

The Problem Solving Mirror Solution

Shatter Proof Mirrors

Combining unbreakable polymer resilience with a specially formulated, tough, UV protected, scratch-resistant coating, Mirrorworld Armoured Polymer Mirror holds the key to success for many projects globally.

Very much at home in highly destructive and impact-prone environments, the core strength of Mirrorworld Armoured Polymer Mirror lies at the heart of its success, and the added benefit of tough abrasion resistance and anti-graffiti properties makes it a favorite with specifiers and contractors alike.

Fixing is simple; Mirrorworld Armoured Polymer Mirror can be bonded to any flat substrate, or mechanically fixed. In demanding, high-security applications, a combination of both provides an extra safeguard.

Mirrorworld Armoured Polymer Mirror can be provided with pre-drilled holes and various options of anti-ligature edge finishing and radius corners.

Common uses

- Mental healthcare
- Hospitals and clinics
- Schools
- Prisons
- Public amenities
- Shop-fitting
- Dance halls
- Gyms and sports centres
- Swimming pools
- Food preparation

Imagine a mirror that doesn't smash.

A plastic that doesn't scratch. A surface spray paint doesn't really stick to. A plastic that doesn't melt like wax when burned. You no longer need to imagine as the answer is the

MIRRORWORLD ARMOURED POLYMER MIRROR®

Qualities

- Virtually unbreakable
- Excellent scratch resistance
- Anti-graffiti properties
- Excellent Class 1/0 fire rating
- Superior clarity
- UV resistant - suitable for internal and external use
- Reduced maintenance costs
- Anti-ligature options available
- Can be bonded for hidden fixing



Combining unbreakable Polycarbonate polymer resilience with a specially formulated, tough, UV protected, scratch-resistant coating, it holds the key to success for many projects globally.

Very much at home in highly destructive and impact-prone environments, the core strength of MIRRORWORLD ARMOURED POLYMER MIRROR® lies at the heart of it's success, and the added benefit of tough abrasion resistance and anti-graffiti properties makes it a favorite with specifiers and contractors alike. Fixing is simple; MIRRORWORLD ARMOURED POLYMER MIRROR® can be bonded to any flat substrate, or mechanically fixed. In demanding, high security applications, a combination of both provides an extra safeguard. In sensitive locations, anti-ligature edge-finishing can be applied with ease.

MIRRORWORLD ARMOURED POLYMER MIRROR® samples are readily available on request.



FINISHING OPTIONS

Saw Cut

Where the **Mirrorworld Armoured Polymer Mirror®** is being installed in a frame, or where the edges are not seen, then the standard machine saw cut edge is the most cost-effective option. The Saw Cut edge is a machine cut edge and will have slight serrations as with standard machine cutting of plastic sheet products.

Flat CNC

The **Mirrorworld Armoured Polymer Mirror®** Flat Edge Finish provides a smooth flat edge that is acceptably finished where the edge is exposed. This is processed on the latest automated CNC machinery, and choosing this type of edge finish allows extra options of radius corners or fixing holes to be added if required

Anti-ligature edge finishing

Sadly, there is an increasing number of people in society today at risk of self-harm. Health institutions, prisons and detention centers have an obligation to protect these vulnerable individuals to the best of their ability. Anti-ligature edge-finishing is a prerequisite in many situations, and **Mirrorworld Armoured Polymer Mirror®** is available with specially formed edging and corners, which caters for this requirement, and obviates the need for expensive and unsightly framing.

Radius Corners

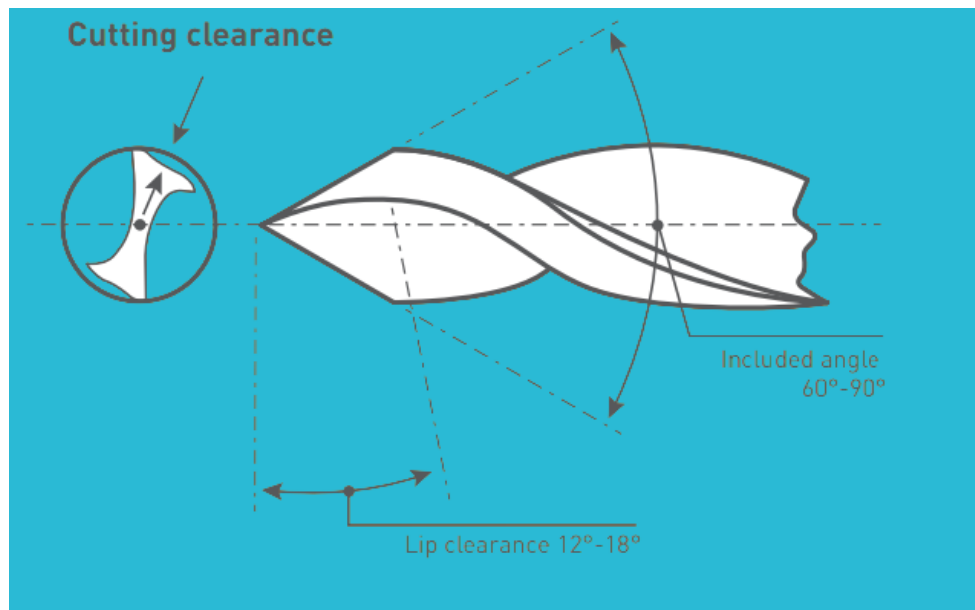
The addition of Radius Corners adds further style and safety to the look for the **Mirrorworld Armoured Polymer Mirror®**. Radius corners are normally manufactured as 20mm radius corners, however any bespoke radius corner size can be manufactured at no extra cost.

Holes and shapes

Available in squares, rectangles, circles and ovals in standard and bespoke sizes. Any shape option chosen is available with edge finishing and fixing holes. In addition, using the latest automated CNC machining **Mirrorworld Armoured Polymer Mirror®** can be formed to any shape required, both mass-production and single units, using our latest computer-aided cutting machinery. No matter how irregular the shape, simply email us the dimensions or send a template, and a perfect replica will be produced for you. Additionally, we can add holes of any diameter and in any position on your mirror.

Mirrorworld Armoured Polymer Mirror® Technical Data

Mirrorworld Armoured Polymer Mirror® is the ultimate solution for virtually unbreakable mirrors combining specially formulated, scratch-resistance coating with incredible strength; it holds the key to success for many projects nationally.



Mirrorworld Armoured Polymer Mirror®: Drilling Holes on Site

Standard twist drills for wood or metal can be used to drill **MIRRORWORLD ARMoured POLYMER MIRROR®**; 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 **MIRRORWORLD ARMoured POLYMER MIRROR®** sheets with a 5-speed drill press operating at speeds from 500 to 2500 rpm. Twist drills for **MIRRORWORLD ARMoured POLYMER MIRROR®** A 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 **MIRRORWORLD ARMoured POLYMER MIRROR®** sheets it is recommended that the rpm speed is reduced. With all drilling it is important that the **MIRRORWORLD ARMoured POLYMER MIRROR®** sheet is well secured during drilling to prevent vibration causing any chipping or cracking.

Depending on actual final application of the **MIRRORWORLD ARMoured POLYMER MIRROR®**, 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 **MIRRORWORLD ARMoured POLYMER MIRROR®** samples are available for testing purposes.

Mirrorworld Armoured Polymer Mirror Scratch Resistant Crust Properties: Physical			
Mirrorworld Armoured Polymer Mirror® surface gloss level	Gloss level percentage	Approximately 80%	Similar to standard Polycarbonate® surface
Mirrorworld Armoured Polymer Mirror® operating temperature	The operating temperature will be governed by the Polycarbonate®	See properties in below specifications	
Mirrorworld Armoured Polymer Mirror® impact strength	The impact strength will be governed by the Polycarbonate®	See properties in below specifications	
Mirrorworld Armoured Polymer Mirror® pencil hardness	5H - 6H		
Mirrorworld Armoured Polymer Mirror® surface protection adhesive	Method: Cross hatch test on dry Mirrorworld Armoured Polymer Mirror®	Result: GTO / GT	
KEY: Cross hatch results	GTO = the edges are completely smooth, none of the squares of the lattice is are detached	GT1 = detachment of small flakes of the coating at intersections of the cuts. A cross hatch area not distinctly greater than 5%	
Mirrorworld Armoured Polymer Mirror® fire resistance	The resistance to fire will be mainly governed by the Polycarbonate®	See properties in below specifications	
Mirrorworld Armoured Polymer Mirror® water resistance: immersed in water at 40 degrees	Water temperature: 40°C	Duration: 7 days	Observation: Zero top surface delamination
Mirrorworld Armoured Polymer Mirror® stain resistance	Substances applied: Coffee, marking pen, stamping ink	Duration: 24 hours	Observation: No staining observed

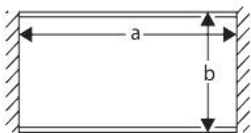
Mirrorworld Armoured Polymer Mirror Layer: Physical		
Mirrorworld Armoured Polymer Mirror® surface properties	Material used	Aluminium and protection compound
Axgard-MSR reflective properties	Reflective substance	Aluminium
Mirrorworld Armoured Polymer Mirror® surface process	Application process	High vacuum chamber application process
Mirrorworld Armoured Polymer Mirror® surface method	Mirror application	Sublimation of Aluminium evaporation and even vacuum deposition
Mirrorworld Armoured Polymer Mirror® chemical hardening	Oven cured and dried	Sheets cured in oven at approx. 50°C

Mirrorworld Armoured Polymer Mirror: Scratch Resistant Crust Properties: Chemical

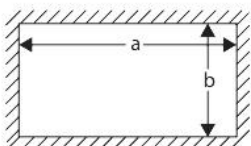
Acetone	N	M
Ethanol	L	L
Petrol	N	L
10% Caustic Soda	S	L
10% Sulphuric Acid	M	L
5% Ammonia	L	L
L = Long term resistance (up to 24 hours)	M = Medium term resistance (8 up to hours)	
S = Short term resistance (1 hour) spills / drips	N = Not recommended	

Mirrorworld Armoured Polymer Mirror®: Spanning Guide

2 Sides Fixed



4 Sides Fixed



Mirrorworld Armoured Polycarbonate Mirror

t (mm)	q (N/m ²)				
	a (mm)	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	7
750		6	6	7	7
800		6	7	7	7
850		7	7	8	8

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

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 Mirrorworld 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 Mirrorworld Armoured Polymer® together with any supporting posts, frames, or walls and fixings, are enough 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.

Mirrorworld Armoured Polymer Mirror®

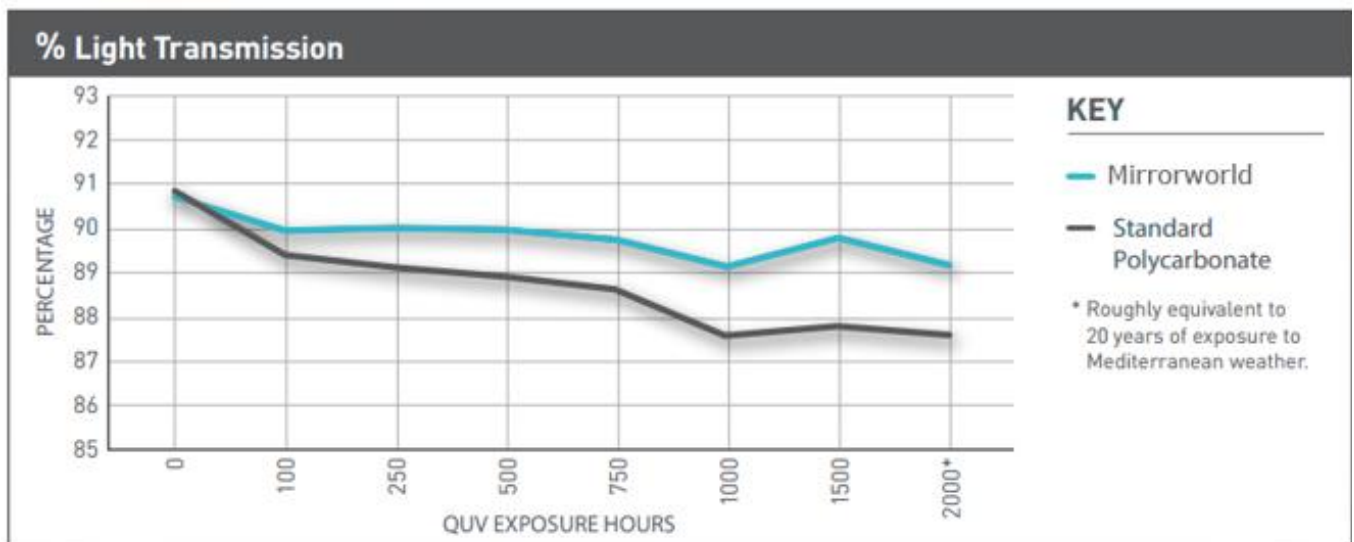
	q = 600 N/m ²			q = 750 N/m ²			q = 850 N/m ²			q = 1000 N/m ²		
t (mm)	a:b relation			a:b relation			a:b relation			a:b relation		
a (mm)	>1:2	1:1.5	1:1	>1:2	1:1.5	1:1	>1:2	1:1.5	1:1	>1:2	1:1.5	1:1
400	3	3	3	4	3	3	4	4	3	4	4	3
450	4	4	3	4	4	3	4	4	3	4	4	4
500	4	4	3	4	4	4	5	4	4	5	5	4
550	5	4	4	5	5	4	5	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	7	6	5
750	6	6	5	6	6	5	7	6	5	7	7	6
800	6	6	5	7	6	5	7	7	6	7	7	6
850	7	6	5	7	7	6	7	7	6	8	8	6
900	7	7	6	8	7	6	8	8	6	8	8	7
950	7	7	6	8	8	6	8	8	7	9	8	7
1000	8	7	6	-	-	-	-	-	-	-	-	-
1050	8	8	7	-	-	-	-	-	-	-	-	-

Mirrorworld Armoured Polymer Mirror®: Weather Resistance

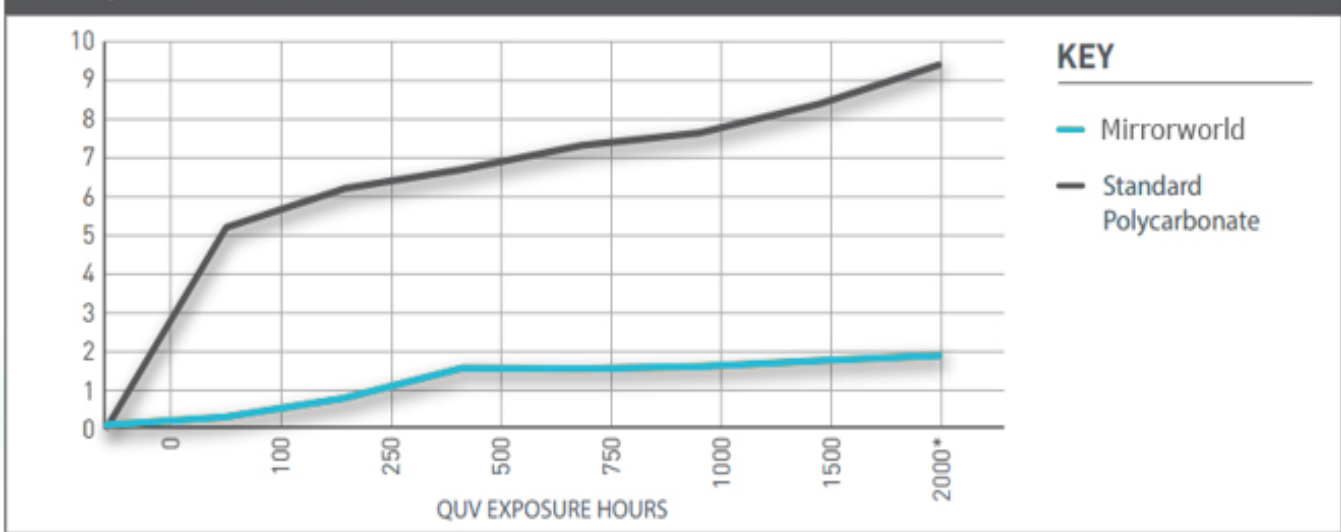
MIRRORWORLD ARMoured POLYMER MIRROR® sheet has an extra UV protective layer on both sides which greatly improves resistance against UV radiation. Estimated changes in optical properties of 3mm **MIRRORWORLD ARMoured POLYMER MIRROR®** compared to standard polycarbonate under accelerated UV exposure (QUV) 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 **MIRRORWORLD ARMoured POLYMER MIRROR®** are very minimal making **MIRRORWORLD ARMoured POLYMER MIRROR®** an excellent choice for enhanced longevity.

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



Change in Yellowness Index



Mirrorworld Armoured Polymer Mirror®: Service Temperature

Mirrorworld Armoured Polycarbonate has a service temperature range from -50°C to $+100^{\circ}\text{C}$, withstanding up to $+120^{\circ}\text{C}$ 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 à 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

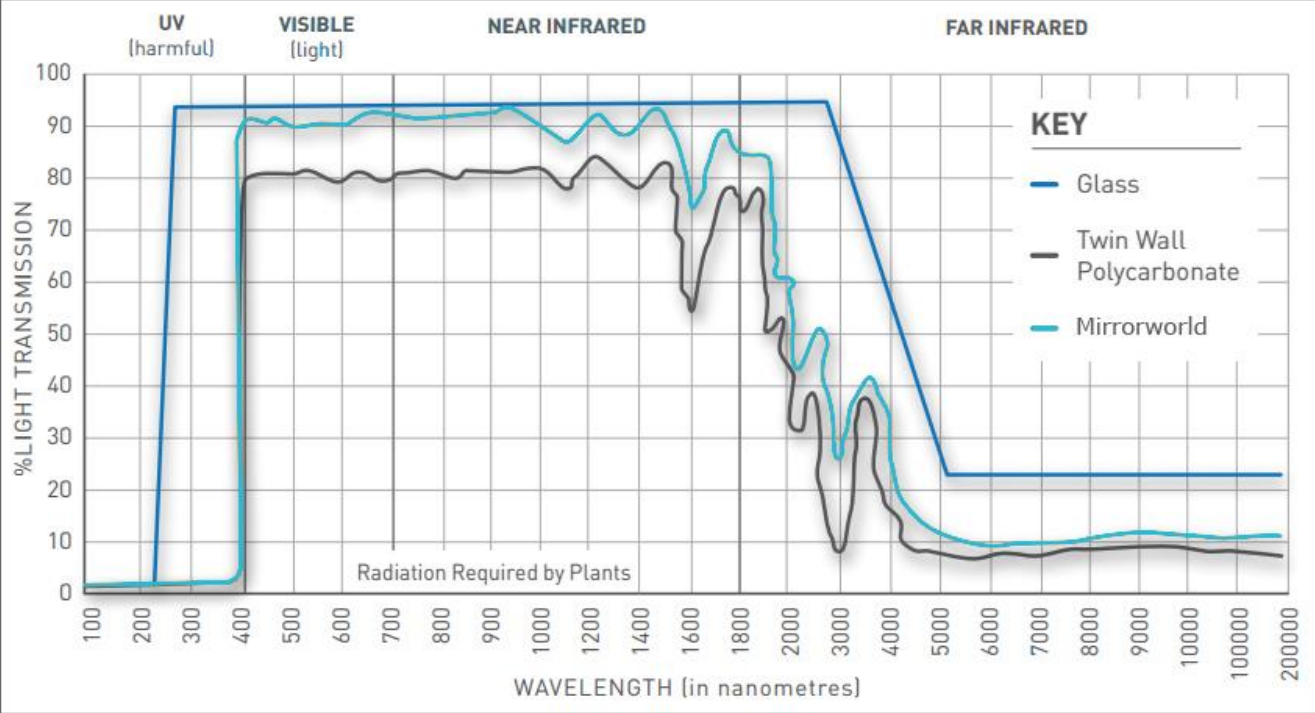
Weight/Area Ratio

The specific gravity of Mirrorworld Armoured Polycarbonate sheet is 1.2, which is about half that of glass. The following table shows the ratio between the weight of Mirror world Armoured Polycarbonate sheets of various thicknesses and glass.

Sheet Thickness mm	(in.)	Axgard kg/m ²	(lb/ft ²)	Glass kg/m ²	(lb/ft ²)
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)

Mirrorworld Armoured Polymer polycarbonate mirror almost totally blocks harmful UV radiation whilst still allowing exceptional levels of visible light transmission. The graph below shows comparisons with other products.

Mirrorworld Armoured Polycarbonate Light Transmission



Mirrorworld Armoured Polymer Mirror®: Cold Bending

	Property	Conditions	ASTM Method	Units-SI	Value
Physical	Density		D-1505	g/cm ³	1.2
	Water absorption	24 hr. @ 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 modulus 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*	J	158
	Rockwell hardness		D-785	R scale	125
	Thermal	Long term service temp			°C
Short term service temp				°C	-50 to +120
Heat deflection temp		Load: 1.82 MPa	D-648	°C	135
Vicat softening temp		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	5.1x10 ¹⁵
Volume resistance	Ketley	D-257	Ohm-cm	1.3x10 ¹⁷	

Hotline Bending and Thermoforming

Mirrorworld Armoured Polycarbonate can also be 'hot-line' bent and thermoformed provided specific instructions are followed, which are available on request.

Chemical Resistance

Whilst Mirrorworld Armoured Polycarbonate 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 Mirrorworld Armoured Polycarbonate. 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 Mirrorworld Armoured Polycarbonate which has a scratch resistant coating.

www.mirrorworld.co.uk

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