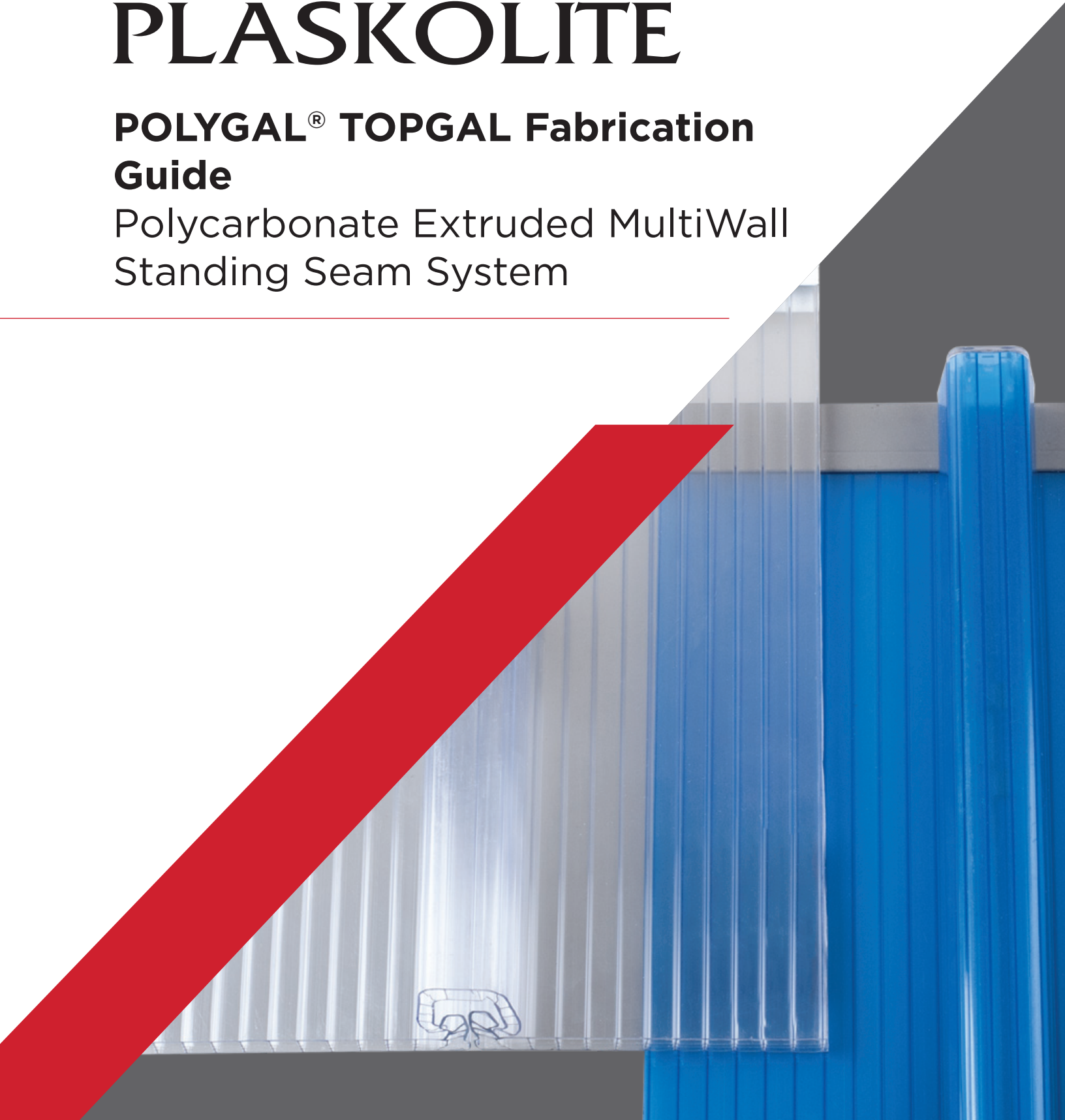


PLASKOLITE

POLYGAL® TOPGAL Fabrication Guide

Polycarbonate Extruded MultiWall
Standing Seam System

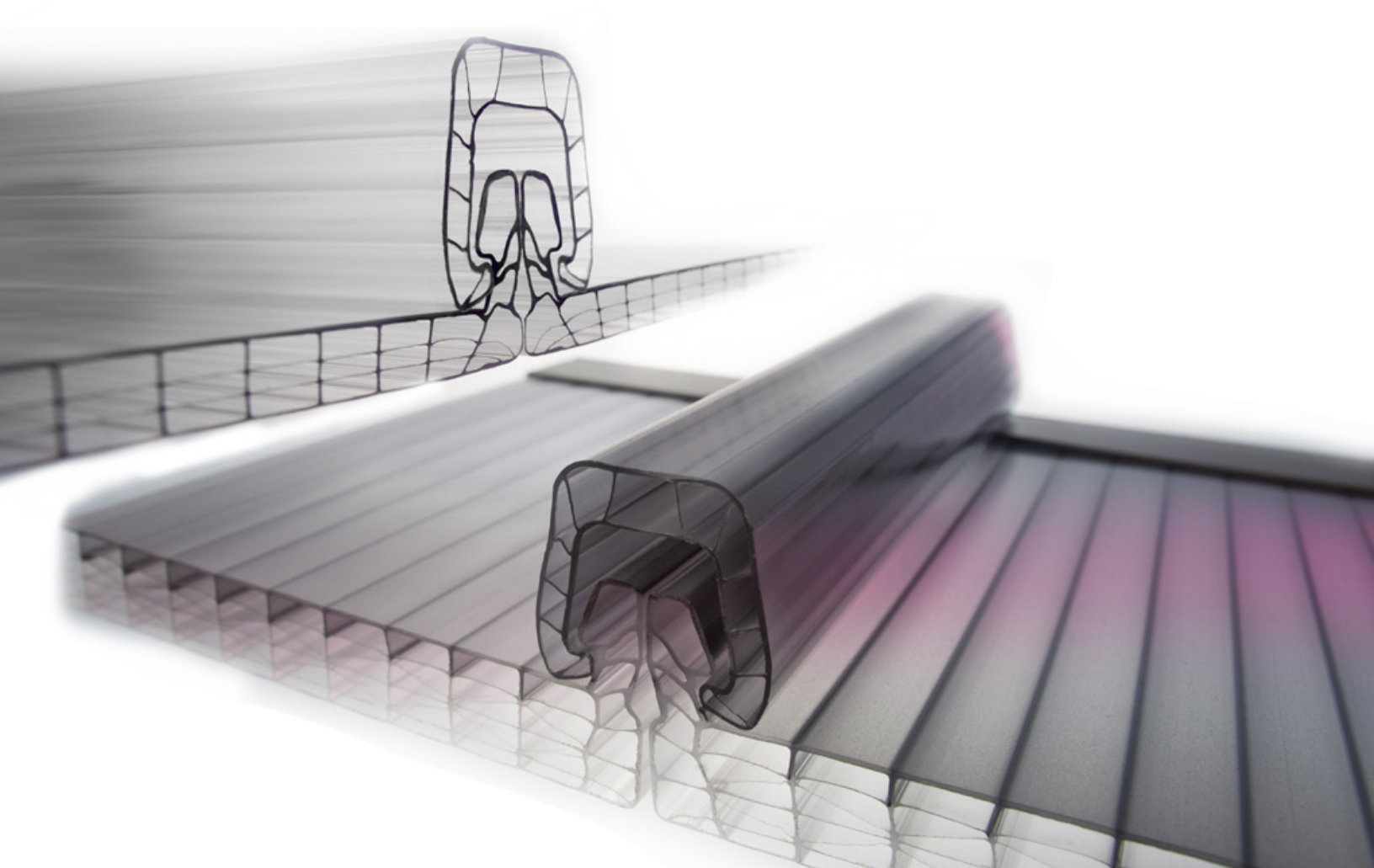




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Introduction



Polycarbonate is a unique engineered thermoplastic which combines a high level of mechanical, optical, and thermal properties. It can be UV enhanced, 1 or 2 sides, for high resistance to sunlight and environmental degradation. It also has excellent electrical properties and it is self-extinguishing.

This versatile sheet can be modified by different additives to perform in specific applications: light reflection, diffusion, and IR blocking and it is suitable for many engineered applications.

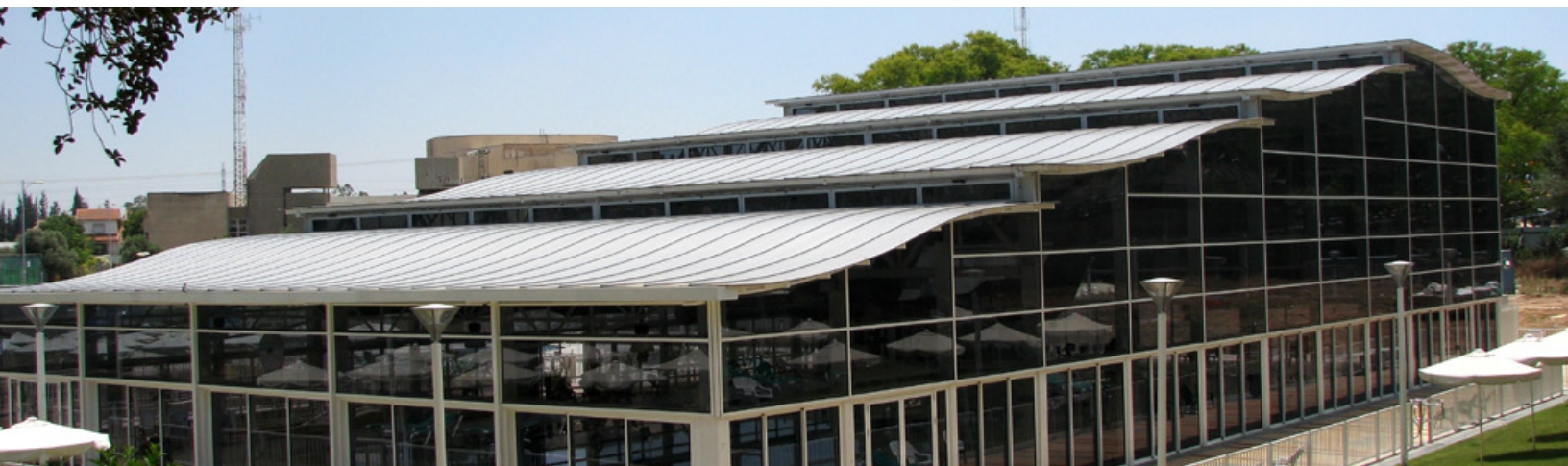
Extruded MultiWall sheets offer excellent optical and mechanical properties. This material is ideally suited for many roofing applications.

TOPGAL™ extruded MultiWall polycarbonate standing seam system is produced by Plaskolite. With high visible light transmission and ease of fabrication, TOPGAL sheets are available in a broad range of thicknesses, colors, and specialty coatings.

Features and Benefits

The TOPGAL system manufactured by Plaskolite is ideal for installation in public buildings, sports facilities, transportation hubs, and interior spaces of industrial and commercial buildings:

- » High light transmission
- » Outstanding impact strength
- » Lightweight
- » UV protection on one side or two sides
- » Excellent weathering and resistance to degradation
- » Available in standard colors as well as special color layers
- » Rigid structure provides strength under wind and snow loads
- » Cold bending capability
- » Engineered watertight system
- » Good chemical resistance to a wide range of substances
- » Covered by 10 Year Limited Product Warranty



Applications



Swimming pools



Gas Station



Canopies



Interior Design - Lighting

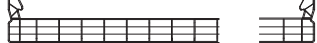


Stadiums, industrial roofing, swimming pools, cladding and public areas



Architecture Cladding

Technical Specification of TOPGAL System

Structure	Thickness / Width, mm	Weight / Dead Load*, g/m ²	K-Value, W/m ² .°C	Min. Radius for Cold Bending*, m
	6/600	1600/2000	3.1	1.2
	8/600	1900/2200	2.4	1.8
	10/600	2200/2500	2.1	2.0
	16/600	3000/3300	1.9	3.2
	16/998	3000/3300	1.8	3.2
	20/998	3200/3500	1.5	4.0

Standard Sheet Lengths: Max length 39'

Service Temperature Range: -40°C-+120°C (-40°F to +248°F) for short time service, -25°C to +85°C (-13°F to 185°F) for prolonged service

Coefficient of linear expansion: 6.65•10⁻⁵ cm/cm•°C, 3.75•10⁻⁵ in/in•°F

*** Dead Load is a weight of 1m² of TOPGAL system, includes installation accessories**

Color Description and Light Transmission Chart

Color		6mm, 8mm, 10mm Light Transmission%	16mm, 20mm Light Transmission%
Clear -	Clr- standard	65	49
Opal -	ICE standard	30	20
Bronze -	BRZ standard	20	20
Blue -	BLU standard	30	20
Polyshade Gray -	SLV standard	12	12

Properties

Color Description and Light Transmission Chart

Load bearing capacity is dependent on proper design and installation of TOPGAL sheets.
Recommended span between purlins in flat structures (M)

Recommended Span Between Purlins in Flat Structures

Sheet Thickness	Pressure Direction	16 PSF	21 PSF	27 PSF	32 PSF	37 PSF	42 PSF
8mm	Wind Load	43.3"/1099mm	37.4"/950mm	31.5"/800mm	27.6"/701mm	23.6"/599mm	19.7"/500mm
8mm	Gravity Load	45.3"/1150mm	39.37"/1000mm	35.4"/899mm	29.5"/749mm	25.6"/650mm	23.6"/599
20mm	Wind Load	56.1"/1425mm	53.2"/1351mm	49.2"/1250mm	43.3"/1100mm	39.37"/1000mm	37.4"/950mm
20mm	Gravity Load	61"/1549mm	57.1"/1450mm	51.2"/1300mm	47.24"/1200mm	43.3"/1100	39.37"/1000mm





Properties

Typical Metric Properties

Property	Test Method	Units	Values
Physical			
Density	ISO 1183	g/cm ³	1.2
Light Transmission - Thickness dependant	ASTM D 1003	%	81-90
Water Absorption	ISO		1585
Mechanical			
Tensile Strength at yield	ISO 527-2	MPa	60
Tensile Modulus	ISO 527-2	MPa	2300
Elongation at break	ISO 527-2	%	>100
Elongation at yield	ISO 527-2	%	6
Flexural Modulus	ISO 178	MPa	2330
Charpy Un-notched	ISO 179	kJ/m ²	No Break
Izod Impact notched	ISO 180a	kJ/m ²	>65
Thermal			
Deflection Temperature - 1.8 MPa	ISO 75-1	°C	144
Vicat softening temp (50°C/h 50N)	ISO 306	°C	1130
Thermal conductivity	DIN52612	W/m x °C	65
Coefficient of linear thermal expansion 0-50°C	ISO 11359	mm/(m x 1/°C)	0.2
GWFI (Glow-Wire Flammability index)	IEC60695-2	°C	120
Electrical			
Volume Resistivity	IES 60093	Ohms - cm	3 x 10 ¹⁴
Surface Resistivity, dry	IEC 60093	Ohms	6 x 10 ¹⁵
Dissipation Factor 1Mhz	IEC 60250		0.009
Dissipation Factor 100Hz	IEC 60250		0.006

* Typical properties are not intended for specification purposes

Typical Imperial Properties

Property	Test Method	Units	Values
Physical			
Density	ASTM D1505	ft/lb ³	75
Light Transmission - Thickness dependant	ASTM D 1003	%	81-90
Water Absorption	ASTM D570		.15
Mechanical			
Tensile Strength at yield	ASTM D638	psi	8700
Tensile Modulus	ASTM D638	psi	333,000
Elongation at break	ASTM D638	%	>100
Elongation at yield	ASTM D638	%	6
Flexural Modulus	ASTM D790	psi	338,000
Charpy Un-notched	ASMT D256		No Break
Izod Impact notched	ASMT D256	ft*lb/in	15
Thermal			
Deflection Temperature - 264 psi	ASTM D648	°F	144
Vicat softening temp (122°F/h50N)	ASTM D1525	°F	1130
Thermal conductivity	DIN 2612	W/m x °C	65
Coefficient of Linear Expansion 122°F	ASTM D696	mm/(m x 1/°C)	3.6 10 ⁻⁵ /°F
Electrical			
Volume Resistivity	ASTM D257	Ohms - cm	3 x 10 ¹⁴
Dissipation Factor 60Hz	ASTM D150		0.004

* Typical properties are not intended for specification purposes

Thermal properties

Service temperature and thermal expansion

Service Temperature

TOPGAL MultiWall Polycarbonate sheets and profiles can be installed in a variety of applications, with varying temperatures. However, the material's mechanical performance is known to remain stable in prolonged service in temperatures ranging from -25°C (-13°F) to +85°C (185°F) (according to EN 13650).

Polycarbonate has a maximum service temperature of 120°C (248°F).

Thermal Expansion/Contraction

The coefficient of linear expansion of polycarbonate material is $6.65 \cdot 10^{-5} \text{ m}/(\text{m} \cdot ^\circ\text{C})$ $3.75 \cdot 10^{-5} \text{ in}/(\text{in} \cdot ^\circ\text{F})$. It is necessary to allow for 1/16th inch (0.063", 1.6mm per 12") from a change in room temperature +/- 70°F (total delta 140°F, 0°F to 140°F). Where those applications that have a greater temperature swing, a higher expansion allowance is needed to accommodate the thermal expansion of the material.

Example: 1) 1/16" per foot: $12" \times 0.0000375 \times 140^\circ\text{F} = 0.063"$. 2) $12" \times 0.0000375 \times 180^\circ\text{F} (+/- 90^\circ\text{F}) = 0.081"$

Thermal Insulation and U-Value

Thermal Insulation is the reduction to heat transfer (i.e. the transfer of thermal energy between objects of differing temperature) between objects in thermal contact or in range of radiative influence.

The importance of thermal insulation can be seen in applications with closed structures, such as sunrooms and swimming pools.

U or K-Value is the coefficient which determines heat loss in the glazing of a building. As the U-Value decrease the thermal insulation increase.

Product	Gauge (")	U-Value (Btu/h/ft ² /°F)	R-Value (Btu/h/ft ² /°F)
6mm SG	1/4"	0.63	1.587
6mm SG	1/4"	0.63	1.587
6mm SG	1/4"	0.63	1.587
6mm Freeze	1/4"	0.63	1.587
8mm SG	5/16"	0.60	1.667
8mm SG	5/16"	0.60	1.667
8mm SG	5/16"	0.60	1.667
8mm Polymatte	5/16"	0.60	1.667
8mm PC3-Wall	5/16"	0.50	2.000
8mm Rainbow	5/16"	0.60	1.667

Product	Gauge (")	U-Value (Btu/h/ft ² /°F)	R-Value (Btu/h/ft ² /°F)
10mm SG	3/8"	0.53	1.887
10mm SG	3/8"	0.53	1.887
10mm SG	3/8"	0.53	1.887
10mm SG	3/8"	0.53	1.887
10mm SG	3/8"	0.53	1.887
10mm SG	3/8"	0.53	1.887
10mm SG	3/8"	0.53	1.887
10mm SG	3/8"	0.53	1.887
16mm SG	5/8"	0.41	2.439
16mm SG	5/8"	0.41	2.439
16mm SG	5/8"	0.41	2.439
16mm TSK	5/8"	0.36	2.778
16mm TSK	5/8"	0.36	2.778
16mm TSK	5/8"	0.36	2.778
16mm TSK	5/8"	0.36	2.778
16mm RFX	5/8"	0.41	2.439
16mm RFX	5/8"	0.41	2.439
16mm RFX	5/8"	0.41	2.439
16mm RFX	5/8"	0.41	2.439
20mm TPGL	7/8"	0.26	3.846
20mm TPGL	7/8"	0.26	3.846
32mm TRMS	1-1/4"	0.18	5.555
32mm TRMS	1-1/4"	0.18	5.555

Properties

Optical Properties

Electro-Magnetic Waves

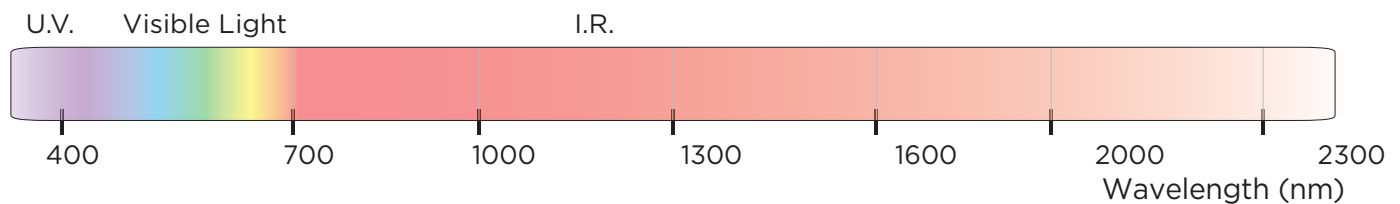
Electromagnetic wave is a physical phenomenon in which energy advances in the space through alternating electric and magnetic fields. The properties of the waves are largely dependent on its wavelength and spans a broad spectrum from very long radio waves to very short gamma rays.

Solar Radiation

We are interested in the range of the electro-magnetic called Light which includes the IR, the visible light and the UV. The IR radiation is emitted from hot bodies; it is invisible, but we can feel it as heat.

Although not sharply defined, visible light is the waves at the range of 400-780 nanometers (nm). When we go through the wavelength from 400 nm and up, we gradually see all the rainbow colors, starting with violet and blue and finish with red. The light below the violet is called ultra-violet (UV) and beyond red called infrared (IR), are invisible to the human eye.

The solar radiation of the sun includes IR, visible light and UV. About half of its energy is in the visible range, 45% is in the IR range and 5% is in the UV range.



Light and material interaction

When a light ray impinges the surface of material, part of it is reflected from the material surface. The rest of it is penetrates into the material. If the material is opaque to light, the entire penetrating light is absorbed within the material and transforms to heat. However, if the material is transparent or partially transparent to light, the penetrating light advances inside the material, part of it is absorbed and turns to heat while the rest impinges the second surface. Part of the light that impinges the surface is reflected back into the material and continue to be absorbed while the other part escapes to the space out of the material.

Therefore, the light that impinge the material is partially reflected, partially absorbed, and partially transmitted. The sum of energies of the reflected, absorbed and transmitted light is equal to the energy of the impinging light.

Light sources

Different light sources have different characteristics. The sun's light reaches the earth after passing through the atmosphere where certain parts of it are absorbed. This is the main light source we refer to, but it is not the only one.

There are artificial light sources such as electric lighting with different characteristics. According to the standard (EN 16153), we use two transmission properties:

τ_e is the solar transmission of the product τ_v is the visible transmission

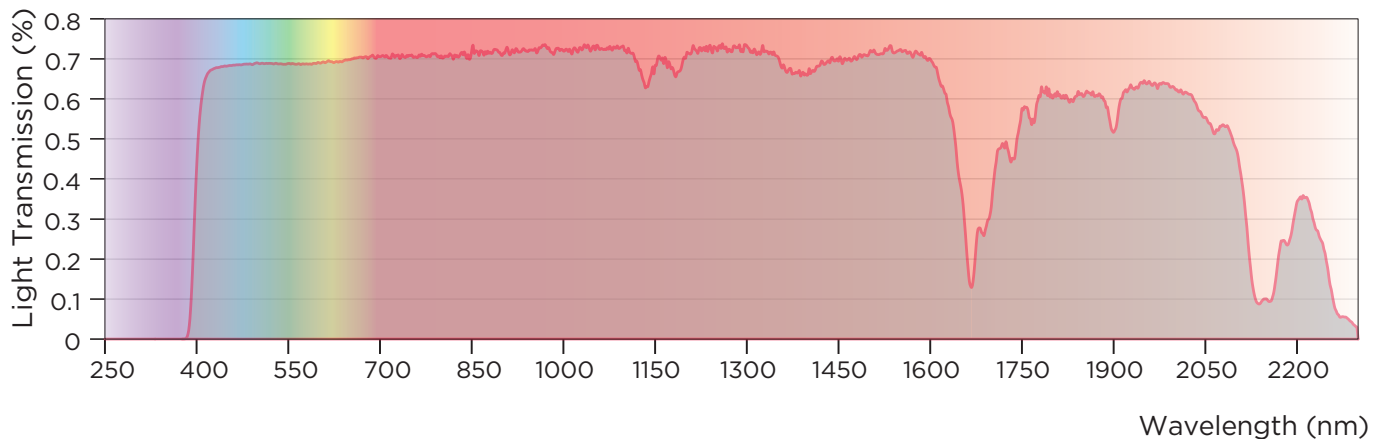
The light sources for the two are different. The light source for τ_e is similar to the sun's light in the range of 350-2400 nm, while the light for τ_v is a standard source designated D65, in the range of 350- 750 nm.

Properties of Transparent MultiWall

Polycarbonate MultiWall sheet is a clear, transparent plastic material with excellent mechanical properties. The material is transparent to visible light, partially absorbs IR light and totally absorbs (opaque) to UV light. The UV blocking property protects from harmful UV radiation.

Below is the Spectral Graph for 8mm TOPGAL MultiWall Polycarbonate Sheet.

Topgal 8 mm Spectral Values



Geometry of Transmission and Reflection

Light that impinges the polycarbonate surface is reflected, partially in a specular reflection (as mirror) and partially in a diffused reflection at various directions. Also, the light that pass the polycarbonate and transmitted through the far surface, is partially specular (continue the original ray direction) and partially diffused. The ratio between the diffused light and the total (diffused + specular) light, in both transmission and reflection, is the Haze property of the sheet which describes the light diffusing property of it.

Properties

The Sheet Color Influence

Colored sheet changes the reflected and the transmitted light. The spectral curves of the transmitted and the reflected light are different from the source spectral curve.

Also, the total values τ_v and τ_e are changed by the color.

When the color exists in the volume of the sheet, the absorption is taking place in the entire sheet, results in temperature increase in the absorption sites.

The more color concentration and sheet weight, more energy is absorbed and less energy pass the remote surface

Colors with Special Spectral Properties

Special selective layers of polycarbonate MultiWall sheets, are one of the most advanced achievements in this field. Such layers make it possible to control the quality of light penetrating an enclosed space, by absorbing and reflecting some part of solar radiation.

- » The PolyShade layer contains a special pigment that adds metallic luster to the surface and provides an optimal level of solar radiation reflection to prevent overheating of a room. The PolyShade layered sheets are manufactured in different colors: silver, metallic blue, and metallic green.
- » Silhouette (PNL) is a pearl color layer sheet and gentle silk appearance, sophisticated and lustrous exterior surface. It is available in a variety of thicknesses and features outstanding reflective qualities making it an excellent choice suitable for all daylight coverings.
- » Primalite (PRL) is a unique color layered sheet that reflects a large portion of the near Infra-Red solar radiation while transmitting more visible light. The color converts the transmitted light to a greenish tint, while the reflected light has a pink tint.

Color optical properties

Sheets optical properties:

Clear sheets:

Thickness, mm	Width, mm	SC**	SHGC**	Light Transmission (%) by ASTM D 1003
TPGL 6	600	0.8	0.7	65
TPGL 8	600	0.7	0.6	65
TPGL 10	600	0.7	0.6	65
TPGL 16	998	0.6	0.51	50
TPGL 16	600	0.65	0.55	60
TPGL 20	998	0.6	0.51	47

Bronze sheets:

Type / Thickness, mm	Width, mm	SC**	SHGC***	Light Transmission (%) by ASTM D 1003
TPGL 6	600	0.6	0.51	30
TPGL 8	600	0.58	0.5	30
TPGL 10	600	0.58	0.5	30
TPGL 16	998	0.46	0.39	20
TPGL 16	600	0.49	0.42	20
TPGL 20	998	0.46	0.39	20

White sheets:

Type / Thickness, mm	Width, mm	SC**	SHGC***	Light Transmission (%) by ASTM D 1003
TPGL 6 ICE	600	0.42	0.37	20
TPGL 8 ICE	600	0.41	0.36	20
TPGL 10 ICE	600	0.4	0.35	20
TPGL 16 ICE	998	0.37	0.32	20
TPGL 16 ICE	600	0.4	0.35	20
TPGL 20 ICE	998	0.37	0.32	20
TPGL 16 NGR	998	0.35	0.3	12
TPGL 20 HWT	998	0.19	0.16	2

Turquoise, blue, green, grey sheets:

Type / Thickness, mm	Width, mm	SC**	SHGC***	Light Transmission (%) by ASTM D 1003
TPGL 8 BLU	600	0.65	0.59	30
TPGL 8 GRY	600	0.51	0.45	15
TPGL 10 BLU	600	0.65	0.59	30
TPGL 10 TRQ	600	0.58	0.53	30
TPGL 16 BLU	988	0.49	0.43	20
TPGL 20 BLU	998	0.49	0.43	20

Properties

Selective layered sheets:

Type / Thickness, mm	Width, mm	SC**	SHGC***	Light Transmission (%) by ASTM D 1003
TPGL 8 PSD Silver	600	0.31	0.27	12
TPGL 8 PNL	600	0.5	0.44	35
TPGL 10 PSD Silver	600	0.31	0.27	12
TPGL 10 PSD metallic blue	600	0.38	0.32	12
TPGL 16 PSD Silver	998	0.3	0.26	10
TPGL 16 PRL	998	0.35	0.3	18
TPGL 16 PNL	998	0.42	0.37	18
TPGL 20 PSD Silver	998	0.3	0.26	10

Fire performance

TOPGAL sheets have received high ratings in several major European, American and other fire performance tests.

Flammability

***Classifications depend on thickness.**

Method	Classification*
ASTM D-635	CC-1
ASTM-E-84	Class A
EN 13501	B, s1, d0

Impact strength - hail resistance

Small Hard Body Impact Test:

A free-falling dart (tup) according to ASTM D5628 (equivalent to ISO 6603-1) is allowed to strike a supported specimen directly. Either a dart having a fixed mass may be dropped from various heights, or a dart having an adjustable mass may be dropped from a fixed height.

The procedure determines the energy (mass x height) that will cause 50 % of the specimens tested to fail (mean failure energy). Impact energy results are expressed in Joules.

Loss of impact strength in the event of hail shall be determined by an impact test according to ASTM-D-5628-95 geometry FE (tup diameter 20mm). In this test, failure is determined when the upper wall of the sheet is penetrated by the tup. The sheet does not reach the required standard if the Mean Failure Energy obtained in the test is less than 0.831 Joule. This energy is equal to the energy generated by a 20 mm diameter ice ball at a speed of 21 m/s.

UV protection

Polycarbonate sheets are a perfect material for construction. They are lightweight, durable, aesthetic and easy to install. However, polycarbonate disadvantage is its sensitivity to ultraviolet radiation from sunlight.

One of the properties of the polymer is its ability to absorb ultraviolet radiation. However, under its influence, polycarbonate degrades and is rapidly destroyed; it leads to yellowing, blushing and reduction in the strength of the material.

During the material production and study, technology of polycarbonate sheet protection against UV was changed. In the early years, to protect the polycarbonate from solar radiation a lacquer was applied. The disadvantages of this coating were cracking, blushing and uneven distribution over the surface of the sheet. Later, application of special protective coating by coextrusion was developed.

Protective coextrusion layer, which is an integral part of the sheet, is a polycarbonate, enriched with a special active additive. The greater is the concentration of the additive, the more effective and thinner can be coextrusion layer.

The limited product warranty provided by the Plaskolite is an indication that the produced material will not lose its physical, mechanical, and optical properties (i.e. preserves its impact resistance, do not become turbid, do not turn yellow) during the guaranteed period.

It is important to remember:

One side of the sheet with Ultraviolet radiation protection only is referred as “external”. Care should be taken on the compliance of the manufacturer’s recommendations for sheets installation. Otherwise, the complaint will not be accepted by manufacturer.

UV Resistance Testing

The UV resistance of the sheet is demonstrated, according to EN 16153, by testing the sheet properties before, during and after artificial ageing.

The properties to test are the Yellowness Index (YI) and the Light Transmission (LT).

There are two levels of radiant exposure in the total daylight range (300 nm to 2500 nm) to consider:

- » 18 GJ/m² (5000 kWh/m²) which is 30% more than the highest Direct Normal Irradiation occurrence on the globe.
- » 10 GJ/m² (2778 kWh/m²) which is reached in Australia, South Africa, South-West USA, North Chile, and Argentina.

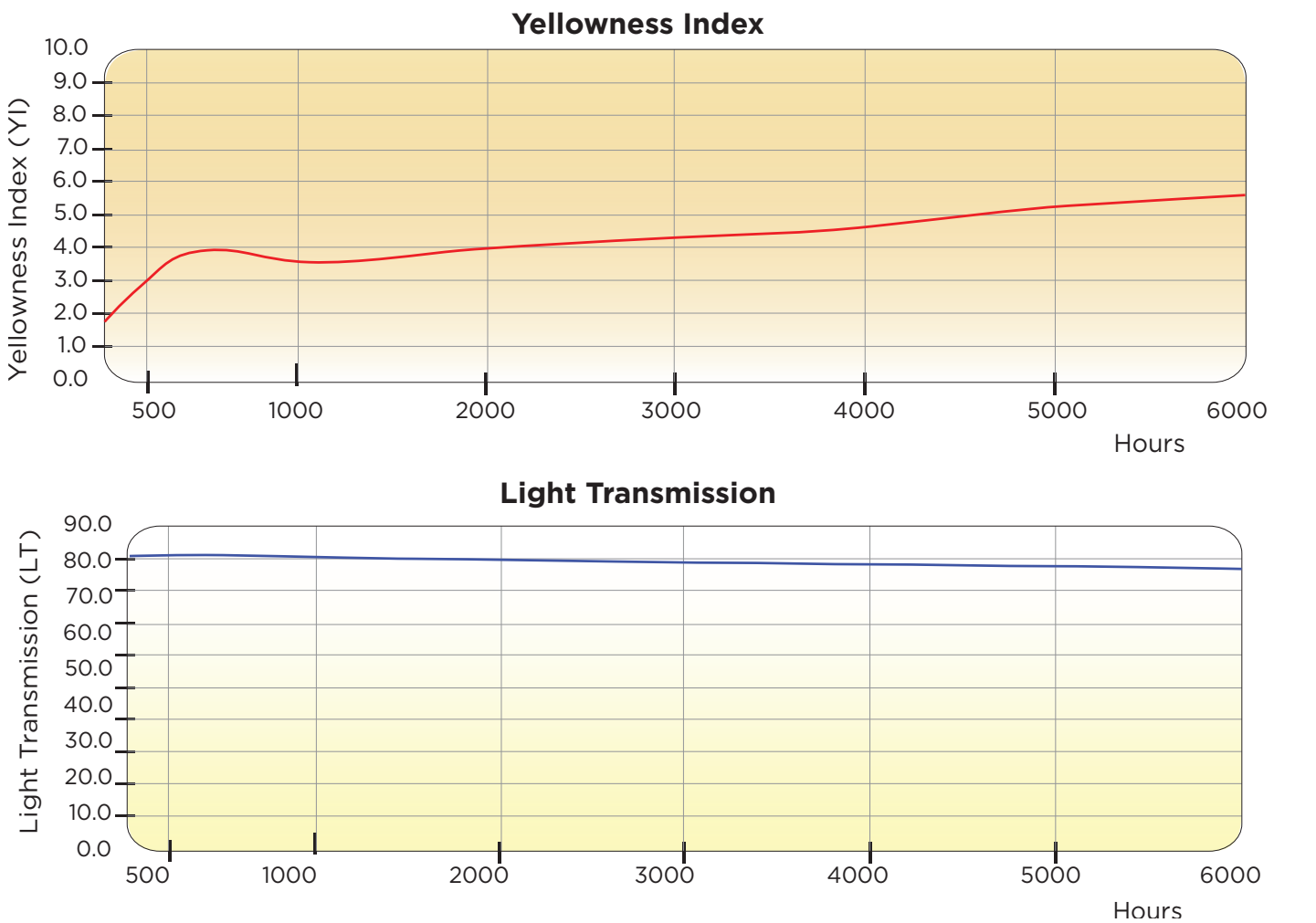
Durability

For safety reasons, all Plaskolite Polycarbonate product data relates to the 18 GJ/m² radiant exposure level. For the purpose of durability assessment, sheet samples are measured for YI and LT and placed in a Xenon ageing tester. Both properties are measured in intervals, until the 18 GJ/m² level is reached. A clear product is classified ΔA when the variation in YI is less than 10 units and the variation in LT is less than 5% of the unexposed sample.

A colored product which has the same polycarbonate material as the clear product and the same UV protection, is classified ΔD without further testing.

Regarding the mechanical properties (E-Modulus and tensile strength), a sample which has been classified according to the above, is assumed to lose less than 10% of its original value.

See below a typical graph of YI and LT vs exposure time:

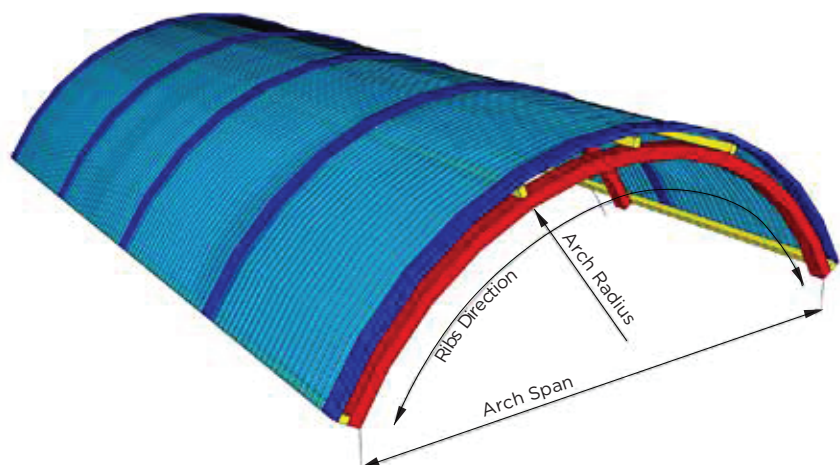


Bending the sheet

TOPGAL sheets can be successfully cold bent 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 with the length, never across the width of the sheet.

Sheet Thickness (mm, inches)	Minimum cold bending radius* (mm, inches)
6, 0.238"	1200, 42"
8, 0.315"	1800, 71"
10, 0.394"	2000, 79"
16, 0.630"	3200, 126"
20, 0.787"	4000, 157"

* Valid for sheets with standard weight only



Acoustic

Accordance with DIN 52210-75, the maximum obtainable sound transmission class for a particular thickness is listed below.

Sheet Thickness (mm)	Sound reduction Values (dB)
6 - 8	18
10	19
16	21
20	22

Chemical Resistance



Chemical resistance

The chemical and environmental resistance of MultiWall Polycarbonate sheets depend on the unique combination of factors and variables it encounters in its application.

Outlined below is an overview of its primary outside influencers, and common types of potential damage. A summary of laboratory tests designed to meet its practical requirements, as well as its resistant to a wide range of chemicals and substances is provide.

Your Plaskolite Representative, with the support of our Technical Service Group, is available to work with you to evaluate your specific application.

Influencing parameters:

- » The composition of chemical ingredients
- » Temperature
- » Duration of exposure
- » The level of internal or applied stress and strain

Types of Damage:

Polycarbonate can sustain several distinct types of damage, including swelling, dissolution, and molecular degradation. Circumstances under which these potential types of damage can occur are detailed below. Different chemicals may act simultaneously on TOPGAL sheet causing one or more types of damage.

Swelling or dissolution:

When low-molecular aromatic, halogenated and polar components migrate into the polycarbonate, the damage can range from a tacky surface, to swelling to complete dissolution.

Molecular degradation:

Many TUFFAK properties are determined by the size of its molecules. If an incompatible chemical causes a reduction in molecular weight, mechanical property degradation can occur. The molecular weight has virtually no influence on electrical properties and only a slight influence on thermal properties.

Solutions with a high pH (bases) can act to lower the molecular weight of polycarbonate. Low pH (acids) solutions typically do no degrade the molecular weight. Ammonia and amines are aggressive toward polycarbonate.

Plaskolite laboratories have tested a series of chemical and commercial products to determine their compatibility with polycarbonate. The results of TOPGAL resistance to substances are included in the following table (pages 25-29).

Laboratory tests supply information on the formulation tested. The composition of many commercial products can change over time.

Chemical Resistance

Oxidative damage:

TOPGAL is relatively stable toward oxidizing agents such as oxygen, nitric acid, and hydrogen peroxide. TOPGAL's resistance to chemicals, common industrial cleaners, pharmaceuticals, household, and cosmetic substance is dependent on the ingredients in the product, as well as the temperature and duration of exposure. The following section provides a general overview of resistance to these commonly used materials. If you require additional information, please contact your Plaskolite representative.

Resistance to sealing compounds, adhesives, and plastics:

TOPGAL's resistance to sealants, adhesives and plastics is largely dependent on the presence of aggressive components, such as plasticizers, (e.g. phthalates) or solvents, which can migrate into polycarbonate.

Resistance to paints:

Solvents in paints may cause stress cracking or swelling depending upon the solvent and the flash-off and drying conditions. It is possible to formulate paints with solvents that do not cause damage. In some applications, painting can increase the chemical resistance of the finished part.

Two component paints are resistant if the individual components do not cause damage to TOPGAL in the short period between application and curing. The SDS can be used to identify the chemical composition of the paint.

Resistance to cleaning and washing agents:

TOPGAL is resistant to most household soaps but not those containing amines, ammonia, and sodium hydroxide as they will cause damage to the sheet.

If the product ingredients are known, it is possible to estimate the compatibility with TOPGAL. However, it is recommended to put the finished part through a practical test if no data is available. Refer to the compatibility table (pages 25-28) for resistance levels.

Testing to meet practical requirements:

The compatibility information presented in this section should be used as a starting point for determining the integrity and durability of your application. Testing is essential if finished TOPGAL components are likely to encounter aggressive chemicals during fabrication or use. The internal and applied stress in a formed part, as well as duration of chemical exposure can lead to very different results.

Compatibility assessment methods:

The data shown in the compatibility table (pages 25-29) was generated using DIN 53449-3. This method uses test pieces of 80 x 10 x 4 mm of TOPGAL sheet clamped into a curved fixture. The fixture applies a graduated strain ranging from 1 – 2%.

Assessment criteria:

The information in the compatibility table is based on exposure to chemical at 23°F (-5°C) and a range from 0-2% strain. Components that lead to damage with a strain of < 1.0% are classified as incompatible.

The results shown in the following tables are based on a one-time test. Change in the composition by the producers of these substances can change the results.

Contact your Plaskolite representative or the Technical Service Group at 800-848-9124 with questions, or if you require additional information.

Chemical Compatibility Chart of polycarbonate products at room temperature:

Chemicals

- Acetaldehyde	+ Carbon dioxide, moist
+ Acetic acid, up to 10%	+ Carbon monoxide
- Acetone	+ Chloride of lime magma
+ Acetylene	+ Chloride of lime solution, 2% in water
- Acrylonitrile	+ Chromic alum, saturated solution in water
+ Alumen	+ Chromic acid, 20% in water
+ Aluminum chloride anhydrous, saturated solution in water	+ Citric acid 10%
+ Aluminum alumen potash, saturated solution in water	+ Copper chloride, saturated solution in water
+ Aluminium oxalate	+ Cupric sulphate, saturated solution in water
+ Aluminium sulfate, saturated solution in water	- Carbon bisulphide
± Allyl alcohol	- Chloric gas, dry
- Ammonia	- Chloroform
- Ammonia water	- Caustic potash
- Ammonium sulphide, saturated solution in water	- Caustic potash solution
- Amyl acetate	- Caustic soda
+ Ammonium chloride, saturated solution in water	- Cresol
+ Ammonium fluoride, saturated solution in water	± Chlorobenzene
+ Ammonium nitrate, saturated solution in water	- Cyclohexanone
+ Ammonium sulphate, saturated solution in water	± Dinonyl phtalate (softener)
- Aniline	± Dioctyl phtalate (softener)
+ Antimony chloride, saturated solution in water	± Diphyl 5.3
+ Arsenic acid, 20%	+ Decalin
+ Benzine (Petroleum Benzin) (non-aromatic)	+ Diethylene glycol
- Benzaldehyde	+ Diglycol acid, saturated solution in water
- Benzoic acid	- Diamyl phtalate
- Benzene	- Diethyl ether
- Benzyl alcohol	- Dibutyl phtalate (softener)
+ Borax, saturated solution in water	± Dimethyl formamide
+ Boric acid	± Dioxan
- Bromine	+ Ethyl alcohol, 96% pure
- Brombenzene	+ Ethylene glycol
- Butyric acid	- Ethyl amine
- Butyl acid	- Ethyl bromide
- Butyl acetate	- Ethylene chlorohydrine
+ Butane (liquid and gaseous)	- Ethyl dichloride
+ Butyl alcohol	± Ether
+ Butylene glycol	- Hydrochloride acid, concentrated
+ Cyclohexanal	- Hydrofluoric acid, concentrated
+ Cyclohexane	+ Heptane
+ Calcium chloride, saturated solution in water	+ Hexane
+ Chloric gas, moist	+ Hydrochloride acid, 20%
+ Calcium nitrate, saturated solution in water	+ Hydrosilicofluoric acid, 30%
Trichloro - acetic acid, 10%	+ Hydrofluoric acid, 5%
+ Calcium soap fat, pure	+ Hydrogen superoxide, 30%
+ Calcium hypochloride	- Formic acid
	- Glycerin
	- Iodine

+ - compatible +/- - limited use - - not compatible

Chemical Resistance

- Isopropyl alcohol
+ Ferric chloride, saturated solution in water
+ Ferrous sulphate
+ Glycol
+ Illuminating gas
- Lead tetraethyl, 10% in benzine
+ Lactic acid, 10% solution in water
+ Ligroine (carbon-hydrogen mixture)
+ Magnesium chloride, saturated solution in water
+ Magnesium sulphate, saturated solution in water
+ Manganese sulphate, saturated solution in water
+ Mercury
+ Mercury chloride, saturated
+ Methane
- Milk of lime, 30% slurry in water
+ Nitric acid, 10%
- Nitric acid, 10-20%
+ Oxalic acid, 10% in water
+ Oxide of zine
+ Oxygen
+ Ozone
- Perchloric acid, concentrated
± Petroleum ether (carbon hydrogen mixture)
± Petroleum
± Potato-spirit oil
+ Pentane
+ Perchloric acid, 10% in water
+ Perhydrol 30%
+ Potassium bichromate, saturated solution in water
+ Potassium bromate, saturated solution in water
+ Potassium carbonate, saturated solution in water
+ Potassium chloride, saturated solution in water
+ Potassium nitrate, saturated solution in water
+ Potassium metabisulphite, 4% in water
- Methyl methacrylate
- Methanol
- Methyl amine
- Methyl ethyl ketone
- Methylene chloride
- Narton solution
- Nitric acid, 20%
- Nitro benzene
- Nitrous fumes, dry
- Perchlorethylene
- Phenol
- Pyridine
± Phenyl ethyl alcohol

± Phosphorus oxychloride
± Potassium cyanide
+ Potassium rhodanide, saturated in water
+ Potassium perchlorate, 10% in water
+ Potassium permanganate, 10% in water
+ Potassium persulphate, 10% in water
+ Potassium sulphate, saturated solution in water
+ Propane gas
+ Propanyl alcohol
+ Propionic acid, concentrated
+ Propyl alcohol
+ Resorcin solution, 1%
- Styrene
- Sulphuric acid, concentrated
- Sulphurous acid, 10%
- Sulphury chloride
+ Soda
+ Sodium bicarbonate, saturated solution in water
+ Sodium bisulphate, saturated solution in water
+ Sodium bisulphite, saturated solution in water
+ Sodium carbonate, saturated solution in water
+ Sodium chlorate, saturated solution in water
+ Sodium chloride, saturated solution in water
+ Sodium hypochloride, 0.5% solution in water
+ Sodium sulphate, saturated solution in water
+ Spirit, pure
+ Sublimate, saturated solution in water
+ Sulphur
+ Sulphuric acid, 50%
+ Sulphuretted hydrogen
± Sodium sulphite, saturated solution in water
± Sulphur dioxide
± Sulphuric acid, 70%
+ Tartaric acid, 10%
- Tetrachloroethane
- Tetrahydrofurane
- Tetraline
- Thiophene
- Toluol
- Trichloroethylamine
± Trichloroethylene
± Tricresylol phosphate (softener)
+ Trichloroethyl phosphate (softener)
+ Urea, saturated solution in water
+ Water
± Xylol
+ Zinc chloride, saturated solution in water
+ Zinc sulphate, saturated solution in water

+ - compatible +/- - limited use - - not compatible

Germicides

+ Baktol, 5%	+ Oktozon, 1%
- Carbolic acid	+ Perhydrol
+ Chloramine	+ Resorcin solution 1%
- DDT	+ Spirit, pure
+ Delegol, 5%	+ Sublimate
± Dimamine T, 5%	- TB-Lysoform
+ Hydrogen superoxide	+ Trosilon G extra, 1.5%
+ Lysoform, 2%	± Sagrotan, 5%
+ Maktol	± Tincture of iodine
+ Merfen, 2%	± Zephirol

Detergents

+ Ajax	+ Silicone fluid-emulsion
+ Javel water	+ Soft soap
+ Laundry soap	

Technical Oils & Lubricants

+ Aral BG [®] 58	+ Mobil DTE oil light [®]
+ Automatic switch grease	+ Mobil special oil 10 w 30 [®]
+ Baysilon [®] -silicone oils	+ Molikote [®] -paste
+ BP Energol HL 100 [®]	+ Molikote [®] -powder
+ BP Energol EM 100 [®]	+ Nato-turbine oil 0-250
+ BP H LR 65 [®]	+ Naphtenic lubricating oil
+ Brake fluid (ATE)	+ Paraffin oil
+ Burnishing oil Brunofix [®]	+ Polyran [®] MM25 (lubricating oil)
- Camphor oil	+ Rape seed oil
+ Cable insulating oil IG 1402	+ Renocalor N [®]
+ Cable insulating oil KH 190	+ Sewing machine oil
+ Calcium soap fat	+ Shell Spriax 90 EP [®]
+ Castor oil	+ Shell Tellus 33 [®]
+ Contact oil 611	+ Silicone fluid
± Diesel oil	+ Sodium soap fat
- Drilling oil	+ Texaco Regal oil BRUO [®]
+ Esso Estic 42-45 [®]	+ Texaco Regal oil CRUO [®]
+ Fish oil	+ Train oil
+ Grease R Z Darina [®]	+ Turbo oil 29
± Heating fuel oil	± Shell Tellus 11-33 [®]
+ Hydraulic oil Vac HLP 16	± Turpentine oil
± Jet propulsion fuel JP4 (kp 97-209°C)	± Valvoline WA 4-7
Skydrol 500 A [®]	± Varnish

+ - compatible +/- - limited use - - not compatible

Chemical Resistance

Technical Oils & Lubricants

+ Aral BG®58	+ Mobil DTE oil light®
Automatic switch grease Baysilon®-silicone oils	Mobil special oil 10 w 30® Molikote®-paste
+ BP Energol HL 100®	+ Molikote®-powder
+ BP Energol EM 100®	+ Nato-turbine oil 0-250
+ BP H LR 65®	+ Naphtenic lubricating oil
+ Brake fluid (ATE)	+ Paraffin oil
+ Burnishing oil Brunofix®	+ Polyran® MM25 (lubricating oil)
- Camphor oil	+ Rape seed oil
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+ Hydraulic oil Vac HLP 16	± Turpentine oil
± Jet propulsion fuel JP4 (kp 97-209°C)	± Valvoline WA 4-7
Skydrol 500 A®	± Varnish

Adhesives & Sealing Materials

± All-purpose glue	+ Silpruf
+ Cellux® - adhesive film	+ Serbaseal MP
+ Gypsum	+ Dow Corning 917
+ Insulating tape	+ Dow Corning 3793 (w.)
+ Perbunan C®	+ Dow Corning 7098
+ Putty	+ Dow Corning 791
+ Rubber (softener-free)	+ Parasilico PL (cl.)
+ Terostat®	+ Proglaze
+ Tesafilm	+ 3M 431 -aluminum tape
+ Tesamoll®	+ Gerlinger 712 -aluminum tape
+ Sea 210	

Polishing Agents & Antistatics

± Antistaticum 58	+ Delu-Antistatic solution®
- Antistatic C, 5%	+ Persoftal®, 2%
± Arquad 18®, 50%	

+ - compatible +/- - limited use - - not compatible



User Guide



User guide information

Packaging

TOPGAL sheets can be shipped in crates, on wood pallets or handloaded into enclosed trailers and will be packaged to protect against scratching and damage during shipment. The panel ends are sealed with masking tape to prevent dust and insects from entering into the flutes of the panels.

The maximum panel length is 11.8 meters, 39' feet, for a 40' container. It is recommended to unload the containers by hand using a slanted roller conveyor with adjustable height.

MultiWall sheets must be stored away from exposure to sunlight.

The maximum sheet length is 5.8 meters for a 20' container and 11.8 meters for a 40' container. Shipping of sheets of different lengths should be coordinated in advance with the regional sales manager. It is recommended to unload the containers by hand using a slanted roller conveyor with adjustable height.

Polycarbonate products must be stored away from exposure to sunlight and according to the company's storage guidelines.

Storage

- » Store in dry, dark & well-ventilated area, with NO EXPOSURE to sunlight, wind, dirt or hard objects to prevent damage.
- » Store on a flat clean raised surface and placed on a soft material (cardboard) to prevent damage. Supported, sloped stacking is recommended. If stacked flat, stack to a maximum height of 1 meter (3 feet).
- » Outdoors, Polycarbonate products should be covered with an opaque material (cardboard, wood, EPDM sheet etc.) that provides protection from the sun.
- » Outdoors, DO NOT store Polycarbonate products under flexible PVC coverings.
- » Outdoors, storage of Polycarbonate products exposed to sun light will cause the protective polyethylene film to bake onto the sheet, and it WILL NOT BE ABLE TO BE REMOVED.

Cleaning

Polygal MultiWall will give longer and better service life with simple cleaning:

- » Rinse sheet with water
- » Use warm soapy (mild liquid dish soap) water to clean sheets. If any dirt remains, gently wipe off with a soft cloth.
- » Apply final rinse and dry with soft cloth, if possible, to prevent water spotting.

DO NOT use sponges, squeegees, brushes or sharp instruments as they may damage the UV protective coating and surface.

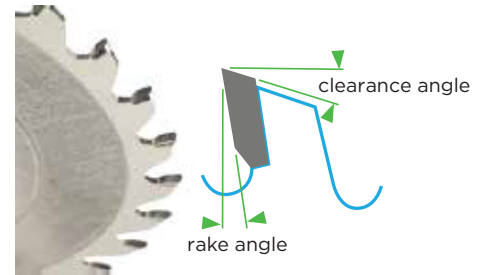
Fabrication

Cutting - Plaskolite MultiWall sheet can be cut easily and accurately with standard workshop equipment. This includes standard circular, jig, or table saw with a blade having 8-12 teeth per inch (mm). Saw dust should be blown out of the channels using clean compressed air. Circular saws should have fine-tooth sheet blades. Thinner, (4-6mm), gauges can be cut with a box knife. It is important that the knife is sharp.

Trimming - standard box cutting knife.

Sawing recommendations:

	Circular saw	Bandsaw
Clearavce angle	20° - 30°	327
Rake angle	15°	0.5°
Cutting speed	180 - 250 m/min	200 - 250 m/min
Blade or hand speed	1800 - 2400 m/min	-
Tooth spacing	2-5 mm	1.5 - 2.5 mm



Drilling - Holes can be drilled by a power drill using standard high-speed sharp steel bits with an angular wedged bit. When drilling, support should be given immediately beneath the drill to avoid vibration.

Very clean holes are easily obtained. All holes should be drilled at least 1.57" (40mm) from the edge of the sheet. The clearance angle should be 15° whereas the rake angle should be 0° - 5°. The use of liquid cooling media is not recommended.

Please note: It is not recommended to drill holes in the sheet. Rather the use of aluminum or polycarbonate profiles to fix the sheets to the structure is recommended.

Drilling recommendations:

	Hole diameter (mm)	Speed (rev/min)
Clearance angle	20° - 30°	327
Rake angle	15°	0.5°
Cutting speed	180 - 250 m/min	200 - 250 m/min
Blade or hand speed	1800 - 2400 m/min	-
Tooth spacing	2 - 5 mm	1.5 - 2.5 mm

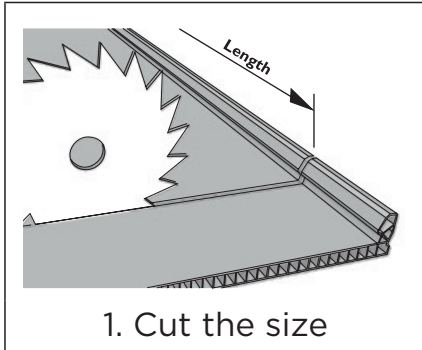
Bonding - Adhesive bonding can be accomplished by using chemically and physically compatible elastomeric adhesives typically by use of neutral, solvent-free silicones and polyurethane adhesive. MultiWall sheets can be bonded to plastics, glass, metals, and other materials. Choice of the bonding agent depends on flexibility, heat resistance, and appearance desired.

Cold forming - Polygal MultiWall sheets can be formed into arches. The arch must be parallel to the ribs. (See page 31 for minimum radius).

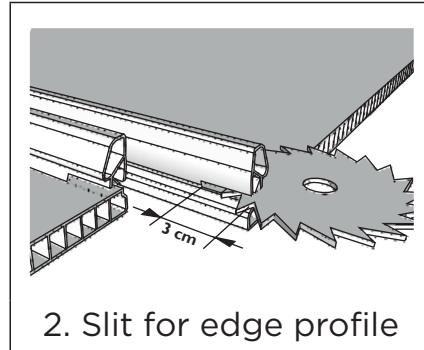


Installation Guide

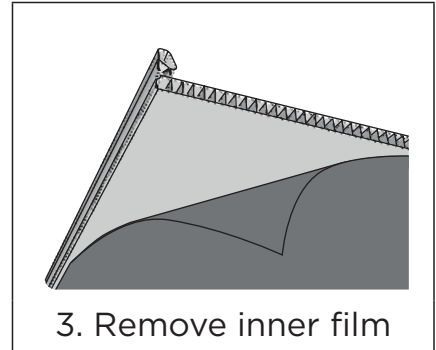
TOPGAL Installation Instructions



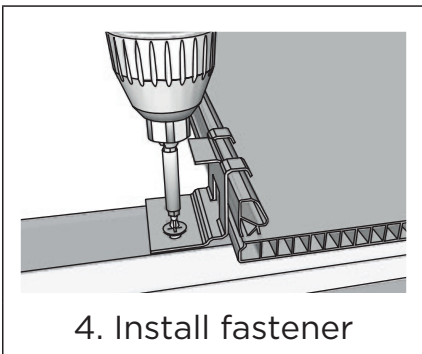
1. Cut the size



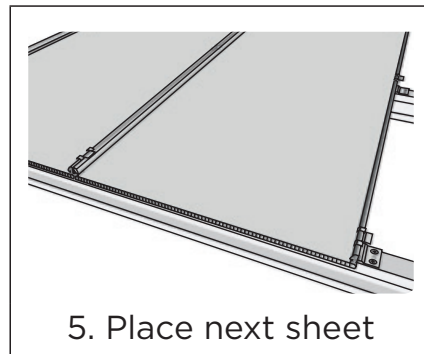
2. Slit for edge profile



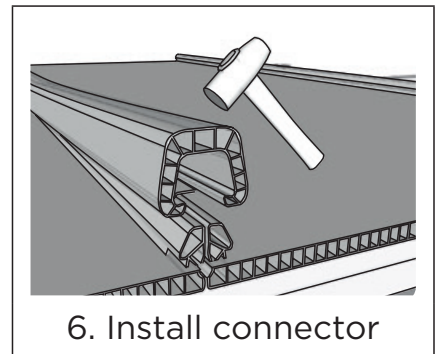
3. Remove inner film



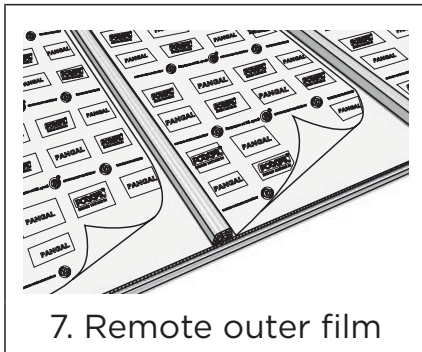
4. Install fastener



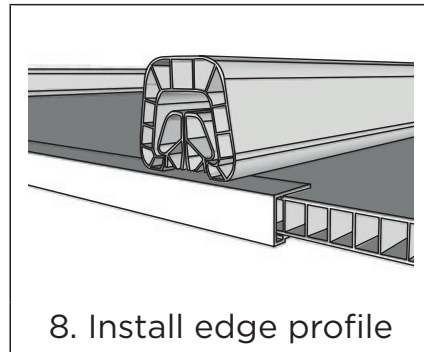
5. Place next sheet



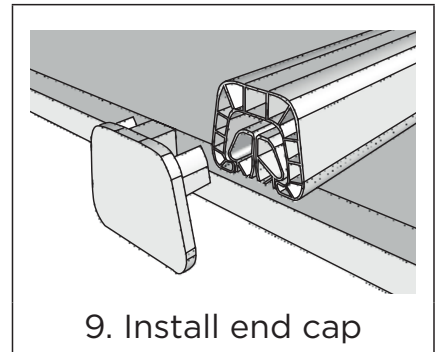
6. Install connector



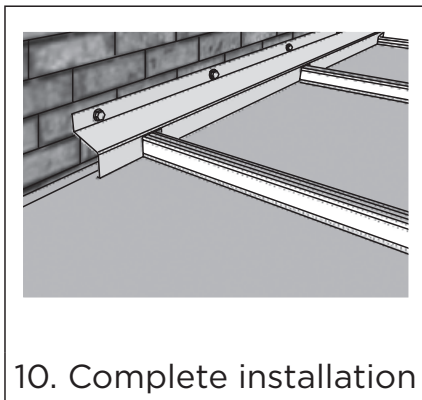
7. Remote outer film



8. Install edge profile



9. Install end cap



10. Complete installation

Important Note: For best results always use Plaskolite accessories, designed especially for use with TOPGAL SYSTEM.

The using of materials not recommended by the manufacturer may lead to damage of MultiWall sheets. Such damage is not covered by the Plaskolite MultiWall Limited Product Warranty.

Planning the Supporting Structure

- » Install the panels with the flutes parallel to slope direction at minimum 5%. In wall and gable applications always ensure that the flutes are positioned vertically.
- » Supporting beams must be at least 40 mm (1.5" inches) wide to ensure good anchorage of panels and fastening accessories.
- » When considering arched structures, check the smallest permissible cold bending radius (R) according to the panels thickness.
- » Ensure that a qualified professional reviews and approves the structure before execution.

Preparing the Supporting Structure

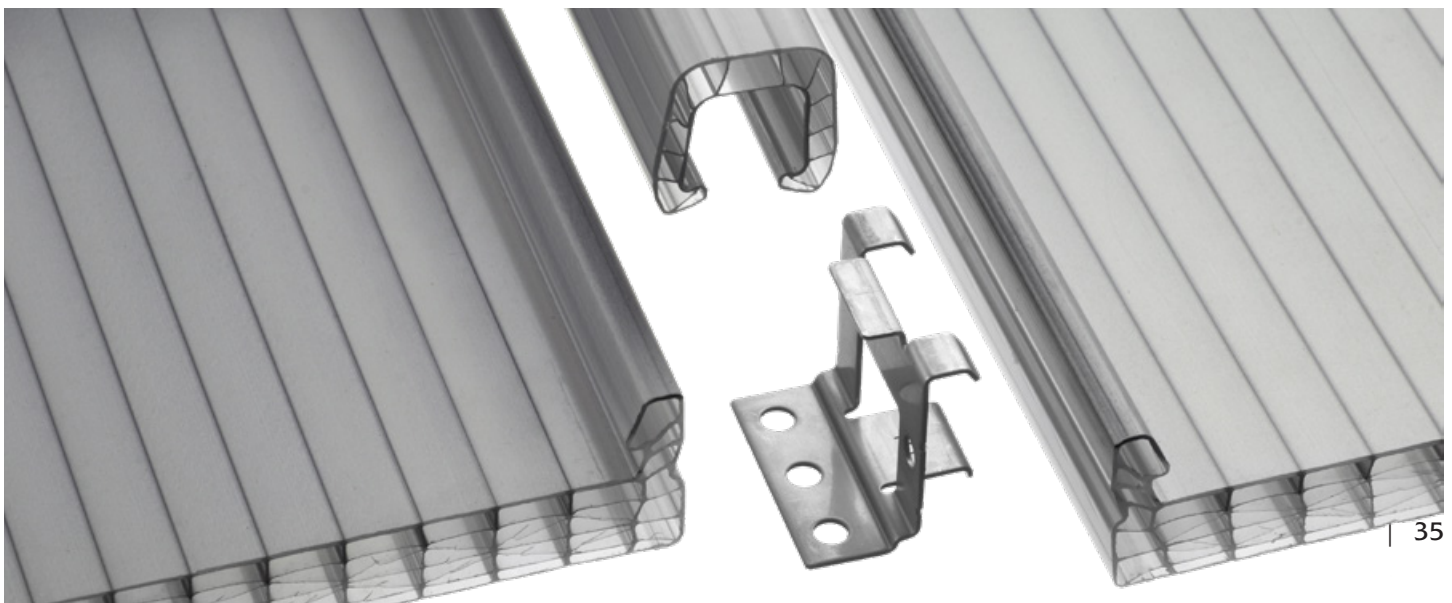
- » Complete all the metalwork and painting before installing TOPGAL.
- » Check the dimensions on site and plan the roofing requirements before ordering Plaskolite Polygal MultiWall products for the project.

Preparing the Sheets

- » Fold back the outer protective film on the sheet, 10 cm (4" inches), on all four sides.
- » Attach perforated edge tape to the fluted ends of the sheet. Anti-DUST tape is made of a strong non-woven material which is designed to adapt to the expansion and contraction of MultiWall sheets.
- » Place the panel on the supporting structure.
- » Fold back the outer protective film on the sheet, 10 cm (4" inches), on all four sides.
- » Attach perforated edge tape to the fluted ends of the sheet. Anti-DUST tape is made of a strong non-woven material which is designed to adapt to the expansion and contraction of MultiWall sheets.
- » Place the sheet on the supporting structure.

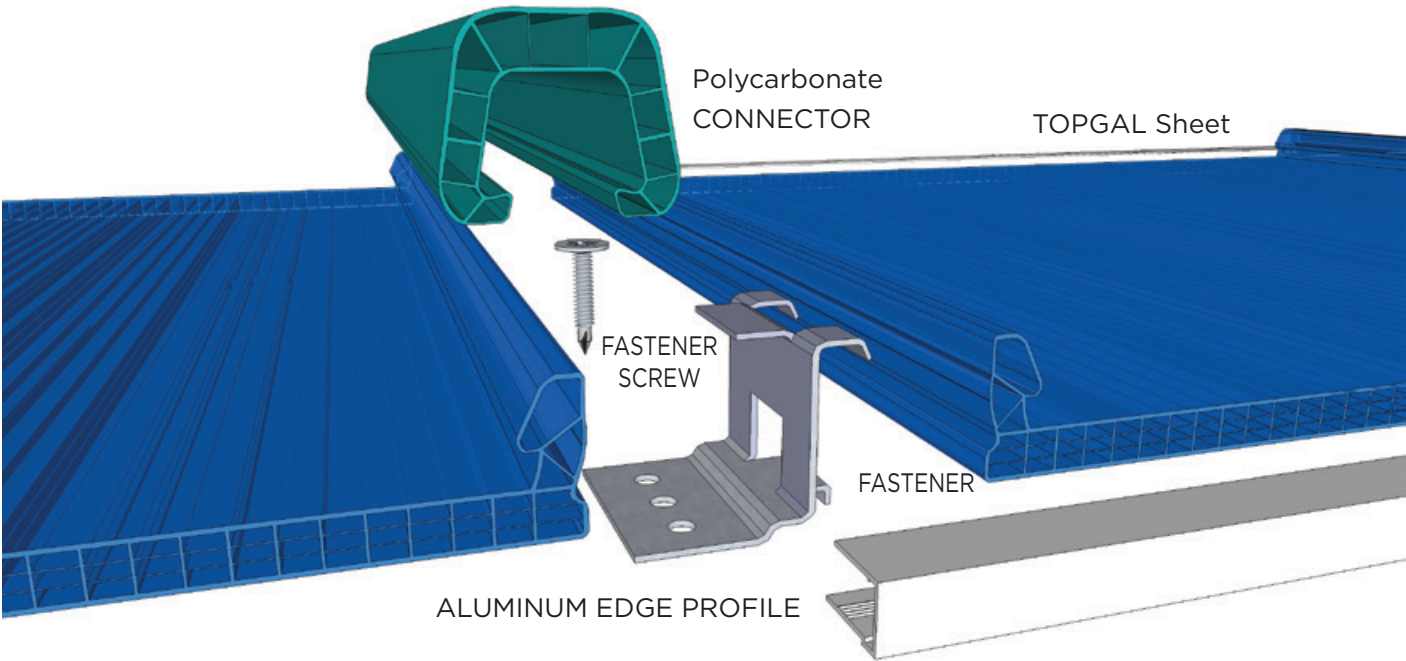
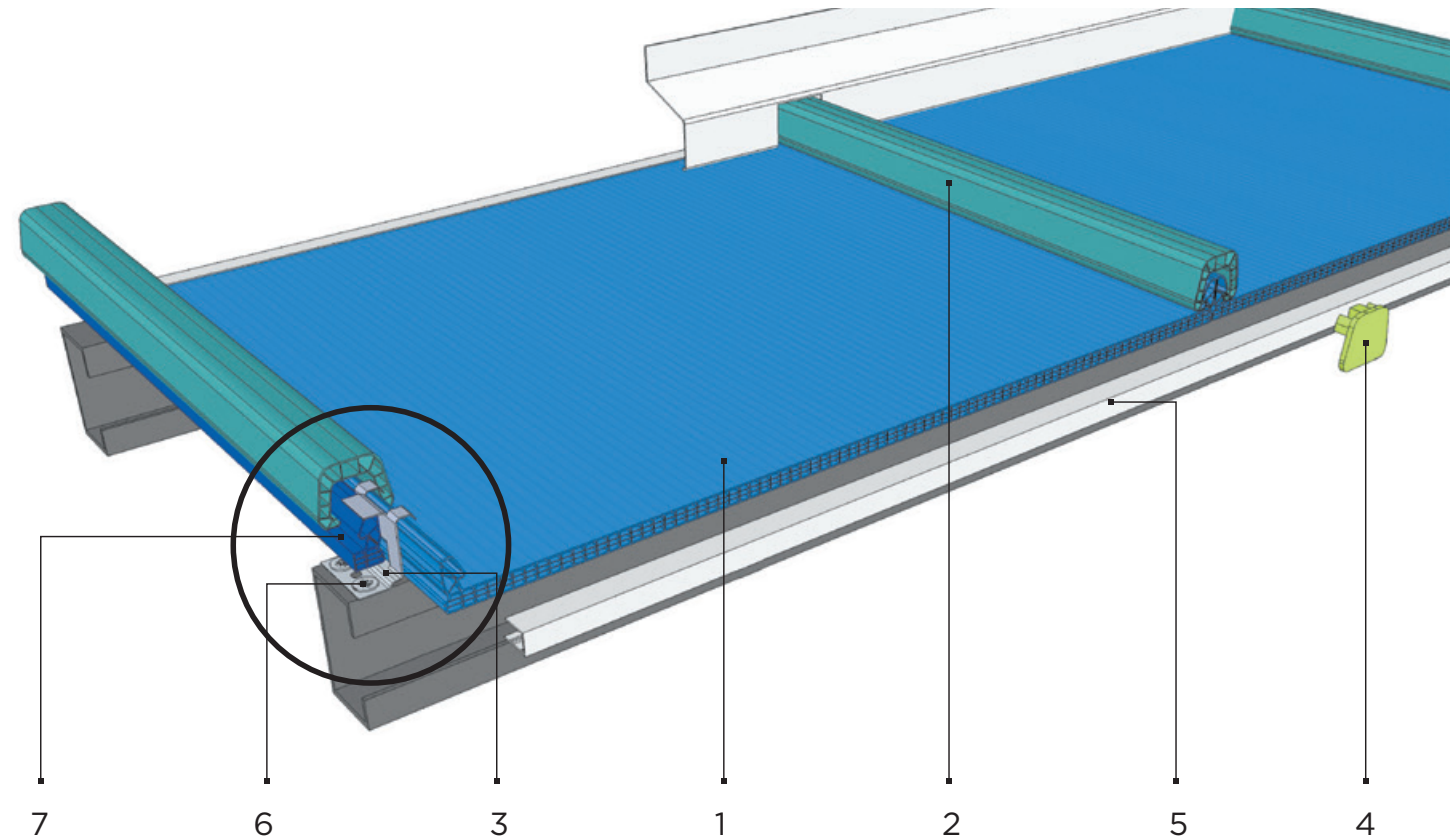
Preparing the Aluminum Edge Profiles

- » Use a metal saw to cut the aluminum edge profiles into appropriate lengths.
- » Drill drainage holes into the bottom of the edge profiles located on the low slope side of the roof.

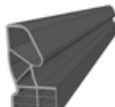


Installation Guide

TOPGAL SYSTEM



TOPGAL SYSTEM ACCESSORIES

NN	Item	Function	Cat. No	Description
1		TOPGAL SHEET		Maximum sheet length for export is 11.90m
2		Polycarbonate CONNECTOR	#240	Color: sheets matched
3		FASTENER	#534 - 6 mm #530 - 8 mm #531 - 10 mm #532 - 16 mm #533 - 20 mm	Stainless Steel
4		CONNECTOR END CAP	#525	Polycarbonate Color: clear
5		ALUMINUM EDGE PROFILE	#327 - 6 mm #311 - 8 mm #312 - 10 mm #313 - 16 mm #328 - 20 mm	Length 6 m
6		FASTENER SCREW	#431 -(for metal structures) #436 -(for wood structures)	Philips #10 / 5/8" Philips #10 / 1"
7		Polycarbonate SIDE PROFILE	#245 - 6 mm #241 - 8 mm #242 - 10 mm #243 - 16 mm #244 - 20 mm	Color: sheets matched
8		STOPPER	#554 - 6 mm #550 - 8 mm #551 - 10 mm #552 - 16 mm #553 - 20 mm	Stainless Steel
9		ALUMINUM CONNECTOR	#360	Length 6 m
10		ANTI DUST TAPE	#508 - 6-8 mm #509 - 10-16 mm #510 - 20 mm	Roll length 33m
11		ALUMINUM SIDE PROFILE	#361	Length 6 m
12		Gap Sealing Foam	#41525 - 6-10 mm #41526 - 16-20 mm	600 mm length (6-10 mm) 1000 mm length (16-20mm)

Installation Guide

Load Bearing Capacity

Wind and Snow Load

The information contained in the wind-load charts has been drafted based on our best knowledge.

Plaskolite reserves the right to change specifications and data, without notice, if deemed necessary in the evolution of its products.

It is the sole responsibility of the customer to confirm with their own architect, engineer or other professional consultant that the materials offered for sale meet the requirements and specifications of the particular project.

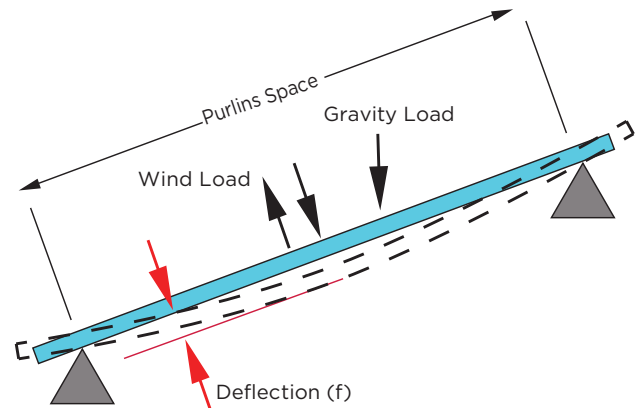
Should you visit or download contents from Plaskolite Group website, please note that it is your responsibility to ensure that you act in compliance with any local legislation or requirements applicable.

Consider the following factors for load data of Plaskolite's MultiWall sheets:

- » Roof type: flat, arched, purlin / rafter supported distance and point fastening means
- » Load direction: positive and negative
- » The required local design load
- » The allowed deflection of the sheet - usually 1.97" (50mm)
- » After considering the factors above chose:
- » The specific sheet to use
- » The distance (span) between supports / point fastening means

TOPGAL coverings are highly resistant to the forces of nature (conditional upon correct structure design and sheet installation).

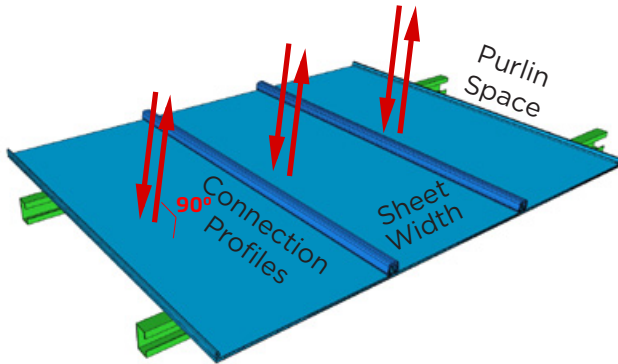
Types of Glazing: The sheets should be connected to each other by rigid connecting profiles and fastened by fasteners to the supported structure.



TOPGAL Supporting structure

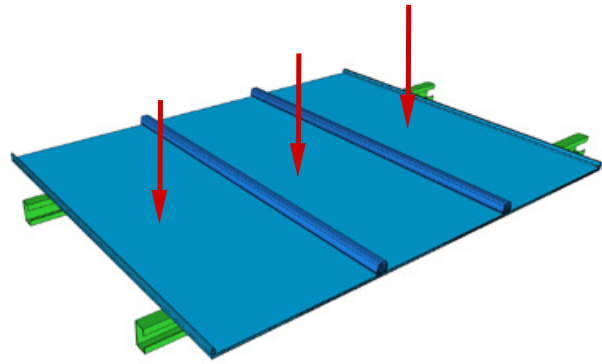
Wind Load

Perpendicular to the plane of the roof



Gravity Load

Perpendicular to the sea surface



The table show recommended span between purlins (intermediate fields) in flat structures depending on type of various sheets and loads, considering the expected deflection, the buckling moment, and the edge translations.

Recommended Span Between Purlins in Flat Structures (m)

Thick./Width	Direction	750Pa	1000Pa	1250Pa	1500Pa	1750Pa	2000Pa
8/600	Wind load	1.1	1	0.85	0.7	0.6	0.5
	Gravity load	1.4	1.3	1.2	1.1	1	0.9
10/600	Wind load	1.3	1.15	0.95	0.85	0.8	0.7
	Gravity load	1.5	1.4	1.3	1.2	1.1	1
16/600	Wind load	1.4	1.25	1.1	1	0.9	0.8
	Gravity load	1.65	1.6	1.55	1.5	1.45	1.4
16/1000	Wind load	0.9	0.6				
	Gravity load	1.5	1.4	1.35	1.3	1.25	1.2
20/1000	Wind load	1.2	0.8	0.6			
	Gravity load	1.6	1.5	1.45	1.4	1.35	1.3

- Pa - Pascal. It is a measure of force per unit area, defined as one newton per square meter.
Allowed deflection of ≤ 50 mm.

- The calculations were made for Stainless Steel Fasteners

- For more specific load calculation please contact Plaskolite Technical Support

PLASKOLITE

A GLOBAL LEADER IN THE PRODUCTION OF THERMOPLASTIC SHEET

FOUNDED IN 1950

Our Mission: to deliver superior thermoplastic sheet, coatings and polymers to the world, through long-lasting customer relationships and hands-on customer service.

MANUFACTURING LOCATIONS



From our founding, PLASKOLITE strives to treat our employees, our customers, our community and the world, with kindness, dignity and respect. This drives our continuing effort to create sustainable products, in a sustainable manner, for future generations. This on-going commitment is expressed in the

PLASKOLITE Sustainable Ecosystem:

QUICK FACTS

STATUS: Privately held

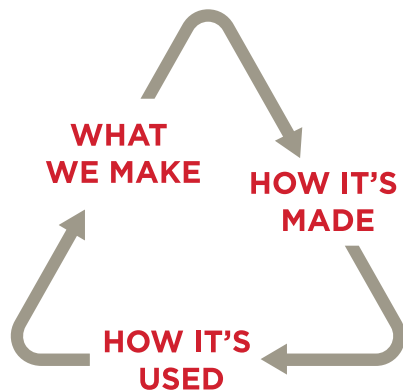
GLOBAL HEADQUARTERS: Columbus, OH

EMPLOYEES: 1800 Worldwide

MARKETS SERVED: Signage, Lighting, Retail Display, Construction, Transportation, Security, Bath & Spa, Industrial, Architecture, Green Houses

OUR PILLARS OF SUSTAINABILITY

EACH CONTRIBUTES TO MAKING THE WORLD A BETTER PLACE



WHAT WE MAKE

Versatile, high-quality, durable thermoplastic materials...not single-use plastics

HOW IT'S MADE

How we make our products reflects our overall philosophy of continuous environmental improvement

HOW IT'S USED

Our thermoplastics play an important role in advancing human well-being, energy conservation and quality of life

These suggestions and data are based on information we believe to be reliable. They are offered in good faith, but without guarantee, as conditions and methods of use are beyond our control. We recommend that the prospective user determines the suitability of our materials and suggestions before adopting them on a commercial scale.

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