

Specialty Film & Sheet



Lexan*Thermoclear* multi-wall

Polycarbonate sheets and systems technical manual

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Lexan® polycarbonate resin

Lexan polycarbonate is a unique engineering thermoplastic which combines a high level of mechanical, optical and thermal properties. The versatility of this material makes it suitable for many engineering applications. When extruded in sheet form, its optical and impact properties in particular render this material an ideal candidate for a wide range of glazing applications. SABIC Innovative Plastics has developed a whole range of products to suit the most demanding of these application needs.

Lexan Thermoclear® sheet LTC

Lexan Thermoclear is an impact resistant, energy-saving, multi-wall polycarbonate glazing sheet. It features a proprietary surface treatment which provides almost total resistance against degradation caused by UV radiation in sunlight. The entire Lexan Thermoclear sheet range carries a ten year limited warranty against discoloration, loss of light transmission and/or loss of strength due to weathering.

Typical applications include

- Industrial roofs and sidewalls
- Commercial greenhouses
- Sunroom, swimming pool and conservatory roofing
- Shopping center roofing
- Railway/metro station
- Football stadium roofing

Lexan Thermoclear Dripgard® sheet LTD

Lexan Thermoclear Dripgard sheet, in addition to the extraordinary properties of standard Lexan Thermoclear, also 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. There is no reduction in light transmission due to condensation water droplets. It is the ideal roof glazing material in any application where water drops are unacceptable. For instance - greenhouses/verandas/sunrooms/swimming pool enclosures/industrial roof glazing.

See limited warranty for details.

Lexan Thermoclear venetian LTC-VEN

Lexan Thermoclear venetian grades are members of the Lexan Thermoclear sheet range of high quality, multiwall polycarbonate glazing sheets extruded from Lexan resin. LTC venetian is LTC which has been screen printed with white stripes on the non UV coated side. The white striped side should always be installed facing inwards, the other side, clearly identified as protected against UV, being installed facing outwards. Although the screenprinted white stripes are mainly intended for additional decorative purposes, the belonging shadow effect results in an improved comfort level inside the building.

Lexan Thermoclear plus LT2UV

Lexan Thermoclear plus sheet features a proprietary both sides surface treatment designed to protect the sheet against the degrading effects of ultra-violet radiation in natural sunlight. Both sides UV protected surfaces offers advantage in economical cutting the sheet in desired shapes and installation mistakes are minimized since both sheet surfaces may be faced outwards.

Lexan Thermoclear solar control

Lexan Thermoclear solar control sheet features in addition to the extraordinary properties of standard Lexan Thermoclear, a unique and specially developed solar control coating at the non-UV protected side of the sheet which reduces the heat build-up beneath the sheet. Despite the reduction of the heat build-up a high light transmission will remain. The excellent properties result in an agreeable comfort level inside the building.

Lexan Thermoclick®

Lexan Thermoclick sheet system is an impact and weather resistant energy-saving multi-wall sheet system with a profiled tongue and groove connection, joint cover on the outside and groove for double-sided tie on the inside. These excellent properties result in a click system which has a high stiffness and is therefore easy and fast to install.

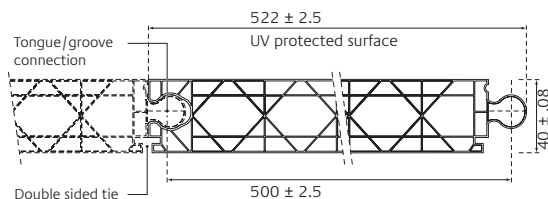
Lexan Thermopanel®

Lexan Thermopanel sheet system features in addition to the extraordinary properties of standard Lexan Thermoclear extremely high stiffness and a specially developed structure with calibrated side-wings. Its optical and impact properties in particular render this panel highly suitable as roof glazing for industrial buildings made of metal corrugated sheet. These excellent properties result in a Thermopanel system which can be matched with virtually any corrugated metal panel.

Extension of Lexan® multi-wall sheet products

Lexan Thermoclick® sheet

Lexan Thermoclick sheet system is an impact resistant, energy-saving multi-wall sheet with profiled tongue and groove connection, joint cover on the outside and groove for double-sided tie on the inside.



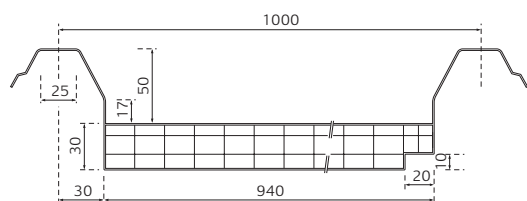
LTC40/4X4000

Lexan Thermopanel® sheet

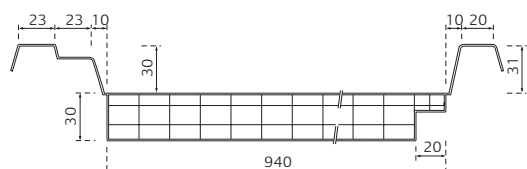
Lexan Thermopanel sheet is an impact resistant, energy-saving multi-wall transparent sheet with calibrated multi-form side-wings matching any insulating corrugated metal panel. Its optical and impact properties in particular render this panel a strong candidate as roof glazing for insulated corrugated metal industrial buildings.

Lexan Thermopanel sheet

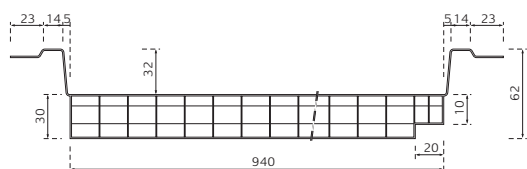
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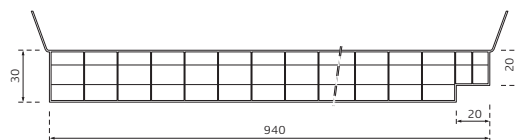
LTP30A/4RS4000



LTP30B/4RS4000

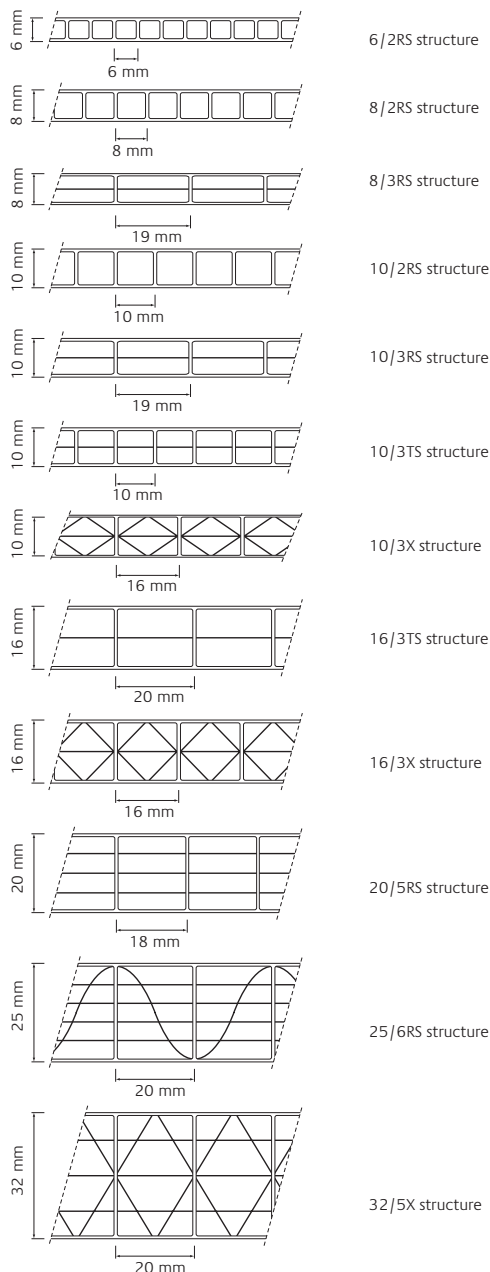


LTP30C/4RS4000



LTP30D/4RS3600

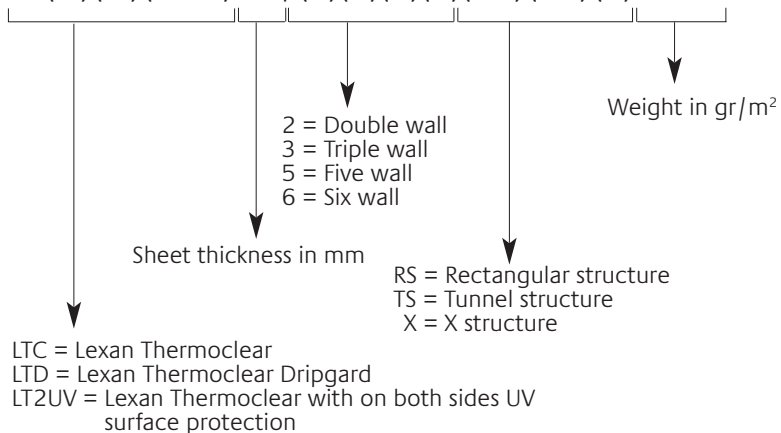
Lexan multi-wall sheet structures



Description

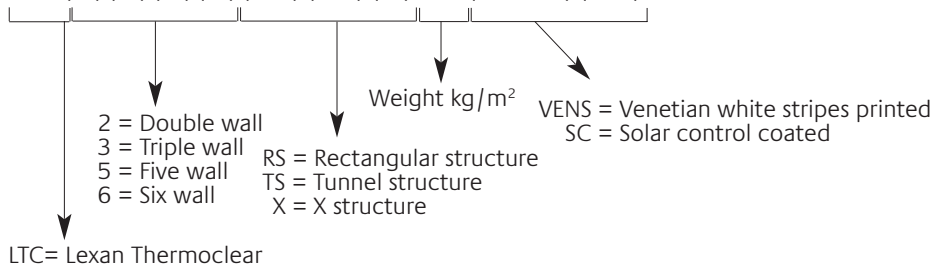
Lexan® Thermoclear®/Dripgard®/Plus

LT(C)(D)(2UV)10/(2)(3)(5)(6)(RS)(TS)(X)1000



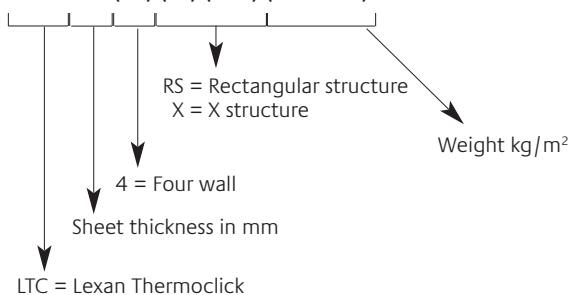
Lexan Thermoclear venetian/solar control

LTC(2)(3)(5)(6)(RS)(TS)(X)1.7(VENS)(SC)



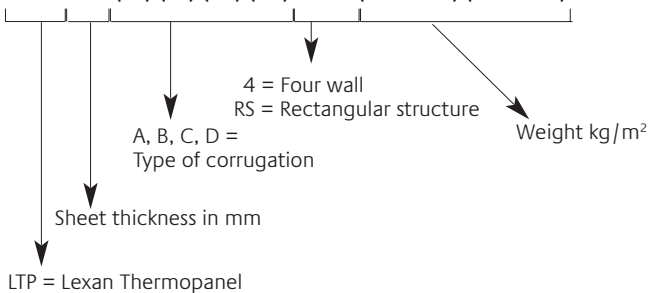
Lexan Thermoclick®

LTC40(4)(X)(RS)(4000)



Lexan Thermopanel®

LTP30(A)(B)(C)(D)4RS(4000)(3600)



Lexan® Thermoclear® sheet availability

Table 1
Standard Lexan Thermoclear sheet products

Product code	Standard sheet width in mm						
Lexan Thermoclear	500	945	980	1050	1200	1250	2100
LTC4/2RS800							X
LTC4.5/2RS1000						X	
LTC 6/2RS1300						X	X
LTC8/2RS1500						X	X
LTC10/2RS1700						X	X
LTC10/3TS2000						X	X
LTC16/3TS2700			X	X		X	X
LTC16/3TS2800			X	X		X	X
LTC20/5RS3300			X			X	X
LTC25/6RS3500			X			X	X
Standard sheet lengths - 6000-7000 mm							
Lexan Thermoclear							
Dripgard® Sheet							
LTD6/2RS1300							X
LTD8/2RS1500							X
LTD10/2RS1700							X
LTD16/3TS2800						X	X
Standard sheet lengths - 6000-7000 mm							
Lexan Thermoclear plus							
LT2UV6/2RS1.3						X	X
LT2UV8/2RS1.5						X	X
LT2UV8/3RS1.7							X
LT2UV10/2RS1.7						X	X
LT2UV10/3RS1.9							X
LT2UV10/3TS2.0						X	X
LT2UV10/3X2.0			X		X		
LT2UV16/3TS2.7			X	X		X	X
LT2UV16/3TS2.8			X	X		X	X
LT2UV16/3X2.9			X		X		
LT2UV20/5RS3.3			X			X	X
LT2UV25/6RS3.5			X			X	X
LT2UV32/5X3.8						X	
Standard sheet lengths - 6000-7000 mm							
Lexan Thermoclear venetian							
LTC10/2RS1.7 VEN S						X	
LTC16/3TS2.7 VEN S			X			X	
LTC16/3TS2.8 VEN S			X		X	X	
LTC20/5RS3.3 VEN S						X	
LTC32/5X3.8 VEN S						X	
Standard sheet length - max. 6000 mm							
Lexan Thermoclear solar control							
LTC10/2RS1.7SC						X	
LTC16/3TS2.8SC			X			X	
LTC16/3X2.9SC			X				
LTC20/5RS3.3SC			X			X	
LTC25/6RS3.5SC			X			X	
LTC32/5X3.8SC						X	
Standard sheet length - max. 6000 mm							
Lexan Thermoclick®							
LTC 40/4X/4000	X						
LTC40/4RS/3600	X						
Standard sheet length - 6000 and 7000 mm							
Lexan Thermopanel®							
LTP30(A,B,C)/4RS4.0		X					
LTP30 D 4RS3600		X					
Standard sheet length - 6000 and 7000 mm							

Property profile

Lexan® multi-wall sheet products

Typical property values for -
Lexan Thermoclear® sheet (LTC)
Lexan Thermoclear Dripgard® (LTD)
Lexan Thermoclear plus (LT2UV)

Table 2

Sheet thickness mm	6	8	10	10	10	10	16	16	16	20	25	32
Structure	2RS	2RS	2RS	3TS	3X	5RS	3TS	3X	6RS	5RS	6RS	5X
Approx weight gsm	1300	1500	1700	2000	2000	1750	2700	2900	2900	3300	3500	3800
Clear 112												
Light transmission %	82	81	81	74	71	65	74	67	61	64	58	55
Total solar transmission %	82	82	80	77	71	65	78	71	64	71	66	65
Shading coefficient	0.94	0.94	0.92	0.89	0.82	0.75	0.90	0.82	0.74	0.82	0.76	0.75
Solar heat gain coefficient	0.82	0.82	0.8	0.77	0.71	0.65	0.78	0.71	0.64	0.71	0.66	0.65
Direct solar transmission %	76	77	76	70	67	61	70	63	57	60	54	54
Light to solar gain ratio	1.00	0.99	1.01	0.96	1.00	1.00	0.95	0.94	0.95	0.90	0.88	0.85
Grey 715081												
Light transmission %	20		20				20	37				
Total solar transmission %	50		50				50	52				
Shading coefficient	0.58		0.58				0.58	0.6				
Solar heat gain coefficient	0.5		0.5				0.5	0.52				
Direct solar transmission %												
Light to solar gain ratio	0.4		0.4				0.4	0.71				
Opal WH7A092X												
Light transmission %	66	64	64	61	62	60	63	60	52	55	49	48
Total solar transmission %	69	68	68	66	67	59	69	64	60	60	63	48
Shading coefficient	0.79	0.78	0.78	0.76	0.77	0.68	0.79	0.74	0.69	0.69	0.72	0.55
Solar heat gain coefficient	0.69	0.68	0.68	0.66	0.67	0.59	0.69	0.64	0.6	0.6	0.63	0.48
Direct solar transmission %	63	62	62	59	59	58	60	57	49	53	47	46
Light to solar gain ratio	0.96	0.94	0.94	0.92	0.93	1.02	0.91	0.94	0.87	0.92	0.78	1.00
Bronze 515055												
Light transmission %	37	38	35			60	63		29	26	23	
Total solar transmission %	58	59	55			59	69		53	50	49	
Shading coefficient	0.67	0.68	0.63			0.68	0.79		0.61	0.57	0.56	
Solar heat gain coefficient	0.58	0.59	0.55			0.59	0.69		0.53	0.5	0.49	
Direct solar transmission %	43	43	44			58	60		33			
Light to solar gain ratio	0.64	0.64	0.64			1.02	0.91		0.55	0.52	0.47	
Metallic grey GY6A744M												
Light transmission %	16	17	16		16		16	16	20			
Total solar transmission %	34	31	29		30		22	28	32			
Shading coefficient	0.39	0.36	0.33		0.34		0.26	0.33	36			
Solar heat gain coefficient	0.34	0.31	0.29		0.3		0.22	0.28	0.32			
Direct solar transmission %	15	17	15		15		15	15	15			
Light to solar gain ratio	0.47	0.55	0.55		0.53		0.73	0.57	0.63			
IR grey GY5B422T												
Light transmission %	24		22					22			27	12
Total solar transmission %	46		42					30			40	30
Shading coefficient	0.53		0.48					0.34			0.46	0.34
Solar heat gain coefficient	0.46		0.42					0.3			0.40	0.3
Direct solar transmission %	26		22					18			16	11
Light to solar gain ratio	0.52		0.48					0.73			0.68	0.34
IR green GN8B038T												
Light transmission %	66	17	65				55	46		46	41	36
Total solar transmission %	60	31	60				52	45		46	44	42
Shading coefficient	0.69	0.36	0.69				0.6	0.52		0.53	0.5	0.49
Solar heat gain coefficient	0.6	0.31	0.6				0.52	0.45		0.46	0.44	0.42
Direct solar transmission %	47	17	45				36	29		29	26	23
Light to solar gain ratio	1.1	0.55	1.08				1.06	1.02		1	0.93	0.86
IR blue BL8B089T												
Light transmission %			52				40				20	20
Total solar transmission %			60				49				36	35
Shading coefficient			0.69				0.56				0.42	0.4
Solar heat gain coefficient			0.6								0.36	0.35
Direct solar transmission %			44				32				17	16
Light to solar gain ratio			1.08				0.82				0.56	0.57
K-value	3.5	3.3	3	2.7	2.5	2.3	2.4	2.3	1.9	1.8	1.5	1.4
Sound insulation db	18	18	19	19	19	19	21	21	21	22	23	23

Table 3**Typical properties for Lexan® Thermoclear® venetian (LTC VEN)**

Sheet thickness mm	10	16	20	32
Structure	2RS	3TS	5RS	5X
Approx. weight g/m ²	1700	2700/ 2800	3300	3800
Clear code 112				
Light transmission** %	38	33	30	26
Solar transmission %	51	47	39	32
Shading coefficient	0.58	0.54	0.45	0.37
K-value W/m ² •K	3,0	2,4	1,8	1,4
Sound insulation dB	19	21	22	23
Hail impact test	>21	>21	>21	>21
Bullet 20 mm				
Velocity m/sec				

* Typical values only

** Light transmission value may vary by plus or minus 3%

Table 3a**Typical properties for Lexan Thermoclear solar control (LTC SC)**

Sheet thickness mm	10	16	16	20	25	32
Structure	2RS	3TS	3X	5RS	6RS	5X
Approx. weight g/m ²	1700	2800	2900	3300	3500	3800
Clear code 112 + SC						
Light transmission** %	58	53	38	46	30	35
Solar transmission %	49	46	32	39	25	35
Shading coefficient	0.56	0.52	0.37	0.45	0.29	0.37
K-value W/m ² •K	3,0	2,4	2,0	1,8	1,5	1,4
Sound insulation dB	19	21	21	22	23	23
Hail impact test	>21	>21	>21	>21	>21	>21
Bullet 20 mm						
Velocity m/sec						

* Typical values only

** Light transmission value may vary by plus or minus 3%

Property profile

Lexan® multi-wall systems

Typical property values for
Lexan Thermoclick®
Lexan Thermopanel®

Table 3b

	Thermoclick	Thermopanel			
Sheet thickness mm	40	30	30	30	30
Structure	4X	A/4RS	B/4RS	C/4RS	D/4RS
Approx. weight g/m ²	4000	4000	4000	4000	3600
Clear code 112					
Light transmission** %	40	67	67	67	67
Solar transmission %	56	76	76	76	76
Shading coefficient	0.63	0.87	0.87	0.87	0.87
K-value W/m ² •K	1,5	1,9	1,9	1,9	1,9
Sound insulation dB	21	22	22	<22	22
Hail impact test	>21	>21	>21	>21	>21
Bullet 20 mm					
Velocity m/sec					

* Typical values only

** Light transmission value may vary by plus or minus 3%

Table 4

Typical properties for Lexan Polycarbonate

Property	Test method	Unit	Value+
Oxygen index	ASTM D2863	%	25
VICAT VST/B/120	DIN 53460	°C	145
DTUL, 1 82 MPa	DIN 53461	°C	135
Thermal conductivity	DIN 52612	W/m°C	0,21
Coefficient of linear thermal expansion	VDE 03041 1	m/m°C	7x10 ⁻⁵
Refractive index	DIN 53491	-	1,586
Specific gravity	DIN 53479	g/cm ³	1.20
Water absorption	ASTM D570		
24 hours		%	0.10
Equilibrium		%	0.35
Tensile strength yield	DIN 53455	N/mm ²	60
Tensile modulus	DIN 53457	N/mm ²	2300

Value measured on injection-moulded laboratory sample.

Mechanical properties

Impact strength

Lexan® Thermoclear® sheet has outstanding impact performance over a wide temperature range, -40°C to +120°C, and also after prolonged outdoor exposure.

Hail simulation

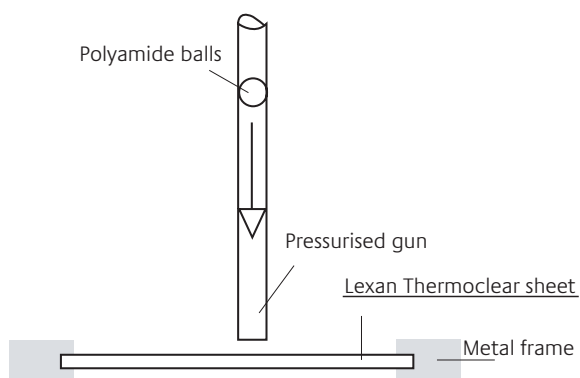
As a roof glazing material Lexan Thermoclear sheet is subject to extremes of weather; storms, hail-stones, wind, snowfalls and ice formation. Under these conditions, the product is virtually unbreakable and is able to withstand the subsequent temperature change to sunny conditions without breaking or buckling.

In a test developed by the Dutch Testing Institute TNO, samples of Lexan Thermoclear sheet have been subjected to simulated hail-stones of varying diameters without significant damage. A test sample is clamped into a metal frame 3.2 m x 4.0 m and polyamide balls of varying diameters are fired at the surface of the sample using a pressurized airgun.

Hail simulation test results

Material	Ball diameter
	20 mm
Acrylic multi-wall 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
Equilibrium velocity of hail stones in practice	21 m/s

Figure 1



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

It should be noted that when the glass and the acrylic are tested their failure characteristics are typically brittle, while the Lexan Thermoclear shows ductile behavior - upon impact the ball will leave indentations but the sheet will not break. SABIC Innovative Plastics offers a ten year limited warranty* on Lexan Thermoclear sheet covering loss of strength or impact due to weathering.

* see warranty statement on page 14.

Physical properties

Light transmission

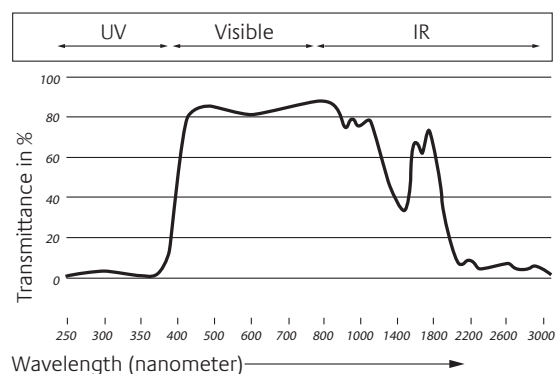
The sunlight which reaches the surface of the earth has a wavelength that ranges between 295 - 2140 nanometers (10-9 meters). This optical window is divided into the following sections.

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 figure 2 below, Lexan® Thermoclear® 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 infrared region. This useful shielding property can prevent discoloration 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 center.

Figure 2
Light transmission spectrum of Lexan Thermoclear



Total light transmission* in % venetian (LTC-VEN)

Materials	LTC10 VEN 2RS	LTC16 VEN 3TS	LTC20 VEN 5RS	LTC32 VEN 5X
Clear 112 + Venetian white stripes	38	33	30	26

Total light transmission* in % solar control (LTC-SC)

Materials	TC10 2RS 1.7SC	LTC16 3TS 2.8SC	LTC16 3X 2.9SC	LTC20 5RS 3.3SC	LTC25 6RS 3.5SC	LTC32 5X 3.8SC
Clear 112 + Venetian white stripes	58	53	38	46	30	35

Total light transmission** in % Thermoclick*

Materials	LTC40 4RS 3600	LTC40 4X 4000
Clear 112	62	40

Total light transmission* in % Thermopanel*

Materials	LTC30 A/B/C/D 4RS 4000/3600
Clear 112	67

* Light transmission value may vary by plus or minus 3%

** Light transmission value may vary by plus or minus 5%

Table 5
Total light transmission in % (LTC, LTD, LT2UV)

Materials	LTC4 2RS	LTC4.5 2RS	LTC6 2RS	LTC8 2RS	LTC8 3RS	LTC10 2RS	LTC10 3RS	LTC10 3TS	LTC16 3TS	LTC10 3X	LTC16 3X	LTC20 5RS	LTC25 6RS	LTC25 6RS
Clear 112	83	83	82	82	76	80	74	73	76	60	55	64	44	38
Opal white WH7A092X	-	-	58	54	49	48	49	48	48	37	37	37	24	20
Bronze 515055	-	-	35	35	-	35	36	35	35	-	-	26	23	-
Dark grey 715081	-	-	20	-	-	20	-	20	-	-	-	-	-	-
Blue 21271	-	-	53	48	-	48	-	37	-	-	-	-	-	-
Dark blue 215102	-	-	27	27	-	27	-	27	-	-	-	-	-	-
Green 31923	-	-	42	42	-	42	-	42	-	-	-	-	-	-

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 infrared 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 or by Lexan Thermoclear venetian grades.

Solar control

Transparent grades of Lexan Thermoclear sheet have excellent light transmission, between 38 and 83% depending upon thickness. However, for buildings in hot climates or with south facing aspects, Lexan Thermoclear is available in translucent grades of bronze, grey, blue, green, opal white, Lexan Thermoclear solar control with solar control coating and Lexan Thermoclear venetian with screen printed white stripes on the non UV protected side. These grades significantly reduce solar heat build-up, helping to maintain comfortable interior temperatures.

The specially tinted sheet, Lexan Thermoclear venetian and Lexan Thermoclear solar control cuts down the brightness of sunlight to a pleasing level and reduces air conditioning costs in the summer.

Solar heat gain

The solar radiation reaching the sheet is reflected, absorbed and transmitted, as shown in figure 3. The greatest proportion is transmitted and the total solar transmission (ST) is the sum of the direct transmission (DT) and the inwardly released part of the absorbed energy (A). Table 6 lists the solar control properties of the Lexan Thermoclear sheet range and Lexan Thermoclear venetian products.

Figure 3

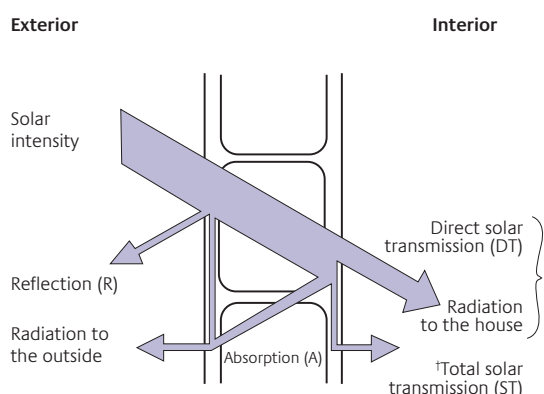


Table 6
Total solar transmission† in % LTC venetian (LTC-VEN)

Materials	LTC10 VEN 2RS	LTC16 VEN 3TS	LTC20 VEN 5RS	LTC32 VEN 5X
Clear 112 + Venetian white stripes	51	47	39	32

Total solar transmission† in % LTC solar control

Materials	LTC10 2RS 1.7SC	LTC16 3X 2.9SC	LTC16 3TS 2.8SC	LTC20 5RS 3.3SC	LTC25 6RS 3.5SC	LTC32 5X 3.8SC
Clear 112 + Solar control	49	32	46	39	25	35

Total solar transmission† in % LTC Thermoclick*

Materials	LTC40 4RS 3600	LTC40 4X 4000
Clear 112	76	56

Total solar transmission† in % LTC Thermopanel*

Materials	LTP30 A/B/C/D 4RS 4000/3600
Clear 112	76

† Solar transmission value may vary by plus or minus 3-5% depending grade

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.

Lexan® Thermoclear® sheet has on one or both sides 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, color retention, transparency, etc.

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

Accelerated weathering tests have been carried out on Lexan Thermoclear sheet by SABIC Innovative Plastics Structured Products. 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.

* WARRANTY

SABIC Innovative Plastics Structured Products offers a ten year limited warranty on Lexan Thermoclear sheet covering discoloration, 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 SABIC Innovative Plastics Structured Products Sales Office for more details.

Various properties

Temperature resistance

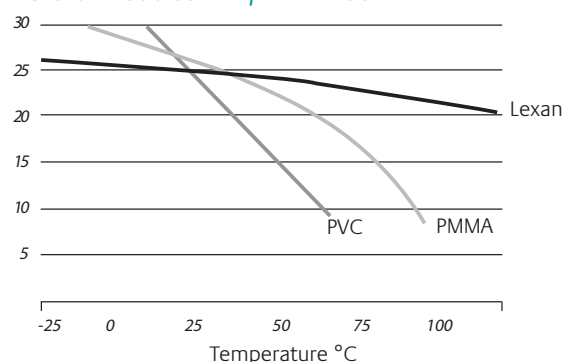
The heat build-up of glazing materials can be seen as a function of the solar energy absorption of the glazing material and the solar intensity.

In countries 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.

Figure 4
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 7 outlines the UL continuous-use temperatures of typical thermoplastic glazing materials.

Table 7
UL temperature ratings UL746B

Underwriters Laboratories continuous-use temperature rating	
Lexan polycarbonate	100°C
Acrylic	50°C
PVC	50°C

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 at lower temperatures is possible since the embrittlement temperature is as low as -110°C.

Fire performance

Lexan Thermoclear sheet has good fire behavior characteristics, and receives high ratings in several major European fire performance tests. More detailed information is available from your local SABIC Innovative Plastics Structured Products Service Center or authorized dealer.

Weight factors

Lexan Thermoclear sheet is an ideal 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 8
Weight

Lexan Thermoclear sheet	Thickness mm	Weight kg/m ²
	4	0.8
	4.5	1.0
	6	1.3
	8	1.5-1.7
	10	1.7-2.0
	16	2.7-2.9
	20	3.3
	25	3.5
	32	3.8
Lexan Thermoclick*	Thickness mm	Weight kg/m ²
	40	3.6-4.0
Lexan Thermopanel*	Thickness mm	Weight kg/m ²
	30	3.6-4.0

Sound insulation

The sound insulation characteristics of a material are largely pre-determined by its stiffness, mass and physical construction. In accordance with DIN 52210-75, the maximum obtainable sound transmission class for a particular thickness of Lexan Thermoclear is listed on the following page.

Thermal properties

Table 9
Sound reduction values

Lexan* Thermoclear* sheet	Thickness mm	Sound reduction dB
	4	15
	4.5	16
	6	18
	8	18
	10	19
	16	21
	20	22
	25	23
	32	23
Lexan Thermoclick*	Thickness mm	Sound reduction dB
	40	21
Lexan Thermopanel*	Thickness mm	Sound reduction dB
	30	22

Thermal insulation

The multi-wall 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 K-value, which is the amount of energy transmitted through a material per square meter of glazing area and per degree temperature difference. It is expressed in terms of $W/m^2 \cdot K$.

Table 10
Material K-values ($W/m^2 \cdot K$)

Lexan Thermoclear	Thickness mm	K-value
	4.5(2RS)	4.0
	6(2RS)	3.5
	8(2RS)	3.3
	8(3RS)	3.0
	10(2RS)	3.0
	10(3RS)	2.7
	10(3TS)	2.7
	10(3X)	2.5
	16(3TS)	2.4
	16(3X)	2.0
	20(5RS)	1.8
	25(6RS)	1.5
	32(5X)	1.4
Lexan Thermoclick	Thickness mm	K-value
	40(4X)	1.5
Lexan Thermopanel	Thickness mm	K-value
	30 A,B,C,D (4RS/3.6RS)	1.9

Overglazing

Installing Lexan Thermoclear 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 multi-wall sheet.

Table 11
Overglazing

Glass thickness mm	Air space mm	Thermoclear thickness mm	K-value $W/m^2 \cdot K$
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

Double Lexan multi-wall sheet units

Extremely low K-values can be obtained by double-glazed multi-wall Lexan sheet units. A combination of Lexan Thermoclear 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.

Table 12
Double Lexan multi-wall sheet units

Thermoclear sheet outside	Air gap mm	Thermoclear sheet inside	K-value $W/m^2 \cdot K$
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
20(5RS)	20-50	6(2RS)	1.19
20(5RS)	20-50	8(2RS)	1.16

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 Liters of oil or 1.0 - 1.5 m^3 of gas per m^2 of glazing area will be obtained by decreasing the K-value by $0.1 W/m^2 \cdot K$.

Table 13 shows the minimum and maximum amount of savings of fuel consumption per m^2 glazing area when the K-value is decreased by varying amounts.

Calculation example

Annual fuel saving when glass is replaced by Lexan Thermoclear sheet

Data

4 mm glass, K-value - $5.8 W/m^2 \cdot K$
10 mm Lexan Thermoclear sheet, K-value - $3.0 W/m^2 \cdot K$

in table 12, the minimum and maximum amount of annual fuel savings per m^2 glazing area are

25.2-36.4 Liters of oil
28-42 m^3 of gas

Table 13

K-value difference $W/m^2 \cdot K$	Annual saving per m^2 glazing area	
	Oil - liters	Gas - m^3
0.1	0.9 - 1.3	1 - 1.5
0.2	1.8 - 2.6	2 - 3
0.3	2.7 - 3.9	3 - 4.5
0.4	3.6 - 5.2	4 - 6.0
0.5	4.5 - 6.5	5 - 7.5
0.6	5.4 - 7.8	6 - 9.0
0.7	6.3 - 9.1	7 - 10.5
0.8	7.2 - 10.4	8 - 12
0.9	8.1 - 11.7	9 - 13.5
1	9 - 13	10 - 15
1.2	10.8 - 15.6	12 - 18
1.4	12.6 - 18.2	14 - 21
1.6	14.4 - 20.8	16 - 24
1.8	16.2 - 23.4	18 - 27
2.0	18 - 26	20 - 30
2.2	19.8 - 28.6	22 - 33
2.4	21.6 - 31.2	24 - 36
2.6	23.4 - 33.8	26 - 39
2.8	25.2 - 36.4	28 - 42
3.0	27 - 39	30 - 45
3.2	28.8 - 41.6	32 - 48
3.4	30.6 - 44.2	34 - 51
3.6	32.4 - 46.8	36 - 54
3.8	34.2 - 49.4	38 - 57
4.0	36 - 52	40 - 60

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 K-value, the higher the inner sheet surface temperature will be maintained during the winter season.

Figure 5 presents an example of the temperature profile through 6 mm Lexan Thermoclear when the outside temperature is $-10^{\circ}C$ and the inside building temperature is $+20^{\circ}C$.

The multi-wall 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.

Figure 5
Temperature process through Lexan Thermoclear sheet at low outside temperature.

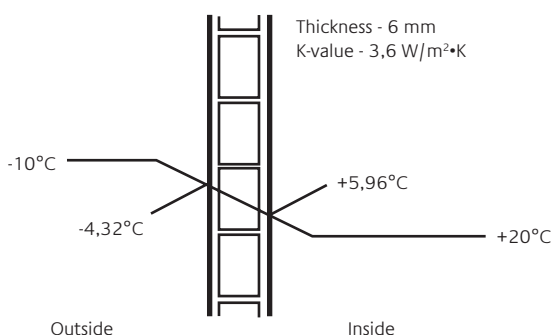
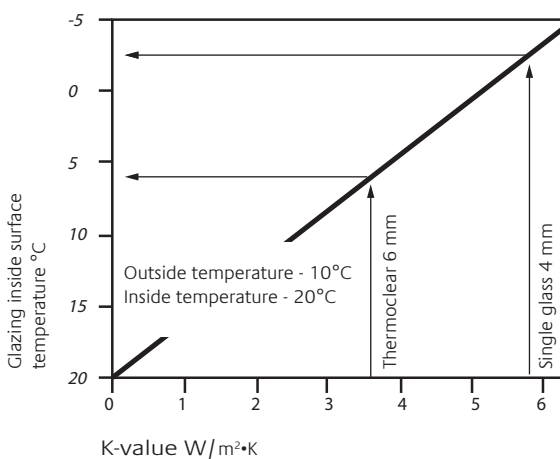


Figure 6 compares Lexan Thermoclear sheet with single glazed glass under the same conditions. The inside glass surface temperature is well below zero, which means that cold radiation will negatively influence the overall building temperature and will affect the comfort level near the windows.

Figure 6
Lexan Thermoclear sheet vs single glazed glass



Cleaning

Periodic cleaning using correct procedures with compatible household cleaners is recommended to prolong service life. For general cleaning, it is recommended that the following instructions be adhered to.

Table 14
Recommended solvent cleaners

Cleaner/solvent	Supplier
Petroleum Ether (BP65°)	Various
Hexane	Various
Heptane	Various

Procedure 1 - small areas

1. Rinse sheet with lukewarm water
2. Wash sheet with a solution of mild soap or household detergent and lukewarm water, using a soft cloth or sponge to loosen any dirt and grime
3. Rinse with cold water and dry with a soft cloth to prevent water spotting

Procedure 2 - large areas

1. Clean surface with a high pressure water and/or steam cleaner
2. Use of additives to the water should be restricted to those compatible with Lexan Thermoclear sheet

Important

Never use an abrasive or highly alkaline cleaner on Lexan® Thermoclear® sheet

- Cleaners and solvents generally recommended for use on polycarbonate are not necessarily compatible with the UV-protected surface of Lexan Thermoclear sheet
- Do not use either alcohols on the UV-protected surface of Lexan Thermoclear sheet
- Never scrub with brushes, steel wool or other abrasive materials
- Don't clean Lexan Thermoclear, Thermoclick® and Thermopanel® in the hot sun or at deviated temperatures as this can lead to staining

Recommended Cleaner Suppliers

DiverseyLever Divizia
Odborárska 52
SK-831 02 Bratislava
Slovakia
T 07 501 29 88/
T 07 525 48 95

DiverseyLever
Haachtsteenweg 672
B-1910 Kampenhout
Belgium
T 016 61 77 77

DiverseyLever AG
CH-9542 Munchwilen
Switzerland
T 071 969 27 27

DiverseyLever
Wienerbergstrasse 7
A-1103 Vienne
Austria
T 01 60 55 70

DiverseyLever SRO
Táborská 5/979
140 00 Praha 4
Czech Republic
T 02 61 22 25 24

DiverseyLever A/S
Smedeholm 3-5
DK-2730 Herlev
Denmark
T 044 85 61 00

DiverseyLever France
9-11, Avenue du Val de
Fontanay
94133 Fontanay Sous
Bois
France
T 01 45 14 76 76

DiverseyLever (Offices)
Via Meucci 40
20128 Milan
Italy
T 022 670 24 32

DiverseyLever Sp.z.o.o.
Ul Zupnica 17
03-821 Warsaw
Poland
T 022 670 24 32

DiverseyLever
Rautatienkarn 9-11
FIN-20200 Turku
Finland
T 02 269 72 22

DiverseyLever AB
Röntgenvägen 3
S-14152 Huddinge
Sweden
T 08 779 93 00

DiverseyLever
Jamestown Road
Finglas
Dyblin 11
Ireland
T 08 779 93 00

DiverseyLever
Calle Rosselon 174-176
08036 Barcelona
Spain
T 93 323 10 54

DiverseyLever
General Offices
Weston Favell Centre
Northampton NN3 8 PD
United Kingdom
T 01604 40 53 11

DiverseyLever
Mallaustrasse 50-56
Postfach 81 03 60
D-68 219 Mannheim
Germany
T 0621 875 70

DiverseyLever
Maarssebroekseweg 2
3606 AN Maarssen
Netherlands
T 030 247 69 11

Web page
www.diverseylever.com

Recommended cleaner
SUMALIGHTD 12
BRUCODECID
for heavy duty
(i.e. railway stations)

Condensation

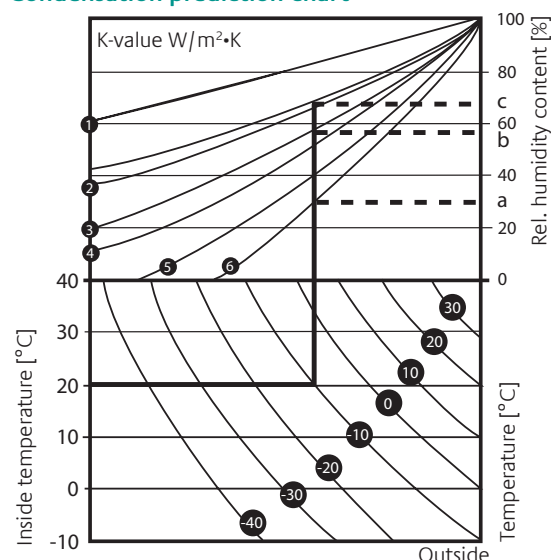
Condensation is formed when moisture in the atmosphere changes back to water as it comes into contact with a surface at a temperature below the 'dewpoint' of the surrounding air.

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.

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

Example

Figure 7
Condensation prediction chart



Inside temperature 20°C
Outside temperature -10°C

Condensation will occur on		
a	Glass K-value 5.8 w/m² °K at a humidity content of	32%
b	LTC 6 mm K-value 3.0 w/m² °K at a humidity content of	50%
c	LTC 20 mm K-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 SABIC Innovative Plastics Structured Products 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. Silicone sealants are generally recommended for use with Lexan Thermoclear sheet, see table 14. It is strongly advised when using sealing compounds to check compatibility before use.

Table 14
Recommended Sealants

Sealant	Supplier
Silpruf	SABIC Innovative Plastics Bayer Silicones
MultiSil	SABIC Innovative Plastics Bayer Silicones

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 15
Recommended gasket systems

Gasket type*	Supplier
EPDM	Helvoet
Chloropene, RZ4-35-81	
EPDM	Vredestein
4330, 4431, 5530, 5531	
EPDM	Phoenix
3300/670, 64470	
* more grades available	

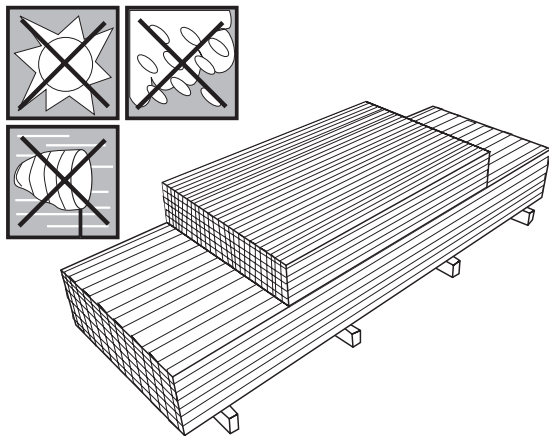
In case of doubt about any aspect of the chemical compatibility of the Lexan Thermoclear sheet range, always consult your nearest SABIC Innovative Plastics Structured Products sales office for further advice.

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.

Figure 8



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 minimize the risk of these problems

- The top face is covered with a printed masking.
For LTC, LTC VEN, LTC SC and LTD this is the UV protected side and should face outwards
- The bottom face has a neutral clear masking
- The edges have colored protective edge tapes
- blue for LTC, yellow for LTC Plus and green for LTD
- The sheets 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. Sawdust should be blown out of the channels using clean 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.

Installation

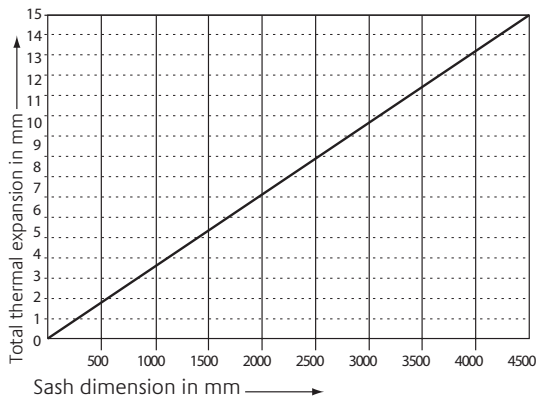
Glazing with Lexan® Thermoclear® sheet should be considered a finishing operation and seen as the final step in the completion of an application.

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.

Figure 9

Thermal expansion allowance



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.

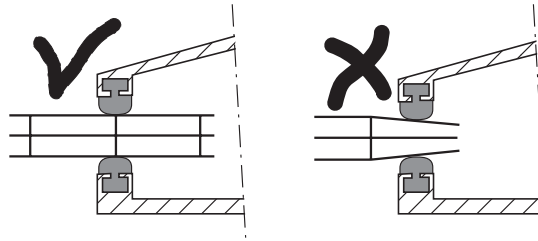
In general thermal expansion of the sheet is approximately 3 mm per linear meter at a delta of 50°C.

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.

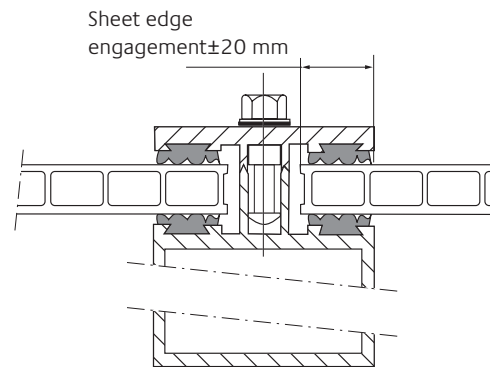
A cover plate, or glazing bead, with rubber gaskets or silicone sealant, hold the sheet in place and create a water-tight seal. In both cases there must be sufficient clearance to allow for thermal expansion of the sheet. It is also important that the edge of the sheet is engaged for a minimum of 20 mm into the glazing frame with at least one rib located in the clamping area. See figures 10 and 11.

Figure 10



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 center of the rebate.

Figure 11



Dry glazing systems

This selection 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 ideal 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 figures 12 and 13.

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 distributors and specialized installers.

Figure 12

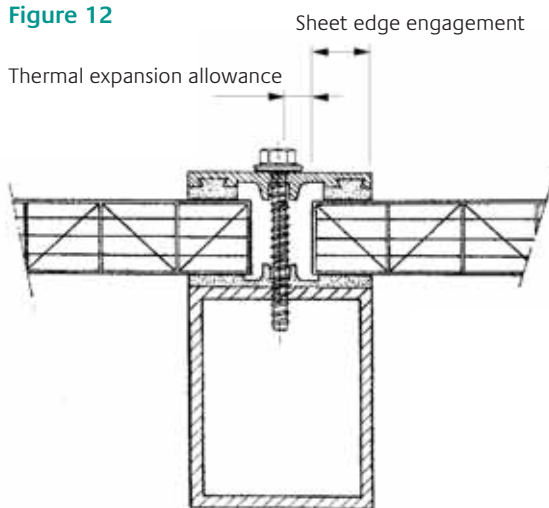
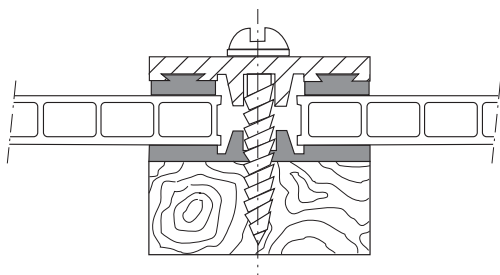


Figure 13 Neoprene, EPT or EPDM rubber gasket



Wet glazing systems

This type of installation system is mainly used in small domestic type applications, carports, 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 figures 14 and 15.

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 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 page 19, table 14, for suitable sealant.

Figure 14

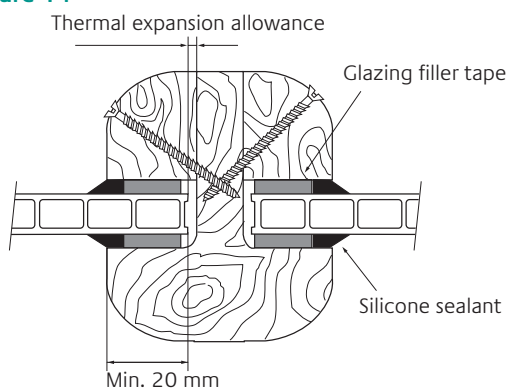
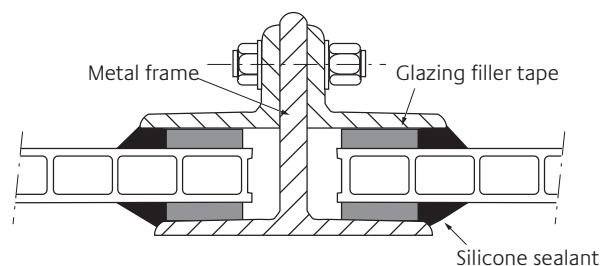


Figure 15



Sealing guidelines

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 a 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 G3629 and an anti-dust venting tape AD3429 have been developed. Multifoil will provide within Europe a 10 Year Guarantee on the operation of the tapes

MULTIFOIL

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Sealing guide-lines

The following guidelines are recommended to minimize 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 specialized 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 figures 16 and 17.

An additional 'U' profile can be installed to cover the perforated bottom tape and to facilitate condensation drainage. See figures 20 and 21

- Integrated filter which minimizes dust/insect penetration
- Condensation water drainage possibility
- Ventilation into channels helping to prevent excessive condensation
- Clearance between the bottom sheet edge and the sash platform necessary to allow for condensation drainage

Figure 16

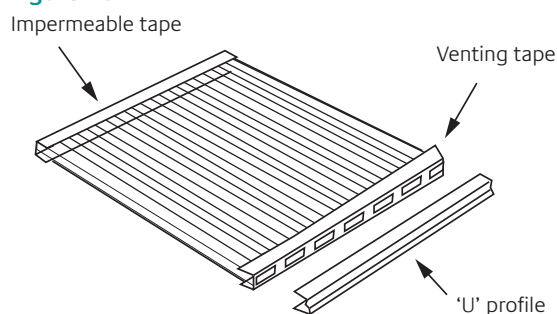
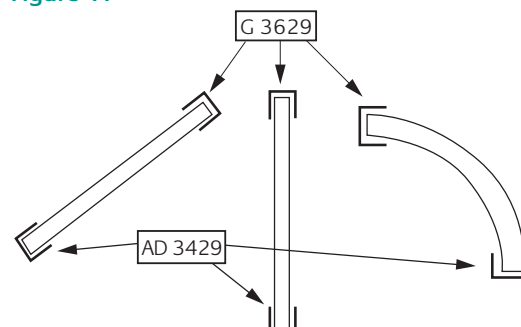


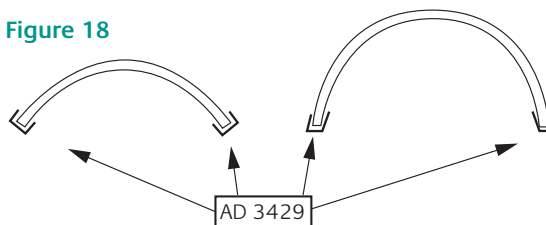
Figure 17



Sealing guidelines

In semicircular barrel vaults both channel ends should be sealed with perforated filter tape e.g. Multifoil AD 3429. See figure 18. Care should be taken to provide a clearance between both the sheet edges and the sash platform to allow for condensation drainage. See figures 19 and 20.

Figure 18



Specific glazing conditions

In certain environments, it is recommended that both channel ends are sealed with an impermeable tape.

See figure 21.

These environments include

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

Figure 21 Impermeable tape on both sides

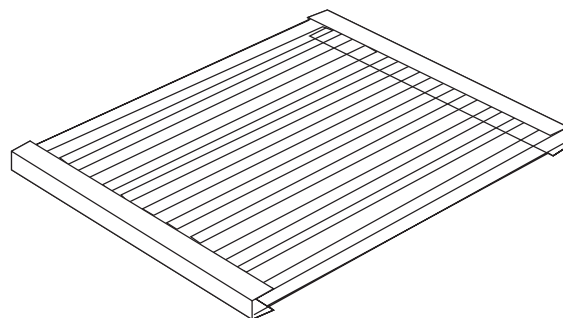


Figure 19

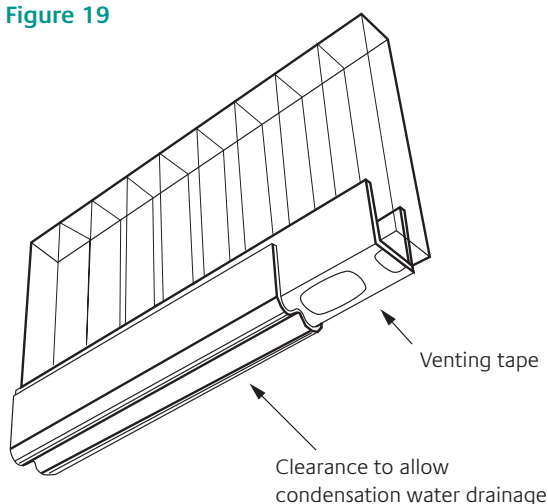
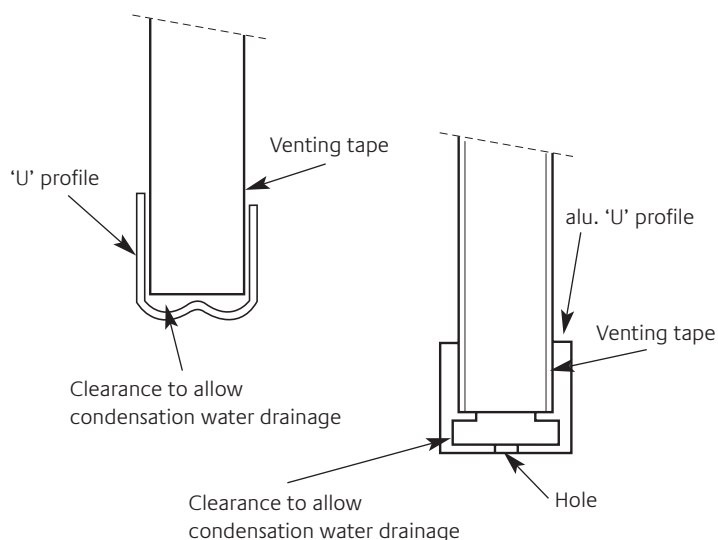


Figure 20



Wind and snow loading

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 16
Values of q in SI units (N/m^2)

Wind speed m/s	Wind pressure N/m^2	Wind speed m/s	Wind pressure N/m^2
10	61	40	981
15	138	45	1240
20	245	50	1530
25	383	55	1850
30	552	60	2210
35	751	65	2590

For glazing projects with an unusual loading condition, please contact your local SABIC Innovative Plastics Structured Products 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

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 glazings 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 centimeter of height

Fresh snowfall - 0.8-1.9 kg/m^2 per cmh.

Wet snowfall - 2-8 kg/m^2 per cmh.

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

Computer aided sheet engineering

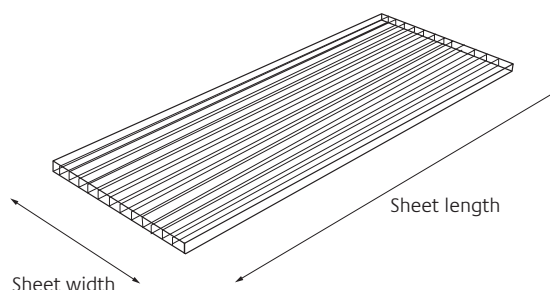
A computer aided design program has been developed especially for large glazing projects, or projects with an uncommon shape or unusual loading conditions. The program creates the finite element model of a particular glazing design, applies the specified loads and edge conditions and runs the deflection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

Sheet thickness criteria

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.

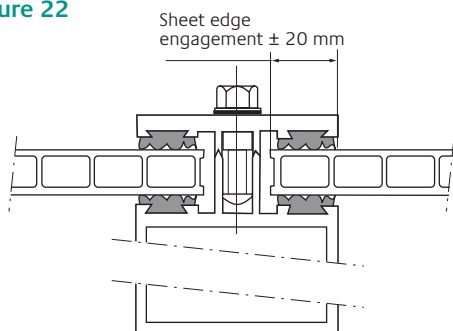


Safety factor

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

N.B. The values indicated in the tables are applicable for a Lexan* Thermoclear* sheet edge engagement in the glazing frame of at least 20 mm.

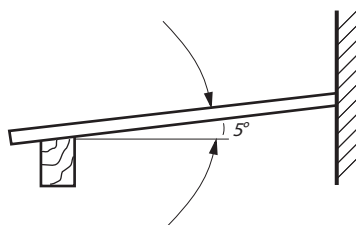
Figure 22



Sloped roofing

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

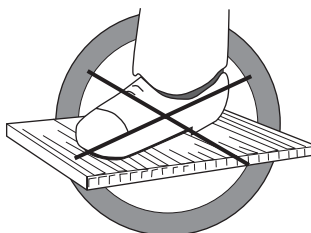
Figure 23



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 24



Flat glazing sheet thickness

Four sides clamped

The deflection characteristics in this particular configuration are dependent upon the ratio of the support bar spacing a:b, see figure 25.

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

“b” represents the center to center 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 25

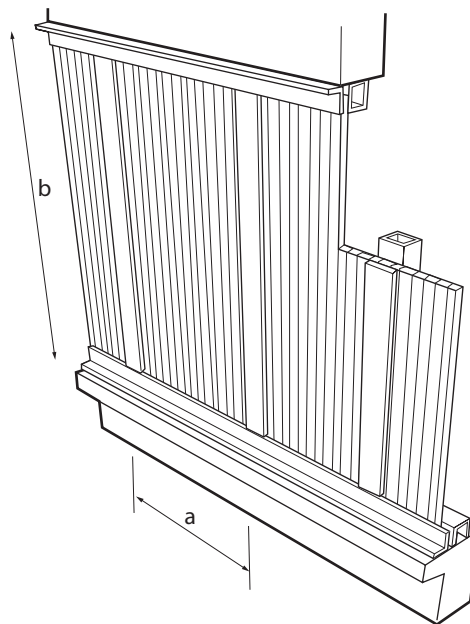


Table 17

Center to center distance (mm) of glazing profiles (shortest side (a))

Lexan* Thermoclear* sheet type	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	1:1	1:1.5	1:>1.5	1:1	1:1.5	1:>1.5
LTC 4.5/2RS1000	690	580	450															
LTC 6/2RS1300	1050	920	610	950	850	570	900	780	530									
LTC 8/2RS1500	1250	1100	720	1150	1020	655	1075	940	610	1020	900	570	970	830	535	930	780	510
LTC 8/3RS1700	1150	1020	680	1100	960	650	1050	920	590	1000	870	560	950	820	535	900	770	500
LTC 10/2RS1700	1500	1150	815	1375	1070	730	1280	950	670	1215	920	620	1160	850	585	1110	800	545
LTC 10/3RS1900	1470	1110	800	1355	1035	730	1265	935	675	1205	895	625	1150	830	575	1105	780	540
LTC 10/3TS2000	1540	1310	890	1410	1250	810	1320	1150	750	1250	1060	700	1200	980	660	1150	920	630
LTC 10/3X2000	1200	1200	980	1200	1200	910	1200	1200	850	1200	1150	810	1200	1100	770	1200	1050	740
LTC 16/3TS/ 2700 2800	1700	1420	1100	1600	1310	980	1500	1210	880	1450	1120	810	1400	1060	750	1300	1000	700
LTC 16/3X2900	1200	1200	1200	1200	1200	1200	1200	1200	1130	1200	1200	1080	1200	1200	1030	1200	1200	995
LTC 20/5RS3000	1800	1650	1200	1700	1550	1160	1600	1400	1070	1550	1310	980	1500	1220	920	1450	1170	860
LTC 25/6RS3500	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1150	1250
LTC 32/5X3800	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250
Loading in N/m ²	600			800			1000			1200			1400			1600		
																1800		
																2000		

Example I

Window size - width 1100 mm
length 3000 mm
(Ratio a:b = 1 : >1.5)
Loading - 600 N/m²
Required sheet type - LTC 16/3TS 2800

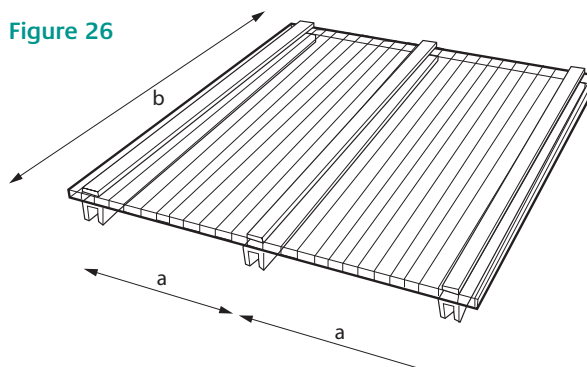
Example II

Window size - width 800 mm
Length - 1200 mm
(Ratio a:b = 1 : 1.5)
Loading - 1600 N/m²
Required sheet type - LTC 10/2RS 1700

Two sides clamped, glazing bars parallel with rib structure

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

Figure 26



a = Center to center distance of glazing profiles
b = Sheet length

Table 18

Center to center distance (mm) of glazing profiles “a”; glazing profiles parallel with rib structure

Lexan® Thermoclear® sheet type							
LTC 4.5/2RS1000	450						
LTC 6/2RS1300	570	530					
LTC 8/2RS1500	655	610	535	510			
LTC 8/3RS1700	650	590	570	500			
LTC 10/2RS1700	730	670	585	545	520		
LTC 10/3RS1900	800	730	625	575	540	510	
LTC 10/3TS2000	890	810	700	660	630	610	585
LTC 10/3X2000	980	910	810	770	740	720	700
LTC 10/3X2000	1100	980	810	750	700	665	620
LTC 16/3X2900	1200	1200	1080	1030	995	960	950
LTC 20/5RS3300	1200	1160	980	920	860	810	770
LTC 25/6RS3500	1250	1250	1250	1250	1150	1100	1050
LTC 32/5X3800	1250	1250	1250	1250	1250	1250	1250
Loading in N/m ²	600	800	1200	1400	1600	1800	2000

Two sides clamped, glazing bars 90° to rib structure

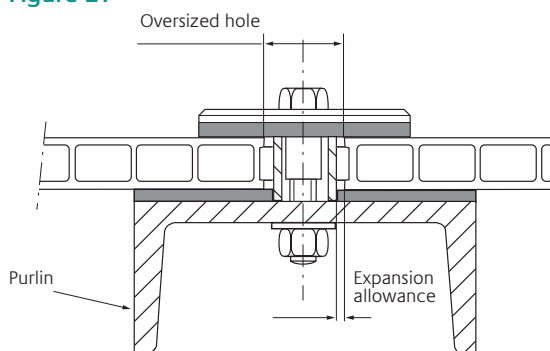
In this situation, the major factor influencing deflection behavior is the purlin spacing. The sheet width has no influence on the deflection behavior of the sheet when exposed to loading. This means that any sheet width up to the maximum standard width can be selected.

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, watertight 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.

Figure 27



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 authorized Lexan® Thermoclear® 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 28

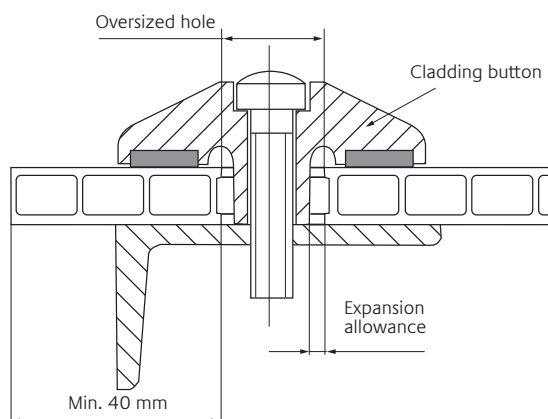
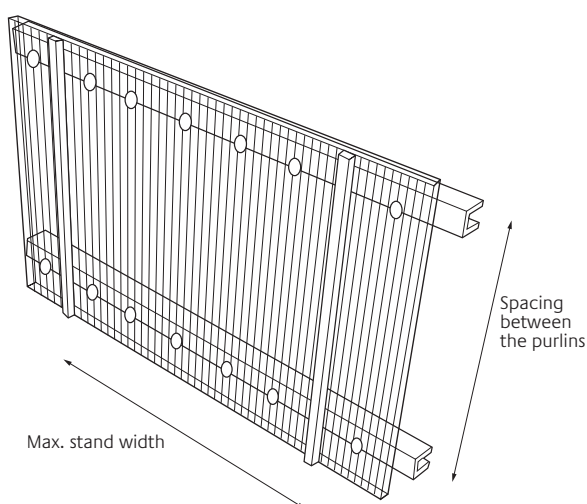


Figure 29



Note

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

- The transparent polycarbonate "H" profile is not UV protected. Discoloration of this profile in time can be expected
- 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.

Table 19

Center to center distance of purlins in mm; glazing profiles 90° to rib structure

Lexan Thermoclear sheet type								
LTC 4.5/2RS1000	500							
LTC 6/2RS1300	690	630	590	570	540	520	500	480
LTC 8/2RS1500	830	760	720	680	650	630	600	580
LTC 8/3RS1700	830	760	720	680	650	630	600	580
LTC 10/3RS1900	900	910	855	800	770	740	710	
LTC 10/3X2000								
LTC 10/2RS1700	1010	930	875	830	790	760	730	710
LTC 10/3T2000								
LTC 16/3TS/2700								
LTC 16/3TS/2800	1450	1325	1240	1180	1130	1085	1050	1000
LTC 16/3X2900								
LTC 20/5RS3300	1550	1440	1350	1275	1220	1175	1140	1100
LTC25/6RS3500	1675	1525	1435	1360	1290	1250	1200	1150
LTC32/5X3800	2000	1850	1700	1600	1500	1450	1400	1350
Loading in N/m ²	600	800	1000	1200	1400	1600	1800	2000

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.

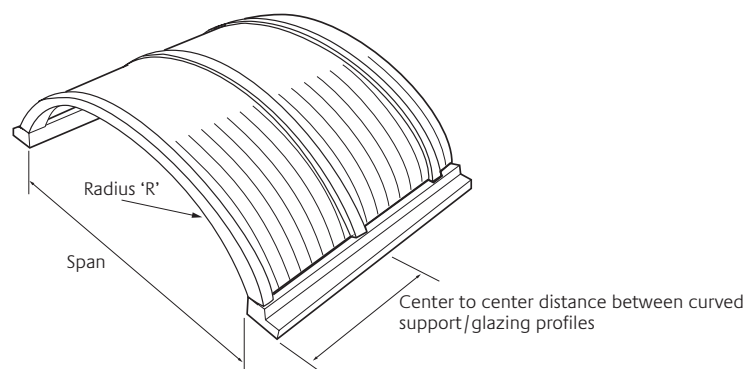
Table 20 - Minimum radius values

Lexan Thermoclear sheet thickness	Min. radius in mm
6	1050
8	1400
10	1750
16	2800
20*	3500
25	4375

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.

Figure 30



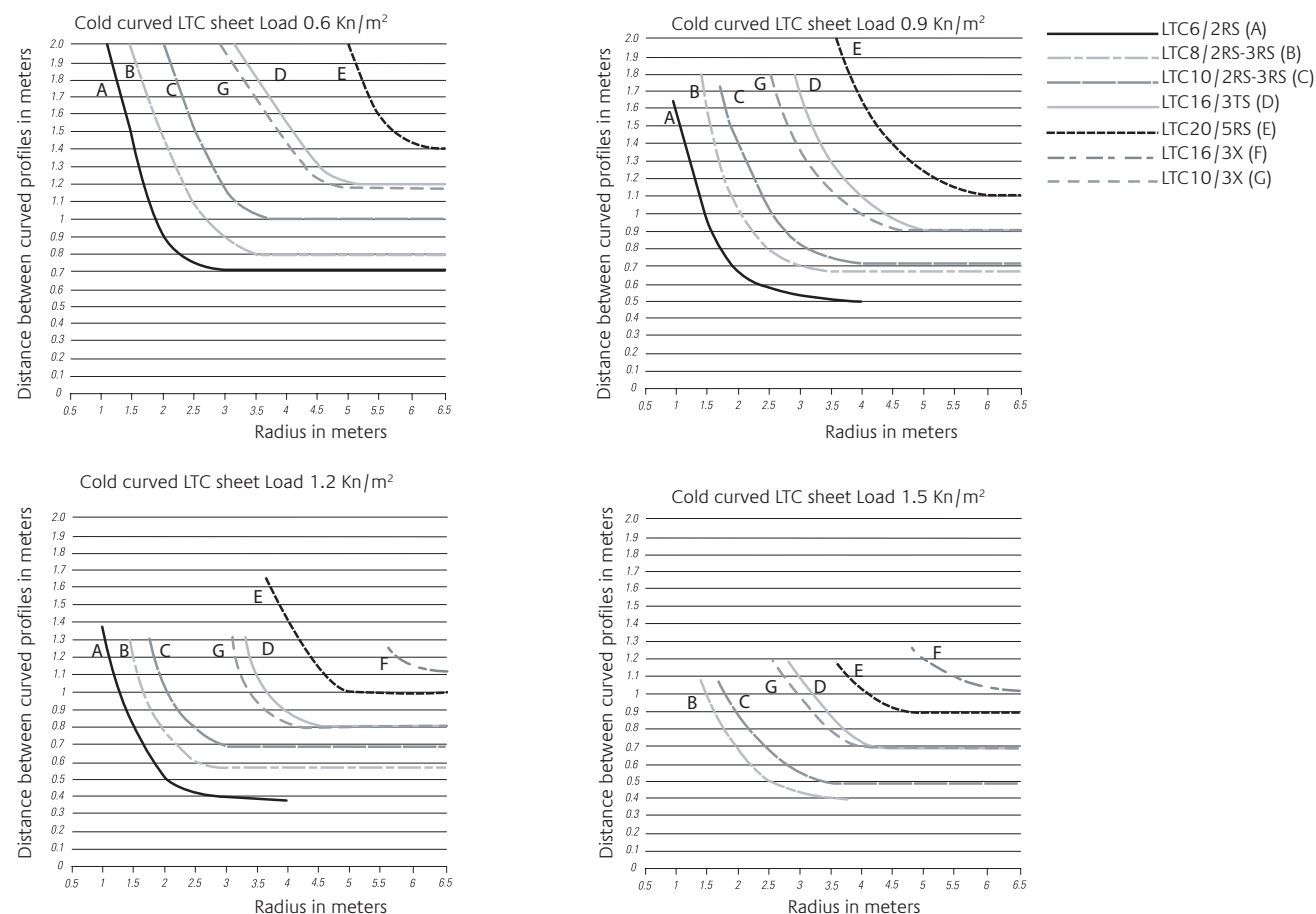
How to read the table.

At a specified load the distance between the curved profiles can be found for different Lexan Thermoclear sheet thickness and radii.

LTC25 Distance between curved profiles - 1250 mm at all radii >4375 mm until a load of 1400 N/m²

LTC32 Only for flat glazing applications

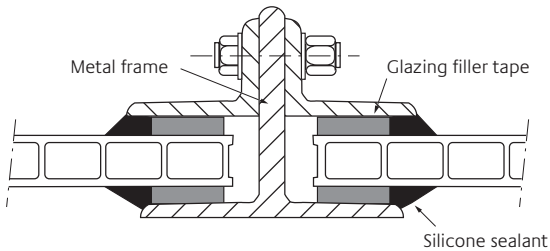
Table 21



Sheet glazing guidelines

Wet glazing

Figure 31

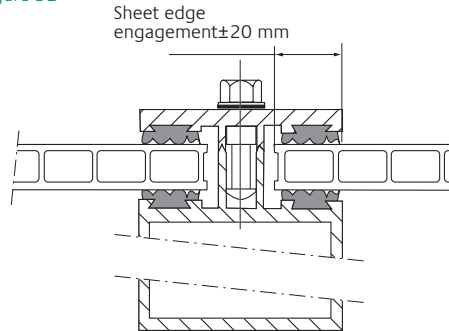


Do's

- 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 meter)
- Select the right thickness to fulfill loading requirements, K-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 clean 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 G3629 / AD 3429. 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 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 Multisil/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 wool cloth

Dry glazing

Figure 32



Don'ts

- Do not use plasticized 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

General guidelines

Storage

Lexan Thermoclick sheet should be stored and protected against atmospheric influences like sun, rain, etc. Care should be exercised when handling and transporting Lexan Thermoclick sheet in order to prevent scratches on the panel surface and damage to the panel edges.

Sawing

Lexan Thermoclick sheet can be cut easily and accurately with most standard workshop equipment. This includes common circular, hand and hacksaws both with fine-toothed blades. The panel should be clamped to the worktable to avoid undesirable vibration and the sawdust should be blown out of the channels.

Pre-installation guidelines

Thermal expansion allowance

Take into account a clearance of approximately 3 mm per linear meter between panel top edge and top glazing profile platform, and between the first and last panel side and side glazing profile platform. This thermal expansion clearance is already taken into account when using the special developed glazing profiles indicated in this chapter.

Sealing recommendations

In order to minimize moisture build-up and dust contamination inside the channels, edge sealing of the open ended channels is very important. An anti-dust impermeable tape and an anti-condensation venting tape have been developed by the company Multifoil†. Both tapes are available from your local distributors' sales offices.

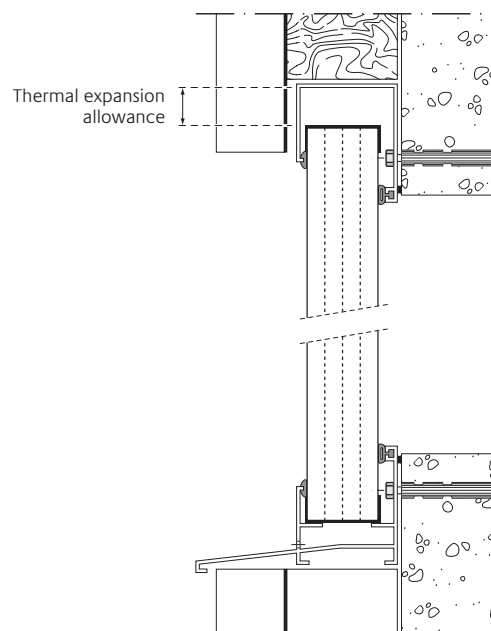
† Multifoil - Verl. Hoogravenseweg 63h, 3525 BB Utrecht, The Netherlands
T +31 30 2896333
F +31 30 2894545

Standard glazing

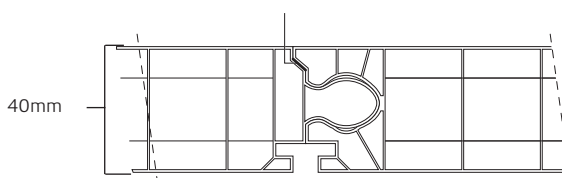
For standard glazing applications it is generally recommended to seal the top end channels with an impermeable tape (G3660C) and the bottom end channels with an anti-condensation venting tape (AD 3460C). A clearance between the bottom panel end and the sash profile platform helps allow for condensation drainage.

Specific conditions

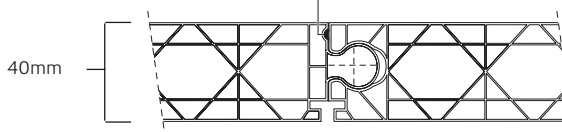
In extremely dusty environments such as saw mills, welding stations, etc., it is usually advisable to seal both the top and bottom channel ends with an impermeable tape (G3660C).



LTC40/4RS3600

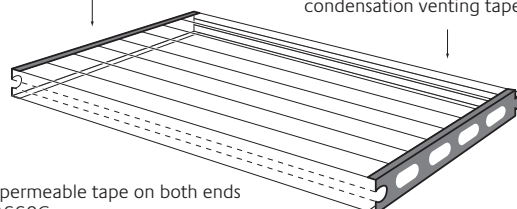


LTC40/4X4000

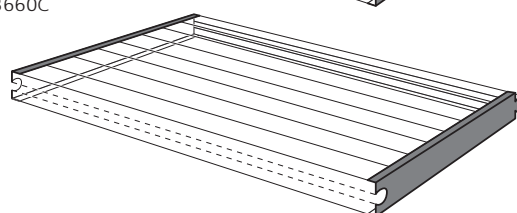


Top end channels
impermeable tape G3660C

Bottom end channels
condensation venting tape AD3460C



Impermeable tape on both ends
G3660C



LTC40 / 4X4000

Vertical wall glazing

This chapter illustrates some glazing proposals using commercially available aluminum glazing profiles which have been proven to be successful in combination with Lexan® Thermoclick® panels. A wide range of easy to use aluminum glazing profiles and metal fastener clips are available at the vast majority of approved Lexan Thermoclick distributors and specialized installers. Lexan Thermoclick panels can be installed either from inside the building or from the outside.

Maximum recommended span 'H'

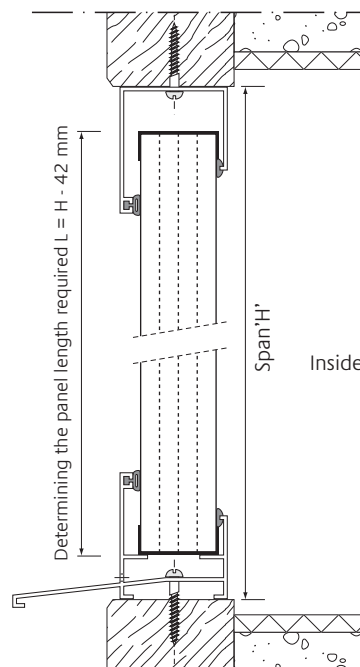
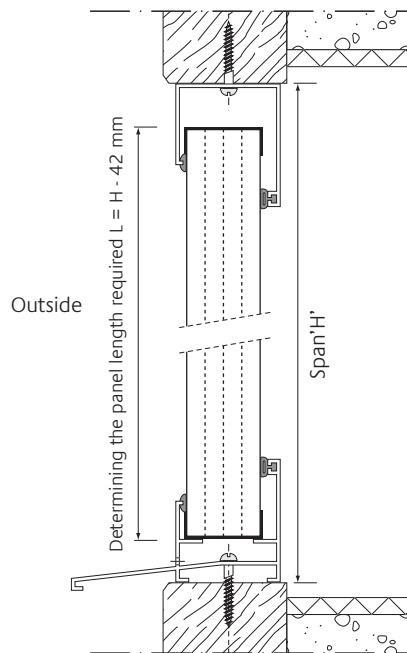
Wind pressure/wind suction, snow load in N/m ²	Maximum recommended span 'H' in mm
600	2500
900	2250
1200	2000

The above table indicates the maximum recommended span at a specific loading which results in acceptable panel deflection behavior, minimal risk of buckling or pop-out effect calculated with sufficient safety factor.

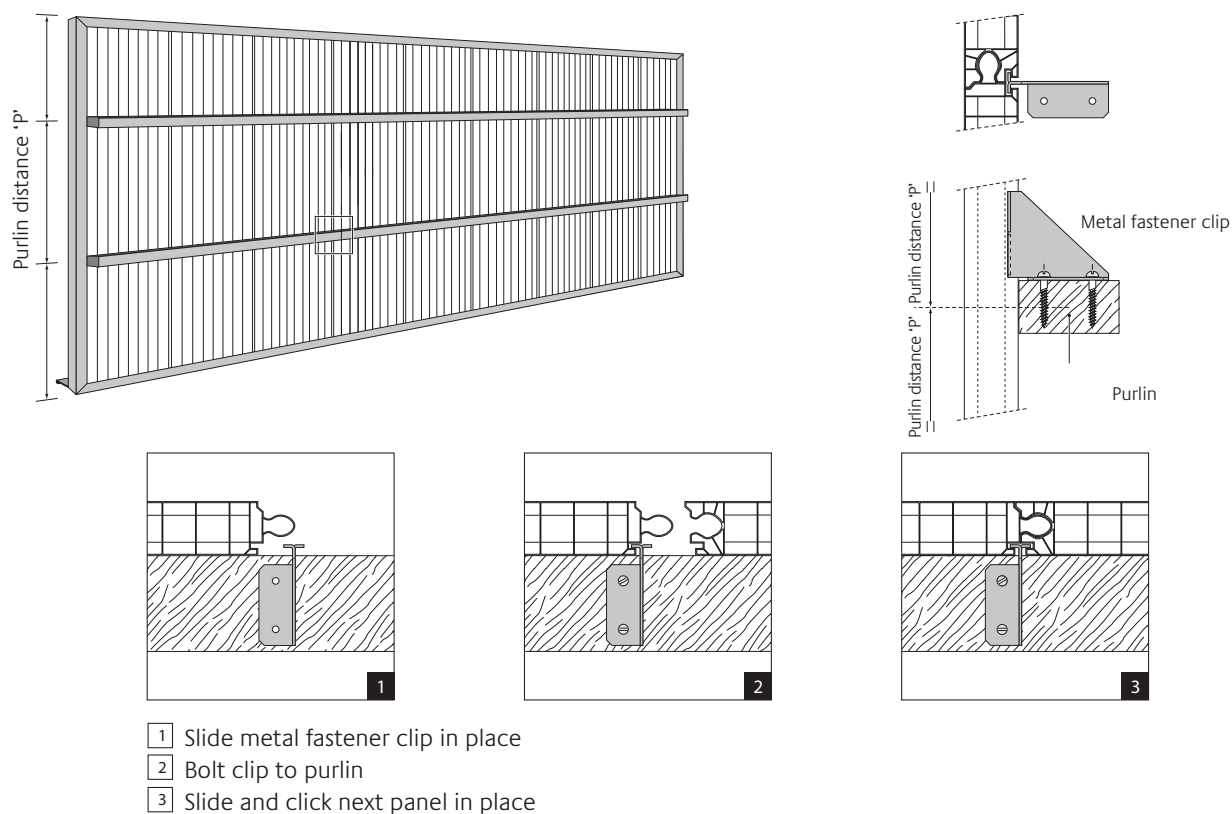
Maximum recommended purlin distance 'P'

When the glazing height exceeds the maximum recommended span 'H', intermediate horizontal purlins should be used to support the Lexan Thermoclick sheet panel. Lexan Thermoclick sheet may be fixed to these purlins using special non-rusting metal fastening clips positioned in the double sided tie on both panel sides. The distance between the horizontal intermediate purlins should not exceed the maximum recommended span dimensions 'P' as indicated in the table below.

Wind pressure/wind suction, snow load in N/m ²	Maximum recommended span 'P' in mm
600	2000
900	1750
1200	1500



LTC40 / 4X4000

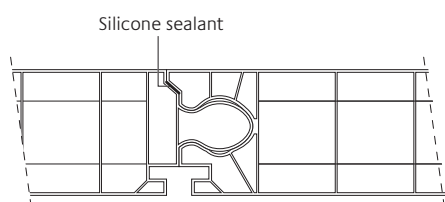


Alternative for connecting panels

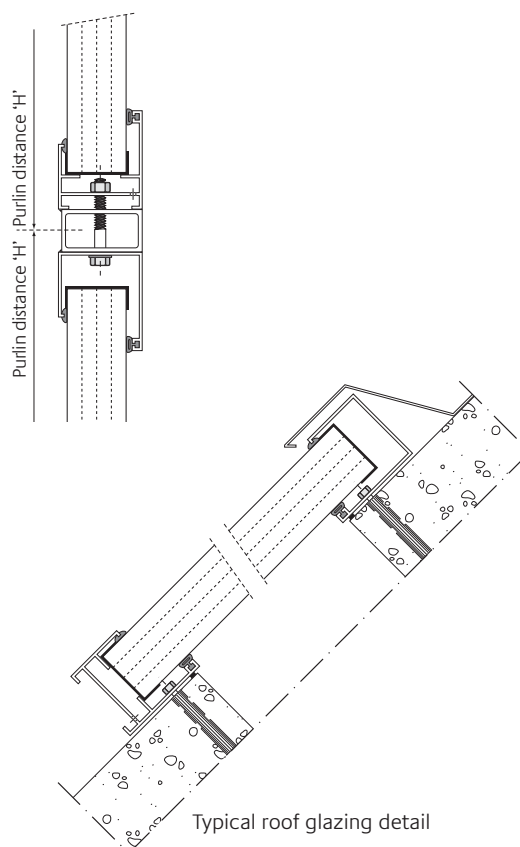
Using the aluminum top and bottom glazing profiles, bolted to the intermediate purlins is a good alternative for connecting Lexan Thermoclick panels when the glazing height exceeds the maximum allowable span 'H'.

Roof glazing

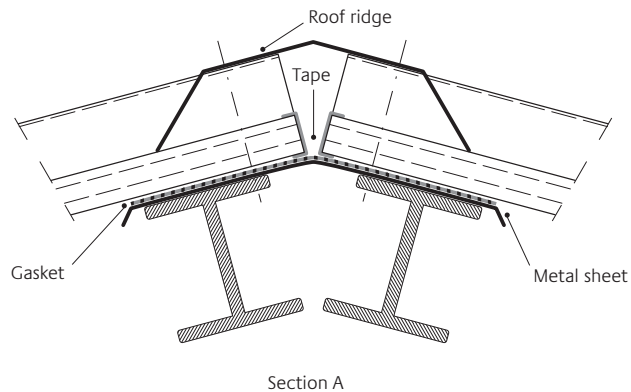
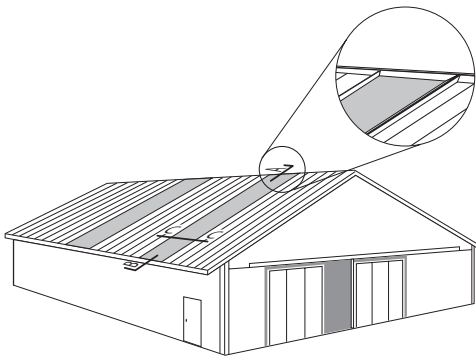
For most sloped roofing applications a minimum slope of 10 degrees is advised to allow for rainwater drainage. Silicone sealant, for additional watertightness, can be applied into the groove between two panels before installation.



On roof constructions Lexan Thermoclick sheet may never be used to support a person's weight during installation or cleaning. A temporary wooden beam, supported by the roof structural members, should always be used.

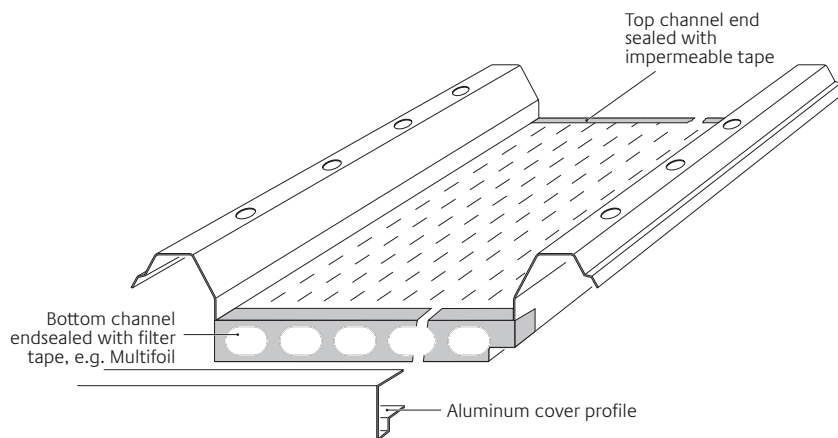
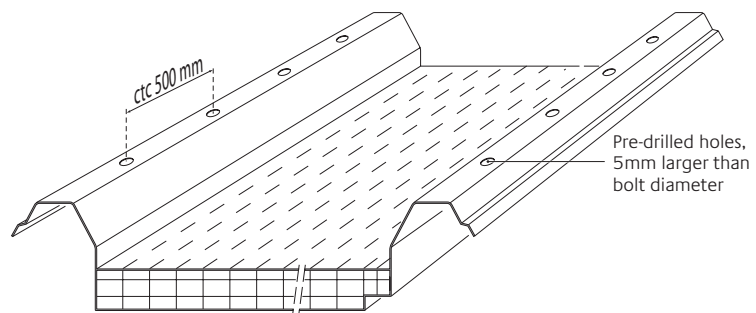


LTP30A / 4RS4000

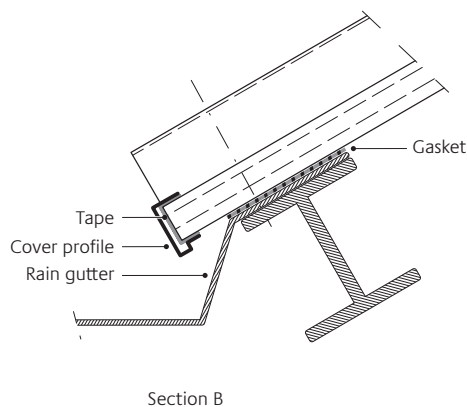


Roof glazing

Lexan Thermopanel sheet will be mainly used as roof lights covering the roof from ridge to eaves. To obtain a watertight connection on the roof ridge well known metal flashing accessories can be used. See section A. Fixing holes at both side wings must be pre-drilled approx. 5 mm larger than the diameter of the shank of the fixing to allow for thermal expansion. The center to center distance between the fixings may not exceed 500 mm.



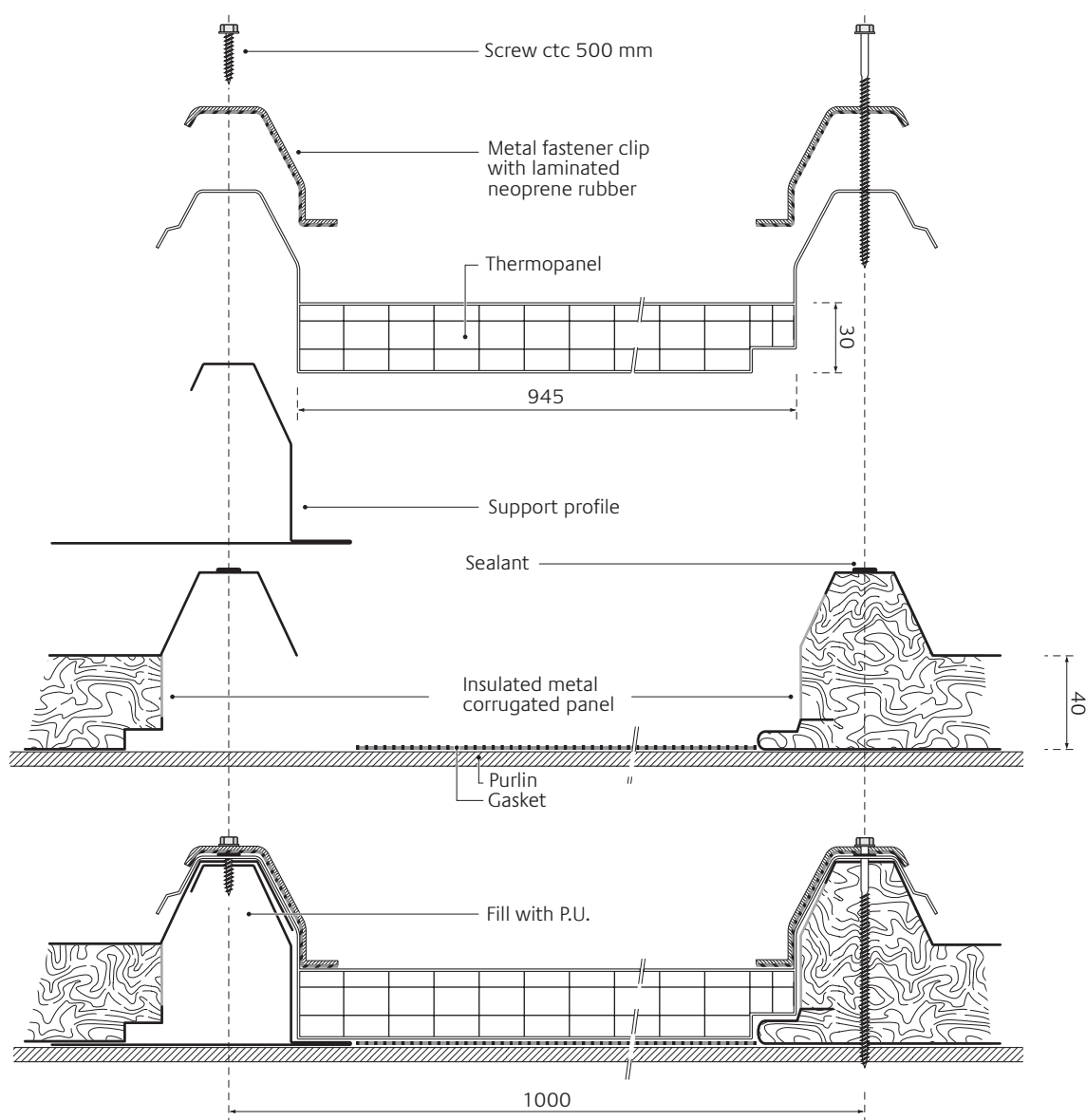
To cover the tape and to facilitate condensation drainage out the channels a 'U' profile as indicated on section B is suggested. To avoid sheet damage and to restrict the rattle noise effect during extreme wind pressure/suction it is recommended to apply a neoprene or foam gasket on the metal purlins.



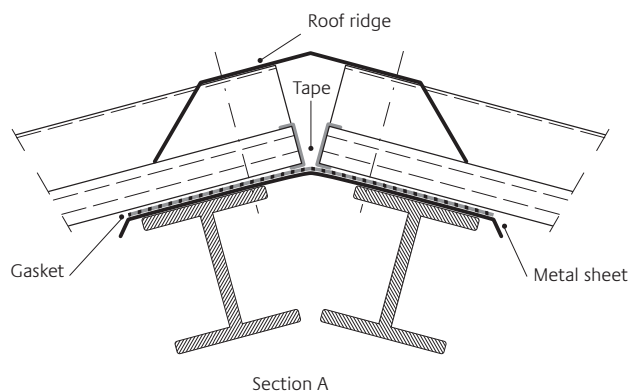
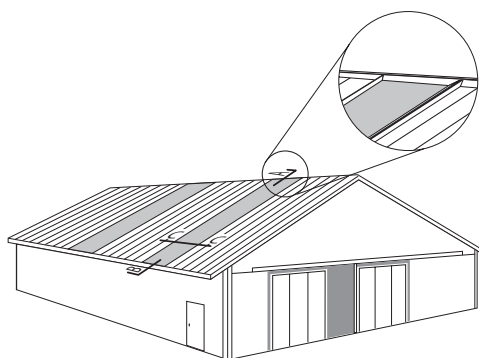
LTP30A / 4RS4000

Metal fastener clips with laminated neoprene rubber, as indicated above, can be used to fix the side wings of the Lexan Thermopanel sheet with bolts to the sides of the metal corrugated insulated panel. The metal fasteners force the Lexan Thermopanel sheet downwards and hold it in place during loading.

The arised empty place on one side between the metal corrugated insulated panel and the multi-wall part of the Lexan Thermopanel sheet must be filled with an insulated infill piece. This infill piece may be cut out of the metal corrugated insulated panel.

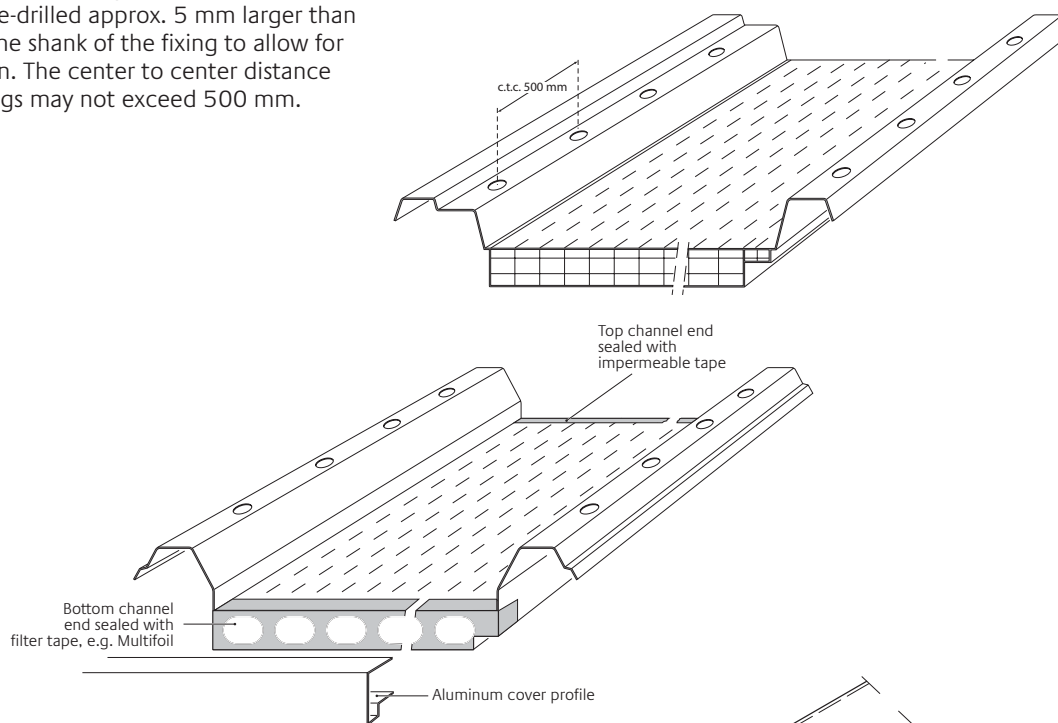


LTP30B / 4RS4000

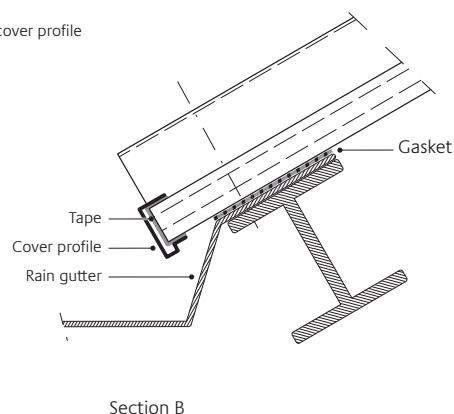


Roof glazing

Lexan® Thermopanel® sheet will be mainly used as roof lights covering the roof from ridge to eaves. To obtain a watertight connection on the roof ridge well-known metal flashing accessories can be used. See section A. Fixing holes at both side wings must be pre-drilled approx. 5 mm larger than the diameter of the shank of the fixing to allow for thermal expansion. The center to center distance between the fixings may not exceed 500 mm.



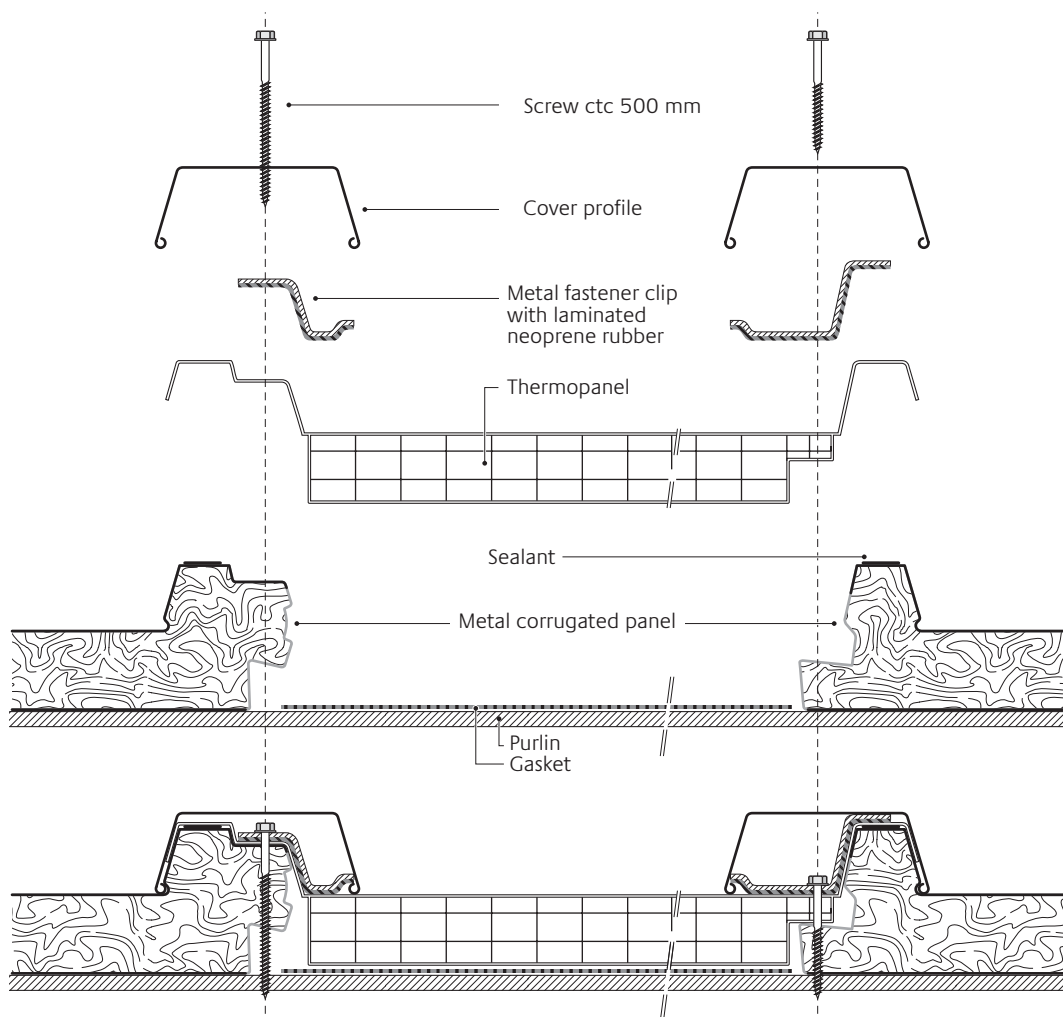
To cover the tape and to facilitate condensation drainage out the channels a 'U' profile as indicated on section B is suggested. To avoid sheet damage and to restrict the rattle noise effect during extreme wind pressure/suction it is recommended to apply a neoprene or foam gasket on the metal purlins.



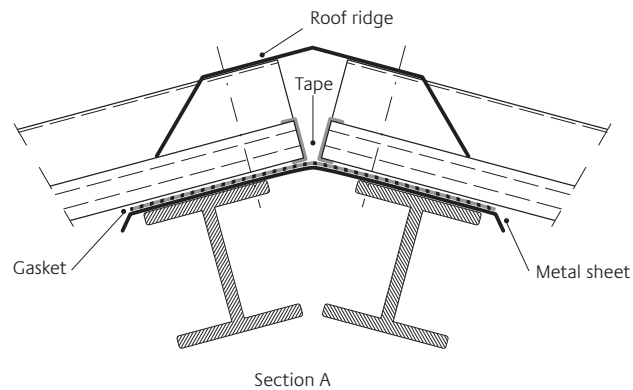
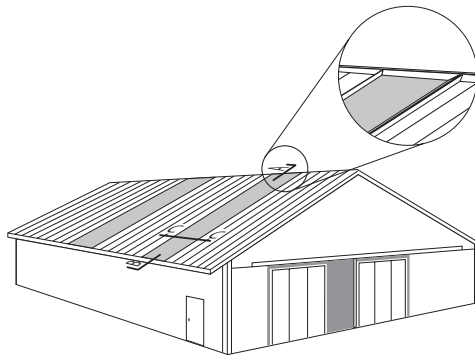
LTP30B / 4RS4000

Metal fastener clips with laminated neoprene rubber, as indicated above, can be used to fix the side wings of the Lexan Thermopanel sheet with bolts to the sides of the metal corrugated insulated panel. The metal fasteners force the Lexan Thermopanel sheet downwards and hold it in place during loading.

The arised empty place on one side between the metal corrugated insulated panel and the multi-wall part of the Lexan Thermopanel sheet must be filled with an insulated infill piece. This infill piece may be cut out of the metal corrugated insulated panel.



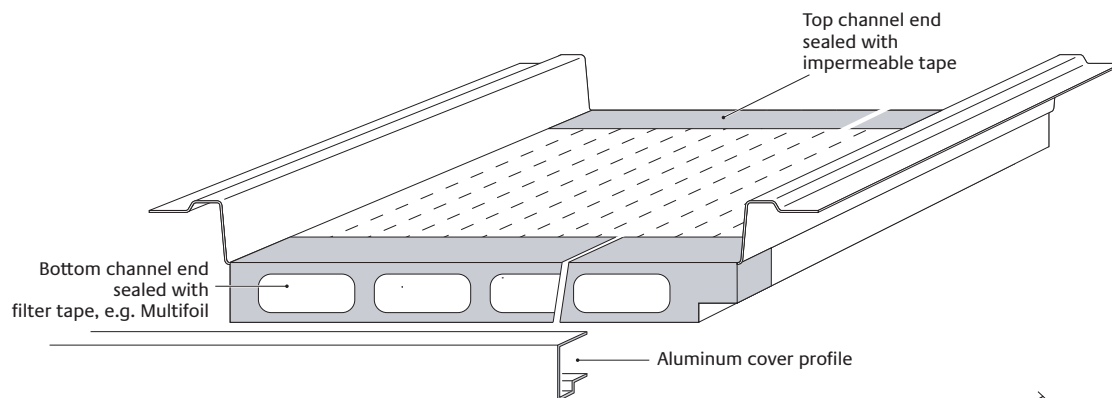
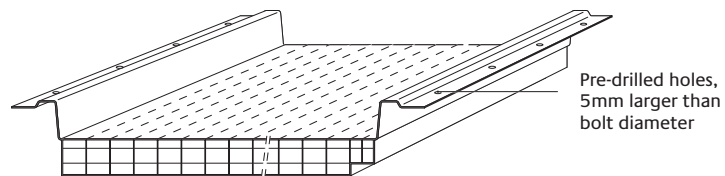
LTP30C / 4RS4000



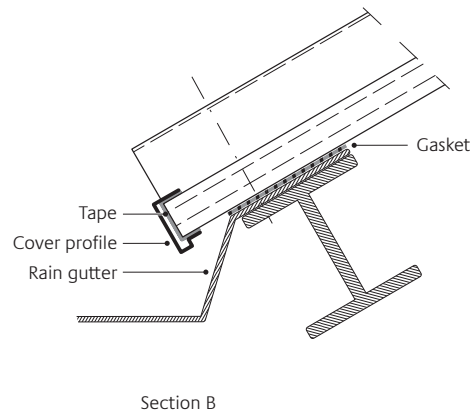
Roof glazing

Lexan® Thermopanel® sheet will be mainly used as roof lights covering the roof from ridge to eaves. To obtain a water tight connection on the roof ridge well known metal flashing accessories can be used. See section A.

Fixing holes at both side wings must be pre-drilled approx. 5 mm larger than the diameter of the shank of the fixing to allow for thermal expansion. The center to center distance between the fixings may not exceed 500 mm.



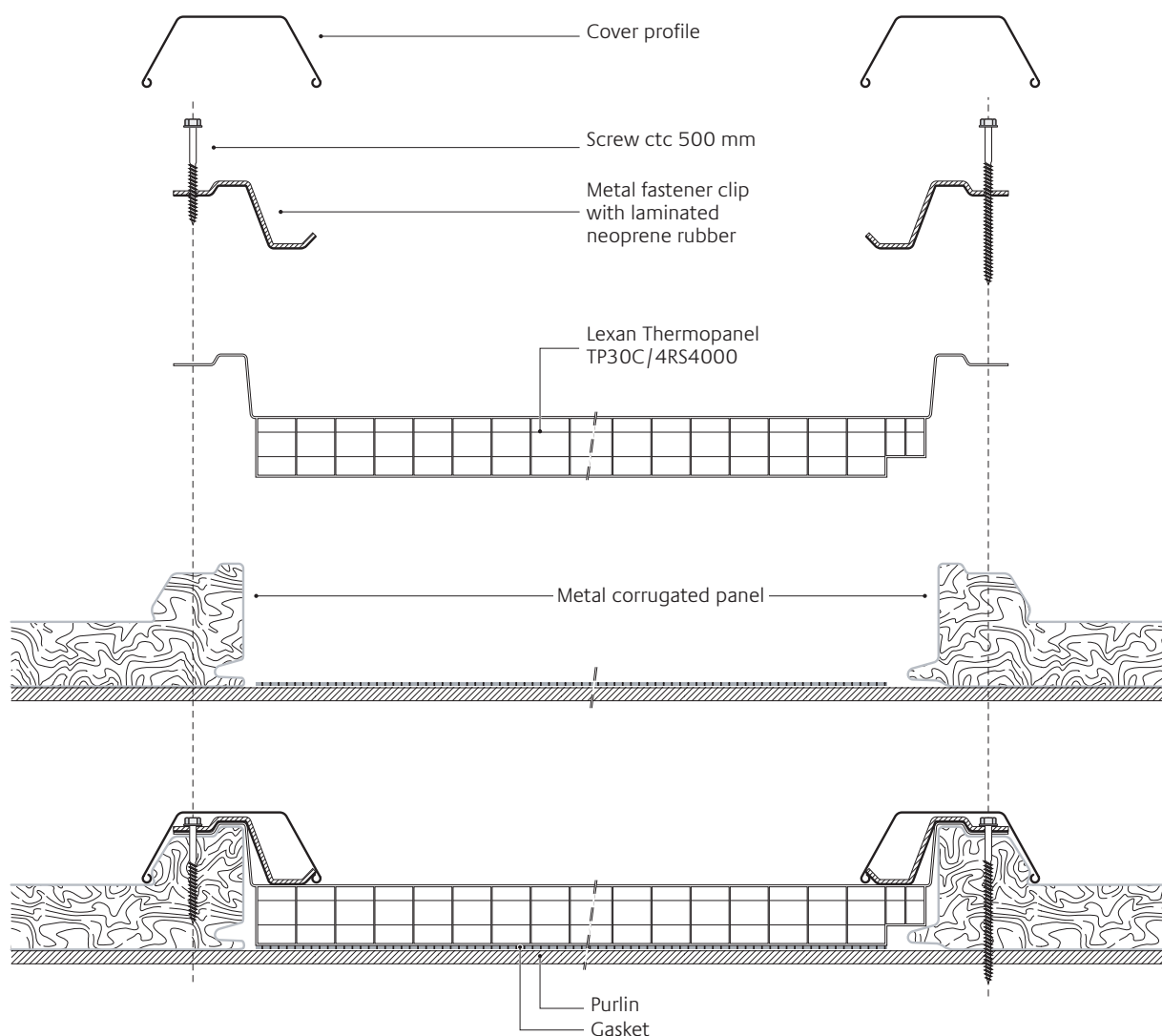
To cover the tape and to facilitate condensation drainage out the channels a 'U' profile as indicated on section B is suggested. To avoid sheet damage and to restrict the rattle noise effect during extreme wind pressure/suction it is recommended to apply a neoprene or foam gasket on the metal purlins.



LTP30C / 4RS4000

Metal fastener clips with laminated neoprene rubber, as indicated above, can be used to fix the side wings of the Lexan Thermopanel sheet with bolts to the sides of the metal corrugated insulated panel. The metal fasteners force the Lexan Thermopanel sheet downwards and hold it in place during loading.

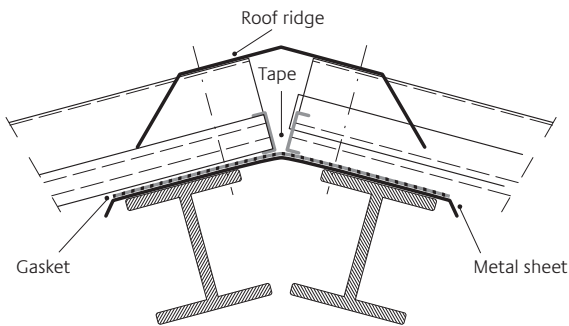
The arised empty place on one side between the metal corrugated insulated panel and the multi-wall part of the Lexan Thermopanel sheet must be filled with an insulated infill piece. This infill piece may be cut out of the metal corrugated insulated panel.



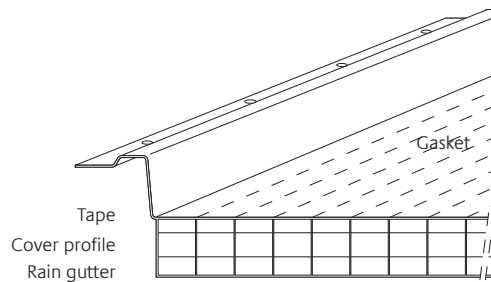
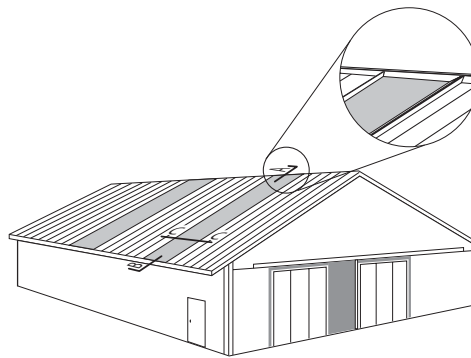
LTP30D / 4RS3600

Roof glazing

Lexan® Thermopanel® sheet will be mainly used as roof lights covering the roof from ridge to eaves. To obtain a water tight connection on the roof ridge well known metal flashing accessories can be used. See section A.



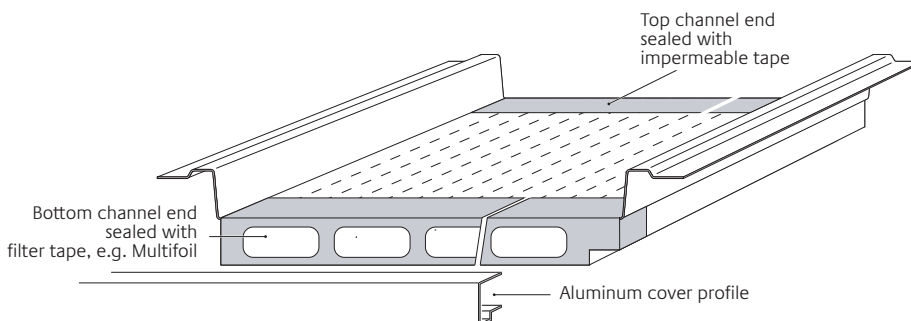
Section A



Section B

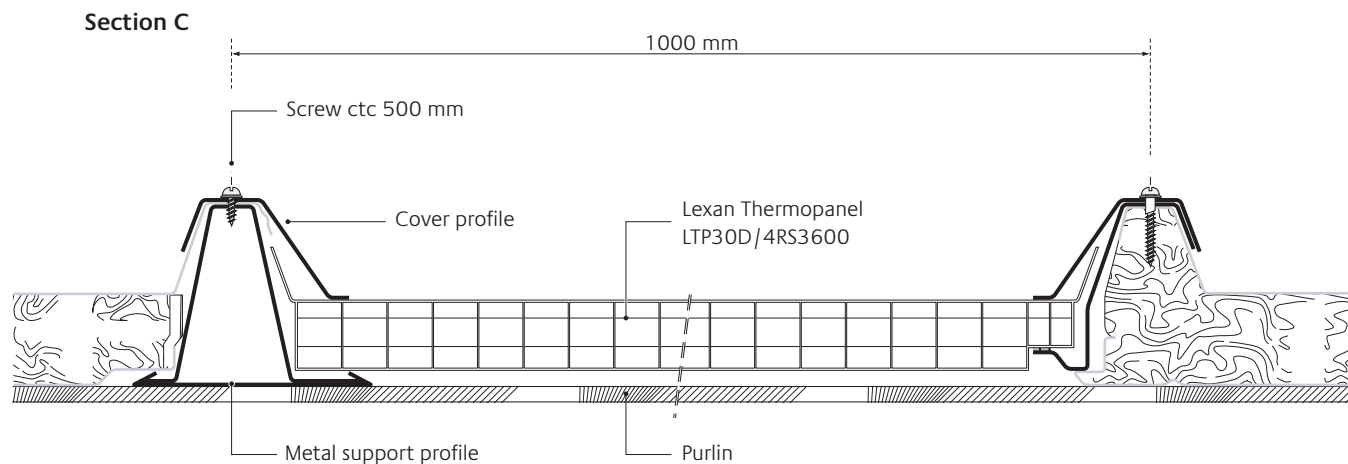
To cover the tape and to facilitate condensation drainage out the channels a 'U' profile as indicated on section B is suggested.

To avoid sheet damage and to restrict the rattle noise effect during extreme wind pressure/suction it is recommended to apply a neoprene or foam gasket on the metal purlins.



LTP30D / 4RS3600

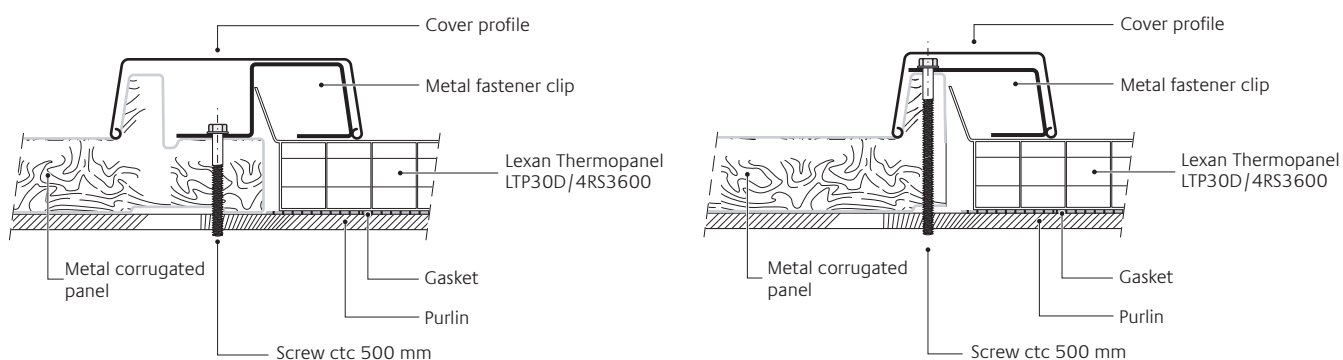
Proposal 1



As indicated at proposal 1 the Thermopanel is clamped between a metal support profile and a metal cover profile.

There are no additional purlins required to support the Thermopanel. The Lexan Thermopanel installed as indicated at proposal 1 may be exposed to a wind pressure/suction of 1750 N/m².

Proposal 2



As indicated at proposal 2 the Thermopanel is supported by the purlins.

Wind pressure in N/mm	Max. purlin distance in mm
1000	2000
1200	1900
1400	1800
1600	1700
Max. allowable wind suction = 1750 N/mm ²	

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