads and edge conditions and runs the deflection analysis. Consult your nearest POLYVANTIS Technical Service Centre for further advice.

SUPPORT CONDITIONS

Note

Regardless of the support configuration selected, the sheet should always be installed so that the rib structure channels are sloping downwards. sheet "width" is the dimension perpendicular to the rib structure, "length" the dimension parallel.

Figure 16



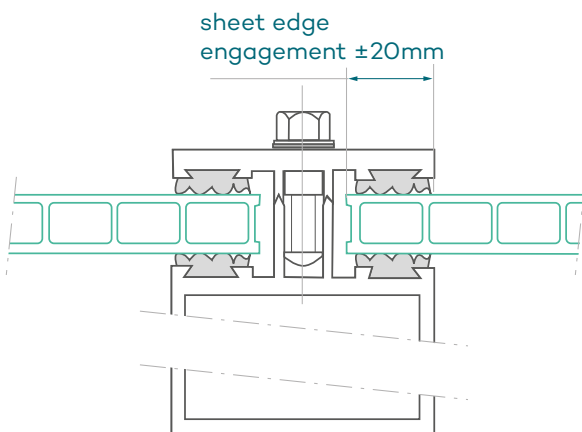
SAFETY FACTOR

Tables 17, 18 and 19 indicate the maximum allowable sheet size at a specified loading which results in an acceptable sheet deflection behaviour without the risk of sheet buckling or pop-out effect calculated with a safety factor of 1.5.

Note:

The values indicated in the tables are applicable for a LEXAN THERMOCLEAR sheet edge engagement in the glazing frame of at least 20 mm.

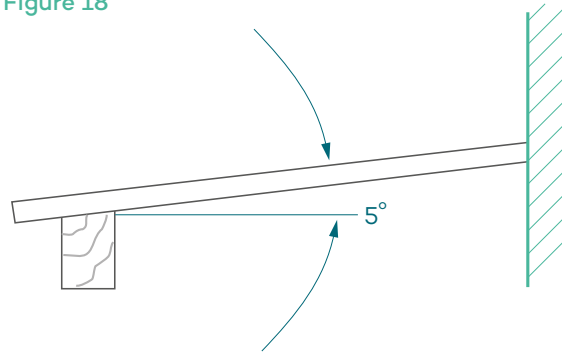
Figure 17



SLOPED ROOFING

For sloped glazing applications a minimum slope of 5° (9 cm/m sheet length) is advised to allow for rainwater drainage.

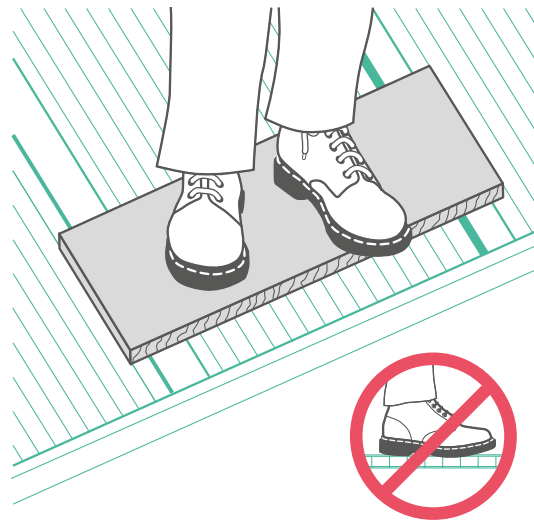
Figure 18



Site Safety

On roof constructions LEXAN™ THERMOCLEAR™ sheet should not be used to support a person's weight during installation or cleaning. A temporary wooden beam or other device, supported by the roof members, should always be used.

Figure 19



FLAT GLAZING SHEET THICKNESS

The deflection characteristics in this particular configuration are dependent upon the ratio of the support bar spacing a:b (See fig. 20).

In practice “a” represents the centre to centre distance of glazing profiles on the short glazing side i.e. the width of sheet.

“b” represents the centre to centre distance of glazing profiles on the long glazing side i.e. length of sheet.

Table 18, indicates the maximum allowable short glazing side of three different ratios of glazing bar spacing.

Ratio sheet width “a”: sheet length “b” 1:1

Ratio sheet width “a”: sheet length “b” 1:<1.5

Ratio sheet width “a”: sheet length “b” 1:>1.5

Figure 20

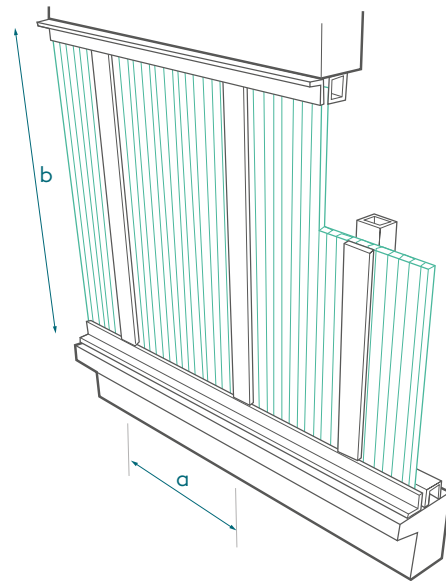


Table 17: Centre to Centre Distance (mm) of glazing profiles (shortest side (a))

	RATIO SHEET WIDTH: SHEET LENGTH											
	1:1	1:<1.5	1:>1.5	1:1	1:<1.5	1:>1.5	1:1	1:<1.5	1:>1.5	1:1	1:<1.5	1:>1.5
Loading in N/m²	600			800			1000			1200		
LT2UV452RS10	850	690	450									
LT2UV62RS13	1050	920	610	950	850	570	900	780	530			
LT2UV82RS15	1250	1100	720	1150	1020	655	1075	940	610	1020	900	570
LT2UV102RS17	1500	1150	815	1375	1070	730	1280	950	670	1215	920	620
LT2UV105R175	1600	1200	850	1500	1100	800	1425	1050	750	1375	980	700
LT2UV163TS27	1700	1420	1100	1600	1310	980	1500	1210	880	1450	1120	810
LT2UV165X26	2100 [#]	1700	1100	2100 [#]	1600	1050	1900	1450	980	1800	1350	950
LT2UV169X	2095 [#]	1390	1080	2000	1280	980	1850	1180	890	1740	1090	820
LT2UV205X32	2100 [#]	1800	1250	2100 [#]	1650	1200	2100 [#]	1550	1150	200	1400	1100
LT2UV209X	2095 [#]	1490	1140	2000	1390	1040	1880	1290	940	1770	1190	890
LT2UV255X34	2100 [#]	1850	1500	2100 [#]	1750	1400	2100 [#]	1650	1300	2100 [#]	1450	1200
LT2UV259X	2095 [#]	1570	1180	2000	1450	1080	1900	1380	980	1800	1280	900
LT2UV325X38	2100 [#]	1900	1600	2100 [#]	1800	1500	2100 [#]	1700	1400	2100 [#]	1600	1350
Loading in N/m²	1400			1600			1800			2000		
LT2UV452RS10												
LT2UV62RS13												
LT2UV82RS15	970	830	535	930	780	510						
LT2UV102RS17	1160	850	585	1110	800	545	1070	760	520			
LT2UV105R175	1300	950	650	1200	900	600	1100	850	550	1000	800	500
LT2UV163TS27	1400	1060	750	1300	1000	700	1250	950	665	1200	900	620
LT2UV165X26	1700	1200	900	1600	1100	850	1500	1000	800	1400	950	750
LT2UV169X	1640	1020	750	1540	950	690	1440	890	660	1340	830	630
LT2UV205X32	1900	1300	1050	1800	1200	1000	1700	1070	980	1500	1020	920
LT2UV209X	1670	1090	840	1570	1040	760	1470	990	710	1370	890	680
LT2UV255X34	2100 [#]	1350	1150	1900	1280	1100	1800	1150	1050	1650	1100	1000
LT2UV259X	1700	1180	850	1600	1100	790	1500	1050	730	1400	980	680
LT2UV325X38	2100 [#]	1500	1300	2100 [#]	1400	1250	2000	1300	1150	1900	1200	1100

[#] centre to centre distance = maximum sheet width

FLAT GLAZING SHEET THICKNESS

Example I

Window size: width 800 mm
 length: 1200 mm
 (Ratio a:b = 1 : 1.5)
 Loading: 1600 N/m²
 Required sheet type: LT2UV102RS17

Example II

Window size: width 1100 mm
 length 3000 mm
 (Ratio a:b = 1 : >1.5)
 Loading: 600 N/m²
 Required sheet type: LT2UV163TS27

Figure 21

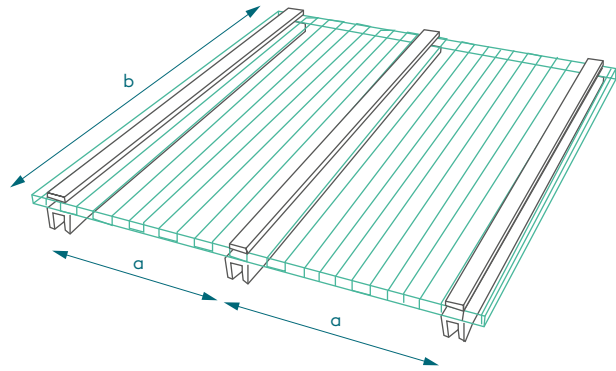


Table 18: Centre to Centre Distance (mm) of glazing profiles “a”; glazing profiles parallel with the rib structure

Loading in N/m ²	CENTRE TO CENTRE DISTANCE (MM)							
	600	800	1000	1200	1400	1600	1800	2000
LT2UV62RS13	570	530						
LT2UV82RS15	655	610	570	535	510			
LT2UV102RS17	730	670	620	585	545	520		
LT2UV105R175	850	800	750	700	650	600	550	
LT2UV163TS27	1100	980	880	810	750	700	665	620
LT2UV165X26	1100	1050	980	950	900	850	800	750
LT2UV169X	1080	980	890	820	750	690	660	630
LT2UV205X32	1600	1400	1250	1150	1050	1000	950	900
LT2UV209X	1140	1040	940	890	840	760	710	680
LT2UV255X34	1700	1500	1350	1250	1175	1100	1050	1000
LT2UV259X	1180	1080	980	900	850	790	730	680
LT2UV325X38	1800	1600	1450	1350	1250	1200	1150	1100

Two sides clamped, glazing bars parallel with rib structure

a = centre to centre distance of glazing profiles
b = sheet length

The major factor determining the sheet deflection behaviour is the distance “a” between the centre points of two adjacent supports. Since any length of sheet can be selected, the measurement “b” does not influence the overall deflection performance.

In this situation, the major factor influencing deflection behaviour is the purlin spacing. The sheet width has no influence on the deflection behaviour of the sheet when exposed to loading. This means that any sheet width up to the maximum standard width can be selected.

In the case of vertical glazing, should a greater span width be required, a standard polycarbonate “H” profile is sufficient to join two sheets together to form a sound, water-tight joint. No additional vertical glazing support bars are necessary. In the case of sloped glazing, a support/glazing profile is recommended to join two sheets together, not only for a watertight joint, but also to avoid excessive sheet deflection already caused by the sheet’s own weight.

Fastening LEXAN THERMOCLEAR sheet to the intermediate purlins using conventional nuts, bolts and washers is possible. However, all joints and clamping areas require support in the form of compatible rubber washers to distribute the clamping force over as wide an area as possible. To facilitate this, large metal washers laminated with compatible rubber and assembled with spacing collars should be used. Bolts should not be tightened so that the force permanently deforms the sheet or restricts its natural expansion and contraction. An alternative method of assembly involves a specially designed polyamide “cladding button” which is available at any authorised LEXAN THERMOCLEAR sheet distributor. The button is designed so that the compatible rubber gasket is an integral part of the bolt which has a large head to distribute the clamping forces.

When using any type of bolt assembly it is important to remember that the spacing between the hole and the sheet edge should be at least 40 mm.

Figure 22

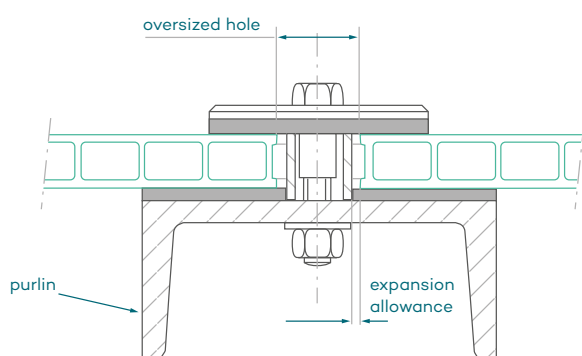
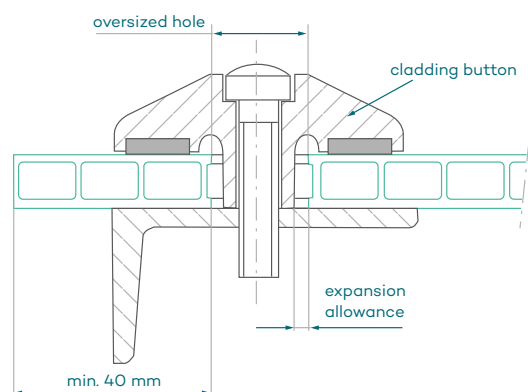


Figure 23



FLAT GLAZING SHEET THICKNESS

Note:
When applying the glazing method described above, the following points must be taken into consideration.

- Penetration of water and dust between the “H” profile and the sheet surface may create streaks. By applying a recommended silicone sealant this penetration can be restricted.
- It is extremely difficult to obtain a watertight connection between the washer or button and the LEXAN THERMOCLEAR sheet surface.
- Water and dust can easily penetrate into the bolted sheet channel which consequently results in algae growth or cobweb formation.

Consider this glazing system as suitable only when appearance is of minor importance.

Figure 24

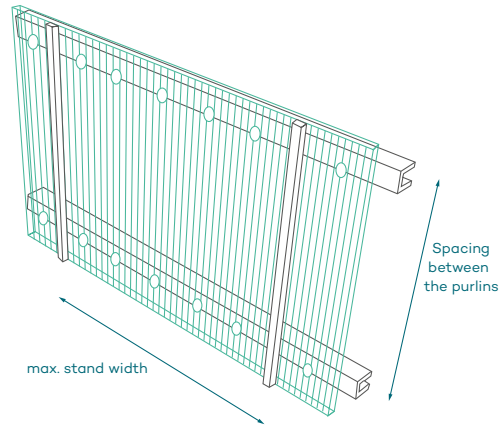


Table 19: Centre to centre distance of purlins in mm; glazing profiles 90° to rib structure

Loading in N/m ²	CENTRE TO CENTRE DISTANCE (MM)							
	600	800	1000	1200	1400	1600	1800	2000
LT2UV452RS10	500							
LT2UV62RS13	690	630	590	570	540	520	500	480
LT2UV82RS15	830	760	720	680	650	630	600	580
LT2UV102RS17	1010	930	875	830	790	760	730	710
LT2UV105R175	1010	930	875	830	790	760	730	730
LT2UV163TS27	1450	1325	1240	1180	1130	1085	1050	1000
LT2UV165X26	1350	1225	1140	1080	1050	985	950	900
LT2UV169X	1450	1325	1240	1180	1130	1085	1050	1000
LT2UV209X	2075	1880	1750	1655	1575	1510	1450	1400
LT2UV259X	2095#	2095#	1960	1850	1760	1675	1620	1550

centre to centre distance = maximum sheet width



Wörthersee Stadium Roofing.
Roof is made of transparent LEXAN™ THERMOCLEAR™16 mm sheet.

CURVED GLAZING SHEET THICKNESS

LEXAN THERMOCLEAR sheet can be successfully cold-curved over curved support glazing profiles, to suit many glazing applications, e.g. domes, roof-lights, etc. Providing the radius is not below the minimum recommended value, then the introduced stress by cold-curving will not have any adverse effect upon the mechanical performance of the sheet. Sheets must always be bent longitudinally, never across the width of the sheet.

The loading characteristics given in Table 21 are based upon curved glazing applications clamped on all four edges. The Table shows linear buckling load values, (calculated with a safety factor of 2.0), against installation radii for different sheet widths. Sheet length 'L' needs to be greater than sheet width 'W' to facilitate curvature; in practice, a ratio of 1:2 or less is never contemplated because of the practicalities of installation geometry.

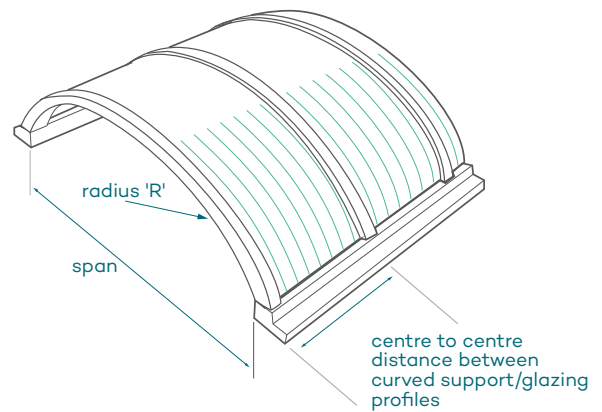
Table 20: Minimum radius values

LEXAN THERMOCLEAR SHEET THICKNESS	MIN. RADIUS (MM)
6	900
8	1200
10	1500
16	2400

Note on cold curved applications:

Although the LEXAN THERMOCLEAR-PLUS 9 Wall sheet can be cold curved in the thicknesses 16 and 20mm at a radius of 150 times the thickness of the sheet, there might appear a optical distortion of the internal layers. This optical distortion will have no negative influence on the mechanical performance of the product provided that the guidelines for cold curved applications in this data sheet are correctly followed.

Figure 25



Swimming Pool Shelter with LEXAN™ THERMOCLEAR™ transparent sheet

CURVED GLAZING SHEET THICKNESS

Table 21: Examples of centre to centre distance (mm) curved glazing profiles

LT2UV62RS13								
Loading in N/m ²	600	800	1000	1200	1400	1600	1800	2000
Radius "R" (mm)	centre to centre distance (mm) curved glazing profiles							
900	2100*	2100	1750	1450	1250	1100	1000	960
1050	2100	1800	1500	1250	1070	960	860	750
1200	1900	1500	1250	1000	900	800	700	600
1300	1700	1400	1100	900	790	700	630	570
1400	1600	1200	960	830	720	630	570	500
1500	1450	1100	900	750	660	570	500	450
1600	1350	1000	820	680	600	500	450	
1700	1250	930	760	650	530	450		
1800	1150	860	700	620	450			
1900	1050	800	640	580				
2000	920	750	600	530				
2100	850	700	550	470				
2200	800	670	500	450				
2300	750	600	450					
2400	700	550	450					
2500	650	550						
2600	650	500						
2700	650							

LT2UV82RS15								
Loading in N/m ²	600	800	1000	1200	1400	1600	1800	2000
Radius "R" (mm)	centre to centre distance (mm) curved glazing profiles							
1200	2100*	2100*	1900	1500	1300	1100	1000	900
1400	2100*	1900	1700	1300	1100	1000	870	780
1500	2000	1700	1350	1160	1000	880	800	720
1600	1950	1650	1270	1060	920	810	720	660
1700	1830	1510	1180	990	860	760	670	600
1800	1710	1370	1090	920	800	710	620	550
1900	1600	1230	1000	840	730	650	580	
2000	1480	1150	920	780	680	600	550	
2100	1380	1070	870	730	640	550		
2200	1320	980	820	700	600			
2300	1220	930	770	660	550			
2400	1150	880	700	600				
2500	1100	830	650	550				
2600	1020	750	600					
2700	950	700						
2800	870							

LT2UV102RS17								
Loading in N/m ²	600	800	1000	1200	1400	1600	1800	2000
Radius "R" (mm)	centre to centre distance (mm) curved glazing profiles							
1500	2100*	2100*	1700	1500	1300	1150	1000	900
1750	2100*	1930	1530	1320	1140	1000	900	800
1900	2100*	1680	1380	1160	1020	880	800	720
2000	2000	1600	1280	1080	930	830	750	680
2100	1900	1470	1200	1010	870	770	700	600
2200	1820	1390	1120	950	820	780	650	560
2300	1700	1300	1060	890	780	690	620	
2400	1600	1230	1000	840	740	630		
2500	1530	1150	950	800	700			
2600	1450	1070	900	750	660			
2700	1380	980	860	700				
2800	1280	930	820					
2900	1220	900	790					
3000	1160	880	750					
3200	1080	830						
3400	1000							

* centre to centre distance = maximum sheet width

CURVED GLAZING SHEET THICKNESS

Table 21: Centre to centre distance (mm) curved glazing profiles (continued)

LT2UV105R175								
Loading in N/m ²	600	800	1000	1200	1400	1600	1800	2000
Radius "R" (mm)	centre to centre distance (mm) curved glazing profiles							
1750	2100*	1930	1530	1320	1140	1000	900	800
1900	2100*	1680	1380	1160	1020	880	800	720
2000	2000	1600	1280	1080	930	830	750	680
2100	1900	1470	1200	1010	870	770	700	600
2200	1820	1390	1120	950	820	780	650	560
2300	1700	1300	1060	890	780	690	620	
2400	1600	1230	1000	840	740	630		
2500	1530	1150	950	800	700			
2600	1450	1070	900	750	660			
2700	1380	980	860	700				
2800	1280	930	820					
2900	1220	900	790					
3000	1160	880	750					
3200	1080	830						
3400	1000							

LT2UV163TS27								
Loading in N/m ²	600	800	1000	1200	1400	1600	1800	2000
Radius "R" (mm)	centre to centre distance (mm) curved glazing profiles							
2800	2100*	1920	1580	1330	1150	1020	920	830
3000	2100*	1780	1450	1210	1060	940	840	760
3200	2050	1620	1320	1110	970	860	760	690
3400	1920	1480	1210	1030	890	780	700	620
3600	1780	1400	1120	950	830	700	665	
3800	1670	1300	1040	890	750			
4000	1560	1200	960	810				
4200	1460	1120	880					
4400	1360	1040						
4600	1300	980						
4800	1200							
5000	1100							

LT2UV165X26								
Loading in N/m ²	600	800	1000	1200	1400	1600	1800	2000
Radius "R" (mm)	centre to centre distance (mm) curved glazing profiles							
2400	2100*	2100*	2100*	2100*	2100*	1800	1500	1200
2800	2100*	2100*	2100*	2100*	1800	1500	1250	1150
3200	2100*	2100*	2100*	1850	1550	1400	1250	1100
3400	2040	2000	1900	1650	1450	1300	1200	1050
3600	1980	1900	1850	1550	1350	1200	1100	950
3800	1920	1800	1700	1450	1250	1120	1000	
4000	1850	1700	1600	1350	1200	1050	950	
4200	1790	1600	1500	1275	1150	1000		
4400	1740	1500	1400	1200	1100	950		
4600	1700	1400	1300	1140	1050			
4800	1650	1300	1200	1100	1000			
5000	1600	1200	1150	1050	950			
5200	1550	1100	100	950				
5400	1400	1050	950					
5600	1300	1000						
5800	1200	950						

* centre to centre distance = maximum sheet width

CURVED GLAZING SHEET THICKNESS

Table 21: Centre to centre distance (mm) curved glazing profiles (continued)

LT2UV169X(25)								
Loading in N/m ²	600	800	1000	1200	1400	1600	1800	2000
Radius "R" (mm)	centre to centre distance (mm) curved glazing profiles							
2800	2095*	1920	1580	1330	1150	1020	920	830
3000	2095*	1780	1450	1210	1060	940	840	760
3200	2050	1620	1320	1110	970	860	760	690
3400	1920	1480	1210	1030	890	780	700	620
3600	1780	1400	1120	950	830	700	665	
3800	1670	1300	1040	890	750			
4000	1560	1200	960	810				
4200	1460	1120	880					
4400	1360	1040						
4600	1300	980						
4800	1200							
5000	1100							

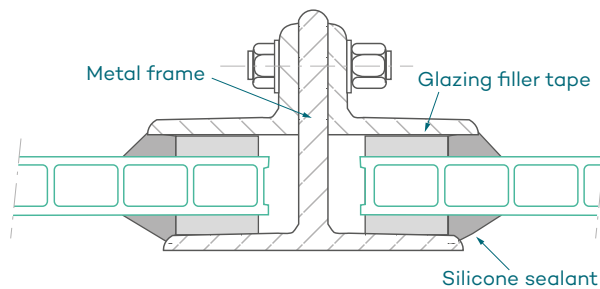
LT2UV205X32								
Loading in N/m ²	600	800	1000	1200	1400	1600	1800	2000
Radius "R" (mm)	centre to centre distance (mm) curved glazing profiles							
3700	1200	1200	1200	1200	1200	1200	1200	1200
3900	1200	1200	1200	1200	1200	1200	1200	1200
4100	1200	1200	1200	1200	1200	1200	1200	1150
4300	1200	1200	1200	1200	1200	1200	1150	1100
4500	1200	1200	1200	1200	1200	1150	1100	1050
4700	1200	1200	1200	1200	1150	1100	1050	1000
4900	1200	1200	1200	1150	1100	1050	1000	950
5100	1200	1200	1150	1100	1050	1000	950	
6300	1200	1150	1100	1050	1000	950		
5500	1150	1100	1050	1000	950			
5700	1100	1050	1000	950				
5900	1050	1000	950					
6100	1000	950						
6300	950							

LT2UV209X28								
Loading in N/m ²	600	800	1000	1200	1400	1600	1800	2000
Radius "R" (mm)	centre to centre distance (mm) curved glazing profiles							
2800	2095*	2095*	2070	1742	1507	1336	1205	1087
3000	2095*	2095*	1900	1585	1389	1231	1100	996
3200	2095*	2095*	1729	1454	1271	1127	996	904
3400	2095*	1939	1585	1349	1166	1022	917	812
3600	2095*	1834	1467	1245	1087	917	871	
3800	2095*	1703	1362	1166	983			
4000	2044	1572	1258	1061				
4200	1913	1467	1153					
4400	1782	1362						
4600	1703	1284						
4800	1572							
5000	1441							

* centre to centre distance = maximum sheet width

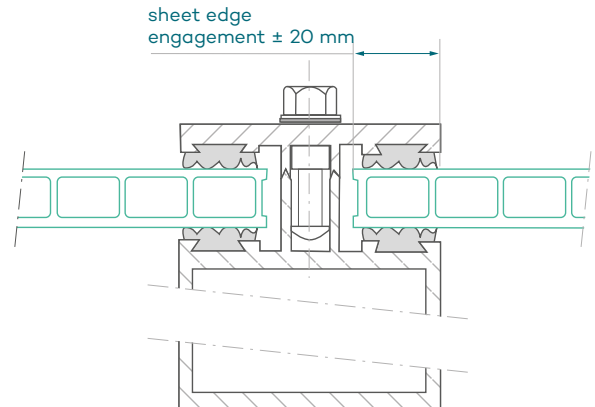
WET GLAZING

Figure 26



DRY GLAZING

Figure 27



DO'S

- Clean the window frame. Remove old putty or broken glass, if necessary.
 - Measure the sheet edge engagement area (± 20 mm) and internal window frame dimensions, i.e. the space into which the LEXAN THERMOCLEAR sheet will be fitted.
 - Calculate the sheet size, allowing clearance for thermal expansion (3 mm per linear metre).
 - Select the right thickness to fulfil loading requirements, U-value, etc.
 - Clamp the LEXAN THERMOCLEAR sheet to a support table to avoid vibration and rough cutting.
 - Cut the sheet to the required size, using a standard electric circular or jig saw.
 - Blow away saw dust build-up in the channels with dry compressed air.
 - Remove any sharp edges and irregularities from the sheet.
 - Peel back approximately 50 mm of the masking film from all edges of the cut sheet on both sides.
 - Carefully select the sealing tape appropriate to the glazing application.
 - Seal the top and the bottom sheet channels with impermeable and/or venting tape, f.i. multifoil G3600 / AD 3400 / AD4500.
- Please refer to the processing instructions provided by the sealing tape supplier.

- In case of venting tape, and to allow condensation drainage, apply an alu closure profile with drainage possibilities or apply some single sided self adhesive glazing tape as distance holder between the venting holes.
- For wet glazing apply single sided self adhesive glazing tape or rubber profile to both window frame and bead.
- For dry glazing, snap-fit compatible neoprene rubber gaskets in place in the support profile as well as in the clamping cover profile.
- Insert the LEXAN THERMOCLEAR sheet into the window frame.
- LEXAN THERMOCLEAR sheet must always be installed with the ribs running vertically. The UV protected surface should always face outwards.
- Fix the window bead or the clamping cover profile in place.
- For wet glazing apply an approved silicone sealing compound, such as Silglaze/Silpruf between the sheet and the window frame/bead.
- Remove all masking film immediately after installation.
- Clean the window carefully with warm soapy water and with a soft cellulose sponge or woollen cloth.

DONT'S

- Do not use plasticised soft PVC or incompatible rubber sealing tapes or gaskets.
- Do not use Amine, Benzamide or Methoxy based sealants.
- Do not use abrasive or highly alkaline cleaners.
- Never scrape LEXAN THERMOCLEAR sheet with squeegees, razor blades or other sharp instruments.
- Do not walk on LEXAN THERMOCLEAR sheet at any time.
- Do not install LEXAN THERMOCLEAR sheet with damaged tapes.
- Do not clean LEXAN THERMOCLEAR sheet in hot sun or at elevated temperatures.
- Benzene, gasoline, acetone, carbon tetrachloride or butyl cellosolve should never be used on LEXAN THERMOCLEAR sheet.



This LEXAN multiwall Technical Manual only refers to our standard portfolio.
For unlisted requests or questions please contact your local agent at Polyvantis.

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