

# MAKROLON HYGARD®

P O L Y C A R B O N A T E   S H E E T



...Ideal for Security, Forced Entry, and Bullet Resistant Applications

**Sheffield Plastics Inc.**

A  Bayer MaterialScience Company

# MAKROLON HYGARD® –The Ultimate Security Product

## AR Hard-Coat Technology Provides Exceptional Resistance to Physical Attack, Abrasion, and UV Degradation

Sheffield Plastics Inc. is a recognized market leader in the production of high performance thermoplastic sheet for over half a century. As one of the leading suppliers of high performance polycarbonate glazing products, Sheffield has been at the forefront of security glazing for years. Sheffield's new generation of laminates, featuring MAKROLON AR hard-coat technology, assures long lasting surface clarity and resistance to yellowing. Whatever the security application, MAKROLON HYGARD laminates offer unsurpassed performance versus competitive glass and glass clad polycarbonate products.

With its unique multilayer construction, MAKROLON HYGARD can withstand both physical attack and gunfire from high powered hand guns. This "None Tougher" laminate line offers multiple levels of protection ranging from certified containment glazing to Level 3 bullet-resistant material.

MAKROLON HYGARD laminates will not "spider web" or spall. This allows for complete vision, which can be critical for appropriate response in the event of an attack.

Designed for security installations such as detention and correctional centers, government facilities, and banks, MAKROLON HYGARD is being used increasingly for employee protection in 24-hour gas stations and convenience stores as well as other cash transaction areas.

Typical applications include:

- Jails/Prisons
- Detention Centers
- Correctional Facilities
- Psychiatric Hospitals
- Government Facilities
- Physical Attack Areas
- Schools and Institutions
- 24-Hour Gas Stations and Convenience Stores
- Drive-Up Windows
- Train/Bus Glazing
- Bus Shelters
- Ticket Booths
- Kiosks
- Banks



# MAKROLON HYGARD®

## Combines MAKROLON AR Technology with the Latest Security Glazing Techniques for High Level Security and Cost Effective Installation

Increasing violent crime, readily available weapons, and larger glazed areas in modern detention center designs have created a need for higher performing security glazing materials. Sheffield Plastics has developed MAKROLON HYGARD to meet this need. Consisting of multiple layers of polycarbonate or polycarbonate/acrylic with bonding interlayers, these “None Tougher”, yet lightweight materials, offer proven resistance to physical and ballistic attack. Additionally, the relative light weight of MAKROLON HYGARD laminates, combined with easy on-site fabrication, give you a competitive edge on remodeling or retrofit projects where timely job completion is essential. Sheffield offers MAKROLON HYGARD laminates in six levels of protection ranging from containment rated sheet to UL Level 3 bullet resistant material capable of withstanding multiple rounds fired from superpowered handguns. All MAKROLON HYGARD laminated products feature hard coated surfaces for exceptional resistance to abrasion and UV degradation and are covered by a limited warranty against coating failure, excessive yellowing, and structural delamination caused by manufacturing defects.



## MAKROLON® AR Abrasion Resistant

MAKROLON AR offers the dual protection of impact strength and superior hard-coat. MAKROLON AR polycarbonate coating is manufactured to demanding specifications for long lasting performance when the glazing materials are exposed to graffiti, vandalism, and chemical attack. This “None Tougher” material can withstand punishing abuse as it maintains superior clarity and protection when subjected to repeated contact from cyclical cleaning and vandalism. In addition to being easy to clean, MAKROLON AR can also reduce replacement costs. Every sheet of MAKROLON AR carries a limited warranty against breakage, coating delamination, yellowing, and hazing.

*Based on tests dated 6/12/02, MAKROLON AR 3/8 satisfied modified forced entry resistance requirements of HPW-TP-0500-02, Level I*

## Chemical Resistance

### MAKROLON AR Sheet

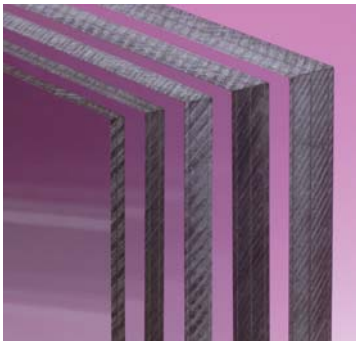
#### Samples tested per ASTM D1308

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

# MAKROLON HYGARD® –The Ultimate Security Product...Gives You Top Industry Containment Ratings, Ballistics Testing, and UL Listings

## MAKROLON HYGARD Laminates

Tested to H.P. White TP0500.02 and ASTM F1233 ballistic and sequential attack criteria, these laminates offer proven performance. While no material can withstand physical attack indefinitely, MAKROLON HYGARD laminates offer sufficient time in riot situations to protect employees while rescue operations are underway.



Product	Description	Gauge	Weight per Sq. Ft.	Shading Coefficient	U Factor
CG375 2 ply	3/16 MAKROLON AR Interlayer 3/16 MAKROLON AR	.390 (± 5%)	2.4	.92	.88
CG500 3-ply	1/8 MAKROLON AR Interlayer 1/4 MAKROLON GP Interlayer 1/8 MAKROLON AR	.530 (± 5%)	3.3	.90	.80
CG750 3-ply	1/8 MAKROLON AR Interlayer 1/2 MAKROLON GP Interlayer 1/8 MAKROLON AR	.780 (± 5%)	4.9	.87	.70
BR750 3-ply	1/8 MAKROLON AR Interlayer 1/2 Acrylic Interlayer 1/8 MAKROLON AR	.775 (± 8%)	5.1	.89	.70
BR1000 4-ply	1/8 MAKROLON AR Interlayer 3/8 MAKROLON GP Interlayer 3/8 MAKROLON GP Interlayer 1/8 MAKROLON AR	1.05 (± 5%)	6.5	.84	.61
BR1250 4-ply	1/8 MAKROLON AR Interlayer 1/2 MAKROLON GP Interlayer 1/2 MAKROLON GP Interlayer 1/8 MAKROLON AR	1.30 (± 5%)	8.1	.81	.55

## H.P. White TP0500.02-Ballistic/Forced Entry–Actual Ratings

Phase I Ballistic Caliber	Level A .38 Special	Level B 9 mm	Level C .44 Magnum	Level IV 39	Level V 54
Phase II Forced Entry Total Forced Entry Sequences	5	15	26		

## UL 752 - Bullet-Resistant–Actual Ratings

Power Rating	Weapons	Grain	Ammunition	Muzzle Velocity	Muzzle Energy
<b>Level 1–</b> Medium Power Small Arms (MPSA)	9 mm Automatic	124	Metal Case	1,175 ft/sec	380-460 ft/lb
<b>Level 2–</b> High Power Small Arms (HPSA)	.357 Magnum	158	Soft Point or Lead	1,250 ft/sec	548-663 ft/lb
<b>Level 3–</b> Super Power Small Arms (SPSA)	.44 Magnum	240	Soft Point or Lead	1,350 ft/sec	971-1175 ft/lb

### MAKROLON HYGARD CG375

HPW Level II Step 10  
HPW TP0500.02 Level A Ballistics (.38 Special)  
ASTM F1233 Class III Step 12

### MAKROLON HYGARD CG500

HPW Level II Step 12  
HPW TP0500.02 Level A Ballistics (.38 Special)  
ASTM F1233 Class III Step 15

### MAKROLON HYGARD CG750

HPW Level IV Step 31  
HPW TP0500.02 Level B Ballistics (9 mm)  
ASTM F1233 Class IV Step 26

### MAKROLON HYGARD BR750

UL Level I  
HPW TP0500.02 Level B Ballistics (9 mm)

### MAKROLON HYGARD BR1000

HPW Level V Step 42  
HPW TP0500.02 Level B Ballistics (9 mm)  
UL Level 2

### MAKROLON HYGARD BR1250

HPW Level V  
HPW TP0500.02 Level C Ballistics (.44 magnum)  
ASTM F1233 Class IV Step 38  
UL Level 3

Sheffield Plastics Inc. will 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 application. No warranty is made for the fitness of any product, and nothing herein waives any of the seller's conditions of sale.

## PRODUCT SPECIFICATIONS

### Section 08840 Plastics Glazing

#### PART 1: GENERAL

##### 1.1 Section Includes

- A. Polycarbonate plastics glazing
- B. Abrasion-resistant polycarbonate plastic glazing
- C. Enhanced UV-resistant polycarbonate plastic glazing
- D. Laminated polycarbonate plastic glazing for bullet resistant security applications

##### 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 or security glazing materials and systems

##### 1.4 Submittals

- A. Submit under provisions of Section 01300
- B. Product Data: Submit manufacturers' printed product information that includes physical properties and recommended installation and glazing procedures
- 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 manufacturers' written warranty covering coating failure, loss of light transmission, and yellowing

#### PART 2: PRODUCTS

##### 2.1 Manufacturer

- A. Polycarbonate Sheet: Comply with ANSI Z971.1 and properties as follows:

1. Specific gravity: 1.2 per ASTM D792
2. Tensile strength yield: 9500 psi per ASTM D638
3. Tensile modulus: 345,000 psi per ASTM D638
4. Flexural strength at 5% strain: 13,500 psi per ASTM D790
5. Flexural modulus: 345,000 psi per ASTM D638
6. Izod impact strength (0.125" notched): 12-15 ft. ft/lb per ASTM D256
7. Self-ignition temperature: 1070°F per ASTM D1929

- B. General Purpose Type: Provide MAKROLOLON GP, UV inhibiting polycarbonate glazing sheet

1. Thickness range: .118 nominal, .177 nominal, .236 nominal, .375 nominal, .500 nominal
2. Color: clear A00
3. Color: grey I30
4. Color: bronzel K09
5. Color: dark grey I35
6. Custom color to match architect's sample

- C. Solar Resistant: Provide MAKROLOLON SL, UV enhanced polycarbonate sheet

1. Thickness range: .118 nominal, .177 nominal, .236 nominal, .375 nominal, .500 nominal
2. Color: clear A00
3. Color: grey I30
4. Color: bronzel K09
5. Color: dark grey I35
6. Custom color to match architect's sample

- D. Abrasion Resistant and UV enhanced: Provide MAKROLOLON AR hard coated polycarbonate sheet

1. Thickness range: .118 nominal, .177 nominal, .236 nominal, .375 nominal, .500 nominal
2. Color: clear A00
3. color: grey I30
4. Color: bronzel K09
5. Color: dark grey I35
6. Custom color to match architect's sample

- E. Glazing accessories as recommended by manufacturers of polycarbonate glazing sheet for wet or dry glazing installations

##### 2.2 Laminated Glazing

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

##### B. Containment Glazing

1. Provide HYGARD CG375 2-ply polycarbonate laminate with the following properties:
  - a. Forced entry rating: HPW TP0500.02 Level II, Step 10; HPW TP0500.02 Level A Ballistics (.38 special); ASTM F1233 Class III Step 12
  - b. Gauge: 0.390" ± 5% tolerance
  - c. Weight: 2.4 lbs./sq. ft.
  - d. Shading coefficient: 0.92
  - e. Light transmittance (clear): 86%
2. Provide HYGARD CG500 3-ply polycarbonate laminate with the following properties:
  - a. Forced entry ratings: HPW TP0500.01 Level II Step 12; HPW TP0500.01 Level A Ballistics (.38 Special); ASTM F1233 Class III Step 15
  - b. Gauge: 0.530" ± 5% tolerance
  - c. Weight: 3.3 lbs./sq. ft.
  - d. Shading coefficient: 0.90
  - e. Light transmittance (clear): 83%
3. Provide HYGARD CG750 3-ply polycarbonate laminate with the following properties:
  - a. Forced entry ratings: HPW TP0500.02 Level IV Step 31; HPW TP0500.01 Level B Ballistics (9mm); ASTM F1233 Class IV Step 26
  - b. Gauge: 0.780" ± 5% tolerance
  - c. Weight: 4.9 lbs./sq. ft.
  - d. Shading coefficient: 0.87
  - e. Light transmittance (clear): 77%

##### C. Bullet Resistance Glazing

1. Provide HYGARD BR750 3-ply polycarbonate laminate with acrylic interlayer with the following properties:
  - a. Ballistic ratings: UL 752 Level 1 MSPA .38 Super Automatic/9 mm; HPW TP0500.02 Level B Ballistics (9 mm)
  - b. Gauge: 0.775" ± 8% tolerance
  - c. Weight: 5.1 lbs./sq. ft.
  - d. Shading coefficient: 0.89
  - e. Light transmittance (clear): 87%
2. Provide HYGARD BR1000 4-ply polycarbonate laminate with the following properties:
  - a. Ballistic rating: UL 752 Level 2 HPSA .357 magnum
  - b. Forced entry ratings: HPW TP0500.02 Level V, Sequence 42, Level B 9 mm, ASTM F-1233 Class V, Ballistics .38 super
  - c. Gauge: 1.05" ± 5% tolerance
  - d. Weight: 6.5 lbs./sq. ft.
  - e. Light transmittance (clear): 72%
3. Provide HYGARD BR1250 4-ply polycarbonate laminate with the following properties:
  - a. Ballistic ratings: UL 752 Level 3 SPSA .44 magnum
  - b. Forced entry ratings: HPW TP0500.02 Level V, HPW TP0500.02 Level C Ballistics (.44 magnum); ASTM F-1233 Class IV Step 38
  - c. Gauge: 1.30 ± 5% tolerance
  - d. Weight: 8.1 lbs./sq. ft.
  - e. Light transmittance (clear): 67%

#### PART 3: EXECUTION

##### 3.1 Examination

- A. Inspect pallets upon delivery for evidence of damage
- B. Inspect and verify frame openings are correct size and conform to recommendations of 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 sheet by peeling back factory applied protective masking to a dimension sufficient for edge engagement.

##### 3.3 Installation

- A. Install polycarbonate sheet 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 polycarbonate glazing sheet.
- C. Remove protective masking immediately after all glazing operations are completed.

##### 3.4 Adjusting and Cleaning

- A. If installed properly, polycarbonate 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 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 MAKROLOLON® polycarbonate sheet products are available upon request. For more information, please write or call Sheffield Plastics Customer Service Department at 800-254-1707; 119 Salisbury Road, Sheffield, MA 01257.

**MAKROLON HYGARD®**  
**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.

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