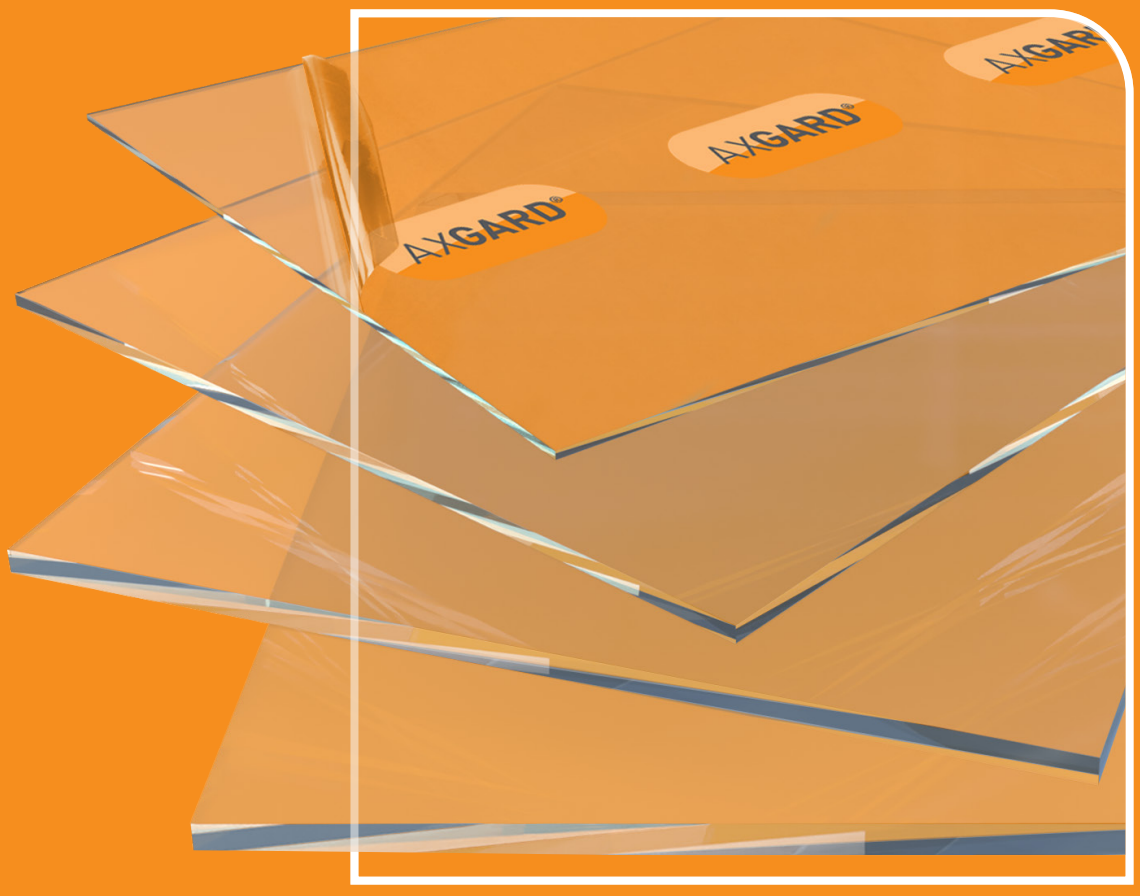
AXGARD®

Solid Glazing Products

Technical Guide



clearamber.com

The Solid Glazing Solution

Axgard® is produced from one of the most advanced polymers produced today.

Axgard® combines unique strength, superior transparency, and proven durability, whilst remaining lightweight, flexible and fire resistant, making it the perfect security glazing material for any application.

Axgard® is virtually as transparent as glass, more than 200 times stronger, less than half the weight and is classed as virtually unbreakable. It is widely used in vandal-prone areas, high impact applications or where security is at risk.

Common uses:

- ✓ Solid Security Glazing
- ✓ Machine Guards
- ✓ Glazing in Schools, Prisons and Other Public Buildings
- ✓ Bus Shelters and Smoking Shelters
- ✓ Riot and Crowd-Control Shields
- ✓ Boat, Train, Bus and Aircraft Window Glazing
- ✓ Excavation and Forestry Plant Glazing
- ✓ Lighting and Signage
- ✓ Acoustic Barriers
- ✓ Stadium Roofing and Glazing
- ✓ Church Windows and Stained Glass Protection
- ✓ Barrel Vaults and Covered Walkways

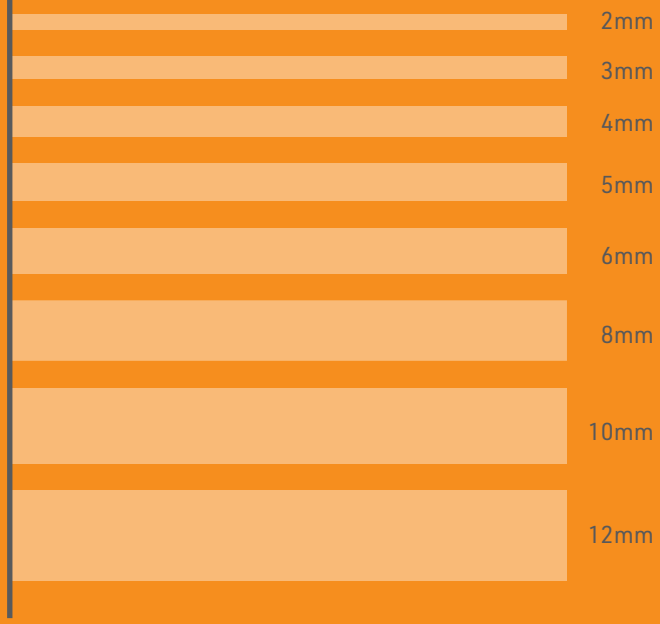
Qualities:

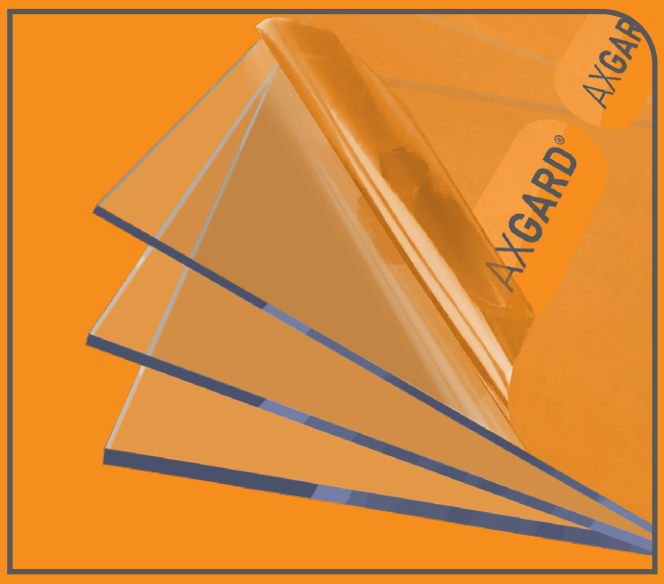
- ✓ High Impact Strength
- ✓ Easy to Cut Onsite
- ✓ Excellent Wipe Clean Surface
- ✓ UV Stabilised
- ✓ Durable
- ✓ Class 1 Fire Rating
- ✓ Can Be Fixed Entirely with Specialised Adhesive
- ✓ Excellent Seal with Silicones

Axgard® : Clear Glazing Sheets

Axgard® clear sheets are the most popular choice for roof glazing, canopies, shelters, and many other glazing applications. Manufactured in a wide range of thicknesses, Axgard® clear sheets are available from 2mm thick to 12mm. The thinner 2mm gauge provides advantages of being the most cost effective solution and offers the greatest degree of flexibility. The thicker gauges such as 10mm and 12mm clear Axgard® provide greater strength and rigidity.

Axgard® Clear Sheet Sizes





Axgard® clear glazing sheets - 4, 6 and 8mm

Axgard® Clear UV Protected Size Availability

Metric Lengths (available in **standard widths** of **500mm**, **1000mm** and **2050mm** or cut to size)							Thickness (code)	Imperial Lengths (available in **standard widths** of **620mm** and **1250mm** or cut to size)					
500mm	1000mm	1500mm	2000mm	3050mm	4000mm	6105mm		620mm	675mm	1020mm	1240mm	2050mm	2500mm
✓	✓	✓	✓	✓			**2mm** (AP2CUV)	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	**3mm** (AP3CUV)	✓			✓		✓
✓	✓	✓	✓	✓	✓	✓	**4mm** (AP4CUV)	✓			✓		✓
✓	✓	✓	✓	✓	✓	✓	**5mm** (AP5CUV)		✓	✓		✓	
✓	✓	✓	✓	✓	✓	✓	**6mm** (AP6CUV)	✓			✓		✓
✓	✓	✓	✓	✓	✓		**8mm** (AP8CUV)	✓			✓		✓
✓	✓	✓	✓	✓	✓		**10mm** (AP10CUV)	✓			✓		✓
✓	✓	✓	✓	✓			**12m m** (AP12CUV)						

AXGARD®

Axgard®: Patterned Glazing Sheets

The Axgard® patterned finish provides privacy whilst maintaining a good level of light transmission. This is very popular for industrial glazing applications, and security areas.

Axgard® Patterned Sheet Sizes

Axgard® 4mm patterned glazing sheet

Axgard® Patterned UV Protected Size Availability

Thickness (code)	Metric Lengths (available in **standard widths** of **500mm**, **1000mm** and **2050mm** or cut to size)				
	500mm	**1000mm**	**1500mm**	**2000mm**	**3050mm**
3mm (AP3PUV)	✓	✓	✓	✓	✓
4mm (AP4PUV)	✓	✓	✓	✓	✓
6mm (AP6PUV)	✓	✓	✓	✓	✓

Key Benefits:

- ✓ Provides privacy
- ✓ Maintains great light transmission
- ✓ Allows a degree of visibility whilst retaining privacy

Axgard®: Bronze Glazing Sheets

Bronze tint Axgard® offers a tinted solution which reduces glare and provides shade. The darker colour will encourage heat absorption.

Axgard® Bronze Sheet Sizes

Axgard® 4mm bronze glazing sheet

Axgard® Bronze UV Protected Size Availability

Thickness (code)	Metric Lengths (available in **standard widths** of **500mm**, **1000mm** and **2050mm** or cut to size)					
	500mm	**1000mm**	**1500mm**	**2000mm**	**3050mm**	**6105mm**
4mm (AP4BUV)	✓	✓	✓	✓	✓	✓
5mm (AP5BUV)	✓	✓	✓	✓	✓	✓

Key Benefits:

- ✓ Provides shading from glare
- ✓ Stylish tint for applications such as boat windows

Axgard®: Opal Glazing Sheets

Our opal Axgard® option provides both privacy, shading and heat rejection properties and is very popular in many glazing applications including backlit projects.

Axgard® Opal Sheet Sizes

Axgard® 3mm opal glazing sheet

Axgard® Opal UV Protected Size Availability

Thickness (code)	Metric Lengths (available in **standard widths** of **500mm**, **1000mm** and **2050mm** or cut to size)						
	500mm	**1000mm**	**1500mm**	**2000mm**	**3050mm**	**4000mm**	**6105mm**
3mm (AP3OUV)	✓	✓	✓	✓	✓	✓	✓
5mm (AP5OUV)	✓	✓	✓	✓	✓	✓	✓

Key Benefits:

- ✓ Allows approximately 30% light transmission
- ✓ Provides privacy
- ✓ Removes almost all visibility
- ✓ Provides even white tint

Axgard®: Black Glazing Sheets

Axgard® black sheet is a solid black colour which is ideal for blackout areas where light transmission is not required.

Axgard® Black Sheet Sizes

Axgard® 3mm black glazing sheet

Axgard® Black UV Protected Size Availability

Thickness (code)	Metric Lengths (available in **standard widths** of **500mm**, **1000mm** and **2050mm** or cut to size)				
	500mm	**1000mm**	**1500mm**	**2000mm**	**3050mm**
3mm (AP3KUV)	✓	✓	✓	✓	✓
6mm (AP6KUV)	✓	✓	✓	✓	✓

Key Benefits:

- ✓ Complete opaque
- ✓ Provides block from light
- ✓ Offers total privacy

AXGARD®

Axgard® : Installation with Alukap®-XR

An example lean-to rafter supported roof with Alukap®-XR glazing bars and Axgard® sheets

Securbond® Silicone LMN Sealant

Alukap®-XR Top Wall Flashing

Option : Alukap®-XR Wall Bar

Alukap®-XR Gable Bar

Alukap®-XR Rafter Gasket

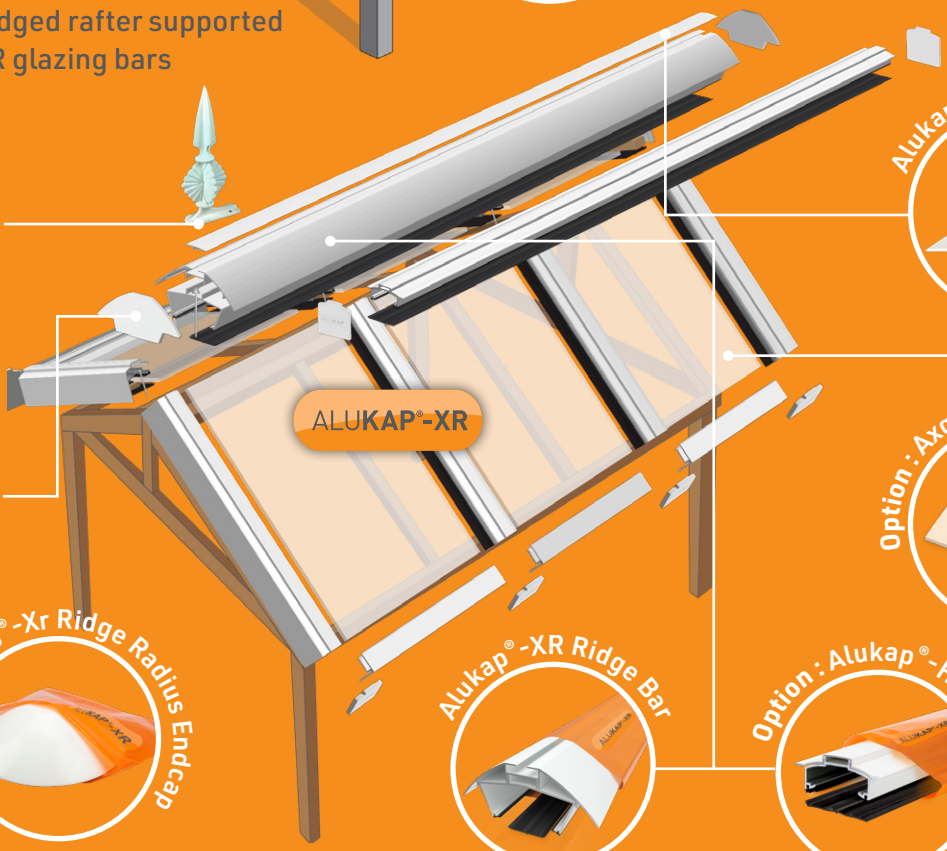
Alukap®-XR Standard Bar

Axgard® 6mm Clear Sheet

Alukap®-XR 6.4mm Endstop Bar

Alukap® Endcap

An example apex / ridged rafter supported roof with Alukap®-XR glazing bars



Option : Alukap®-XR Standard Finial

Alukap®-XR Ridge Gable End Plate

Option : Alukap®-Xr Ridge Radius Endcap

Alukap®-XR Ridge Bar

Alukap®-XR Snap Cover

Option : Axgard® 5mm Opal Sheet

Option : Alukap®-Hip Bar

Axgard® : Installation with Alukap®-SS

An example self supporting roof with Alukap®-SS glazing bars and Axgard® sheets

Securbond® Silicone LMN Sealant

Alukap®-SS Gable Bar

Alukap®-SS Top Wall Flashing

Option : Alukap®-SS Wall Bar

Alukap®-SS Wall & Eaves Beam

Alukap®-XR 6.4mm Endstop Bar

Alukap®-SS Standard Bar

Alukap®-SS Low Profile L-Cap

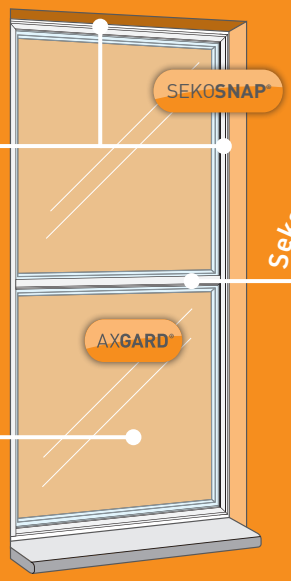
Alukap®-SS Endcaps

Alukap®-SS Post & Bracket Set

Axgard® : Installation with Sekosnap®

Sekosnap® provides a high quality secondary glazing system that is affordable and provides all the features that are required for the perfect result! The Patented and Registered design of Sekosnap® secondary glazing system allows it to be used with either 2mm or 3mm Axgard® and provides a huge range of benefits for use in general housing, recreational, public, commercial and listed buildings.

Sekosnap® Side Fix Kit



Sekosnap® H-Connector Fix Kit

Option : Axgard® 2 or 3mm Clear Sheets

Axgard® : Easy to Cut and Shape

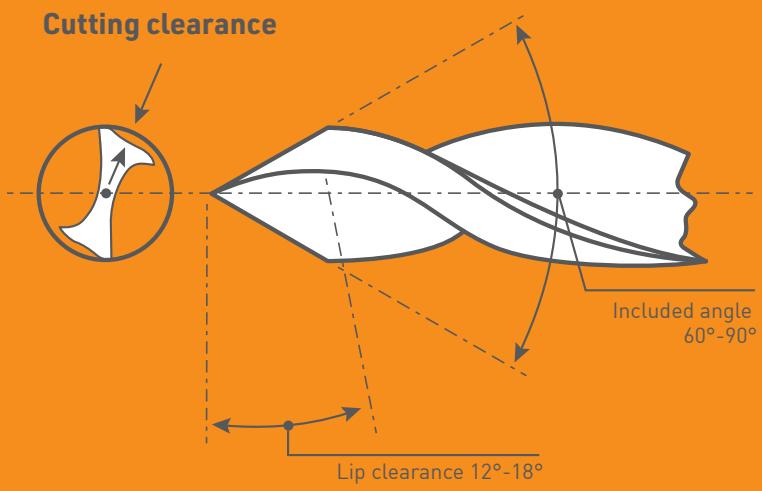
Axgard® can be cut to any shape using the latest automated CNC machinery. Also holes for fixing, speaker areas and hinges for example can also be drilled at any diameter.

Video: How 2 Cut Axgard® Sheets

Axgard® : Drilling Holes on Site

Standard twist drills for wood or metal can be used to drill Axgard®; however, slower speeds and feed rates are required for best results in producing clean, non-gummed holes. In most situations, acceptable holes with minimal shavings are produced on Axgard® sheets with a 5-speed drill press operating at speeds from 500 to 2500 rpm.

Twist drills for Axgard® sheet should have 2 flutes, a point with an included angle of 60° to 90°, and a lip clearance of 12° to 18°, as shown in the following figure. These factors help to reduce the heat by allowing the cuttings to escape easily as the hole is drilled.



For larger diameter holes in Axgard® sheets it is recommended that the rpm speed is reduced. With all drilling it is important that the Axgard® sheet is well secured during drilling to prevent vibration causing any chipping or cracking.

Depending on actual final application of the Axgard®, it is generally recommended that holes are drilled 1.5 times bigger than the screw diameter to account for sheet expansion.

During the drilling process it is recommended that the drill is backed out often to free chips, especially when drilling deep holes. Water or compressed air can be used on thicker sheets to cool the sheet and prevent overheating.

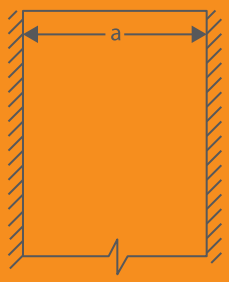
It is recommended that tests are carried out for each specific application. Free Axgard® samples are available for testing purposes.

Video: How 2 Drill Axgard® Sheets

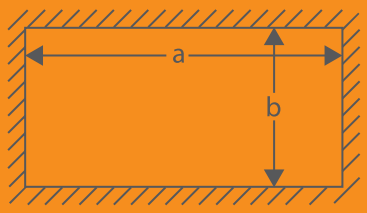
Axgard®: Spanning Guide

The following charts below provide spanning guides for Axgard® sheets when clamped on two sides in the first chart or clamped four sides on the second chart. Most applications use Glazing Bars to install Axgard® so are classed as '**Two Sides Fixed**' so please refer to the top table.

Two Sides Fixed



Four Sides Fixed



Axgard® (Minimum thickness suggested)

Sheet width - a (mm)	Load -q (n/m²)			
	600	750	850	1000
400	3	4	4	4
450	4	4	4	4
500	4	4	5	5
550	5	5	5	5
600	5	5	5	6
650	5	6	6	6
700	6	6	6	8
750	6	6	8	8
800	6	8	8	8
850	8	8	8	8

The calculations have been made for a maximum deflection of 2% on the minimum width/length. See the disclaimer.

Axgard® (Four sides fixed)

Sheet Width - a (mm)	q = 600 N/m²			q = 750 N/m²			q = 850 N/m²			q = 1000 N/m²		
	a:b relation			a:b relation			a:b relation			a:b relation		
	>1:2	1:1.5	1:1	>1:2	1:1.5	1:1	>1:2	1:1.5	1:1	>1:2	1:1.5	1:1
400	3	3	3	4	3	3	4	4	3	4	4	3
450	4	4	3	4	4	3	4	4	3	4	4	4
500	4	4	3	4	4	4	5	4	4	5	5	4
550	5	4	4	5	5	4	5	5	4	5	5	4
600	5	5	4	5	5	4	5	5	4	6	5	5
650	5	5	4	6	5	5	6	6	5	6	6	5
700	6	5	5	6	6	5	6	6	5	8	6	5
750	6	6	5	6	6	5	8	6	5	8	8	6
800	6	6	5	8	6	5	8	8	6	8	8	6
850	8	6	5	8	8	6	8	8	6	8	8	6
900	8	8	6	8	8	6	8	8	6	8	8	8
950	8	8	6	8	8	6	8	8	8	9	8	8
1000	8	8	6									
1050	8	8	8									

All loads are unfactored and based on uniformly distributed loads (UDL).
The calculations have been made for a maximum deflection of 2% on the minimum width/length.

Inasmuch as Clear Amber have no control over the circumstances in which our material may be used, or site specific parameters, we cannot guarantee that any particular results will be achieved. Users should carry out their own tests to determine the suitability of the material for their application. Installers should satisfy themselves that published permissible loadings for Axgard® glazing, together with any supporting posts, frames, or walls and fixings, are sufficient to provide adequate strength for the intended use and to meet regional loading requirements. Installers should also obtain their own job-specific structural engineer's report for their individual site. Samples are readily available to users to test and verify the exact sizes according to their site requirements.

AXGARD®

Service Temperature

Axgard® has a service temperature range from **-50°C** to **+100°C**, withstanding up to **+120°C** for short term exposure. This makes it suitable for use in any climate.

Flammability Tests

Polycarbonate has one of the highest melting points of any thermoplastic material and resists flame spread across its surface. The following table shows the high ratings achieved in building standards fire tests.

Standard	Classification
NSP 92501,4	M1 (1mm)
NSP 92501,4	M2 (1.5 to 12mm)
BS 476/7	Class 1
DIN 4102	B1, B2
CSE RF 2/75/A, CSE RF 3/77	Class 1
UL Classified	V2 (File e221255)
ASTM D-635	CC1

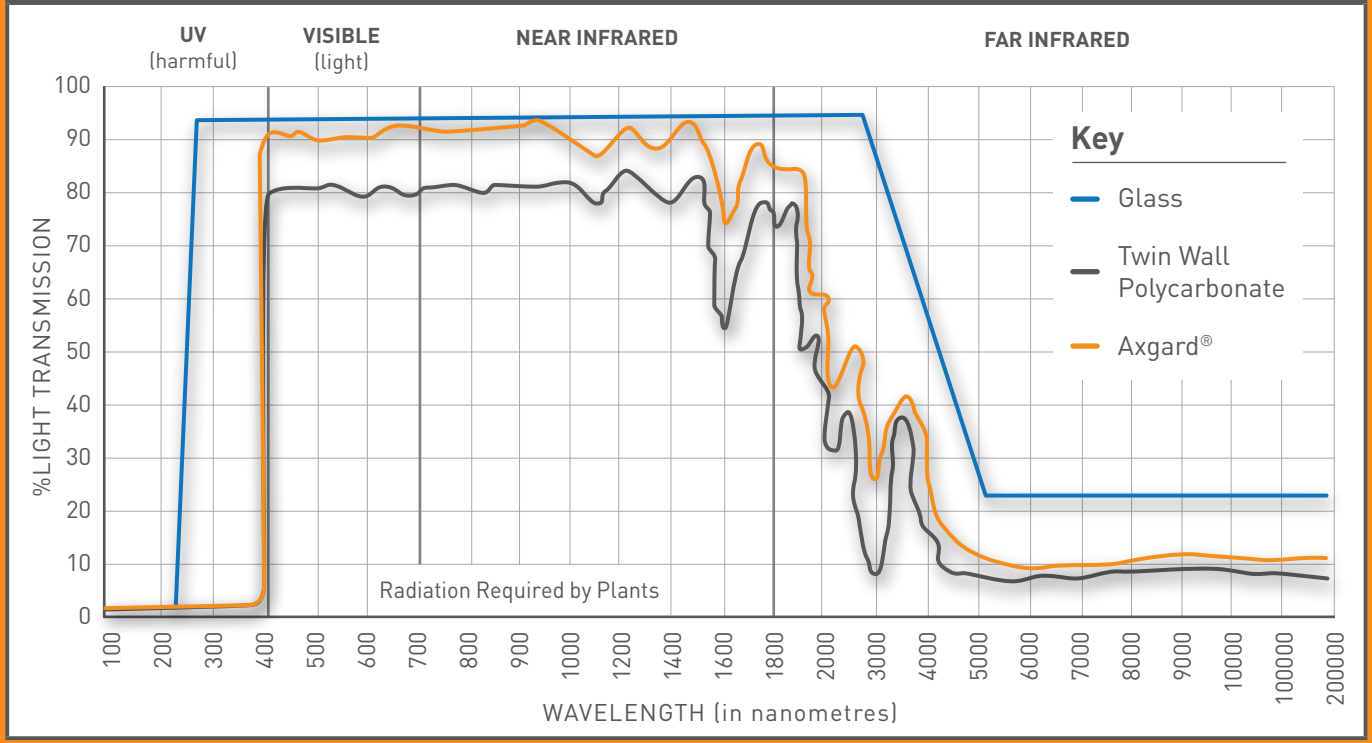
Weight/Area Ratio

The specific gravity of Axgard® sheet is 1.2, which is about half that of glass. The following table shows the ratio between the weight of Axgard® sheets of various thicknesses and glass.

Sheet Thickness mm	(inches)	Axgard® kg/m²	(lb/ft²)	Glass kg/m²	(lb/ft²)
2	(0.08)	2.40	(0.491)	4.90	(1.00)
3	(0.12)	3.60	(0.737)	7.34	(1.50)
4	(0.16)	4.80	(0.983)	9.80	(2.00)
5	(0.20)	6.00	(1.23)	12.24	(2.51)
6	(0.24)	7.20	(1.47)	14.68	(3.00)
8	(0.31)	9.60	(1.97)	19.60	(4.01)
10	(0.39)	12.00	(2.46	24.48	(5.01)

Axgard® polycarbonate **almost totally blocks harmful UV radiation** whilst still allowing exceptional levels of visible light transmission. The graph below shows comparisons with other products.

Axgard® light transmission

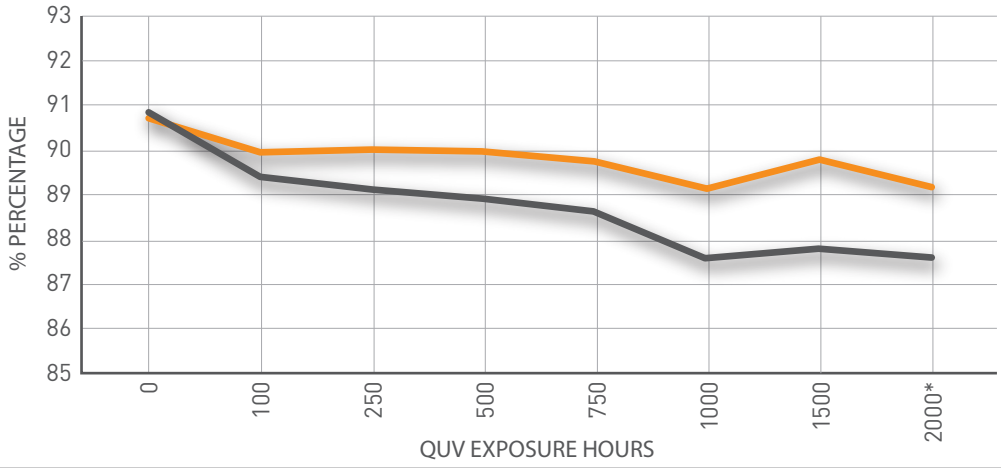


Weather Resistance

Axgard® sheet has an extra UV protective layer on both sides which greatly improves resistance against UV radiation. Estimated changes in optical properties of 3mm Axgard® compared to standard polycarbonate under accelerated UV exposure (QUV) are shown in these diagrams below. 100 hours of QUV exposure is roughly equivalent to one year actual outdoor exposure of mediterranean weather. The changes in optical properties of Axgard® are very minimal making Axgard® an excellent choice for enhanced longevity.

The table of properties below shows some additional characteristics and qualities of Axgard® sheet material, the combination of which makes Axgard® a world class security glazing material.

% light transmission

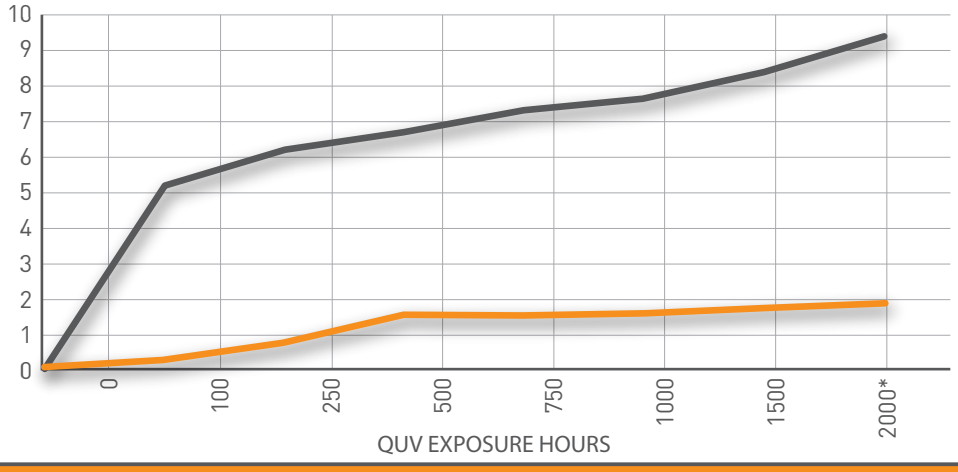


Key

- Axgard®
- Standard Polycarbonate

* Roughly equivalent to 20 years of exposure to Mediterranean weather.

Change in the yellowness index



Key

- Axgard®
- Standard Polycarbonate

AXGARD®

Cold Bending

Axgard® may be installed with a stressed curve to create an arch or dome, as long as the curve and resulting stress is within specified limits. This stress will fall within an acceptable limit and there will be no effect on the sheet characteristics if the magnitude of the radius is at least 200 times that of the sheet thickness, as indicated in the following table.

Axgard® Thickness	Minimum Bending Radius
3mm	600mm
4mm	800mm
5mm	1000mm
6mm	1200mm
8mm	1600mm

Naturally, due to the bending forces involved the sheets need well secured. Alukap®-XR Standard Glazing bars can be used to secure sheets in mediumly curved applications. For tighter curves, the glazing bars will need extra fixings for safety, please contact with any queries.

	Property	Conditions	ASTM Method	Units-SI	Value
Physical	Density		D-1505	g/cm^3	1.2
	Water absorption	24 hour @ 23°C	D-570	%	0.15
Mechanical	Tensile strength at yield	10mm/min	D-638	MPa	65
	Tensile strength at break	10mm/min	D-638	MPa	60
	Elongation at yield	10mm/min	D-638	%	6
	Elongation at break	10mm/min	D-638	%	>90
	Tensile modus of elasticity	10mm/min	D-638	MPa	2,300
	Flexural modulus	1.3mm/min	D-790	MPa	2,500
	Flexural strength at yield	1.3mm/min	D-790	MPa	100
	Notch impact strength izod	23°C	D-256	J/m	800
	Charpy impact strength notched	23°C	ISO 180	Kj/m^2	55
	Impact falling weight	3mm sheet	ISO-663/1[a]	J	158
	Rockwell hardness		D-785	R scale	125
Thermal	Long-term service temperature			°C	-50 to +100
	Short-term service temperature			°C	-50 to +120
	Heat deflection temperature	Load: 1.82 MPa	D-648	°C	135
	Vicat softening temperature	Load: 1kg	D-1525	°C	150
	Co-efficient of linear thermal expansion		D-696	10^{-5} cm/cm°C	6.5
	Thermal conductivity		C-177	W/m K	0.21
	Specific heat capacity		C-351	kj/kg K	1.26
Optical	Haze		D-1003	%	<0.5
	Light transmission		D-1003	%	89
	Refractive index		D-542		1.586
	Yellowness index		D-1925		<1
Electrical	Dielectric constant	1kHz	D-150		3.0
		1MHz	D-150		2.9
	Dissipation factor	1kHz	D-150		0.001
		1MHz	D-150		0.01
	Dielectric strength short-time	500 V/s	D-149	kV/mm	>30
	Surface resistance	Ketley	D-257	Ohm	5.1 x 10^{15}
	Volume resistance	Ketley	D-257	Ohm-cm	1.3 x 10^{17}

Hotline Bending and Thermoforming

Axgard® can also be 'hot-line' bent but we have not tested the best method or results. We can provide a free Axgard® sample for testing on request.

Chemical Resistance

Whilst Axgard® is resistant to many everyday chemicals, some stronger chemicals can attack the sheet reducing its strength and clarity.

Installation

Compatible fixings, adhesives and sealants must always be used when installing Axgard®. Also the polythene film must be removed immediately after installation.

Cleaning

For best results use clean 100% cotton cloth and large quantities of mild detergent solution. Where very regular cleaning is essential we recommend Axgard®-SR which has a scratch resistant coating.

WARNING : REGISTERED DESIGNS & PATENTS

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Inasmuch as Clear Amber have no control over the circumstances in which our material may be used, or site specific parameters, we cannot guarantee that any particular results will be achieved. Users should carry out their own tests to determine the suitability of the material for their application.

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