GLAZING INSTALLATION GUIDE

UN-COATED AND COATED SOLID LEXAN™ SHEET

INDEX

INTRODUCTION

SABIC offers a high-performance, engineering thermoplastics LEXAN™ sheet and film portfolio and full-service solutions for customers in various segments, including mass transportation, consumer electronics, glazing, building and construction. The company supports customers by providing materials that comply with relevant regulations, enabling customers to find new solutions to evolving requirements for fire safety, as well as related challenges of sustainability and cost reduction.

SABIC‘s LEXAN sheet products are directly extruded from LEXAN resin, which is a polycarbonate material, and offer significant advantages over many other glazing materials in terms of design freedom, light-weight, fire performance, UV protection and thermal insulation.

Furthermore, LEXAN sheet combines high impact resistance with optical clarity, thus providing superior safety and security against vandalism and intrusion.

PRODUCT PROFILE

LEXAN™ 9030 AND 9030TG SHEET

LEXAN 9030 sheet is a standard polycarbonate sheet grade for transparent protective glazing. Used for either primary or secondary glazing, to provide added protection against breakage or intrusion, it is a better insulator than glass and is easily fabricated for a wide range of indoor applications, machine guards or vandal-resistant street furniture. The TG version can be used for thin gauge applications.

LEXAN F2000 SHEET

LEXAN F2000 sheet is a standard transparent flame retardant polycarbonate sheet specially developed for industrial applications.

LEXAN F2000 sheet has a 5 year written limited warranty[Δ].

Due to the flame retardant properties of the material, the processing conditions may differ from the conditions used for the processing of standard LEXAN material.

LEXAN EXELL™ D SHEET

LEXAN EXELL D sheet is a transparent polycarbonate sheet with proprietary UV protection on both sides. With its excellent weathering properties and outstanding impact resistance, it can be used for a wide variety of building and construction applications.

LEXAN EXELL D sheet can be cold-formed into gentle curves which makes it an excellent candidate for skylights, covered walkways, barrel vaults, etc. LEXAN EXELL D sheet can be thermoformed into the desired shape whilst retaining the UV resistant coating specially developed for weather resistant applications.

The superior UV resistance and durability of LEXAN EXELL D sheet is covered by a 10 year written limited warranty[Δ] against yellowing, loss of light transmission and breakage.

LEXAN EXELL D ST SHEET

LEXAN EXELL D ST sheet is a UV protected, translucent product that yields excellent light diffusion. Its pebbled surface provides an excellent solution for privacy glazing with all the performance characteristics of standard polycarbonate.

LEXAN EXELL D ST sheet has a 10 year written limited warranty[Δ].

Δ Please contact SABIC for details about the product warranty.

LEXAN EXELL™ D OB SHEET

LEXAN EXELL D OB sheet is an opal white translucent sheet with proprietary UV protection on both sides offering excellent balance on light transmission and hiding power, in particular for LED and sign displays.

LEXAN EXELL D OB sheet has a 10 year written limited warranty∆.

Due to the UV resistance properties of the material, the processing conditions may differ from the conditions used for the processing of standard LEXAN sheet material.

LEXAN EXELL D SC IR** SHEET

LEXAN EXELL D SC IR sheet is a transparent proprietary Infrared absorbing polycarbonate sheet with UV protection on both sides. With its excellent weathering properties and outstanding impact resistance, it can be used in a wide variety of building and construction applications.

LEXAN EXELL D SC IR sheet can be cold-formed into gentle curves which makes it an excellent candidate for skylights, covered walkways, barrel vaults, etc, in which heat management is required. This product can be thermoformed into the desired shape whilst retaining the UV resistant coextrusion layer specially developed for weather resistant applications.

The superior UV resistance and durability of LEXAN EXELL D SC IR sheet is covered by a 10 year written limited warranty∆ against yellowing, loss of light transmission and breakage.

LEXAN™ ULG1000 SHEET

LEXAN ULG1000 is a transparent automotive grade offering excellent optical properties for applications in the automotive industry. The product is unique in the market in terms of visual defects and low optical distortion. The optical qualities of LEXAN ULG1000 sheets are superior to standard polycarbonate sheet, providing excellent value.

Our manufacturing facilities where this product is produced, are ISO 14001 and ISO 9001 certified. This product is produced in a clean room environment under the supervision of SABIC's Quality Management department.

LEXAN ULG1003 SHEET

LEXAN ULG1003 sheet is a non-UV protected transparent high optical quality polycarbonate sheet which is produced for applications which need excellent optical qualities such as symmetrical glass-pc laminates. LEXAN ULG1003 sheet is produced in a clean room environment and tested for diopter values based on the DIN 52305-A-AZ standard, which determines the optical distortion and refractive power of safety glazing material for road vehicles.

LEXAN™ MARGARD™ MR5E SHEET

Mar/UV resistant LEXAN MARGARD MR5E sheet combines the impact strength of LEXAN sheet with a proprietary abrasion/UV resistant surface that is close to glass in performance. This polycarbonate glazing material is covered by a 7 year written limited warranty∆ against yellowing, loss of light transmission, coating failure and a 10 year written limited warranty against breakage.

LEXAN MARGARD sheet is resistant to many chemicals, cleaning fluids, paints and adhesives.

Its unique coating defies graffiti to stick, enabling restoration to pristine condition. In addition, LEXAN MARGARD MR5E sheet offers improved resistance to weathering as well as forced entry protection. It is an excellent material option for use in shops, public buildings, schools, bus shelters and other high traffic areas. LEXAN MARGARD MR5E sheet is based on high optical LEXAN sheet. This product is tested for diopter values based on the DIN 52305-A-AZ standard, which determines the optical distortion and refractive power of safety glazing material for road vehicles.

LEXAN MARGARD MR5E IR** SHEET

Mar/UV resistant LEXAN MARGARD MR5E IR sheets combines the excellent properties of LEXAN MARGARD MR5E sheet with proprietary infrared absorbing properties. LEXAN MARGARD MR5E IR is an excellent material option to be used for flat glazing applications in which heat management is required.

∆ Please contact SABIC for details about the product warranty.

** Patented technology of SABIC

LEXAN™ MARGARD™ MR5FR SHEET

LEXAN MARGARD MR5FR sheet is a flame retardant version of MR5E sheet.

Due to the flame retardant properties of the material, the processing conditions may differ from the conditions used for the processing of standard LEXAN sheet material.

FLAT APPLICATIONS ONLY

Due to its mar-resistant coating, LEXAN MARGARD MR5E, MR5 IR and MR5FR sheet cannot be formed by using cold curving or cold line bending techniques. These products are intended for flat applications only.

ABRASION RESISTANCE

Tested for abrasion resistance, LEXAN MARGARD MR5E, MR5 IR and MR5FR sheets exhibit significantly less hazing than uncoated polycarbonate sheet.

LEXAN MARGARD FMR5 XT (FORMABLE) SHEET

LEXAN MARGARD FMR5 XT sheet is a transparent UV and abrasion resistant glazing material based on high optical LEXAN sheet. This product was tested for diopter values based on the DIN 52305-A-AZ standard, which determines the optical distortion and refractive power of safety glazing material for road vehicles.

LEXAN MARGARD FMR5 XT sheet combines the impact strength of LEXAN sheet with a proprietary formable abrasion/UV resistant surface.

It complies with ANSI Z26.1 standard (the American National Standard) for safety glazing materials.

LEXAN MARGARD FMR5 XT sheet can be cold-curved into shallow radii. It can also be drape-formed at a maximum temperature of 165 °C.

CURVED APPLICATIONS

Design freedom, light weight and optical clarity combined with superior mechanical properties make LEXAN MARGARD FMR5 XT sheet an excellent glazing material candidate for shaped applications such as curved windows (e.g. revolving doors), partitions, skylights, barrel vaults, balcony glazing, stair glazing, shelters and machine safety guards.

OPTICAL PERFORMANCE

Transparent, optical quality grades of LEXAN sheet for glazing offers excellent clarity and has the highest transmission in the visible light and near infrared region of the spectrum compared to standard polycarbonate sheet materials. As it is essentially opaque to all wavelengths below 385 nanometers, it can help protect things behind it from the damaging effects of UV rays. Its potential uses range from protection of art and antiques to retail displays and fabrics.

LEXAN sheet is normally manufactured in the standard sizes and colors listed below. Delivery of these products and cut-to-size materials are available through SABIC's wide distribution network.

For inquiries regarding the availability of different colors, dimension and pricing, please contact your SABIC representative for details.

PRODUCT OPTIONS

LEXAN™ 9030 sheet **Standard gauge in mm 2-3-4-5-6-8-9.5-12** LEXAN 9030 TG sheet **Standard gauge in mm 0.75-1-1.5**	
Standard colors	Light transmission*
• clear code 112	84-87% dep. on thickness
• solar bronze code 5109	50% all thicknesses
• solar grey code 713	50% all thicknesses
• opal white WH6D060X**	
Standard sizes:	
1250 x 2050 mm (Gauges <5mm)	
2050 x 3050 mm	
Masking:	
Top side:	Coex. opal white PE
Bottom side:	Coex. transparent

*Subject to a variance of 5% depending on the thickness of the sheet.
** Available up to 8mm.

LEXAN EXELL™ D sheet **Standard gauge in mm 2-3-4-5-8-9.5-12**	
Standard colors	Light transmission*
• clear code 112	84-87% dep. on thickness
• solar bronze code 5109	50% all thicknesses
• solar grey code 713	50% all thicknesses
• opal white code WH7D287O	50% all thicknesses
• opal white code WH4D348O	25% all thicknesses
Standard sizes:	
1250 x 2050 mm (Gauges <5mm)	
2050 x 3050 mm	
Masking:	
Top side:	Coex. opal white PE
Bottom side:	Coex. transparent PE

*Subject to a variance of 5% depending on the thickness of the sheet.
** Available up to 8mm.

LEXAN EXELL D ST sheet **Standard gauge in mm 3-4-5-6-8**	
Standard colors	Light transmission*
• Clear	84-87% dep. on thickness
• Bronze	50% all thicknesses
Standard sizes:	
2050 x 3050 mm	
Masking:	
Top side:	Non
Bottom side:	Coex. transparent PE

*Subject to a variance of 5% depending on the thickness of the sheet.

PRODUCT OPTIONS

LEXAN™ EXELL™ D SC IR sheet **Standard gauge in mm 3-4-5-6-8**		
Standard colors	Light Transmission*/**	Solar Transmission
• code GN8A081T	73% all thicknesses	61% all thicknesses
Standard sizes:		
2050 x 3050 mm		
Masking:		
Top side:	Coex. opal white printed PE	
Bottom side:	Coex. transparent PE	

Note: top side is textured

*Subject to a variance of 5% depending on the thickness of the sheet.

LEXAN™ MARGARD™ MR5E sheet/ LEXAN MARGARD FMR5 XT sheet **Standard gauge in mm 3-4-5-6-8-9.5-12**	
Standard colors	Light transmission*
• clear code 112 • solar bronze code 5109	73-87% dep. on thickness 50% all thicknesses
Standard sizes:	
2000 x 3000 mm	

Note: For some applications the ripple orientation may affect the optical performance of the sheet.
This orientation is indicated on the masking.

*Subject to a variance of 5% depending on the thickness of the sheet.

LEXAN MARGARD MR5 IR sheet **Standard gauge in mm 3-6-8-12**	
Standard colors	Light transmission*
• code GN8A081T	74.5% (for 6 mm)
Standard sizes:	
2000 x 3000 mm	

Note: For some applications the ripple orientation may affect the optical performance of the sheet.
This orientation is indicated on the masking.

*Subject to a variance of 5% depending on the thickness of the sheet.

LEXAN MARGARD MRX sheet **Standard gauge in mm 2-3-4-5-6-8-9.5-12**	
Standard colors	Light transmission*
• clear code 112	73-87% dep. on thickness
Standard sizes:	
2000 x 3000 mm	

Note: For some applications the ripple orientation may affect the optical performance of the sheet.
This orientation is indicated on the masking.

*Subject to a variance of 5% depending on the thickness of the sheet.

LEXAN MARGARD HLG5 sheet **Standard gauge in mm 2.5-3-4-5-6-78-9.5**	
Standard colors	Light transmission*
• clear code 112	85-92% dep. on thickness
Standard sizes:	
1220-2920 mm (gauges <3 mm) 2000-2920 mm (gauges >3 mm)	

Note: For some applications the ripple orientation may affect the optical performance of the sheet.
This orientation is indicated on the masking.

*Subject to a variance of 5% depending on the thickness of the sheet.

LEXAN MARGARD HLGA2 sheet **Standard gauge in mm 1-1.5-2-2.5-3-4-5-6**	
Standard colors	Light transmission*
• clear code 112	85-92% dep. on thickness
Standard sizes:	
1220-2920 mm (gauges <3 mm) 2000-2920 mm (gauges >3 mm)	

Note: For some applications the ripple orientation may affect the optical performance of the sheet.
This orientation is indicated on the masking.

*Subject to a variance of 5% depending on the thickness of the sheet.

TYPICAL PROPERTIES OF LEXAN™ SHEET

LEXAN SHEET

Solid LEXAN sheet exhibits an excellent balance of physical, mechanical and environmental properties which are maintained over a wide range of temperature and humidity conditions.

Specifics on the properties of these products are dealt with in this section.

TABLE 1:

TYPICAL PROPERTY VALUES* OF SOLID LEXAN SHEET

Property	Test Methods	Unit	LEXAN Sheet
Physical			
Density	ISO 1183	g/cm³	1.20
Water absorption, 50% RH, 23 °C	ISO 62	%	0.15
Water absorption, saturation, 23°C	ISO 62	%	0.35
Mechanical			
Yield stress 50 mm/min	ISO 527	MPa	60
Yield strain 50 mm/min	ISO 527	%	6
Nominal strain at break 50 mm/min	ISO 527	%	>100
Tensile modulus 1 mm/min	ISO 527	MPa	2300
Flexural strength 2 mm/min	ISO 178	MPa	90
Flexural modulus 2 mm/min	ISO 178	MPa	2300
Impact			
Charpy impact, notched 23°C, 3.0 mm	ISO 179/1eA	kJ/m²	75
Izod impact, unnotched 23°C, 3.0 mm	ISO 180/1U	kJ/m²	NB
Izod impact, notched 23°C, 3.0 mm	ISO 180/1A	kJ/m²	70
Thermal			
Vicat Softening Temperature, rate B/120	ISO 306	°C	145
Temperature of deflection under load (type A), 1.8 MPa, flat	ISO 75-2	°C	127
Thermal conductivity	ISO 8302	W/m. °C	0.2
Coefficient of linear thermal expansion, 23-55°C	ISO 11359-2	1/ °C	$7x\ 10^{-5}$
Ball pressure test 125 ±2°C	IEC 60695-10-2	—	Pass
Relative Thermal Index, Electrical properties	UL746B	°C	130
Relative Thermal Index, Mechanical properties with impact	UL746B	°C	125
Relative Thermal Index, Mechanical properties without impact	UL746B	°C	125
Electrical			
Volume resistivity	IEC 60093	Ohm.cm	10^{15}
Dielectric strength, in oil, 3.2 mm	IEC 60243-1	kV/mm	18

*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 SABIC, Functional Forms 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.

TYPICAL PROPERTIES OF LEXAN™ SHEET

PROPERTIES VS TEMPERATURE

An outstanding feature of solid LEXAN sheet is the retention of mechanical properties over a wide range of temperatures.

Solid LEXAN sheet is characterized by its excellent mechanical behavior, maintaining high strength and stiffness when exposed to elevated temperatures over a long period of time. For example, solid LEXAN sheet retains 85% of its room temperature flexural modulus at 82 °C. Figure 2 shows flexural modulus as a function of temperature.

IMPACT STRENGTH

LEXAN sheet is one of the toughest transparent thermoplastic materials. It has the ability to withstand impact from many kinds of objects, from stones to hammers, without shattering. Its energy absorbing characteristics are maintained at sub-zero winter temperatures or high summer temperatures. Polycarbonate sheet has 250 times the impact strength of glass and can be used for safety glazing against vandalism and forced entry.

FALLING DART IMPACT TEST FROM SABIC

SABIC has capability to measure according to the ISO6603 and ASTM D3763. ISO 6603 and ASTM D3763 specifies a test method for the determination of puncture impact properties of rigid plastics. A force-deflection or force-time diagram, can be obtained and is used for characterization of the impact behavior of FF sheet materials.

FIGURE 1

STRESS-STRAIN DIAGRAM FOR SOLID LEXAN SHEET

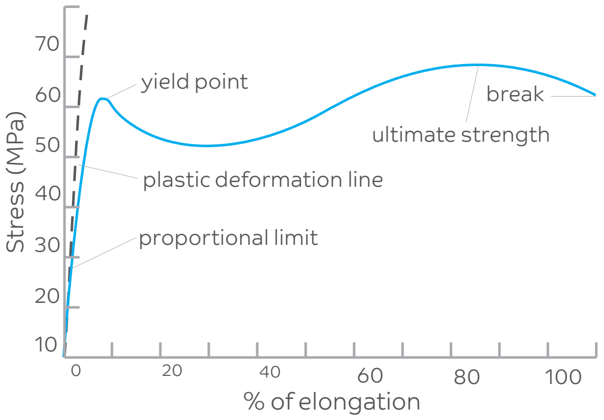
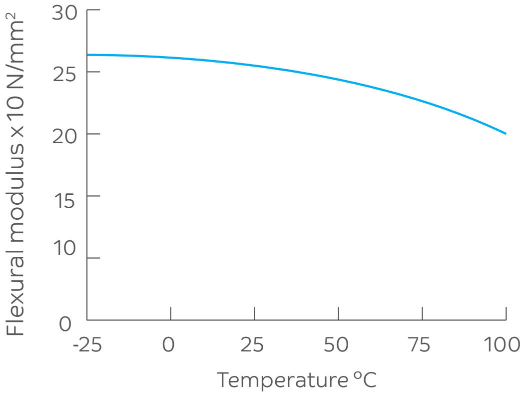


FIGURE 2

FLEXURAL MODULUS VS TEMPERATURE



Isotron droptower

MECHANICAL PROPERTIES

Across the glazing sheet range, which includes LEXAN™ EXELL™ D, LEXAN EXELL D SC IR, LEXAN™ MARGARD™ MR5E, MR5 IR, MRX and FMR5 XT, LEXAN™ 9030 and LEXAN EXELL D ST sheets, the outstanding toughness of this material offers excellent protection against breakage.

The entire product range meets the highest impact performance required by the European Norm EN356 for security glazing.

EN 356 STANDARD

EN 356 is a European Standard for glazing to withstand an intruder attack and uses the drop test to measure impact resistance. It has two resistance levels, the lower levels, P1A - P5A, and the higher resistance levels are P6B, P7B and P8B which require the samples to withstand 30/50, 51,70 or 71+ sledge hammer and axe blows respectively, before a 400mm square aperture is created.

STEEL BALL IMPACT TEST

A steel ball of 4.11 kg with a diameter of 100 mm is dropped freely from different defined heights onto the glazing specimen. In each class the steel ball must impact the specimen three times. The glazing material fulfils the requirements of the test if all impacts do not cause penetration by the steel ball. The relative classes, drop height requirements and test results are outlined in Table 2 with a diagrammatic representation of the test shown in Figure 3. Each of the products tested reached the highest standard required by the test at a thickness of 5 mm and above.

BALCONY GLAZING TEST – EN 12600 STANDARD

SOFT AND HARD BODY IMPACT

EN 12600 standard is a pendulum impact test for flat glazing that is used in buildings. Two different aspects of this particular test simulate the types of impact that may occur on infill glazing panels for balustrades and walkways. The soft body impact involves a pendulum test with a weight of 45 kg being released from a drop height of 1.5 meters onto the specimen. The hard body impact simulates a point-load situation with a pear shaped specimen weighing 10 kg being released from a height of 1.5 meters.

In both cases the impactor must not penetrate the glazing panel which should remain in position.

All solid LEXAN sheet grades with a thickness of 5 mm and above comply with the highest standards of this test.

FIGURE 3

STEEL BALL IMPACT TEST

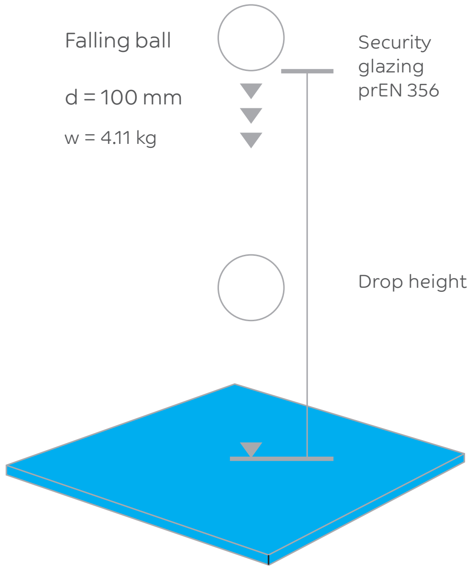


FIGURE 4

BALCONY GLAZING TEST DIN 52337 HARD/ SOFT BODY IMPACT

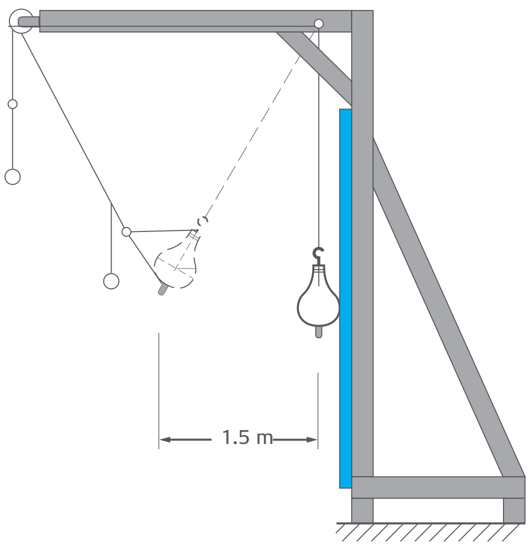


TABLE 2

STEEL BALL IMPACT TEST

Category of resis-tance	Drop height (mm)	Total number of strikes	Code designation for category of resistance	Impact energy per stroke
P1A	1500	3 in a triangle	EN 356 P1A	62 Joule
P2A	3000	3 in a triangle	EN 356 P2A	123 Joule
P3A	6000	3 in a triangle	EN 356 P3A	247 Joule
P4A	9000	3 in a triangle	EN 356 P4A	370 Joule
P5A	9000	3 x 3 in a triangle	EN 356 P5A	370 Joule

Classification table for the resistance of security glazing products according to European Norm EN356

PHYSICAL PROPERTIES

OPTICAL PERFORMANCE

LIGHT TRANSMISSION

The sunlight which reaches the surface of the earth has a wavelength that ranges between 295 – 2140 nanometers (10^{-9} meters).

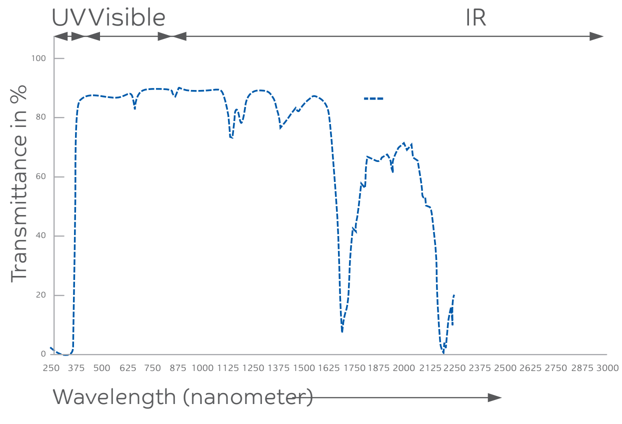
The optical window is divided into the following sections.

UV-B Middle UV Region	280 - 315 nm
UV-A Near UV Region	315 - 380 nm
Visible Light Region	380 - 780 nm
Near Infrared Region	780 - 1400 nm
Middle Infrared Region	1400 - 3000 nm

As shown in Figure 5, clear, solid LEXAN™ sheet products have the highest transmission in the visible light and near infrared region of the spectrum. LEXAN sheet products are opaque to all wavelengths below 385 nanometers. LEXAN sheet glazing can therefore be a good candidate for applications used to shield sensitive materials such as fabrics or other organic materials against discoloration (depending on the colorants sensitivity to visible light) in environments such as factory warehouses, museums or shopping centers.

FIGURE 5

LIGHT TRANSMISSION SPECTRUM OF LEXAN SHEET



CLEAR, SOLID LEXAN SHEET

Clear LEXAN sheet offers excellent clarity almost approaching that of glass, with light transmission values of 75 – 87%, depending upon the thickness of sheet.

However, for buildings in hot climates or with south facing aspects, LEXAN sheet is available in translucent grades of bronze, grey and opal white.

ENVIRONMENTAL FACTORS

UV PROTECTION

Solar radiation has a particularly harmful effect upon polymeric materials by initiating degradation through 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 EXELL™ D, LEXAN EXELL D ST and LEXAN EXELL D SC IR sheets have proprietary UV-protected surfaces, giving excellent resistance to outdoor weathering. The unique proprietary technology applied to these sheets provides long-term optical quality under intensive UV in comparison with other thermoplastic glazing.

Under ISO 4892 standard, a test has been developed using high intensity Xenon lamps to simulate natural sunlight for exposing materials to UV radiation, heat and water in apparatus designed to simulate the weathering effects that occur when materials are exposed in actual end-use environments to global solar radiation. Together with UV filters and programmable rain cycles, the test is able to simulate natural conditions.

Accelerated weathering tests done by SABIC using in-house ATLAS CI5000 Weather-O-Meter have been carried out according to ISO 4892. This test is comparable to 10 years outdoor exposure in moderate climate conditions. The unique protection of LEXAN sheet helps to provide long-term optical quality under intensive sunlight exposure, and maintains its high impact strength in comparison to other thermoplastic glazing products.

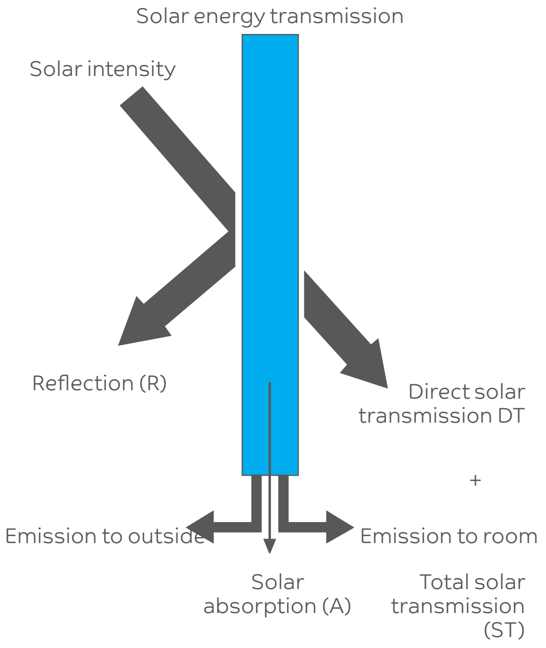
∆ WARRANTY

SABIC offers a ten year written limited warranty on LEXAN EXELL D and LEXAN EXELL D ST sheets covering discoloration, loss of light transmission and loss of strength due to weathering. Please consult SABIC sales office or local distributor for specific details.

SOLAR HEAT GAIN

FIGURE 6

SOLAR ENERGY TRANSMISSION



TEMPERATURE INCREASE INSIDE THE BUILDING

SOLAR CONTROL

LEXAN™ SOLAR CONTROL IR sheet grades can significantly reduce solar heat build-up, helping to maintain comfortable interior temperatures.

The specially tinted sheet cuts down the brightness of sunlight to a pleasing level and can help reduce air conditioning costs in hot climates.

Transparent LEXAN SOLAR CONTROL IR sheet blocks near infrared heat but lets in high levels of light. The heat is managed by proprietary resin additives rather than expensive and fragile coatings. This makes the solar control properties virtually permanent. This product is UV-protected on both sides, which helps installers reduce losses caused by installation errors.

SOLAR HEAT GAIN

The solar radiation reaching the sheet is reflected, absorbed and transmitted, as shown in Figure 6. 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 3 outlines the overall solar control properties of LEXAN sheet.

TABLE 3

SOLAR ENERGY TRANSMISSION

	LT	R	A	DT	ST	SC
LEXAN solid sheet Color number	Light transm. in %	Solar reflection in %	Solar absorption in %	Direct solar transm. %	Total solar transm. %	Shading coefficiency transm. %
Transparent 112	87	9	9	82	84	0.97
Bronze 5109	50	7	38	55	65	0.75
Grey 713	50	7	38	55	65	0.75
Opal white WH7D278O	54	20	29	51	58	0.67
Opal white WH4D348O	25	54	18	28	33	0.38
SC IR GN8A81T	73	7	40	50	61	0.71

TEMPERATURE RESISTANCE

The heat build-up of glazing materials can be seen as a function of the 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 in the glazing can be considerable. Calculations and actual measurements on installed LEXAN™ sheet in several projects throughout Europe have shown that sheet surface temperatures can reach up to 100 °C.

Figure 7 gives an example of the heat pattern of an open ventilated horizontal sloped roof glazed with bronze tinted LEXAN sheet when exposed to intense sunlight

LEXAN sheet is characterized by its excellent retention of impact strength and stiffness at elevated temperatures, even over an extended period.

LEXAN sheet retains 85% of its room temperature flexural modulus at 82 °C. The Vicat softening temperature and the deflection temperature under load of LEXAN sheet are both around 140 °C.

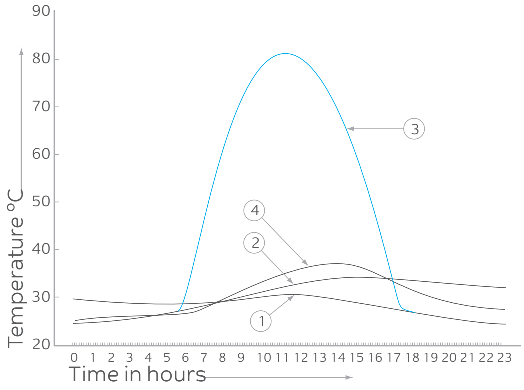
LEXAN sheet has a continuous-use temperature of 100 °C. At the other end of the scale, the minimum continuous-use temperature has been set at -40 °C. Using LEXAN sheet at lower temperatures is possible.

UL RATINGS

The Underwriters Laboratories' (UL) continuous use temperature rating can be considered as a reliable indicator of a thermoplastic sheet's long-term high temperature performance. The most important properties of the thermoplastic are tested at various temperatures. According to accelerated 10 years tests, no property may lose more than 50% of its original value. Table 4 outlines the UL-continuous use temperatures of typical thermoplastic glazing materials.

FIGURE 7

FREE-BLOWN DOMES DURING A DAY



1. Environment temperature
2. Metal construction temperature
3. LEXAN sheet temperature
4. Temperature beneath roof

TABLE 4

UL TEMPERATURE RATINGS UL 746B

LEXAN sheet	100 °C
Acrylic	50 °C
PVC	50 °C

ABRASION RESISTANCE

LEXAN™ MARGARD™ MR5E, MR5 IR, MRX, AND FMR5 XT SHEETS

HIGH RESISTANCE TO ABRASION

LEXAN MARGARD sheet has a unique, hard surface coating which provides a high level of protection against abrasion. It is therefore an excellent material option for use in applications where frequent contact is likely. The state-of-the-art coating on both surfaces of the MARGARD sheet makes it one of the most abrasion-resistant plastic material available today amongst safety and security glazing products.

POTENTIAL BENEFITS OF LEXAN MARGARD MR5E, MR5 IR, MRX AND FMR5 XT SHEETS

- UV PROTECTION

  Whilst the coating of LEXAN MARGARD sheet is essentially an abrasion-resistant barrier, the proprietary technology also offers improved UV protection.
- HIGH RESISTANCE TO CHEMICALS

  LEXAN MARGARD sheet is resistant to many chemicals, cleaning fluids, paints and adhesives.
  Its unique surface coating also resists* graffiti, enabling easy restoration to pristine condition.
- COMPREHENSIVE WARRANTY^Δ

  LEXAN MARGARD ssheet is covered by a seven year written limited warranty^Δ against loss of light transmission and coating failure and ten years against breakage.

^Δ Please contact SABIC for details about the product warranty.
* This does not apply to FMR5 XT.

LEXAN MARGARD MR5E, MR5 IR AND MRX SHEETS

- FLAT APPLICATIONS ONLY

  Due to its mar-resistant coating, LEXAN MARGARD MR5E sheet cannot be cold-formed. The sheet is intended for flat applications only.
- ANTI-VANDAL GLAZING

  Glazing with LEXAN MARGARD sheet is a choice solution in areas where there may be a risk of vandalism.
- SECURITY GLAZING

  LEXAN MARGARD sheet may be used to help prevent a burglar from forcing an entry.
- SAFETY SCREENS AND ACOUSTIC SCREENS

  LEXAN MARGARD sheet is an excellent material option for safety screening in sports stadiums and other outdoor applications.
- PREMISES SAFETY GLAZING

  LEXAN MARGARD sheet will not shatter or splinter, greatly reducing the risk of accidental injury in applications like interior partitions, doors and machine guards.

FORMABLE LEXAN MARGARD FMR5 XT SHEET

CURVED APPLICATIONS

Design freedom, light weight and optical clarity combined with superior mechanical properties make LEXAN MARGARD FMR5 XT sheet an excellent glazing material-candidate for shaped applications like: curved windows, partitions, skylights, barrel vaults, balcony glazing, stair glazing, shelters and safety guards.

TABLE 5

LEXAN MARGARD MR5E, MRX, HLGA2 AND FMR5 XT SHEET ABRASION RESISTANCE

	Test* Method	MARGARD FMR5 XT	MRX	MARGARD MR5E	MARGARD HLGA2	Glass
Taber Abrasion* CS10 F Wheels 500 gm weight	ASTM D1044 ANSI 226.1 1983	% Haze	% Haze	% Haze	% Haze	% Haze
a) 100 cycles	Plastic safety glazing test	4-8	5	1.3	0.5-1	0.5
b) 500 cycles	Extended test	—	<10	3-8	1-4	1.0
c) 1000 cycles	Glass safety glazing test	—	—	<10	—	2.0
Sandriesel Test*	DIN 52348	3,0	—	—	—	1.0

* These values are mean values, however the reproducibility of these test methods between laboratories can be variable.

SOUND AND THERMAL PROPERTIES

SOUND REDUCTION

SINGLE GLAZING

Installing solid LEXAN™ sheet into single or double glazing systems, provides better acoustic insulation compared to single glass. Table 6 compares single glazed LEXAN sheet's performance with that of glass.

TABLE 6:

ACOUSTIC INSULATION ISO 10140 Rw (dB)

Thickness in mm	LEXAN solid sheet	Glass
4	27	30
5	28	30
6	29	31
9.5	32	32
12	34	34
15	35	n.a.

Weighted Sound Reduction Index : Rw : a single-number quantity which characterises the airborne sound insulation of a material or building element over a range of frequencies.

Decibel : dB : a relative unit of measurement widely used in acoustics, electronics and communications

DOUBLE GLAZING

When applied together with existing glass and an airspace of >50 mm, LEXAN sheet considerably reduces sound transmission, particularly at low frequencies, such as traffic noise.

TABLE 7:

ISO 10140 ACOUSTIC INSULATION

Sheet thickness in mm			
LEXAN solid sheet	Glass	Air Space	Rw dB
4	6	85	39
6	6	85	40
8	6	85	42
9.5	6	85	44
4	6	54	36
6	6	54	37
8	6	54	40
9.5	6	54	42

THERMAL INSULATION

ENERGY LOSS CALCULATION

The need to reduce energy consumption, and therefore energy costs, is one of the highest priorities in any business today. Substantial savings in excess of 20% are possible when LEXAN sheet is used instead of mono-layer glass. When calculating according to the guidelines laid out in 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^2K.

SINGLE GLAZING

When using LEXAN sheet, considerable energy cost savings can be achieved by preventing excessive heat loss in winter and heat entry in summer. Heat loss is normally recorded as a K-value, which is the amount of energy transmitted through a material per square meter of glazing area and per degree of temperature difference.

TABLE 8:

SINGLE GLAZING U-VALUES W/M^2K

Thickness in mm	LEXAN solid sheet	Glass
4.0	5.33	5.82
5.0	5.21	5.80
6.0	5.09	5.77
8.0	4.84	5.71
9.5	4.69	5.68
12.0	4.35	5.58
15	4.17	5.45

DOUBLE GLAZING

The selection of LEXAN EXELL™ D sheet or LEXAN™ MARGARD™ sheet as either internal or external secondary glazing will depend upon the specific requirements of the building. Internal or external secondary glazing can improve protection against burglary. External installation can help protect against vandalism. For effective insulation, it is recommended to leave a 20–60 mm space between the existing glazing and the LEXAN EXELL D, LEXAN 9030 or LEXAN MARGARD sheet overglazing. Table 9 shows the K-value as a function of different LEXAN solid sheet thicknesses in combination with different glass thicknesses.

TABLE 9:

DOUBLE GLAZING

Thickness Glass (mm)	Thickness LEXAN Solid Sheet (mm)	Air Space (mm)	K-values (W/m^2K)
4	4	20-60	2.77
4	5	20-60	2.73
5	5	20-60	2.72
4	6	20-60	2.70
6	6	20-60	2.68
5	8	20-60	2.62
6	8	20-60	2.60
6	9.5	20-60	2.56
6	12	20-60	2.54
6	15	20-60	2.50

TRIPLE GLAZING

Extremely low K-values can be obtained by overglazing LEXAN EXELL D, LEXAN MARGARD or LEXAN 9030 sheet in combination with double sealed glass units.

TABLE 10:

TRIPLE GLAZING

*Thickness sealed glass unit (mm)	Thickness LEXAN solid sheet (mm)	Air Space (mm)	K-values (W/m^2K)
4+4	5	30-60	1.85
6+4	6	30-60	1.82
8+4	8	30-60	1.78

*air space = 12 mm

MISCELLANEOUS PROPERTIES

LIGHT WEIGHT

LEXAN™ sheet products are an excellent material option for replacements of more traditional glazing materials. They are safer and easier to handle and install than standard glass, and are virtually unbreakable.

Their light weight offers significant cost savings in transportation, handling and installation; when compared with glass of the same thickness they can offer a weight saving of more than 50%.

TABLE 11:
KG/M²

Thickness (mm)	LEXAN Sheet (kg/m²)	Standard Glass (kg/m²)
3	3.60	7.50
4	4.80	10.00
5	6.00	12.50
6	7.20	15.00
8	9.60	20.00
9.5	11.40	23.80
12	14.40	30.00
15	18.00	37.50

FIRE PERFORMANCE

Fire classification according to European standard EN13501-1:2018 “Fire classification of construction products and building elements: Part 1: Classification using data of reaction to fire tests”, reaches from A1 (non-combustible) – F (no performance determined), smoke density s1, s2 or s3 and d0 (no flaming droplets), d1, d2.
Testing is according to EN-ISO 11925-2, the “Small burner test”, and EN 13823, the “Single burning item” test.

LEXAN solid sheet has good fire behavior characteristics, and receives high ratings in the European fire tests. As a thermoplastic, LEXAN sheet will melt under the intense heat of a fire. However, in terms of its own flammability, it will make almost no contribution to the growth of a fire through flame spread. Based on European standard EN13501-1:2018 uncoated LEXAN sheet is classified as B-s1-d0 up to 6 mm. Above 6 mm the fire test becomes invalid.

REMARK

For more detailed information about properties of sheet products, please contact SABIC.

CHEMICAL RESISTANCE

LEXAN™ sheet is 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 by installer. For sheet products, the most common materials are sealants, gaskets and the various cleaning media. Chemical compatibility testing is an ongoing process at SABIC and many standard products have already been tested. A complete list of recommended cleaners, gaskets and sealants is available on request.

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.

DO NOT USE PVC GASKETS

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

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

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

CHEMICAL RESISTANCE OF LEXAN™ MARGARD™ SHEET

The “mar” resistant coating of LEXAN MARGARD sheet provides an additional benefit in terms of chemical resistance.

The proprietary coating is resistant to a range of chemicals that under normal circumstances is detrimental to LEXAN sheet. Further information is available on request.

CLEANING

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 CLEANING LEXAN SHEET:

- 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.

CLEANING

- 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 Material Safety Data sheet (MSDS) 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, corrugated 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 and corrugated sheets.

CLEANING PRIOR TO FORMING

It is necessary to clean LEXAN™ sheet prior to forming. It is recommended that the dust is blown off with an ionizing air gun or the sheet is wiped with a soft cloth dipped in water or a 30/70 mixture of isopropanol and water.

RECOMMENDATIONS FOR CLEANING LEXAN™ MARGARD™ SHEET

The unique surface of LEXAN MARGARD sheet provides superior protection against chemical attack. Even graffiti such as spray paint can be quickly removed. Although LEXAN MARGARD has a mar-resistant coating, the use of abrasive cleaners and/or sharp cleaning instruments that may damage or scratch the coating should be avoided.

Graffiti removal from LEXAN MARGARD sheet

- Butyl cellosolve can be used to remove paints, marking pen inks and lipstick stains. Afterwards, wash the sheet using mild soap and lukewarm water.
- Masking tape, adhesive tape or lint removal tools can be used to lift off old, weathered paints.
- To remove label stickers, the use of kerosene or petroleum ether (BP65°) can be generally effective. If solvent doesn't penetrate to sticker material, apply heat (hair dryer) to soften the adhesive and promote removal of the sticker. Afterwards please follow the cleaning procedure for small areas as outlined above.

FABRICATION

The following section discusses the techniques and processes used to fabricate finished products from solid LEXAN sheet and LEXAN MARGARD sheet (polycarbonate) and provides recommendations and advice on how to achieve the best results.

CUTTING

LEXAN sheet can be cut with a variety of common hand-held and table mounted sawing equipment. Special attention to blade design and cutting speed is important to obtain good quality finishes.

CAUTION should be taken and required safety equipment should be worn when cutting. When working with LEXAN sheet, always consider safe and careful handling. Use appropriate eye and ear protection and exercise caution when operating cutting equipment.

CIRCULAR SAWS

The blade should be designed to minimize blade body rubbing during sawing. Fine tooth hollow ground blades and triple chip carbides are excellent choices and will produce a good quality surface finish.

- Thin gauge sheet: 1/16"–3/32" (1.6 – 2.4 mm)
  – Hollow ground panel blades.
  – 10-12 teeth per inch (25 mm).
- Heavy gauge sheet: 1/8"–1/2" (3.2 – 12.7 mm)
  – Triple chip cut carbide blades with alternating bevel and straight teeth.
  – 3 teeth per inch (25 mm).

BAND SAWS

LEXAN sheet can be cut in all thicknesses satisfactorily with band saws.

- 10–18 teeth per inch (25 mm).
- Blade speeds: 2500–3000 feet per minute (762 – 914 m/min).

MILLING AND ROUTING

High rotating speeds or low feed rates are advisable for end milling. Higher feed rates are permissible, but only with increased milling speeds.

The use of right or left handed spiral cutting bits with handheld or table mounted routers will minimize material chatter and help hold the LEXAN sheet against the router surface.

CAUTION should be taken and required safety equipment should be worn when milling. When working with LEXAN™ sheet, always consider safe and careful handling. The method and the purpose that you choose to utilize our products are beyond our control. Therefore, it is imperative that you test our products to determine to your own satisfaction whether our products, technical assistance and information are suitable for your intended use and application. This application-specific test must at least include analysis to determine suitability from a technical as well as health, safety, and environmental standpoint. Such testing has not necessarily been done by SABIC. Unless we otherwise agree in writing, all products are sold strictly pursuant to the terms of our standard conditions of sale, which are available upon request. For further technical assistance and recommendations, please contact SABIC, for which you can find the contact details on the back page of this brochure.

BIT RECOMMENDATIONS

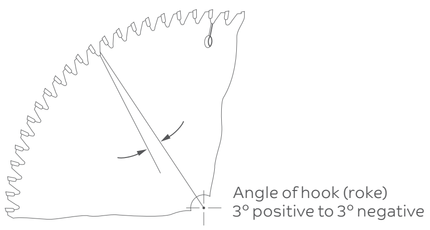
- Spiral router bits are preferred.
- One or Two fluted carbide tipped bits, 3/8”–1/2” (10 – 12.7 mm) diameter, can also be used.

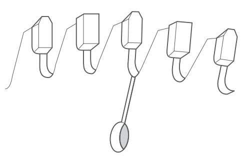
ROUTER SPEEDS

- No-load speeds: 25,000–30,000 rpm.

FIGURE 8

TUNGSTEN CARBIDE TIPPED SAW BLADES USED FOR CIRCULAR SAWS

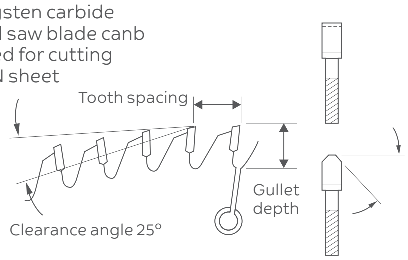




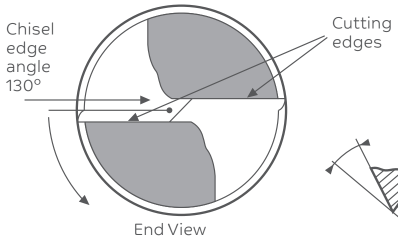
Details of a typical saw:

Diameter	400 mm
Tooth spacing	12 mm
Gullet depth	11 mm
Shaft speed	4000 rev/min

A tungsten carbide tipped saw blade canb be used for cutting LEXAN sheet

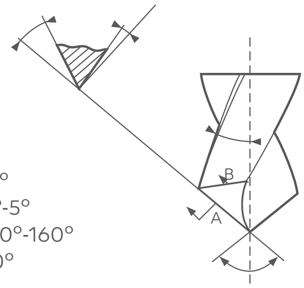


RECOMMENDED DRILL ANGLES



Recommended drill angles:

Clearance Angle	A	15°
Rake Angle	B	0°-5°
Included Tip Angle	C	120°-160°
Helix Angle	D	30°



DRILLING

LEXAN sheet can be drilled easily using a standard twist drill design. High speed steel or carbide tipped twist drills will give the best results with the following conditions.

TABLE 12

DRILLING RECOMMENDATIONS

Hole Diameter	Speed (rpm)
1 / 8 (3.2 mm)	1000-2000
1 / 4 (6.4 mm)	1000-1500
3 / 8 (9.6 mm)	500-1000
1 / 2 (12.7 mm)	325-650
3 / 4 (19.2 mm)	300-400

To minimize the drill’s tendency to pull into the material, modify the standard steel twist design by grinding a small flat on the cutting edge.

NOTE: Make sure drill is clean and free from oil and grease. Please consult equipment suppliers for drilling, cutting, cooling fluids, which are recommended for polycarbonate.

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 w N/m²
K = 0.613
V = design wind speed in meters/second

TABLE 13

VALUES OF Q IN SI UNITS (N/M2)

Wind speed m/s	Wind pressure N/m²	Wind speed m/s	Wind pressure N/m²
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 Sales Office.

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. The wind loading is obtained by multiplying the dynamic wind pressure by the pressure coefficient. Detailed pressure coefficient values can be found in the appropriate building norms.

SNOW LOADING

Snow loading on roof glazings can be considered equivalent to a vertically, uniformly distributed load, acting per m² of the horizontal projection of the glazing. Snow loading factors can be obtained from the appropriate building norm.

COMPUTER AIDED SHEET ENGINEERING

A computer aided design programme has been developed specifically 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 SABIC Technical Service Center for further advice.

WIND AND SNOW LOAD CONSIDERATION

The results shown in Table 15 is applicable for loads varying from 600 up to 2000 N/m². These loads cover most of the normal glazing projects, fulfilling requirements according to European standard NEN 3850.

FIGURE 9

FINITE ELEMENT MODEL

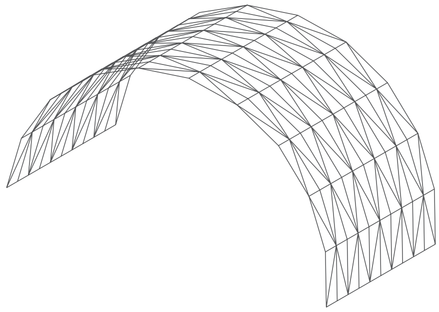


FIGURE 10

DEFLECTION PLOT

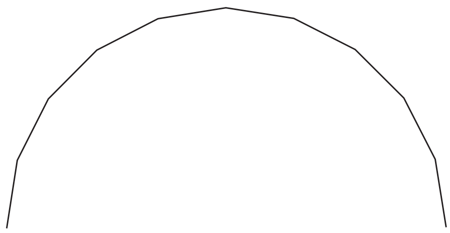
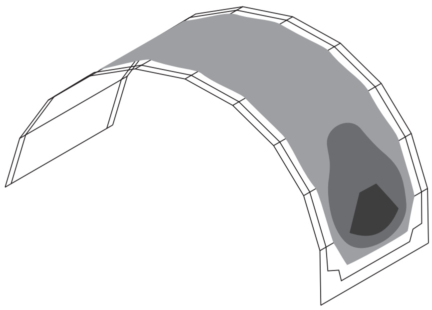


FIGURE 11

DEFLECTION CONTOUR PLOT



GLAZING PRECAUTIONS

- Glazing of LEXAN™ sheet should be considered a finishing operation and should be scheduled as a final step in the completion of a building.
- Care should be taken to avoid surface marring during storage, cutting, transporting and installation.
- After installation and removal of masking, LEXAN sheet should be protected from paint, plaster and other contamination by polyethylene or other covering taped to the framing members.
- Check compatibility of the LEXAN sheet with the suppliers of the selected glazing tapes, gaskets and sealants.

THERMAL EXPANSION ALLOWANCE

Since LEXAN sheet has a larger coefficient of linear thermal expansion than that of the glazing profiles commonly used, care should be taken to allow free expansion of the sheet to avoid bowing and thermal stress. Linear Thermal Expansion Coefficients for various materials are shown below:

TABLE 14

Material	m/m°C x 10^{-5}
LEXAN Sheet	7
Glass	0.7 - 0.9
Aluminium	21. - 2.3
Steel	1.2 - 1.5

Allowance for thermal expansion must be made for both the length and the width of the LEXAN sheet. The recommended allowances for various sheet dimensions are outlined in Table 15.

In general: Thermal expansion of the sheet is approximately 3 mm per linear meter.

SHEET EDGE ENGAGEMENT/REBATE DEPTH REQUIREMENTS

Table 15 indicates the minimum required sheet edge engagement of LEXAN sheet in the glazing profiles. The rebate depth is the sum of the specific edge engagement and the expansion allowance. The total rebate depth should include a minimum edge engagement and an allowance for thermal expansion.

TABLE 15

THERMAL EXPANSION/SHEET EDGE ENGAGEMENT

Sash Dimensions (A-B) (mm)	Trim Sheet by C (mm)	Sheet edge engagement G (mm)
300	1	6
300 - 600	1 - 2	6 - 9
600 - 900	2 - 3	9 - 12
900 - 1200	3 - 4	12 - 15
1200 - 1500	4 - 5	15 - 18
1500 - 1800	5 - 6	18 - 20
1800 - 2100	6 - 7	20
2100 - 2400	7 - 8	20
2400 - 2700	8 - 9	20
2700 - 3000	9 - 10	20

FIGURE 12

THE MINIMUM REQUIRED SHEET EDGE ENGAGEMENT OF LEXAN SHEET IN THE GLAZING PROFILES

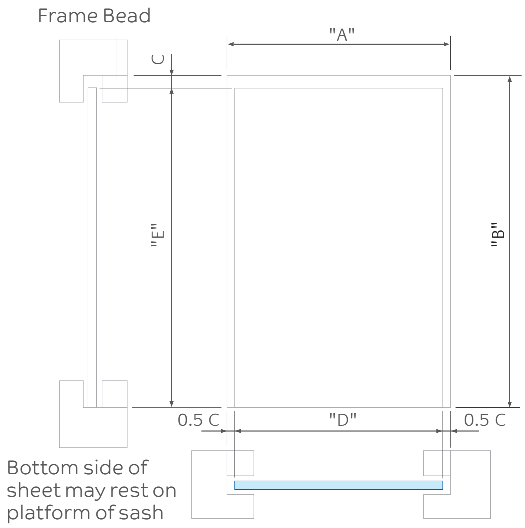
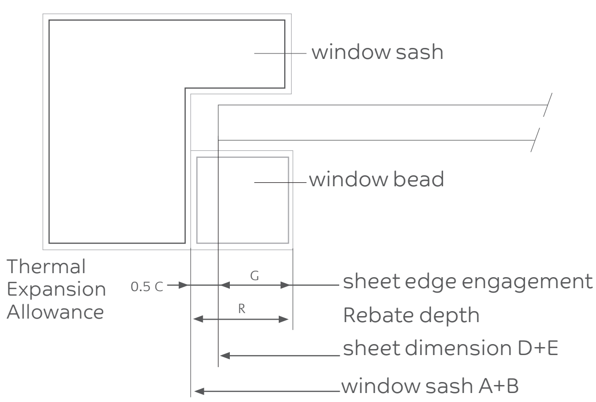


FIGURE 13

THERMAL EXPANSION ALLOWANCE OF LEXAN SHEET IN THE GLAZING PROFILES



GLAZING SYSTEMS

Figures 14 and 15 illustrate typical installations for dry and wet glazing systems using LEXAN™ sheet products, a polycarbonate product.

It is extremely important when installing LEXAN sheet that the edges are correctly clamped, whether the application involves wet or dry glazing conditions.

See page 22 for thermal expansion clearance and minimal sheet edge engagement.

WET GLAZING SYSTEMS

LEXAN sheet can be glazed using standard metal or wooden window frames in combination with glazing tapes and non-hardening glazing compounds, including Polybutylene glazing filler tapes.

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 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 can result in crazing, particularly when stress is involved.

DRY GLAZING SYSTEMS

The advantage of dry glazing is that the rubber gaskets snap-fit into the glazing bars which allows free movement of the sheet during expansion and contraction.

This should be considered therefore for both aesthetic reasons and for applications where sheet expansion exceeds sealant limitations. Neoprene, EPT or EPDM rubbers, ± 65 shore, are recommended.

FIGURE 14
DRY GLAZING INSTALLATION

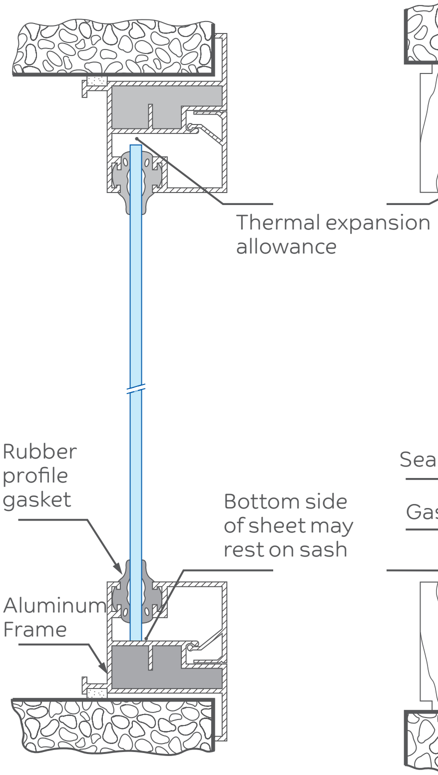
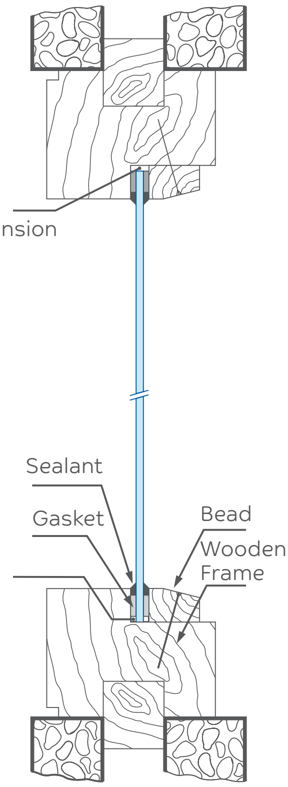


FIGURE 15
WET GLAZING INSTALLATION



SHEET GLAZING GUIDELINES

DO'S

- Clean the window frame. Remove old putty or broken glass, if necessary.
- Measure the sheet edge engagement area and internal window frame dimensions, i.e. the space into which the LEXAN™ 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.
- Clamp the LEXAN 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.
- 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.
- For wet glazing, apply single-sided self-adhesive glazing tape or rubber profile to both the window frame and the 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 sheet into the window frame.
- Fix the window bead or the clamping cover profile in place.
- For wet glazing, apply an approved silicone sealing compound 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.

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 sheet with squeegees, razor blades or other sharp instruments.
- Do not walk on LEXAN sheet at any time.
- Avoid direct sunlight or high temperatures during cleaning of LEXAN sheet as this can lead to staining.
- Benzene, gasoline, acetone, carbon tetrachloride or butyl cellosolve should never be used on LEXAN sheet.

FIGURE 16
WET GLAZING

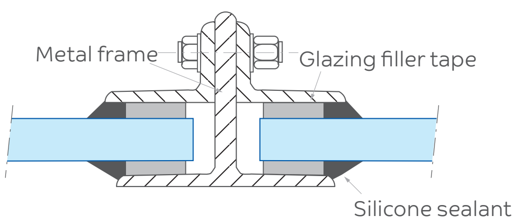
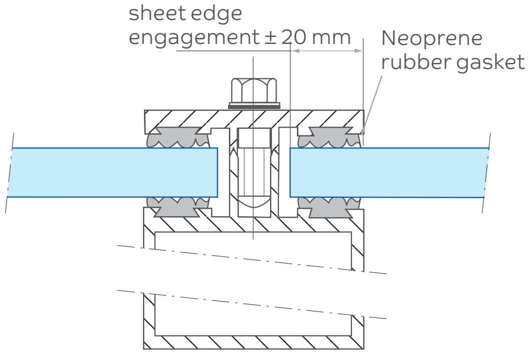


FIGURE 17
DRY GLAZING



OVERGLAZING DOUBLE GLAZING

The selection of LEXAN™ 9030, LEXAN EXELL™ D or LEXAN™ MARGARD™ sheet as either internal or external secondary glazing will depend upon the specific requirements of the building: external or internal secondary glazing for improved burglar resistance and externally for protection against vandalism.

Specialised companies, recognizing the need for more substantial and secure overglazing designs, have developed pre-assembled profile systems.

These systems allow for easy pre-fabrication and the rubber gaskets are interchangeable to hold sheet thicknesses of between 5–10 mm.

Figures 19 and 20 show typical examples of overglazing installations.

INTERNAL OVERGLAZING

LEXAN MARGARD sheet is also an excellent glazing material for interior applications, (Figure 18).

When LEXAN MARGARD sheet is installed internally, the criteria for deflection under wind load no longer apply and therefore the recommended sheet thickness can be reduced.

EXTERNAL OVERGLAZING

Depending upon requirements, either LEXAN MARGARD sheet or LEXAN EXELL D sheet can be used (Figure 19). Functional and aesthetic requirements should be taken into account with respect to deflection under wind load.

FIGURE 18
INTERNAL OVERGLAZING

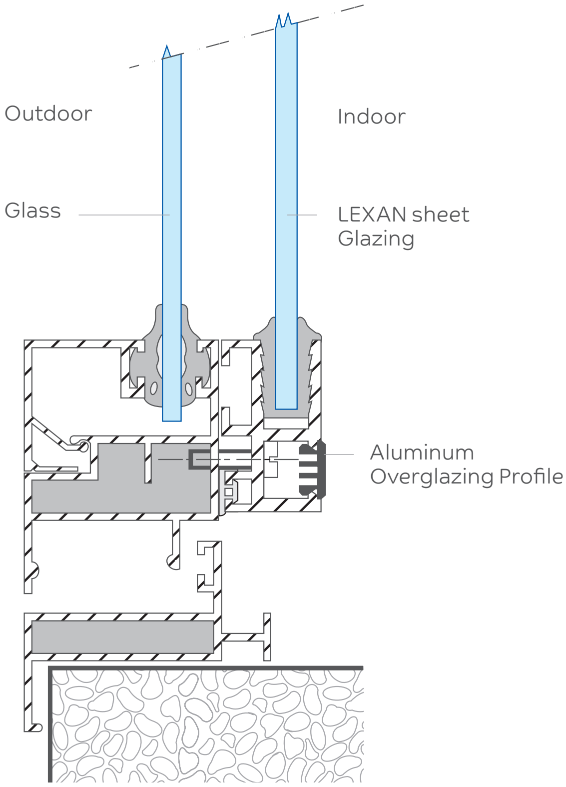
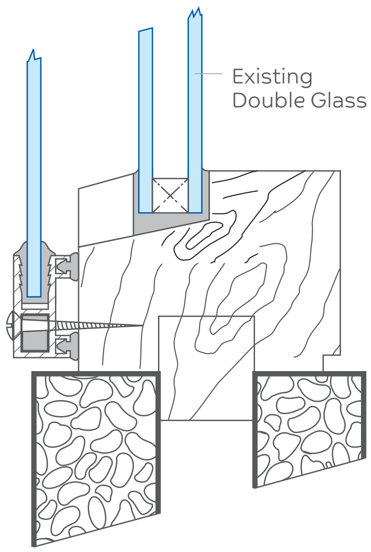


FIGURE 19
EXTERNAL OVERGLAZING



DOUBLE GLAZING UNITS

Due to the water vapor permeability of LEXAN™ sheet, it is possible for condensation to form in the cavity, whether the double glazing unit is made with two LEXAN sheets or made with one LEXAN sheet over a glass sheet. Permanent condensation inside the cavity may occasionally be a problem and algae growth in the form of green deposit can occur. There is a technique that can be adopted to significantly reduce the condensation. U-shaped aluminium distance holders ± 20 mm can be used to create an air gap.

Holes of 6 mm diameter c.t.c. ± 200 mm should be drilled in the aluminium U profile used for the bottom of the glazing.

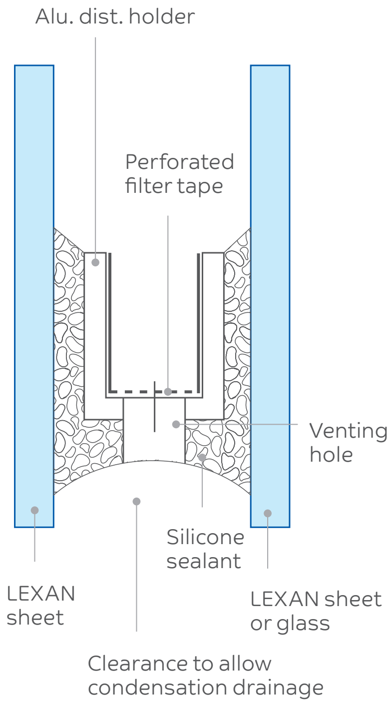
These venting holes allow for some air ventilation and prevent excessive condensation through drainage to the outside. To avoid dust/insect penetration, the holes inside the cavity must be sealed with a perforated filter tape such as Multifoil AD 3429. To seal the LEXAN sheet onto the alu spacer, silicone sealant can be used. Care should be taken to provide clearance between both the sheet edge and the sash platform to allow for condensation drainage.

These guidelines are recommendations only.

No guarantee can be given since the above mentioned problems depend largely on the prevailing environmental conditions.

FIGURE 20

DOUBLE GLAZING UNITS



FLAT GLAZING SHEET THICKNESS SELECTION

FOUR SIDES CLAMPED LEXAN™ SHEET

The deflection characteristics in this particular configuration are dependent upon the ratio of the support bar spacing a:b, (see Figure 21).

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:>2
Ratio sheet width “a”: sheet length “b” 1:2
Ratio sheet width “a”: sheet length “b” 1:1

SAFETY FACTOR

Table 16 indicates the maximum allowable sheet sizes at a specified loading which results in an acceptable sheet deflection behavior without the risk of sheet buckling or pop-out effect. To calculate the allowable deflection, divide the shortest sheet side “a” by 20. A maximum deflection of 50 mm is recommended.

Example I
Window size: Width: 1600 mm Length: 3200 mm
Ratio a:b = 1:2
Loading: 1000 N/m²
Required sheet type: 12 mm
Maximum deflection: 50 mm

Example II
Window size: Width: 1000 mm Length: 4000 mm
Ratio a:b = 1:>2
Loading: 800 N/m²
Required sheet type: 8 mm
Maximum deflection: 50 mm

TWO SIDES CLAMPED LEXAN SHEET

a = center to center distance of glazing profiles
b = sheet length
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.

GENERAL COMMENTS

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

Table 16 assumes an edge engagement as indicated in Table 17, page 28, on both edges.

FIGURE 21
FOUR SIDES CLAMPED LEXAN SHEET

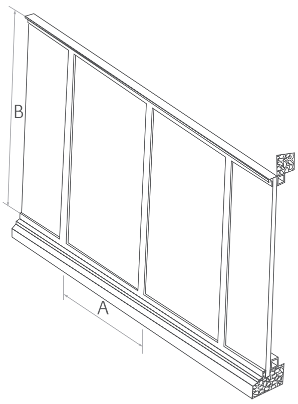


TABLE 16
CENTER TO CENTER DISTANCE OF GLAZING PROFILES (SHORTEST SIDE A)

	Ratio sheet width: sheet length																							
LEXAN sheet thickness in mm	1:1	1:2	1:>2	1:1	1:2	1:>2	1:1	1:2	1:>2	1:1	1:2	1:>2	1:1	1:2	1:>2	1:1	1:1,5	1:>1,5	1:1	1:2	1:>2	1:1	1:2	1:>2
3	775	600	400	700	550	375	650	500	--	600	450	--	575	400	--	550	--	--	525	--	--	500	--	--
4	1050	800	550	950	700	490	875	650	450	825	600	425	780	550	400	740	500	--	710	475	--	685	450	--
5	1300	975	675	1180	875	625	1100	800	575	1025	750	550	975	700	510	930	670	490	900	625	470	875	560	450
6	1475	1150	800	1375	1010	725	1300	960	680	1225	900	650	1175	850	600	1125	800	575	1075	710	550	1025	650	525
8	1850	1450	1150	1700	1350	1000	1600	1275	925	1525	1200	860	1475	1150	810	1425	1075	775	1375	100	750	1325	950	725
9,5	2050	1600	1300	1950	1475	1150	1850	1400	1075	1750	1350	1025	1675	1300	975	1625	1250	925	1575	200	880	1525	1100	850
12	2050	1750	1500	2050	1700	1400	2050	1600	1325	2050	1525	1275	2000	1475	1225	1950	1450	1175	1875	1400	1125	1800	1350	1075
15																								
Loading in N/m²		600			800			1000			1200			1400			1600			1800			2000	

TWO SIDES BOLTED LEXAN™ SHEET

Fastening LEXAN 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.

Large metal washers laminated with compatible rubber should be used. Bolts should not be tightened so that the force permanently deforms the sheet or restricts its natural expansion and contraction.

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 two times the hole diameter. To calculate the allowable deflection for both glazings, divide the unclamped sheet side “a” by 20. A maximum deflection of 50 mm is recommended.

FIGURE 22

ALLOWABLE SLOPE FOR GLAZING

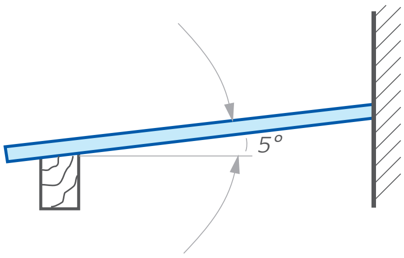


FIGURE 23

BOLT ASSEMBLY OF LEXAN SHEET AND EXAMPLE OF SPACING BETWEEN THE HOLE AND THE SHEET EDGE.

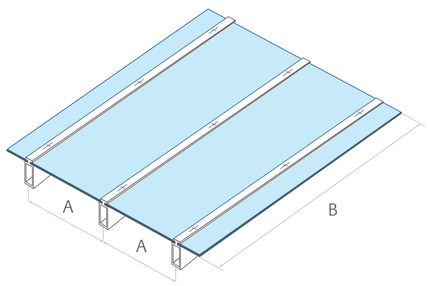


FIGURE 24

USING CONVENTIONAL NUTS, BOLTS AND WASHERS TO FASTEN LEXAN SHEET .

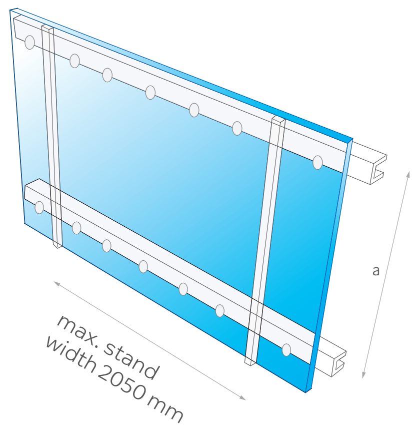


FIGURE 25

FIXATION OF LEXAN SHEET TO SUPPORT/GLAZING PROFILE WITH METAL WASHERS AND BOLTS.

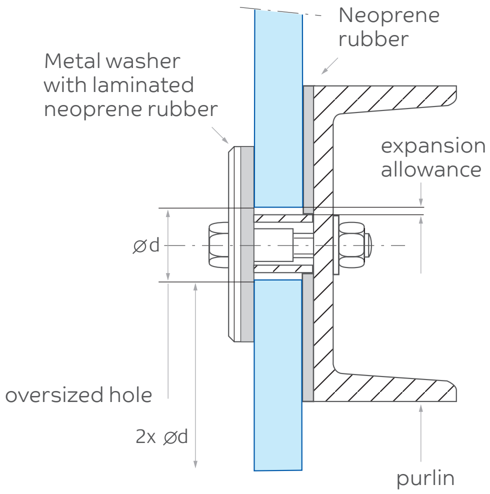


TABLE 17

LEXAN sheet thickness mm	Center to center distance glazing profiles “a”							
3	400	375						
4	550	480	425	400	375			
5	620	565	525	495	470	450	430	420
6	750	675	625	595	560	540	510	500
8	1000	900	840	790	750	720	690	660
9.5	1200	1075	1000	930	890	850	820	790
12	1425	1325	1250	1190	1125	1075	1030	1000
15								
Loading in N/m²	600	800	1000	1200	1400	1600	1800	≥2000

CURVED GLAZING INSTALLATION

With the exception of LEXAN™ MARGARD™ MR5-E sheet, all LEXAN™ 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 minimum radius values are outlined below.

TABLE 18:
MINIMUM RADIUS VALUES FOR COLD CURVING OF LEXAN 9030 SHEET

LEXAN 9030 sheet thickness in mm	Minimum allowable radius in mm
3	300
4	400
5	500
6	600
8	800
9.5	950
12	1200
15	1500

TABLE 19
MINIMUM RADIUS VALUES FOR COLD CURVING OF LEXAN EXELL™ D SHEET

LEXAN EXELL D and D ST thickness in mm	Minimum allowable radius in mm
3	525
4	700
5	875
6	1050
8	1400
9.5	950
12	1200
15	1500

TABLE 20
MINIMUM RADIUS VALUES FOR COLD CURVING OF LEXAN MARGARD FMR5-E SHEET

LEXAN MARGARD FMR5-E thickness in mm	Minimum allowable radius in mm
3	900
4	1200
5	1500
6	1800
8	2400

Note:

LEXAN 9030 sheet is recommended for internal curved glazing applications only.

LEXAN EXELL D ST sheet can be used for curved privacy glazing: stair glazing, balcony glazing. LEXAN EXELL D and LEXAN EXELL D SC IR sheet are great candidates for external architectural curved glazing applications: skylights, roofing.

LEXAN MARGARD FMR5 XT is a choice material for curved revolving doors, partitions, walkways, etc.

LEXAN SHEET CURVED GLAZING USING STANDARD METAL PROFILES

This section illustrates the possibilities of curved glazing, combining standard profiles with LEXAN sheet. When specially developed patented glazing systems are not required, good possibilities still exist for LEXAN sheet curved glazing by using standard metal profiles in combination with glazing tapes and non-hardening glazing compounds.

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

FIGURE 26
CURVING OF LEXAN SHEET

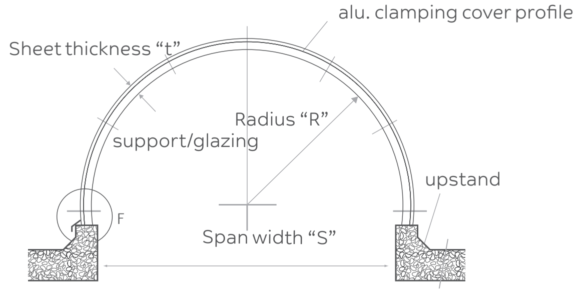


FIGURE 27
WET GLAZING

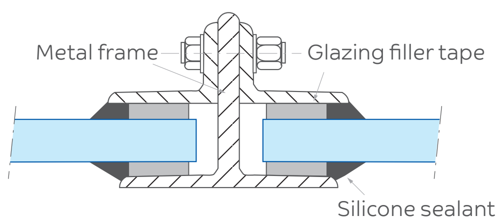
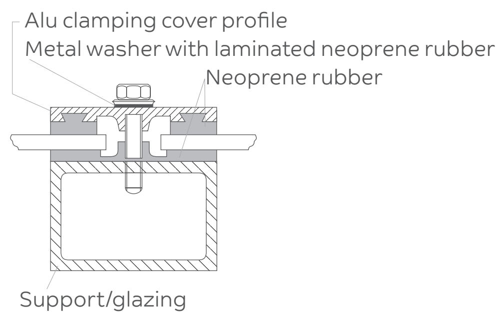


FIGURE 28
LEXAN SHEET INSTALLATION BY USING ALUMINUM CLAMPING PROFILE



LEXAN™ SHEET FOR CURVED GLAZING

A wide range of patented glazing systems are commercially available. Many of these systems have already proved to be suitable for curved constructions in combination with LEXAN sheet. Through close contact with system manufacturers and professional installers, SABIC can advise and assist architects and engineers on the feasibility of a curved design concept with LEXAN sheet with glazing system.

Metal or wooden structural support bars with a rubber gasket and an aluminium cover clamping strip with integrated rubber gaskets are often used.

SHEET THICKNESS SELECTION FOR CURVED GLAZING

Curvature, as well as the span and curved profile distance, influence the cylindrical shell behavior and the buckling load.

The critical load at which buckling occurs is calculated as a function of the shell geometry and the intrinsic properties of the LEXAN sheet. With reference to the calculated linear buckling load as well as the stability, a safety factor of 1.5 is applied.

In this way correct sheet thickness and dimensions can be calculated under given load situations. The stiffness of LEXAN sheet in curved glazing applications is mainly determined by the radius “R” and the distance “W” between the curved profiles. 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.

NOTES ON TABLE 22: At a specified load the distance between the curved profiles can be found for different sheet thicknesses and radii. In the dark tinted section a maximum standard sheet width of 2.05 m may be used.

The light tinted section indicates that the curvature of relevant sheet thickness at that particular loading does not further contribute to increased stiffness of the sheet. The stiffness of the sheet can be considered the same as flat sheet, and the last value is therefore applicable for all larger radii.

FIGURE 29

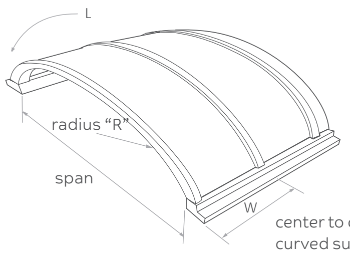


TABLE 21

Example:	
Roof-light Radius: 2800 mm Loading: 1000 N/m^2	
c.t.c. distance curved profiles	LEXAN sheet thickness
400 mm	3 mm
530 mm	4 mm
650 mm	5 mm
1000 mm	6 mm
1950 mm	8 mm

CURVED GLAZING INSTALLATION

TABLE 22

CENTER TO CENTER DISTANCE OF CURVED SUPPORT/GLAZING PROFILES IN METERS

Loading in N/m²	LEXAN™ sheet thickness in mm	Radius in meters 0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4
600	3	2.05	1.83	1.26	1.0	0.8	0.7	0.55	0.48	0.40											
	4			2.05	2.0	1.62	1.35	1.15	0.97	0.85	0.75	0.68	0.6	0.55							
	5						2.05	1.98	1.68	1.45	1.3	1.15	1.03	0.95	0.88	0.8	0.74	0.68	0.63		
	6									2.05	2.0	1.8	1.6	1.46	1.34	1.24	1.14	1.05	1.0	0.9	0.85
	8																	2.05	1.9	1.82	1.7
800	3	2.05	1.34	0.98	0.76	0.6	0.5	0.44													
	4		2.05	1.95	1.50	1.2	1.0	0.86	0.75	0.65	0.58	0.53									
	5					2.05	1.75	1.48	1.26	1.1	0.98	0.88	0.8	0.73	0.67	0.6	0.56				
	6							2.05	1.95	1.72	1.52	1.36	1.22	1.12	1.02	0.95	0.87	0.8	0.75		
	8													2.05	2.0	1.85	1.72	1.6	1.5	1.4	1.3
1000	3	1.60	1.1	0.8	0.6	0.5	0.4														
	4		2.05	1.58	1.25	0.98	0.82	0.7	0.6	0.53											
	5				2.05	1.65	1.38	1.18	1.02	0.9	0.8	0.72	0.65	0.6							
	6						2.05	1.87	1.58	1.37	1.22	1.1	1.0	0.9	0.8	0.77	0.7				
	8											2.05	1.95	1.8	1.63	1.5	1.4	1.3	1.2	1.13	1.06
1200	3	1.40	0.9	0.66	0.52	0.42															
	4	2.05	1.88	1.36	1.02	0.83	0.7	0.6	0.5												
	5			2.05	1.78	1.43	1.2	1.0	0.86	0.76	0.67	0.6									
	6					2.05	1.80	1.53	1.32	1.16	1.03	0.93	0.85	0.77	0.7						
	8										2.05	1.85	1.66	1.50	1.38	1.28	1.17	1.1	1.02	0.96	0.9
1400	3	1.25	0.8	0.58	0.45																
	4	1.9	1.67	1.13	0.9	0.71	0.6	0.5	0.45												
	5			2.05	1.54	1.22	1.0	0.86	0.75	0.66	0.6										
	6				2.05	1.96	1.59	1.34	1.15	1.0	0.9	0.8	0.7								
	8									2.05	1.78	1.58	2.43	1.32	1.2	1.1	1.02	0.95	0.9	0.8	
1600	3	1.02	0.7	0.51	0.4																
	4	1.65	1.36	1.0	0.8	0.64	0.53	0.45													
	5		2.05	1.7	1.32	1.07	0.9	0.8	0.66	0.6											
	6				2.05	1.66	1.38	1.17	1.0	0.9	0.8	0.7									
	8								2.05	1.75	1.57	1.42	1.27	1.15	1.06	1.0	0.9	0.85	0.8		
1800	3	0.9	0.6	0.45																	
	4	1.5	1.22	0.92	.07	0.57	0.47														
	5		2.05	1.52	1.2	1.0	0.8	0.7	0.6												
	6			2.05	1.82	1.47	1.23	1.04	0.9	0.8	0.7										
	8							2.05	1.85	1.6	1.4	1.25	1.15	1.05	0.95	0.9	0.8				
2000	3	0.84	0.56	0.42																	
	4	1.35	1.12	0.82	0.64	0.51	0.43														
	5	2.05	1.8	1.4	1.1	0.9	0.7	0.62													
	6			2.05	1.68	1.35	1.12	0.96	0.83	0.7											
	8						2.05	1.9	1.6	1.45	1.27	1.14	1.03	0.94	0.86	0.8					

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