



THERMAGLAS®

Multiwall Polycarbonate Panels with Anti-Condensate Layer

Technical & Installation Guide

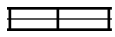


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General Description



 **ThermaGlas® Twin-Wall** polycarbonate provides clarity, durability and strength. Because the panels have an insulating air-filled space between the inner and outer wall, energy efficiency is increased. While 4mm, 6mm, 8mm, 10mm, and 16mm thicknesses are available, 8mm is the industry-standard thickness for most double layer polycarbonate products in the commercial greenhouse market. This is because it offers the best combination of strength, rigidity, good insulation value, and cost, as well as a wide variety of attractively priced glazing systems.

 **ThermaGlas Triple-Wall** polycarbonate offers increased energy efficiency while also offering very good light transmission, which represents a major improvement over standard twin-wall products. While ThermaGlas triple-wall is available in a variety of thicknesses, including 8mm, 10mm and 16mm, the most widely used thickness is 8mm.

Benefits of ThermaGlas 8mm Triple-Wall over 8mm Twin-Wall

Feature	Benefit
14% more insulating efficiency	<ul style="list-style-type: none"> • Greater R.O.I. on glazing • Reduced condensation • Less fluctuation of light transmission due to condensate formation
50% fewer internal vertical ribs	<ul style="list-style-type: none"> • Improved light transmission • Greater clarity • Better aesthetic appeal
A heavy exterior wall	<ul style="list-style-type: none"> • Good impact resistance
Compatibility with industry-standard 8mm glazing systems	<ul style="list-style-type: none"> • Lower cost for glazing systems • Greater variety of system choices



ThermaGlas Technical Specifications

Dimensions										
Product	Thickness		Rib Spacing		Standard Widths		Weight		Lengths	Colors
	mm	in.	mm	in.	mm	in.	g/m ²	psf	ft.	
Twin-Wall 	4	5/32	6	~1/4	1200 1220 1810 1830	47.25 48 71.25 72	777	0.16	24' up to 39' ⁽²⁾	Clear, Solar Soft 80, White Opal, Bronze
	6	1/4	6	~1/4			1300	0.27		
	8	5/16	10	~3/8			1500	0.35		
	10	3/8	10	~3/8			1700	0.35		
	16	5/8	20	~13/16			2670	0.55		
Triple-Wall 	8 ⁽¹⁾	5/16	20	~13/16	2100 ⁽¹⁾	82.68 ⁽¹⁾	1700	0.35	24' up to 39' ⁽²⁾	Clear, White Opal, Bronze
	10 ⁽¹⁾	3/8	20	~13/16			1990	0.41		
	16	5/8	20	~13/16			2670	0.55		

(1) 2100mm (82.68") wide panels not available in all thicknesses.

(2) Please note that panels longer than 24' are not recommended due to expansion and contractions and also may require a longer lead-time and additional freight surcharges.

ThermaGlas Technical Specifications

Thermal		Value		Test Method
Number of Layers	Panel Thickness	R-Factor	U-Factor	
Twin-Wall 	4mm	1.49	0.67	ASTM C-177
	6mm	1.62	0.62	
	8mm	1.72	0.58	
	10mm	1.89	0.53	
Triple-Wall 	8 mm	1.99	0.50	
	10 mm	2.08	0.47	
	16 mm	2.36	0.42	

Optical		Panel Thickness	Clear		White Opal		Solar Soft 80
Property	Test Method		Twin Wall	Triple Wall	Twin Wall	Triple Wall	Twin Wall
PAR Light Transmission (See below for more information about PAR Light)	ASTM D-1003	4mm	82%	—	30%	—	80%
		6mm	80%	—	20%	—	80%
		8mm	80%	76%	45%	45%	80%
		10mm	79%	76%	30%	45%	80%
		16mm	—	76%	—	35%	80%

Fire / Ignition / Smoke	Value	Test Method
Flammability Rating	CC1 [†]	ASTM D-635
Self Ignition	932° F	ASTM D1929
Flash Ignition	878° F	ASTM D1929
Smoke Density (%)	8.6%	ASTM D2843
Smoke Developed	350 (Class A) [†]	ASTM E-84
Flame Spread	15 (Class A) [†]	ASTM E-84

[†] Select products apply.

Typical Physical Properties

A detailed overview of ThermaGlas physical properties can be downloaded at: www.PalramAmericas.com/ThermaGlas-physical-properties

Light Transmission

PAR Light Transmission

An acronym for photosynthetically active radiation. Of the sun's total spectrum of energy, this is the visible portion and is regarded by most horticulturists as being critical for proper plant growth and development. Within this band of energy, colors occur in the sequence seen in a rainbow ranging from violet through blue and green, yellow and orange to red. PAR Light is the spectrum of light that is utilized by the plant for photosynthesis to occur. A measure of visible light intensity (400-700 nanometers) obtained by using a specialized light meter. PAR is simply a count of photons falling upon a surface in a given time and is reported as "micro Mols per square meter per second" ($\mu\text{Mols}\cdot\text{m}^2\cdot\text{sec}$). Quantum meters report all wavelengths between 400 and 700 nm, however, they report only light intensity and do not account for spectral quality.

Ultraviolet Light Transmission (UV)

ThermaGlas incorporates a co-extruded protective UV layer. This layer acts as a barrier and helps to prevent degradation of the panel itself. Co-extrusion offers dramatically superior durability when compared to other types of UV protective barriers and ensures against de-lamination or oxidation. 99.5% of the sun's harmful UV radiation is blocked by ThermaGlas, resulting in a panel that is highly weather resistant, durable, and non-yellowing.

ThermaGlas UV2® (with optional double-sided UV protection)

ThermaGlas UV2 panels are manufactured with built-in UV protection on both sides of the panel. This panel should be used for open roof greenhouses or fully exposed exterior walls or partitions. UV protection prevents yellowing and helps maintain strength, impact resistance, and clarity over time.

Condensation Control

ThermaGlas triple wall has double air space and higher R-Factor, which reduces condensation formation. The double tempering of the air results in lower inside/outside temperature differentials, both within the panel (the primary location of condensation formation on double wall panels), as well as on the underside of the panel. When condensate is present, the droplets reflect light away from the glazing surface. By minimizing condensate formation, light transmission remains constant. Triple-wall minimizes condensate formation better than twin-wall by virtue of the fact that it has two air spaces instead of one.

Internal Rib Spacing

Twin Wall: Conventional 8mm double-wall products have very close internal rib spacing, approximately 10mm. This results in very “busy” looking panels, which are lacking in aesthetic appeal.

Triple Wall: The 100% wider rib spacing of ThermaGlas Triple-Wall provides greatly improved “see-through” qualities, making it a far more attractive choice for use in vertical wall applications, especially in retail oriented facilities. This also keeps that light transmission near to that of twin-wall, in spite of the added layer.

Insulating Characteristics

General Insulating Information



Heat loss occurs when heat transfers from one warmer surface to another colder surface. As an example, if you were to put your warm hand on a cool ceramic tile for a few minutes heat from your body would begin to transfer to the tile and the tile would begin to get warmer. You could easily test this by removing your hand; touching another area of the tile and then quickly putting it back to the spot that your hand just warmed.

During winter months, heat also transfers from the warmer inner surface of greenhouse glazing materials to the colder outer surface (assuming that the greenhouse is enclosed and heated). There are a few weather related elements that can accelerate the heat transfer process: wind, temperature, and humidity.

Multi-wall materials increase energy efficiency by increasing the number of surfaces through which heat must transfer before it reaches the outside, as well as adding an air space in between the layers where heat can accumulate before it transfers through the next surface. The air becomes warmer within the air space, thereby slowing the transfer from the inner-most surface. Additional layers with additional air spaces will increase energy efficiency and reduce heat transfer. (Layers also affect light transmission. More on this later).

Standardized Measurements for Insulating Characteristics

Standardized procedures are used in the building and construction industry to determine the relative energy efficiency of most building products. Insulating values are typically stated in terms of U-value or R-value in the U.S.A., and K-value (the metric equivalent) everywhere else in the world. Where U-factor is concerned, a lower number indicates better energy efficiency. Where R-Factor is concerned, a higher number indicates better energy efficiency.

Insulating Values				
Product	Profile	Thickness	R-Factor	U-Value
Twin-Wall		4mm	1.49	0.67
		6mm	1.62	0.62
		8mm	1.72	0.58
		10mm	1.89	0.53
Triple-Wall		8mm	1.99	0.50
		10mm	2.08	0.47
		16mm	2.36	0.42

Note: R-Factor – The higher the number the better insulator.

U-Value – The lower the number the better insulator.

For 14% More Energy Savings, Choose 8mm Triple Wall: The addition of an ultrathin horizontal center wall results in ThermaGlas having two insulating air spaces instead of only one. This increases ThermaGlas insulating property by 14% compared to 8mm double wall panels. In most cases, the slight additional cost of ThermaGlas triple wall is fully recovered by reduced heating costs in from one to three years. Thereafter, the grower realizes big heating cost savings year after year.

Chemical Compatibilities

ThermaGlas Chemical Resistance, Compatible Sealants and Adhesives

ThermaGlas has good resistance to many chemicals, sealants and adhesives, however, some chemicals may harm the ThermaGlas sheets. Information about many compatible chemicals, sealants, and adhesives can be found by visiting the Palram Web site at: www.PalramAmericas.com/sealants or www.PalramAmericas.com/chemicals

Before using any chemical or accessory product in conjunction with ThermaGlas, you should confirm that it is compatible with polycarbonate. Ask the manufacturer of the accessory product to provide assurance that the product has been tested and approved for use with polycarbonate.

NOTE: Palram can only confirm that the sample submitted for compatibility is compatible with ThermaGlas. Given that Palram has no control over the manufacturing of compatible products after testing, or the changes to raw materials used in the manufacturing process, Palram does not guarantee or warranty compatibility in any way. Before using any product, contact the manufacturer to obtain their written assurance that it is compatible with ThermaGlas polycarbonate products. Failure to use a compatible adhesives, sealants, closures, washers, or any other accessory may void any and all warranties.

Installation

Storage and Handling

Panels can be stored outdoors without suffering damage from rain or snow. However, panels must not be exposed to direct sunlight while they are stacked. Stacks of three or more panels act as a solar heat collector and may incur heat stress damage, which is not covered by the warranty. The original white, watertight polyethylene package is sufficient to protect panels from this type of damage (do not confuse the packaging film mentioned here with protective masking film that is electrostatically adhered to each sheet). Do not stack heavy objects on the panels. Avoid leaving the sheets in the rain, even if still wrapped, for extended periods, as water may condense inside the hollow core.

When necessary to store panels in the open, cover them completely with a white opaque polyethylene sheet or other insulating material. Cardboard cannot be exposed to moisture due to poor weathering performance and introduction of mold to the sheets and is not recommended.

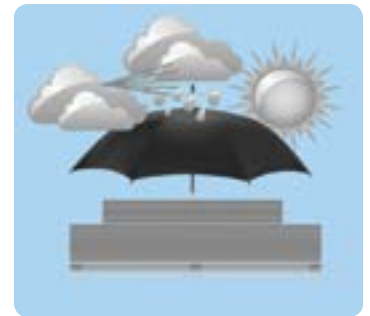
ThermaGlas panels should be transported and stored horizontally, on a flat, sturdy pallet whose dimensions are equal to or larger than the sheets themselves. The sheets must be secured and fastened to the pallet during transportation and handling at the site. It is possible to stack the sheets with the longer sheets at the bottom and the shorter on top, leaving no unsupported overhang.

While moving a pallet with a forklift, use fork extenders if necessary so the full width of the sheet is lifted. Using shorter forks on a wider pallet may cause damage to the sheets.

Panel Positioning/Which Side Goes Out?

ThermaGlas panels have a UV-protected exterior surface. The panels should include a label stating "This side out." If there is no label, look for a production stamp along the vertical edge of the panel. It will state which side of the panel is UV protected (UV protected side should be exposed to the sun).

IMPORTANT NOTE: DO NOT STEP OR WALK ON THERMAGLAS PANELS! Always use a scaffold or, at the very least, crawling boards (chicken ladders) to distribute the installer's weight across the panel. Be certain that the crawling boards span at least two purlins as the panels are not designed to accommodate localized stress cause by concentrated weight. Note that panels can puncture easily under localized pressure.



Scaffolds

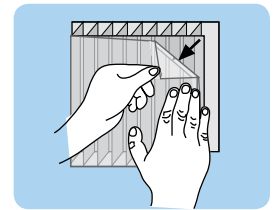
It is best to apply ThermaGlas panels on the roof with a professional greenhouse roof scaffold. If scaffolding is not available, extension ladders or crawling boards, supported by the roofs structural elements, may be used. When using an extension ladder, lay ladder on the roof with the legs resting in the gutter of the greenhouse. Extend the ladder the distance of the roof slope so that it is also supported by the ridge support.

Never step on the ThermaGlas panel between the purlins or in the middle of a framed glazing. In an emergency, step only on the area directly above purlins or structural framing, however, doing so may cause damage to the panel. Never step on the panels directly at the fastener and spacer as the soft sole of a shoe forcefully conforming to the fastener and spacer can cause undue localized stresses and will likely crack the panel.

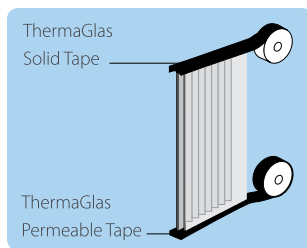
Protective Masking Films (a.k.a., Protective Scrim)

ThermaGlas panels typically ship with a protective scrim on the UV protected side of the panel. In some cases, panels may ship with a protective scrim on *both sides* of the panels. Color of the scrim may vary depending on the factory production and product type.

Should the panels be provided with a protective scrim on both surfaces, remove the underside masking or scrim around edge of panel allowing the panel to be installed. Maintain masking on remainder of panel until installation is complete thus protecting the anti-condensate surface.



Remove the outer side or exterior protective film as soon as the installation of the whole glazed area is completed. This film should be removed shortly after installation. Failing to remove the film and exposing the film to direct sunlight may cause difficulties in removal due to deterioration of the film, and void the warranty.



Protecting Against Dust Infiltration

The upper end of ThermaGlas panels should be sealed using adhesive backed ThermaGlas Solid tape. This prevents moisture and contaminants from entering the panel cavities.

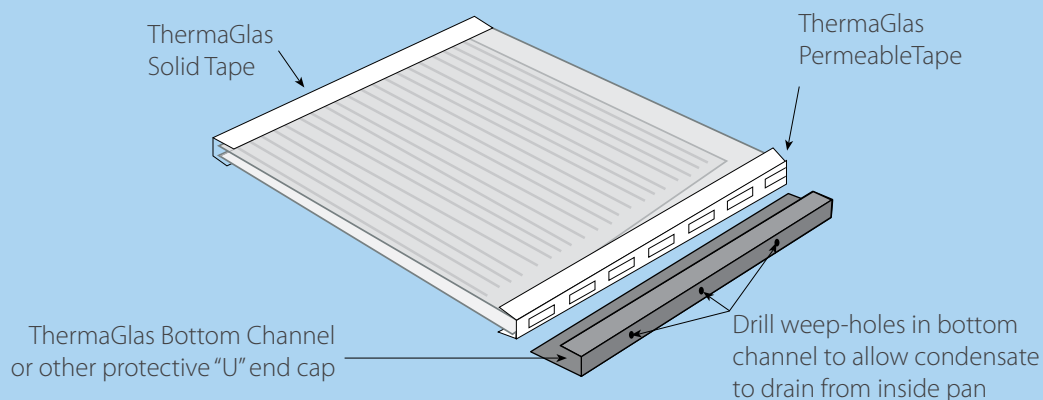
Allowing for Condensation Drainage

The lower end of ThermaGlas panels should be covered using adhesive backed ThermaGlas Permeable Tape. This allows condensation moisture to escape, but keeps dust and contaminants out.

Sealing tapes should be protected from mechanical harm by using a suitable glazing system (i.e., bottom channel, ridge, U-profile, etc.)

Weep holes should be drilled in the bottom glazing member so that moisture can escape (1/8" diameter weep hole every 18"-24").

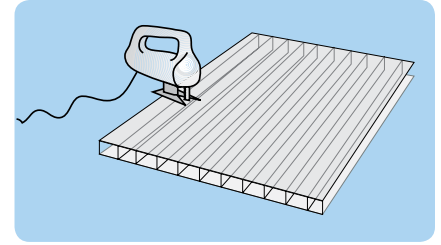
Installation of ThermaGlas Solid Tape at Top of the Sheet and Installation of ThermaGlas Permeable Tape at the Bottom of the Sheet



Cutting Panels

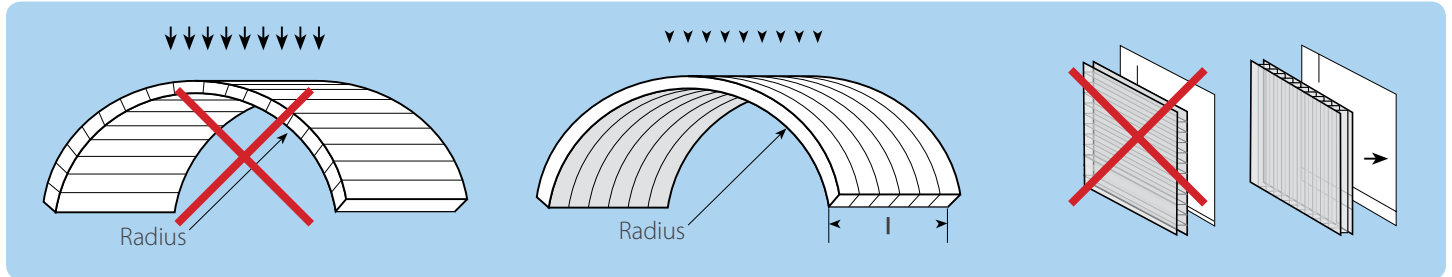
ThermaGlas panels can be cut with a power circular saw equipped with a triple chip fine-tooth blade. Dust can be removed from the flutes by applying compressed air or with a vacuum. A razor knife can be used with cuts made on both surfaces of the sheet to ensure a clean cut.

A hand hacksaw may also be used for local cutting. For short and complex cuts, a band saw or jigsaw can be used taking care to advance the blade slowly. A special cutting wire hand tool may also be used to make lengthwise cuts.





Panel Orientation

ThermaGlas sheets should be installed with the rib channels in the direction of the slope for roof installation or in a vertical position for windows or walls. This position reduces accumulation of dirt inside the sheet and ease gravity drainage of condensation moisture.



Distance Between Purlins (horizontal roof support members)

Based on two-sided clamping method with mid-sheet support(s) for greenhouse applications

Profile	Panel Thickness	Recommended Span Under Given Load (Wind / Snow Load)								
		10 psf	15 psf	20 psf	25 psf	30 psf	35 psf	40 psf	45 psf	50 psf
		Purlin Spacing (inches)								
Twin-Wall 	6mm	31.5	27.6	25.6	24.4	23.6	22.8	22.4	22.2	22.0
	8mm (1.5 KG/M ²)	39.4	35.4	31.5	29.5	28.9	28.3	28.0	27.8	27.6
	8mm (1.7 KG/M ²)	41.3	37.4	33.5	31.5	30.9	30.3	29.9	29.7	29.5
Triple-Wall 	10mm	49.2	42.5	37.8	35.4	33.7	32.7	31.9	31.5	31.3
	8mm	38.4	34.4	30.7	28.9	28.0	27.2	26.6	26.2	26.0
	10mm	48.0	41.3	36.6	33.9	32.3	31.5	30.9	30.5	30.3
	16mm	63.0	55.1	49.2	45.3	42.3	40.4	39.4	38.8	38.6

Notes



1. The data is based on load tests on typical multi-wall sheets and additional extrapolations.
2. The data is based on a maximum deflection of 1/20 of the span (5%) using continuous, multi-span supports.
3. The data refers to mid-spans. The edge spans (lower and upper ends) should be smaller by about 20%.
4. The sheets can withstand even higher loads or wider span without failure, but the deflection may then grow to almost 1/10 the span (10%).

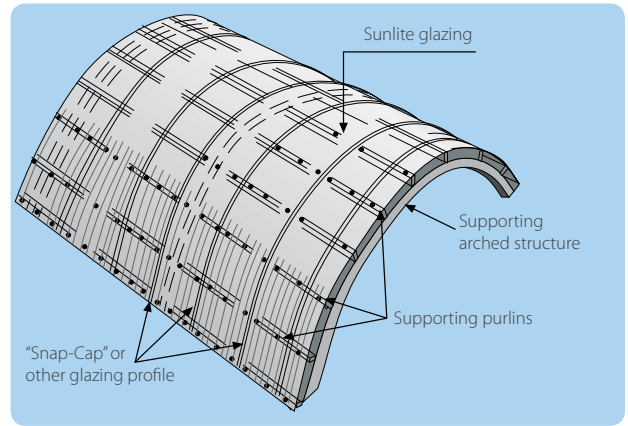
Distance between Girts (horizontal wall support members)

Vertical wall panels should have girt spacing no greater than 4 feet on center. Attachment should occur at the top and bottom of the panel. It is recommended that bottom edges of vertical ThermaGlas panels be affixed to glazing members, rather than simply burying the panel ends into the ground. This will minimize algae growth within the panel cavities.

Arch Radius Construction

ThermaGlas is sufficiently flexible to allow vertically positioned panels to conform to arched construction. Please see allowable minimum bending radii in the table below.

Product	Profile	Panel Thickness	Minimum Bending Radii		
			mm	ft.	in.
Twin-Wall		6mm	1,050	3.44	41.3
		8mm	1,400	4.59	55.1
		10mm	1,750	5.74	68.9
Triple-Wall		8mm	1,400	4.59	55.1
		10mm	1,750	5.74	68.9
		16mm	2,800	9.18	110.2



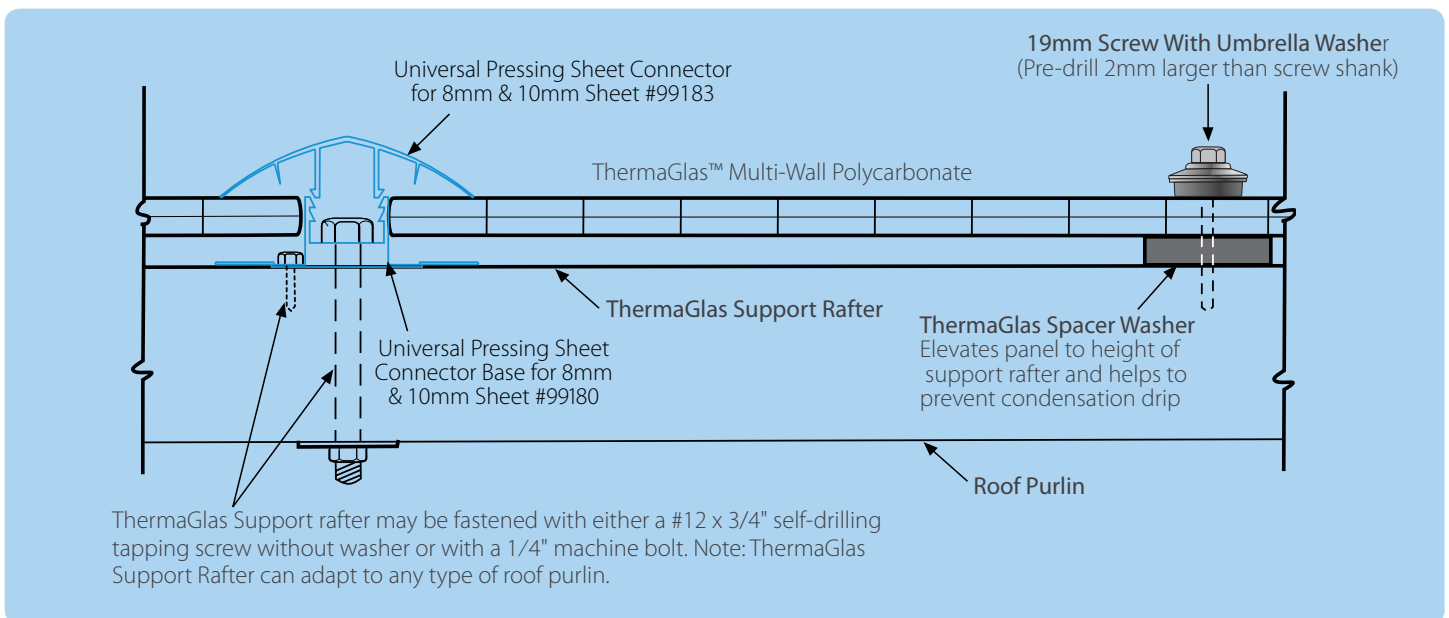
Fastening Requirements

Fasteners, Washers and Spacers

Use a screw that is appropriate for the thickness of the panel being applied (See section titled "Accessories" for more information). All screws should feature a corrosion resistant long-life coating to ensure durability. Stainless steel fasteners are recommended in extremely corrosive environments.

Note: It is recommended that Palram's fasteners and accessories be used with ThermaGlas. If products from other suppliers are used, it is imperative that the supplier test and warrant their products for compatibility with polycarbonate. See section titled "Chemical Compatibility" for more information.

ThermaGlas 8mm panels should be directly point fastened at each purlin location using #10 x 2" wood grip screw or #12 x 1 1/2" self-drilling tapping screw with a 1" (25.4 mm) Umbrella Washer. 1" ThermaGlas Spacer Washers should be used under the panel at every point fastener to keep panel elevated at the same height as the support rafter, bottom channel, or ridge, and to help reduce condensation drip at purlins.

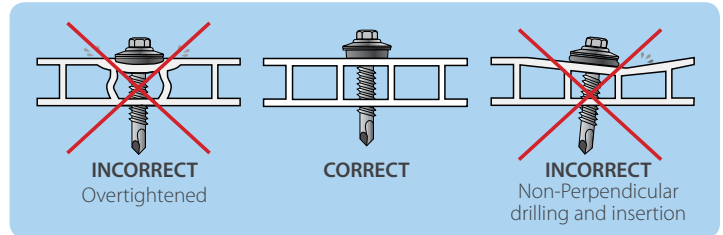


Pre-Drilling

To accommodate thermal expansion and contraction it is critical to pre-drill oversize holes for fasteners and to leave space in profiles or extrusions. The diameter of that hole should be 1/16" or 2mm larger than that of the screw. Special attention should be given to drill all the required holes perpendicular to the face of the material. Be aware of installing in extreme cold or hot weather to ensure proper expansion/contraction is addressed. If installing in such temperatures, please consult your Palram representative for recommended installation instructions.

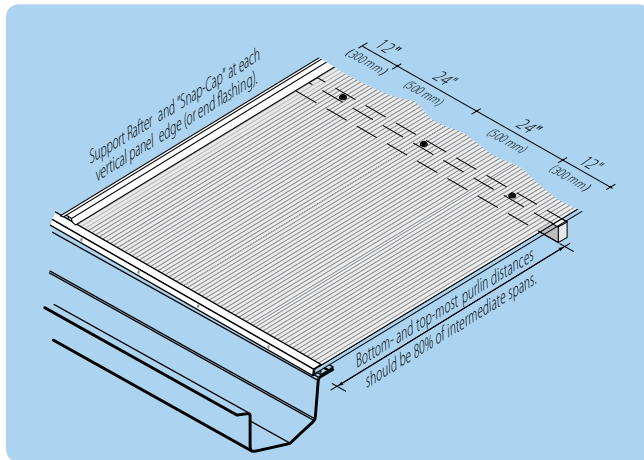
Over Tightening

It is imperative that over tightening be avoided in order to avoid undue stresses, which would cause premature failure and buckling of the sheet. Be certain to insert the screws perpendicular to the material face, as inclined insertion could damage the sheet and/or result in leaks.



Fastener Spacing

At intermediate purlins: The sheets must be fastened to the purlins by fastening screws, inserted along the supporting purlins, spaced about 24" (600 mm) apart, and 12" (30 mm) from the Support Rafter and Snap-Cap.



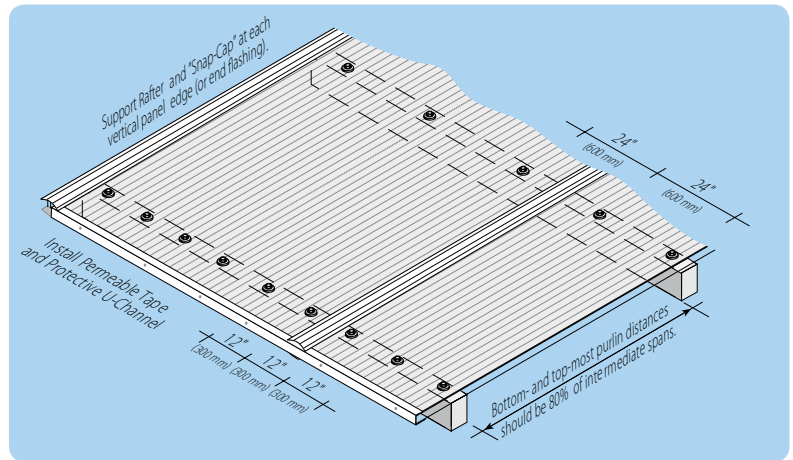
At panel ends:

If panel ends are inserted into glazing profiles with channel recesses designed to accommodate polycarbonate (at ridge, gutter or eave), fasteners are optional, but are highly recommended when wind or snow loads can be excessive. If fasteners are used at these points, placement should be the same as at intermediate purlins.

Along vertical edges of panel:

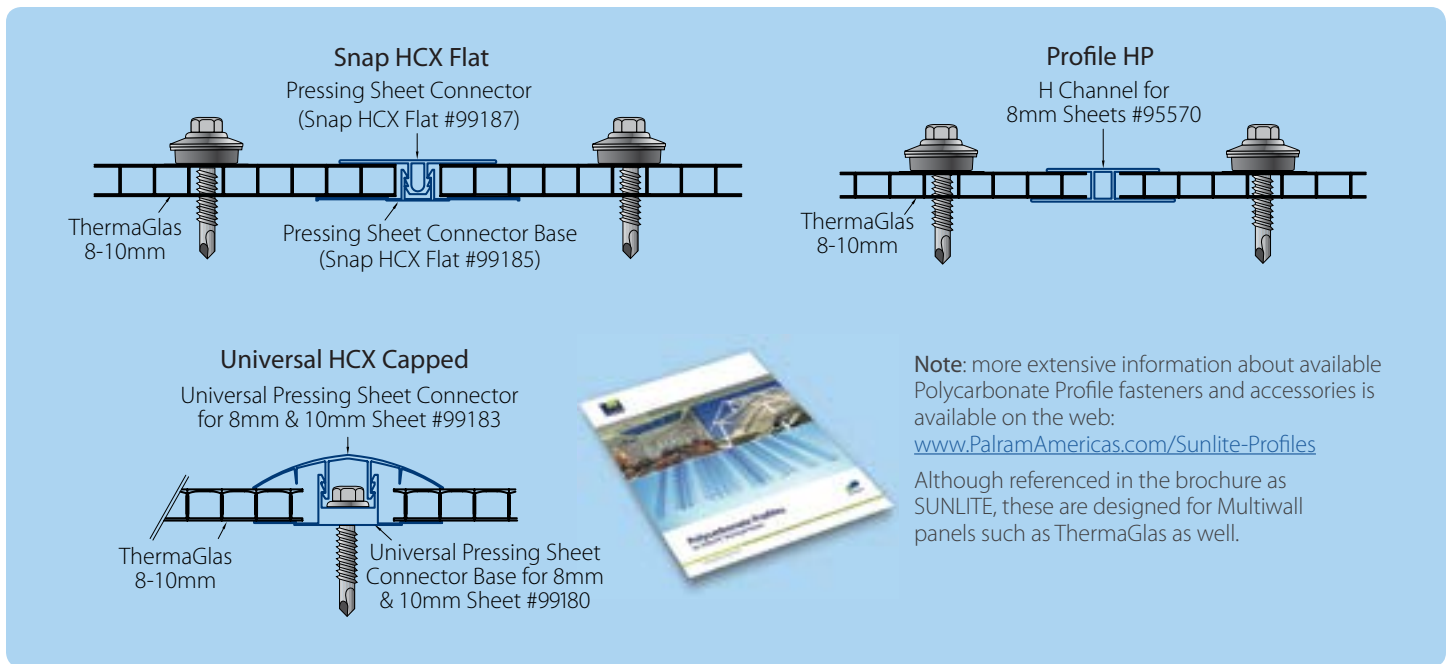
Fasteners are not necessary along the vertical edges of the panel. Securing the vertical edges of the panels is achieved with ThermaGlas Support Rafter and "SnapCap", ThermaGlas "H" Profiles, or other similar glazing system components.

Vertical edges of panels are secured with a glazing profile such as the ThermaGlas Support rafter and Snap-Cap, H-Profile, or other similar glazing member.



When panel end over hangs eave:

Along the edge purlin (or gutter) where the panel is not inserted into a channel recess, the fastening screws should be spaced about 12" (300 mm) apart. Permeable Tape and a Protective U-Channel should be used for this type application. Note: Panel ends should not over hang the eave by more than 3" (76mm).



Note: more extensive information about available Polycarbonate Profile fasteners and accessories is available on the web: www.PalamAmericas.com/Sunlite-Profiles

Although referenced in the brochure as SUNLITE, these are designed for Multiwall panels such as ThermaGlas as well.

Sealing and Bonding

Sealants

Only compatible silicone sealants should be used with ThermaGlas panels if required. Please verify with the sealant manufacture, the sealant's compatibility with polycarbonate prior to using sealant.

Silicone sealants are not typically needed when installing ThermaGlas panels. However, if there is a need to seal odd cuts or gaps approved silicone sealants can be used to seal these gaps.

Different aluminum or steel glazing profiles, structural elements, sealing materials and other components required for the completion of varied projects are usually available through professional suppliers of metals and glazing accessories. Other designated elements like gutters, closures, ridge caps, trimming and flashing, etc. are to be specially fabricated according to specific design.

Shade Compounds

IMPORTANT NOTE: Many typical greenhouse shading compounds are aggressive to polycarbonate. **WARNING:** Some shading materials containing vinyl binders or organic solvents are aggressive to ThermaGlas and should be avoided.

Contact the manufacturer of the shade compound you wish to use and gain their approval for use with polycarbonate. Palram maintains no control over the manufacturing of commercially available shade compounds – or subsequent changes to those products over time – and therefore cannot recommend any particular product for use.

Shade compound manufacturers are encouraged to contact Palram (see page 5 for details) for assistance in developing a compatibility-testing program. Palram can perform preliminary tests to determine if a product is aggressive to polycarbonate.

See PalamAmericas.com/chemicals for more information.

For more Information on Polycarbonate Care & Maintenance, please visit:

www.PalamAmericas.com/PC-Care-and-Maintenance

To view the ThermaGlas Warranty, please visit:

www.PalamAmericas.com/ThermaGlas-Warranty



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