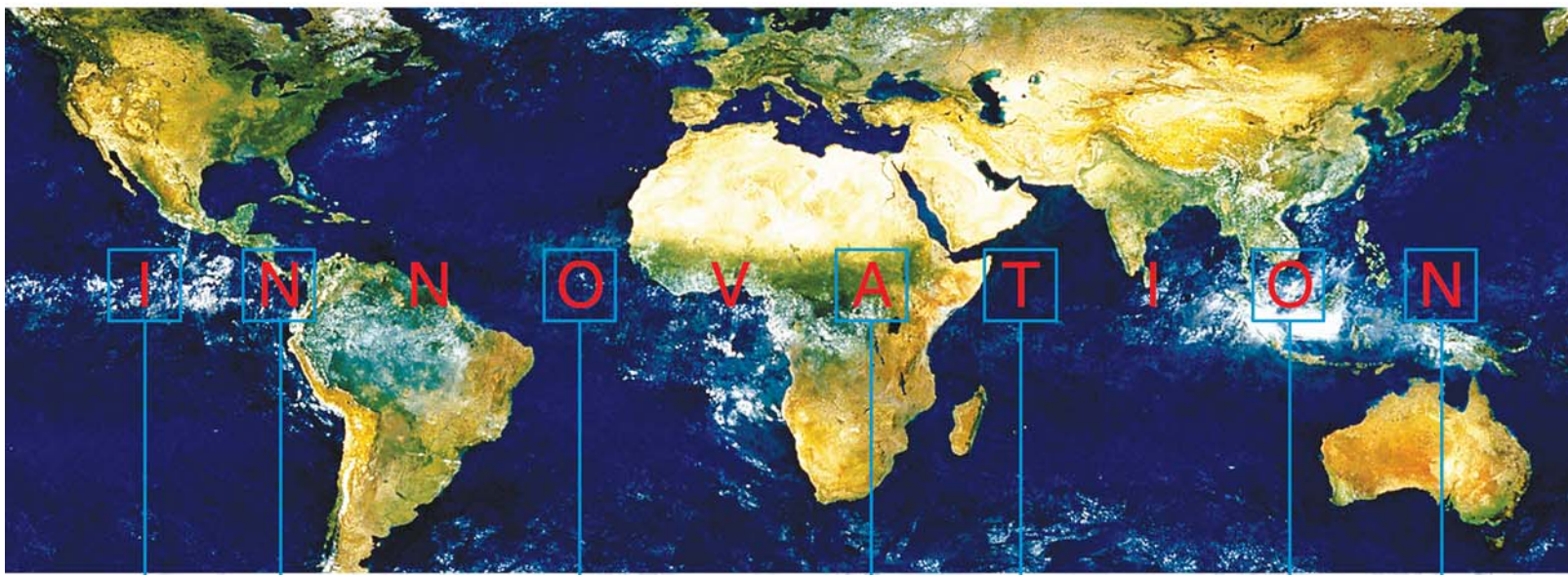


# MAKROLON®

P O L Y C A R B O N A T E S H E E T



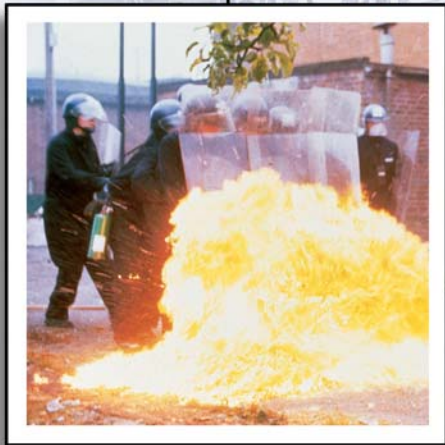
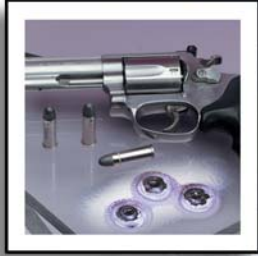
...A Family of Products for Your Toughest Architectural Glazing Applications



Sheffield Plastics Inc.

A  Bayer MaterialScience Company

# Introduction



## Sheffield Plastics Inc.

Sheffield Plastics was founded in 1949 as a producer of high quality plastics products. Today, with fifty years of experience in the industry, Sheffield has grown to become a recognized leader in high performance plastics, supplying materials for architectural, industrial, commercial, and aerospace applications.

Together with its European affiliate, Sheffield Plastics is a global leader in producing polycarbonate sheet in the world. Wherever high performance glazing materials are required, Sheffield has the technology to fit the application.

### None Tougher

Sheffield Plastics polycarbonate sheet is produced under rigid quality control specifications, meeting ISO certification guidelines for both plants and processes. Polycarbonate resins supplied by Bayer, combined with the latest in production technology, assure that the physical properties of MAKROLON® polycarbonate sheet will meet or exceed the performance characteristics of any directly competitive product on the market today.

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# MAKROLON® Polycarbonate Sheet is Clearly the Right Choice

How can you tell if polycarbonate is the right choice for you? It's simple! Only polycarbonate can offer the ideal combination of impact strength, cost effectiveness, and energy efficiency. No glazing alternative can surpass MAKROLON® polycarbonate sheet for superior all-around performance. It's the right choice for almost any demanding glazing application.

MAKROLON polycarbonate sheet is as clear as glass and hundreds of times stronger. It's also many times stronger than acrylic sheet—offering a margin of safety that no other clear glazing material can beat. With its inherent design flexibility, MAKROLON polycarbonate sheet can be cut or cold-formed on-site during installation, without the preforming and fabrication associated with glass or acrylic. It is lightweight and requires less structural support than all-glass systems, saving additional time and labor costs. Its durability and energy efficiency add up to long term cost savings. From skylights and barrel vaults to educational and institutional glazing, the question is not why, but where polycarbonate?

## Built to Perform

- Transportation Glazing
- Barrel Vaults
- Covered Walkways
- Privacy Glazing
- Institutional Glazing
- Skylights
- Storefronts
- Factory Overglazing

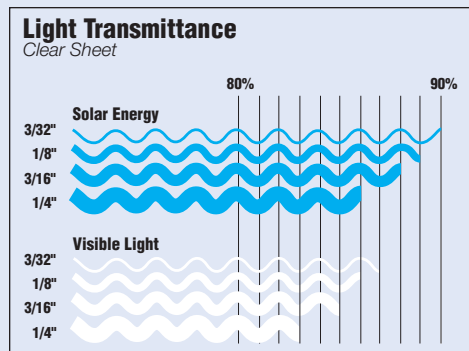
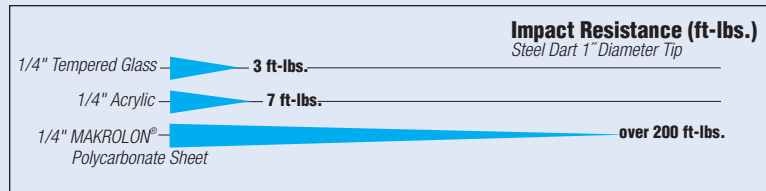
Don't let material limitations compromise your design creativity. MAKROLON polycarbonate sheet is designed to perform in a wide range of applications and meets all standard architectural specifications and codes.

## Impact Protection

Unsurpassed by any clear glazing product on the market, MAKROLON polycarbonate sheet is hundreds of times stronger than plate glass and many times stronger than acrylic. This tough, long lasting material offers attractive protection in areas subject to high traffic, vandalism or burglary. It even withstands natural forces like severe wind, hail, and snow storms. In fact, MAKROLON polycarbonate sheet meets stringent state mandates for hurricane resistant glazing materials.

## Design Latitude

MAKROLON polycarbonate sheet is extremely ductile. It can be cut on-site from flat sheet or cold-formed into curves that would be impossible to construct with laminated glass or acrylic. Forget about costly factory preforming and fabrication. With MAKROLON polycarbonate sheet, you can create cost effective, distinctive structures that feature dramatic expanses of curved glazing.



## Cost Efficiency

The unique combination of lightweight (half the weight of glass) and high strength inherent in MAKROLON polycarbonate sheet allows designs that require less structural support. Since MAKROLON polycarbonate sheet can be cut and cold-formed on-site, you save time and money that would normally be dedicated to preinstallation techniques like oven bending. MAKROLON polycarbonate sheet is much more durable than other material options. The cost of replacement becomes a less immediate (and less costly) concern.

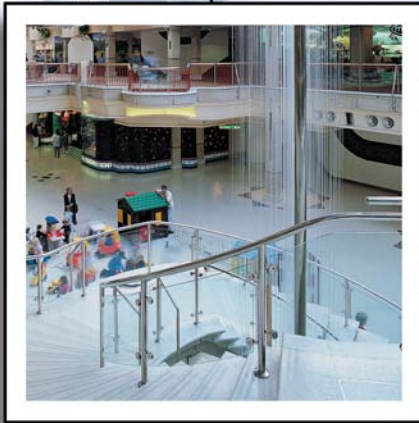
## Energy Efficiency

MAKROLON polycarbonate sheet is a superior insulating material when compared to equivalent thicknesses of glass. Double-glazing and overglazing offer even more energy savings. Overglazing with a patterned grade of MAKROLON polycarbonate sheet adds visual security and enhances the appearance of industrial and commercial sites.

## Light and Energy Transmission

By allowing the transmittance of up to 90 percent of solar energy and 88 percent of visible light, clear MAKROLON polycarbonate sheet is an excellent glazing material for a wide range of applications where clarity is essential. MAKROLON polycarbonate sheet is also available in gray and bronze tints to help control heat gain, and provide a variety of privacy patterns for obscure glazing requirements.

# The None Tougher Polycarbonate Glazing Sheet



## **MAKROLON®** Polycarbonate Glazing

Think of all the places where you wish you could have used glass or acrylic in your designs, but could not due to the environment, building location, or material limitations. Now think of the demanding applications where glass and acrylic have been tried and failed; schools, psychiatric facilities, subways, bus shelters, etc. These sites are increasing because of violence and vandalism. Add applications where other plastics didn't rise to the challenge and your list of failures grows long. Now try MAKROLON polycarbonate sheet and turn failed designs into reality.

The family of MAKROLON polycarbonate sheet glazing products offers superior durability, unmatched design flexibility, and structural integrity that easily surpasses laminated glass and acrylic alternatives. When considering total life cycle costs, MAKROLON polycarbonate sheet comes in several grades to suit your every performance requirement: MAKROLON® GP polycarbonate sheet for general glazing and industrial applications; MAKROLON® SL polycarbonate sheet for increased UV protection; MAKROLON® AR polycarbonate sheet when abrasion resistance, impact strength, and graffiti removal are essential; and MAKROLON HYGARD® laminates for certified containment glazing and bullet resistant protection.

## A Family of Products to Choose From

### Product Features

MAKROLON® GP    MAKROLON® SL    MAKROLON® AR    MAKROLON HYGARD®



(◆ not available in all grades.)



# Clearly The Right Choice

## **MAKROLON® GP** General Purpose Glazing Polycarbonate Sheet

For general purpose applications that require superior impact protection without additional abrasion and UV resistance, MAKROLON GP polycarbonate sheet is everything you need. Available in clear, colors and privacy patterns, MAKROLON GP polycarbonate sheet is a high performance, all purpose glazing material that is both durable and cost effective. This performance is backed by a comprehensive warranty against breakage.



### Shading Coefficient 1/4" Thickness

MAKROLON Single Glazed – Clear	1.02
MAKROLON Single Glazed – Gray	.70
MAKROLON Single Glazed – Bronze	.70
MAKROLON Double Glazed – Clear/Bronze	.67
Tempered Glass Double Glazed	.90

### Products Available Product/Grade

General Purpose  
MAKROLON® GP  
Polycarbonate Sheet

### Description

Polished Surfaces

### Standard Sizes

Gauges: 1/16 – 1/2"  
L:96,120" W:48,60,72,96"

### Standard Colors

Clear  
Gray, Bronze

### Applications

Flat Glazing  
Curved Glazing

### Privacy Patterns

MAKROLON® GP (Matte)  
Polycarbonate Sheet

Matte Surface 1 side  
Polished 1 side

Gauges: 1/16 – 1/4"  
L:96" W:48"

Clear  
Tints available

Privacy/Protective Glazing  
Industrial Overglazing

MAKROLON® GP (Pebble)  
Polycarbonate Sheet

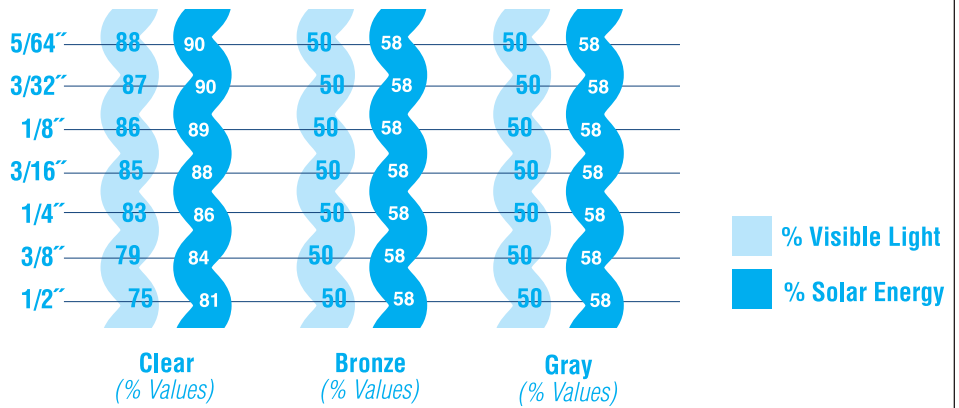
Textured both sides

Gauges: 1/8 – 1/4"  
L:96" W:48"

Partitions  
Light Diffusers

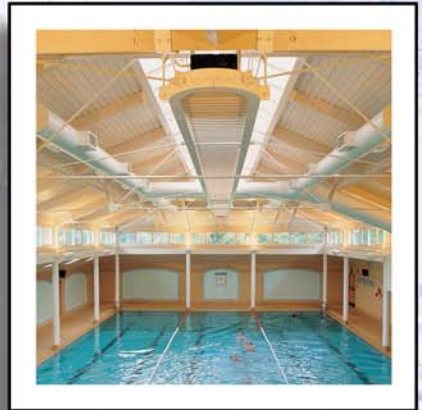
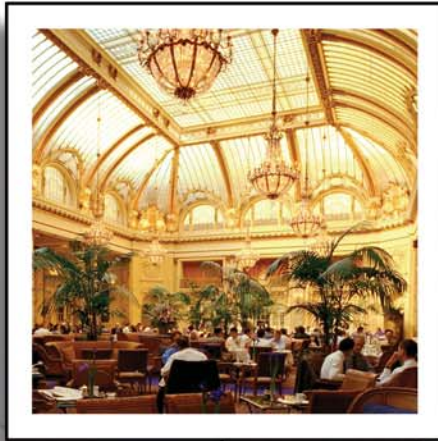


### Light & Energy Transmittance



**MAKROLON®**  
polycarbonate  
sheet is available  
in a wide variety  
of thicknesses,  
colors, sizes,  
and patterns.





**MAKROLON® SL**

For the most demanding  
outdoor environments

# MAKROLON® Polycarbonate Sign Products Offer Outstanding Resistance to Sunlight

## MAKROLON® SL SunLife Polycarbonate Sheet

Prolonged exposure to the sun can weather even the most durable of surfaces. In the past, acrylic was often chosen for plastic glazing applications because of its inherent resistance to yellowing over time. But compared to polycarbonate, the relative brittleness of acrylic made its impact strength insufficient for demanding, vandal resistant applications. To meet this need, Sheffield Plastics developed MAKROLON SL polycarbonate sheet. It offers the best of both worlds—the impact protection of MAKROLON polycarbonate sheet and the UV resistance of acrylic. Utilizing advanced formulations combined with state-of-the-art extrusion technology, Sheffield Plastics has created a tough, consistent quality product that will exhibit superior performance for years to come.

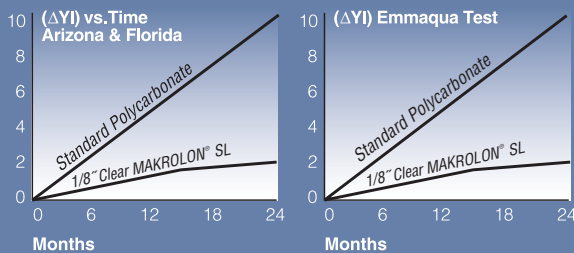
## Performance Warranty

The performance of MAKROLON SL polycarbonate sheet has been well documented through years of laboratory and field testing. In side-by-side comparative testing under severe conditions, MAKROLON SL polycarbonate sheet consistently outperformed competitive materials utilizing older technology. Materials were also tested in forms and bends well beyond recommended guidelines, proving that the integrity of SL, as well as its UV resistance, will not change if the sheet is bent or cold-formed. So conclusive was this testing that Sheffield offers a limited warranty against excessive yellowing, loss of light transmission, and breakage.

Product Available <i>Product/Grade</i>	Description	Standard Sizes	Standard Colors	Applications
MAKROLON® SL <i>Polycarbonate Sheet Enhanced UV Protection</i>	Enhanced UV Protection 1 side, Polished 2 sides	Gauges 1/8–1/2" L:96-120" W:48, 60, 72, 96" Custom lengths available	Clear Gray, Bronze	Skylights, Barrel Vaults, Covered Walkways General Glazing

## Yellowness Index

Visible Yellowness = 8

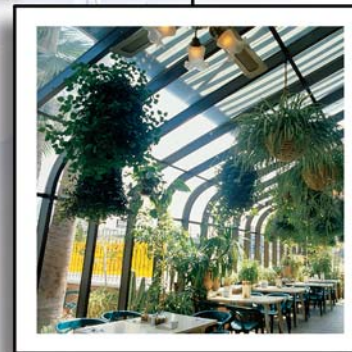
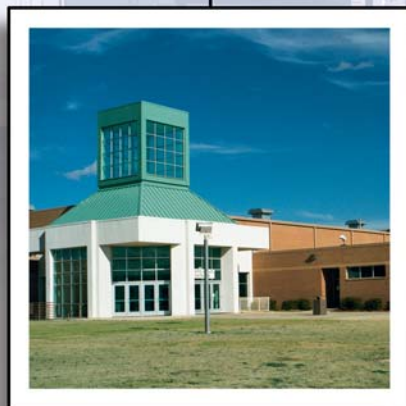


*Clearly The Right Choice*

Meets UL Section 48



# Superior Clarity, Superior Abrasion Resistance



## **MAKROLON® AR** Abrasion Resistant Polycarbonate Sheet

MAKROLON AR polycarbonate sheet offers the dual protection you need to ensure long service life in demanding glazing applications. It offers the high impact strength of standard MAKROLON® GP polycarbonate sheet, coupled with enhanced weatherability and superior abrasion resistance. MAKROLON AR polycarbonate sheet features a unique clear hard coat finish that resists all types of abuse, from physical attack to chemicals and spray paint. General purpose polycarbonate can't be beat for impact strength. That's why it is so widely used in high traffic areas such as street level windows, bus shelters, and security glazing. Add an abrasion and UV resistant surface and the result is MAKROLON AR polycarbonate sheet, a polycarbonate glazing material that provides superior clarity\* when subjected to repeated contact, cyclical cleaning, and even vandalism.

### Standing Up to the Challenge

MAKROLON AR polycarbonate sheet is manufactured to the most demanding specifications in conformance to Sheffield's strict ISO 9001 certified Quality System requirements. Designed for superior performance and long life in high traffic, flat glazing applications, it is available in a wide range of gauges, tints, and sheet

sizes. MAKROLON AR polycarbonate sheet offers all the strength, durability, and clarity inherent to the MAKROLON brand with the added dimension of a leading technology hard coat for improved surface hardness, ultraviolet resistance, and chemical protection. MAKROLON AR polycarbonate sheet comes with a limited warranty against breakage, coating delamination, yellowing, hazing, and loss of light transmission.

### Enhanced Weatherability

In addition to superior abrasion resistance, MAKROLON AR polycarbonate sheet offers unsurpassed weatherability—comparable to that of our MAKROLON® SL polycarbonate sheet product when subjected to prolonged periods of UV exposure.

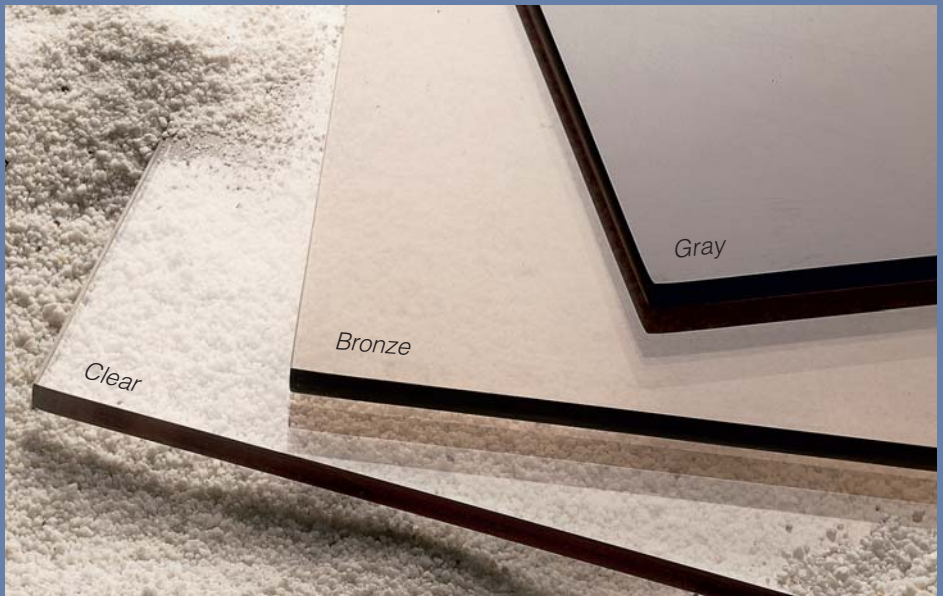
### Chemical Resistance

MAKROLON AR polycarbonate sheet features improved chemical resistance to a variety of cleaners, solvents, and other corrosive elements that can attack standard polycarbonate sheet. Care should be taken to install MAKROLON AR polycarbonate sheet in a sealed frame to protect uncoated saw-cut edges from chemical attack.

## Chemical Resistance

MAKROLON® AR Polycarbonate Sheet  
 Samples tested per ASTM D1308

Acetone	>24hrs
Ethylene Dichloride	>24hrs
Gasoline	>24hrs
Hydrochloric Acid (10%)	>24hrs
Methyl Alcohol	>24hrs
Methylene Chloride	>24hrs
Nitric Acid (100%)	>24hrs
Sodium Hydroxide	<24hrs
Sulfuric Acid (1%)	>24hrs
Toluene	>24hrs



Product Available <i>Product/Grade</i>	Description	Standard Sizes	Standard Colors	Applications
MAKROLON® AR Polycarbonate Sheet <i>Abrasion &amp; UV Resistant Sheet</i>	Polished Surfaces Hard-Coat 2 Sides	Gauges 1/8 – 1/2" L:72, 78 96" W:38, 48, 60, 72"	Clear Gray, Bronze	Flat Architectural & Transportation Glazing, Security Applications

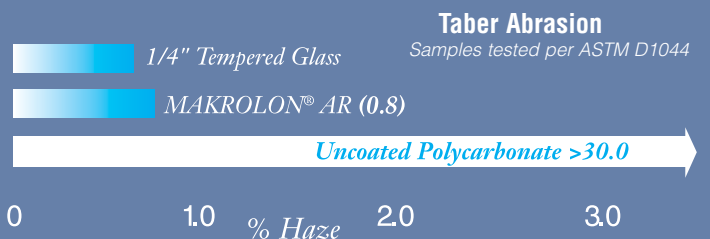
## Cleaning and Maintenance

Under normal conditions, MAKROLON® AR polycarbonate sheet should be washed on a regular basis with a mild solution of soap and warm water, using a soft cloth or sponge. To prevent water spots, thoroughly dry MAKROLON polycarbonate sheet with a chamois or sponge. Do not use abrasive cleaners or sharp instruments such as razor blades or scrapers that may gouge the surface. For graffiti removal, organic solvents, such as butyl cellosolve, kerosene, VM & P naphtha or mineral spirits, work very well. Methanol, denatured ethanol, and isopropyl alcohol are also excellent cleansing agents. It is important to rinse off the surface thoroughly after cleaning.

High impact strength and nonstick, abrasion resistant surfaces are the key features of MAKROLON® AR polycarbonate sheet.



**Clearly The Right Choice**



# The Ultimate Security Product

## MAKROLON HYGARD®

### Laminated Sheet

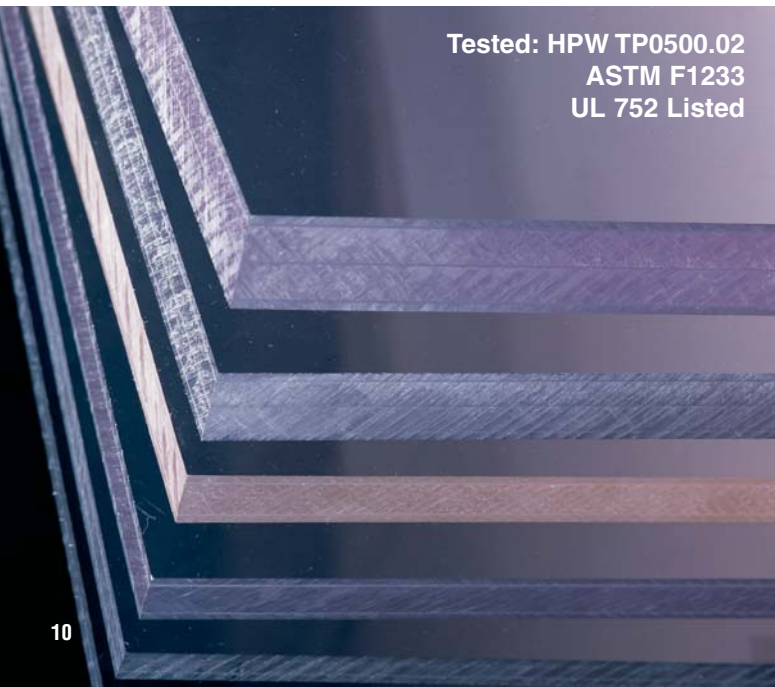
Increasing violent crime, readily available sophisticated weapons, and larger glazed areas in modern detention center design have created a need for higher performing security glazing materials. Sheffield Plastics has developed MAKROLON HYGARD laminates to meet this need. Consisting of multiple layers of polycarbonate or polycarbonate/acrylic with bonding interlayers, these tough, yet lightweight, materials offer proven resistance to physical and ballistic attack.

Sheffield offers MAKROLON HYGARD laminates in six levels of protection, ranging from containment rated security glazing to UL Level 3 bullet-resistant material capable of withstanding multiple rounds fired from high-powered handguns. All MAKROLON HYGARD laminated products feature hard coated surfaces for exceptional resistance to abrasion and UV degradation. They come with a limited warranty against coating failure, excessive yellowing, and structural delamination caused by manufacturing defects.

Whatever the application, MAKROLON HYGARD laminates offer unsurpassed performance versus competitive glass and glass-clad polycarbonate products.



Product Available <i>Product/Grade</i>	Description	Standard Sizes	Standard Colors	Applications
MAKROLON HYGARD® Laminate <i>Security Glazing</i>	Laminated Polycarbonate & Polycarbonate/Acrylic, Hard-Coat 2 sides	Gauges 3/8, 1/2, 3/4, 1, 1-1/4" L:60, 72, 78, 96" W:36, 38, 48, 60"	Clear	Physical Attack & Bullet Resistant Security Glazing



Tested: HPW TP0500.02  
ASTM F1233  
UL 752 Listed

## Typical Applications/Performance Levels

### MAKROLON® CG375

**3/8" Containment**  
*Primary uses: prisons,  
detention centers*

### MAKROLON® CG500

**1/2" Containment**  
*Same as above yet can  
be used in ballistic system  
with 1/2" laminated glass*

### MAKROLON® CG750

**3/4" Containment**  
*Higher rated containment  
glazing, can be used in  
ballistic system with  
1/2" laminated glass*

### MAKROLON HYGARD® BR750

**3/4" Bullet Resistant Level 1**  
*UL listed against 9 mm*

### MAKROLON HYGARD® BR1000

**1" Bullet Resistant Level 2**  
*UL listed against .357 Magnum*

### MAKROLON HYGARD® BR1250

**1-1/4" Bullet Resistant Level 3**  
*UL listed against .44 Magnum*



# Bullet Resistant Glazing and Containment Grade

## Product Specification 08840 Plastic Glazing

<b>MAKROLON HYGARD® Product Description</b>	<b>Gauge lbs./sq. ft.</b>	<b>Weight Coefficient</b>	<b>Shading</b>	<b>U-Factor</b>	<b>Performance Levels</b>
BR750 1/8" MAKROLON® AR, Interlayer, 1/2" Acrylic, Interlayer, 1/8" MAKROLON AR	.775	5.1	.89	.70	UL Level 1 HPW TP0500.02 Level B Ballistics (9mm)
BR1000 1/8" MAKROLON AR, Interlayer, 3/8" MAKROLON Sheet, Interlayer, 3/8" MAKROLON Sheet, Interlayer, 1/8" MAKROLON AR	1.05	6.5	.84	.61	HPW Level V Step 42 HPW TP0500.02 Level B Ballistics (9mm) ASTM F1233 Class V UL Level 2
BR1250 1/8" MAKROLON AR, Interlayer, 1/2" MAKROLON, Interlayer, 1/2" MAKROLON Sheet, Interlayer, 1/8" MAKROLON AR	1.30	8.1	.81	.55	HPW Level V HPW TP0500.02 Level C Ballistics (.44 Magnum) ASTM F1233 Class IV Step 38 UL Level 3
CG375 3/16" MAKROLON AR, Interlayer, 3/16" MAKROLON AR	.390	2.4	.92	.88	HPW Level II Step 11 HPW TP0500.02 Level A Ballistics (.38 Special) ASTM F1233 Class III Step 12
CG500 1/8" MAKROLON AR, Interlayer, 1/4" MAKROLON, Interlayer, 1/8" MAKROLON AR	.530	3.3	.90	.80	HPW Level II Step 12 HPW TP0500.02 Level A Ballistics (.38 Special) ASTM F1233 Class III Step 15
CG750 1/8" MAKROLON AR, Interlayer, 1/2" MAKROLON, Interlayer, 1/8" MAKROLON AR	.780	4.9	.87	.70	HPW Level IV Step 31 HPW TP0500.02 Level B Ballistics (9 mm) ASTM F1233 Class IV Step 26

# Technical Information

## Physical Properties

High impact resistance, abrasion and UV protective surfaces, compliance with flammability ratings of major building codes, and high light transmittance characterize MAKROLO<sup>®</sup> polycarbonate sheet.

## Code Ratings

MAKROLO<sup>®</sup> polycarbonate sheet products satisfy major building code requirements including:

- CC-1\* rating in construction applications (BOCA, ICBO, SBCCI and Dade County)
- Listed with Underwriter's Laboratories for the UL 94 flammability standard and UL 972 standard for Burglary Resisting Glazing Materials
- MAKROLO<sup>®</sup> HYGARD<sup>®</sup> BR750, BR1000, and BR1250 are listed with Underwriter's Laboratories for Level 1, Level 2, and Level 3 Bullet Resisting Glazing under the UL 752 standard, respectively.
- Approved for CPSC (16CFR 1201) Categories I & II
- Meets ANSI Z 97.1 1984 Safety Glazing Standards  
MAKROLO<sup>®</sup> AR polycarbonate sheet meets H.P. White TP0500.02 Physical Attack Test Requirements for Level I containment glazing and MAKROLO<sup>®</sup> HYGARD laminates meet a variety of specific requirements for protection against ballistic and/or physical attack. Test results and other product specific information is available directly from Sheffield Plastics upon request.

## Thermal Properties

MAKROLO<sup>®</sup> polycarbonate sheet is an effective insulating material, particularly when compared to glass.

## Sheet Combustibility

MAKROLO<sup>®</sup> Polycarbonate sheet is among the least combustible of popular plastic glazing materials. However, it will ignite if exposed to an ignition source over 800°F.

### Typical Physical Properties

### MAKROLO<sup>®</sup> Polycarbonate Sheet

#### General

Specific Gravity	1.2
Water Absorption (24 hrs)	0.15

#### Optical

Transmittance .125"	86
Haze .125"	<1.0
Refractive Index	1.586
Δ YI (3 yrs.-AR & SL only)	<2

#### Abrasion Resistance (AR only)

Taber Resistance, 100 cycles	0.8-1.5
------------------------------	---------

#### Thermal

Deflection Temperature 264 psi	270
Deflection Temperature 66 psi	280
Coefficient of Thermal Expansion	3.75 x 10 <sup>-5</sup>
Coefficient of Thermal Conductivity	1.35
Shading Coefficient Clear	1.02
Shading Coefficient Gray/Bronze	.70

#### Mechanical

Tensile Strength Yield .125"	9,000
Tensile Strength, Ultimate	9,500
Tensile Modulus	345,000
Compressive Strength	12,500
Flexural Strength at 5% strain	13,500
Flexural Modulus .125"	345,000
Izod Impact Notched .125"	12-16
Drop Ball Impact .125"	>200
Gardner Impact 1/2" Diameter Dart	>320 @ 1/8"

#### Flammability

Horizontal Burn, AEB	<1
Horizontal Burn, ATB	<1
Ignition Temperature Self	1070
Ignition Temperature Flash	870

\*MAKROLO<sup>®</sup> HYGARD BR750 is rated CC-2 due to acrylic content.

Product Availability Product/Grade	Description	Standard Sizes	Standard Colors	Applications
MAKROLO <sup>®</sup> GP Polycarbonate Sheet	Polished Surfaces	Gauges 1/16 – 1/2" *L:96, 120" W:48, 60, 72, 96"	Clear Gray, Bronze	Flat Glazing, Curved Glazing
<i>General Purpose</i> Privacy Patterns MAKROLO <sup>®</sup> GP (Matte) MAKROLO <sup>®</sup> GP (Pebble)	Matte Surface 1 side, Polished 1 side Textured both sides	Gauges 1/16 – 1/4" *L:96" W:48" Gauges 1/8 – 1/4" *L:96" W:48"	Clear Colors available	Privacy/Protective Glazing, Industrial Overglazing, Partitions, Light Diffusers
MAKROLO <sup>®</sup> SL Polycarbonate Sheet <i>Extended UV Protection</i>	Extended UV Protection 1 side, Polished 2 sides	Gauges 1/8 – 1/2" *L:96-120" W:48, 60, 72, 96"	Clear Gray, Bronze	Skylights, Barrel Vaults, Covered Walkways, Canopies
MAKROLO <sup>®</sup> AR Polycarbonate Sheet <i>Abrasion Resistant Sheet</i>	Polished Surfaces Hard-Coat 2 sides	Gauges 1/8 – 1/2" *L:72, 96" W:48, 60, 72"	Clear Gray, Bronze	Flat Architectural & Transportation Glazing, Security Applications
MAKROLO <sup>®</sup> HYGARD <sup>®</sup> Laminate <i>Security Glazing</i>	Laminated Polycarbonate & Polycarbonate/Acrylic, Hard-Coat 2 Sides	Gauges 3/8, 1/2, 3/4, 1, 1-1/4" *L:60, 72, 78, 96" W:36, 38, 48, 60"	Clear	Physical Attack & Bullet Resisting Security Glazing

# Warranties

Units	Test Method
–	ASTM D792
%	ASTM D570
%	ASTM D1003
%	ASTM D1003
–	ASTM D542
–	ASTM D1925
Δ%	ASTM D1044
°F	ASTM D648
°F	ASTM D648
in./in./°F	ASTM D696
BTU/hr./ft. <sup>2</sup> /°F	ASTM C177
–	ASHRAE
–	ASHRAE
psi	ASTM D638
psi	ASTM D638
psi	ASTM D638
psi	ASTM D695
psi	ASTM D790
psi	ASTM D790
ft.lb./in. of notch	ASTM D256
ft.lbs.	S.P. Test
in.lbs.	ASTM D3029
in.	ASTM D635
min.	ASTM D635
°F	ASTM D1929
°F	ASTM D1929

## MAKROLON® GP

### General Purpose Glazing Polycarbonate Sheet

Standard MAKROLON GP polycarbonate sheet comes with a limited warranty against breakage. This limited warranty applies to glazing sheet installed and cleaned according to the manufacturer's recommendations. If failure occurs within the warranty period, the purchaser will receive a free replacement of MAKROLON polycarbonate sheet when the failed sheet, original sales receipt, and warranty are provided to Sheffield Plastics or the original distributor or dealer. Sheffield Plastics reserves the right to refund the original purchase price of the sheet in lieu of a replacement sheet. **Request warranty for full details.**

## MAKROLON® SL

### SunLife Polycarbonate Sheet

MAKROLON SL polycarbonate sheet comes with a limited warranty against breakage, loss of light transmission, and excessive yellowing. This warranty applies to glazing sheet installed and cleaned according to the manufacturer's recommendations. **Request warranty for full details.**

## MAKROLON® AR

### Abrasion Resistant Polycarbonate Sheet

MAKROLON AR polycarbonate sheet comes with a limited warranty against breakage, loss of light transmission, excessive yellowing, and coating failure. This limited warranty applies to glazing sheet installed and cleaned according to the manufacturer's recommendations. If failure does occur, as defined in the actual warranty, the purchaser will receive a free replacement of MAKROLON AR polycarbonate sheet. To receive the free replacement sheet, you must provide the failed sheet, original sales receipt, and warranty to Sheffield Plastics or the original distributor or dealer from whom the defective sheet was purchased. Sheffield Plastics reserves the right to refund the original purchase price of the sheet in lieu of a replacement sheet. **Request warranty for full details.**

## MAKROLON HYGARD®

### Laminated Sheet

MAKROLON HYGARD® laminates are warranted against structural delamination and coating failure caused by manufacturing defects, as well as excessive yellowing due to weathering. It comes with a limited warranty. If failure occurs within the warranty period, the purchaser will receive a free replacement of MAKROLON HYGARD laminate when the failed sheet, original sales receipt, and warranty are provided to Sheffield Plastics or the original distributor or dealer. Sheffield Plastics reserves the right to refund the original purchase price of the sheet in lieu of a replacement sheet. **Request warranty for full details.**



Sheffield Plastics Inc. shall not be responsible for the use of this information relative to actual application. Users must make their own determination of its suitability for their specific use. No warranty is made for the fitness of any product, and nothing herein waives any of the Seller's conditions of sale.

Gauge	1/8"	3/16"	1/4"
<b>Summer Heat Gain</b>			
U-Value=BTU/hr../ft. <sup>2</sup> /°F	.97	.93	.90
<b>Winter Heat Loss</b>			
U-Value=BTU/hr../ft. <sup>2</sup> /°F	1.05	1.01	.96

# Installation Guidelines for MAKROLON® Polycarbonate Sheet

All grades of MAKROLON polycarbonate sheet can be cut, formed, and installed with ease when specific guidelines are followed. MAKROLON polycarbonate sheet may be installed using either wet or dry glazing systems, although use of PVC gasketing is not recommended.

MAKROLON polycarbonate sheet may also be used for double-glazing or overglazing applications for additional insulation and security. Maintain adequate separation between glazing panels to prevent contact during high humidity and/or high heat conditions.

## Installation Procedures

1. Clean sash and prime if necessary. If glazing is being used as a replacement, make sure to remove all old sealant and projections. Rabbet should be free of burrs and deep enough to allow for natural expansion of the MAKROLON polycarbonate sheet glazing panel.
2. Carefully measure the sash opening and determine the appropriate edge engagement and expansion allowance from the table (opposite page). Cut MAKROLON polycarbonate sheet to the exact size required, making sure edges are smooth and free of any chips and notches.

3. Glaze MAKROLON polycarbonate sheet with the proper sealant. While smaller lites allow for the use of nonhardening oil-based and acrylic-latex caulks (up to 24" x 24"), the thermal and load movements in larger sheet sizes require high-performance, low modulus elastomers such as silicones. Please refer to the table below for recommended sealants, gaskets, and tapes.

*For further information on recommended fabrication or installation techniques and framing methods, contact Sheffield Plastics Inc. Customer Service Department at 800-254-1707.*

## Expansion Allowances

As a general guideline, glazing systems should be designed to allow 1/16" per foot of length and width for expansion of polycarbonate in the sash.

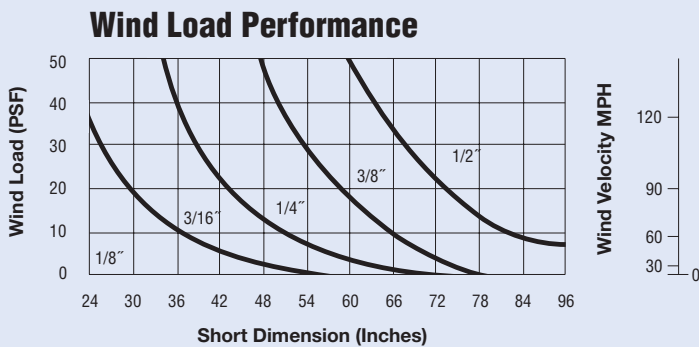
## Cold Bending

MAKROLON polycarbonate sheet may be cold bent on-site with the minimum radius as a function of the sheet thickness. As a guideline, the material can be radiused to 100 times the thickness. See the chart (opposite page) for recommended minimum radii.



## Recommended Sealants, Gaskets, and Tapes

Product Type	Product Name	Manufacturer
Silicone	Dow 795* Dow 999* Trademate*	Dow-Corning Corp. Midland, MI (517) 496-4000
Silicone	Silpruf** Construction 1200**	General Electric Co. Waterford, NY (800) 255-8886
Gasket	Silicone (70D) EPDM (60, 70D)	Tremco Columbus, OH (800) 321-7906
Tape	440	Tremco Beachwood, OH (800) 321-7906
Butyl Tape	303	KPTI Dayton, OH (800) 543-7570
Gasket/Tape	Norrene† Foam V-2100 Urethane	Norton Company Granville, NY (518) 642-2200
Butyl Tape	Isocryl 5600	Schnee-Morehead Irving, TX (214) 438-9111



*Clearly The Right Choice*

\* Registered Trademark of Dow-Corning Corp.  
 \*\* Registered Trademark of General Electric Company  
 † Registered Trademark of Norton Company

## Cutting

MAKROLON® polycarbonate sheet may be cut using most types of conventional power saws utilizing triple chip blade designs. Be sure to leave the protective masking intact when cutting to prevent marring of the surface.

Warning: Failure to use proper blades or cutting an unsecured sheet may cause injury and/or destruction of the material. MAKROLON polycarbonate sheet manuals with safety guidelines are available upon request.

## Compatible Cleaners

Sheffield Plastics suggests the following cleaning agents for use with MAKROLON polycarbonate sheet products. All products should be used in accordance with the manufacturer's specifications.

- Formula 409\*
- Top Job, Joy\*\*
- Palmolive Liquid†
- Windex D with Ammonia D††

\* Registered Trademark of Clorox Company

\*\* Registered Trademarks of Proctor & Gamble

† Registered Trademark of Colgate Palmolive

†† Registered Trademark of Drackett Products Company

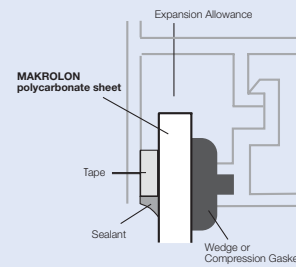
## Comparative Expansion Rates

Material	in./in. °F
Glass	.0000050
<b>MAKROLON</b> Polycarbonate Sheet	.0000375
Aluminum	.0000129
Steel	.0000063
Acrylic	.0000410

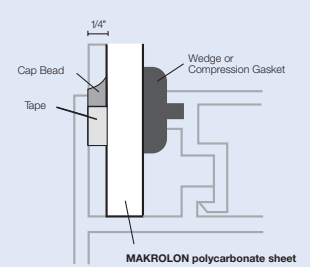
## Cold Bend Radii

Sheet Thickness	1/8"	3/16"	1/4"
Minimum Radius	12.5"	18.7"	25.0"

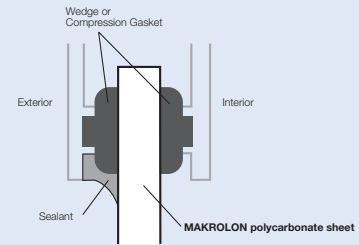
### Typical Head



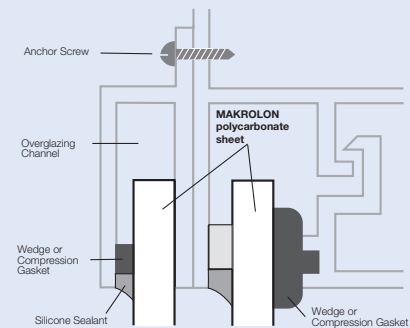
### Typical Sill



### Dry Glazing Detail



### Overglazing or Backglazing



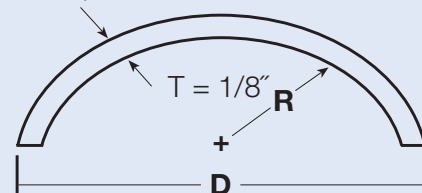
## Expansion Allowance & Edge Engagement Examples

Sheet Size	24" x 24"	24" x 36"	36" x 48"	48" x 60"
Expansion Allowance	1/8" x 1/8"	1/8" x 3/16"	3/16" x 1/4"	1/4" x 5/16"
Edge Engagement	3/8"	1/2"	9/16"	3/4"
Rabbit Depth	1/2"	11/16"	13/16"	1 1/16"

## Cold Bend Formula

$$R = T \times 100$$

Example:



$$R = 12.5'' \text{ Min.}$$

# Product Specifications

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

- A. Polycarbonate plastic glazing.
- B. Abrasion-resistant polycarbonate plastic glazing.
- C. Enhanced UV-resistant polycarbonate plastic glazing.
- D. Laminated polycarbonate plastic glazing for security applications.
- E. Laminated polycarbonate plastic glazing for bullet resisting security glazing.
- F. Multi-wall polycarbonate plastic glazing.
- G. Corrugated polycarbonate plastic glazing.

### 1.2 RELATED SECTIONS

- A. Section 07820–Metal Framed Skylights.
- B. Section 07900–Joint Sealers.
- C. Section 08520–Aluminum Windows.
- D. Section 08800–Glass and Glazing.
- E. Section 08920–Glazed Aluminum Curtain Wall Systems.

### 1.3 REFERENCES

- A. ANSI Z97.1–Safety Performance Specifications and Methods of Test for Safety Glazing Used in Buildings.
- B. ASTM D256–Standard Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials.
- C. ASTM D638–Standard Test Method for Tensile Properties of Plastics.
- D. ASTM D790–Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- E. ASTM D792–Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement.
- F. ASTM D1929–Standard Test Method for Ignition.

### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Submit manufacturer's printed product information that includes physical properties and recommended installation and glazing procedures, including edge engagement guidelines. Include data on material weight, wind load capacity, light transmission, shading coefficient, and thermal expansion.
- C. Verification Samples: Submit samples for each glazing type specified, not less than 12 inches square and framed on two adjacent sides to show glazing system.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver polycarbonate sheets on enclosed pallets.
- B. Store in dry, well ventilated and covered areas at temperatures below 80°F.
- C. Handle polycarbonate sheets carefully to prevent damage; do not drop, slide or drag.

### 1.6 WARRANTY

- A. Comply with provisions of Section 01700.
- B. Provide manufacturer's written warranty covering breakage.
- C. Provide manufacturer's written warranty covering breakage, loss of light transmission, and yellowing.

- D. Provide manufacturer's written warranty covering breakage, abrasion resistance, coating failure, loss of light transmission, and yellowing.

## PART 2 PRODUCTS

### 2.1 MANUFACTURER

- A. Provide products manufactured by Sheffield Plastics Inc., 119 Salisbury Road, Sheffield, MA 01257. Telephone: 800-254-1707.
- B. Substitutions will not be acceptable.

### 2.2 MATERIALS

- A. Polycarbonate Sheet: Comply with ANSI Z97.1 and with properties as follows:
  - 1. Specific gravity: 1.2 per ASTM D792.
  - 2. Tensile strength, yield: 9,000 psi per ASTM D638.
  - 3. Tensile strength, ultimate: 9,500 psi per ASTM D638.
  - 4. Tensile modulus: 340,000 psi per ASTM D 638.
  - 5. Flexural strength at 5% strain: 13,500 psi per ASTM D790.
  - 6. Flexural modulus: 345,000 psi per ASTM D790.
  - 7. Izod impact strength (0.125 inch notched): 12-16 ft./lb./in. per ASTM D256.
  - 8. Self ignition temperature: 1070°F per ASTM D1929.
  - 9. Flash ignition temperature: 870°F per ASTM D1929.
- B. General Purpose Type: Provide MAKROLO<sup>®</sup> GP plastic glazing sheet.
  - 1. Thickness: 0.060 inch nominal.
  - 2. Thickness: 0.093 inch nominal.
  - 3. Thickness: 0.118 inch nominal.
  - 4. Thickness: 0.177 inch nominal.
  - 5. Thickness: 0.236 inch nominal.
  - 6. Thickness: 0.375 inch nominal.
  - 7. Thickness: 0.500 inch nominal.
  - 8. Color: Clear A00.
  - 9. Color: Gray I30.
  - 10. Color: Dark Gray I35.
  - 11. Color: Bronze K09.
  - 12. Color: Custom color to match architect's sample.
- C. Enhanced UV Resistant Type: Provide MAKROLO<sup>®</sup> SL plastic glazing sheet.
  - 1. Thickness: 0.118 inch nominal.
  - 2. Thickness: 0.177 inch nominal.
  - 3. Thickness: 0.236 inch nominal.
  - 4. Thickness: 0.375 inch nominal.
  - 5. Thickness: 0.500 inch nominal.
  - 6. Color: Clear A00.
  - 7. Color: Gray I30.
  - 8. Color: Dark Gray I35.
  - 9. Color: Bronze K09.
  - 10. Color: Custom color to match architect's sample.
- D. Abrasion Resistant and UV Type: Provide MAKROLO<sup>®</sup> AR hard-coated plastic glazing sheet.
  - 1. Thickness: 0.118 inch nominal.
  - 2. Thickness: 0.177 inch nominal.
  - 3. Thickness: 0.236 inch nominal.
  - 4. Thickness: 0.375 inch nominal.
  - 5. Thickness: 0.500 inch nominal.
  - 6. Color: Clear A00.
  - 7. Color: Gray I30.
  - 8. Color: Dark Gray I35.
  - 9. Color: Bronze K09.
  - 10. Color: Custom color to match architect's sample.

E. Glazing Accessories: As recommended by manufacturer of plastic glazing sheet for wet or dry glazing installations.

### 2.3 LAMINATED GLAZING

A. Provide plastic glazing material comprised of face layers of MAKROLON AR polycarbonate sheet factory-laminated into high-impact security glazing assemblies.

B. Containment Glazing:

1. Provide MAKROLON® CG375 two-ply polycarbonate laminate with the following properties:
  - a. Forced entry ratings: H.P. White TP0500.02 Level II Step 11, ASTM F1233 Class III Step 12.
  - b. Gauge: 0.380 inch ± 5% tolerance.
  - c. Weight: 2.4 pounds per sq. ft.
  - d. Shading coefficient: 0.92.
  - e. Light transmittance (clear): 86%.
2. Provide MAKROLON® CG500 three-ply polycarbonate laminate with the following properties:
  - a. Forced entry ratings: H.P. White TP0500.02 Level II Step 12, ASTM F1233 Class III Step 15.
  - b. Gauge: 0.530 inch ± 5% tolerance.
  - c. Weight: 3.3 pounds per sq. ft.
  - d. Shading coefficient: 0.90.
  - e. Light transmittance (clear): 83%.
3. Provide MAKROLON® CG750 three-ply polycarbonate laminate with the following properties:
  - a. Forced entry ratings: H.P. White TP0500.02 Level IV Step 31, ASTM F1233 Class IV Step 26.
  - b. Gauge: 0.775 inch ± 5% tolerance.
  - c. Weight: 4.9 pounds per sq. ft.
  - d. Shading coefficient: 0.87.
  - e. Light transmittance (clear): 77%.

C. Bullet Resistant Glazing:

1. Provide MAKROLON HYGARD® BR750 three-ply polycarbonate and acrylic laminate with the following properties:
  - a. Ballistics rating: UL 752 Level 1 MPSA .38 Super Automatic.
  - b. Gauge: 0.780 inch ± 8% tolerance.
  - c. Weight: 5.1 pounds per sq. ft.
  - d. Shading coefficient: 0.89.
  - e. Light transmittance (clear): 88%.
2. Provide MAKROLON HYGARD® BR1000 four-ply polycarbonate laminate with the following properties:
  - a. Ballistics rating: UL 752 Level 2 HPSA .357 Magnum.
  - b. Forced entry ratings: HP White TP0500.02 Level V Sequence 42.  
Level B Ballistics, ASTM F-1233 Class V.
  - c. Gauge: 1.05 inch ± 5% tolerance.
  - d. Weight: 6.5 pounds per sq. ft.
  - e. Shading coefficient: 0.84.
  - f. Light transmittance (clear): 72%.

3. Provide MAKROLON HYGARD® BR1250 four-ply polycarbonate laminate with the following properties:

- a. Ballistics rating: UL 752 Level 3 SPSA .44 magnum.
- b. Forced entry ratings: HP White TP0500.02 Level V, ASTM F1233 Class V Step 38.
- c. Gauge: 1.30 inch ± 5% tolerance.
- d. Weight: 8.1 pounds per sq. ft.
- e. Shading coefficient: 0.81.
- f. Light transmittance (clear): 67%.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Inspect pallets upon delivery for evidence of damage.
- B. Inspect and verify that frame openings are correct size and conform to recommendations of the plastic glazing sheet manufacturer.

### 3.2 PREPARATION

- A. Clean frame contact surfaces with compatible solvent and wipe dry. Do not allow solvent to pool in glazing channels.
- B. Immediately prior to installation, expose glazing edges of plastic sheet by peeling back factory-applied protective masking to a dimension sufficient for edge engagement.

### 3.3 INSTALLATION

- A. Install plastic glazing in accordance with manufacturer's recommendations for edge engagement and expansion allowance.
- B. Employ only sealants and glazing accessories that have been approved by manufacturer of plastic glazing sheet.
- C. Remove protective masking immediately after all glazing operations are completed.

### 3.4 ADJUSTING AND CLEANING

If installed properly, plastic glazing should not require cleaning. If cleaning becomes necessary, comply with manufacturer's instructions, and use only cleaning agents and techniques that have been approved by the manufacturer.

### 3.5 PROTECTION

Comply with provisions of Section 01700 for protecting installed work. Affix polyethylene film or other covering approved by plastic glazing sheet manufacturer to framing members, as required to protect plastic glazing from other construction operations.

## Support Documentation and Technical Assistance

Additional information regarding the Installation, Forming and Fabricating, UL Testing Procedures, and Product Certification Data of MAKROLON polycarbonate sheet products is available upon request. For more information, please write or call Sheffield Plastics Inc. Customer Service Department at 800-254-1707.

**MAKROLON®**  
**Polycarbonate Sheet is:**  
**“Clearly the Right Choice”**  
**for Any Application**

**Disclaimer**

The manner in which you use and the purpose to which you put and utilize our products, technical assistance, and information (whether verbal, written or by way of production evaluations), including any suggested formulations and recommendations, are beyond our control. Therefore, it is imperative that you test our products, technical assistance, and information to determine to your own satisfaction whether they are suitable for your intended uses and applications. This application-specific analysis must at least include testing to determine suitability from a technical as well as health, safety, and environmental standpoint. Such testing has not necessarily been done by us. Unless we otherwise agree in writing, all products are sold strictly pursuant to the terms of our standard conditions of sale. All information and technical assistance is given without warranty or guarantee, and is subject to change without notice. It is expressly understood and agreed that you assume and hereby expressly release us from all liability, in tort, contract or otherwise, incurred in connection with the use of our products, technical assistance, and information. Any statement or recommendation not contained herein is unauthorized and shall not bind us. Nothing herein shall be construed as a recommendation to use any product in conflict with patents covering any material or its use. No license is implied or in fact granted under the claims of any patent.

**For Additional Information Please Contact...**

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**Sheffield Plastics Inc.**

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