



## Bayer MaterialScience

Makrolon® sheet product portfolio for high performance architectural glazing



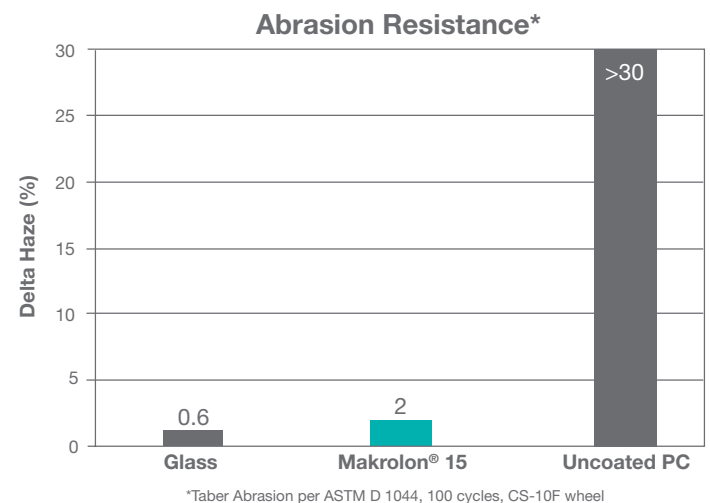
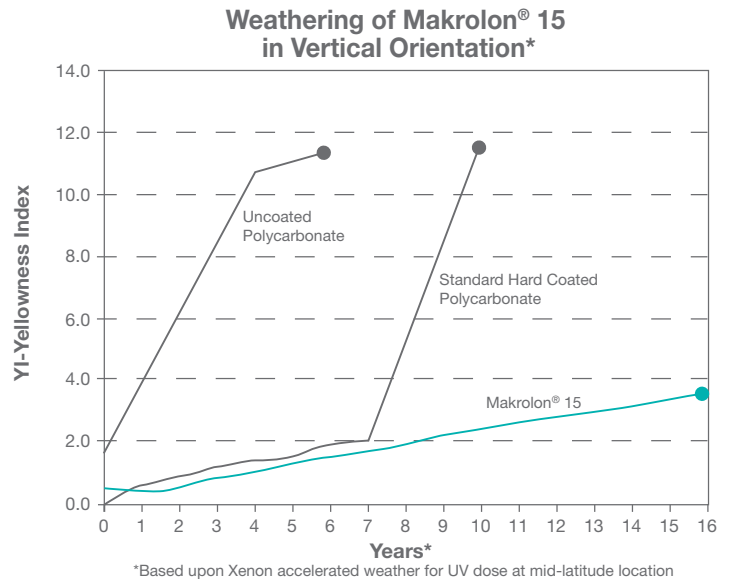
# Makrolon® 15 and Makrolon® AR sheet offer long term performance

## High impact strength resists breakage—enhances security

Choose the right Makrolon® sheet for lasting durability and aesthetics in exterior or interior glazing applications

### Makrolon® 15 sheet for vertical architectural glazing

- Up to twice the abrasion and weathering resistance of other polycarbonate glazing
- 15-year limited product warranty against breakage, yellowing, and loss of light transmission
- Withstands vandalism, forced entry attempts or attacks, and accidental impacts in high risk areas
- Available in a range of standard glazing tints
- Eliminates bars and wire mesh often required with glass
- Glazed with standard materials and framing

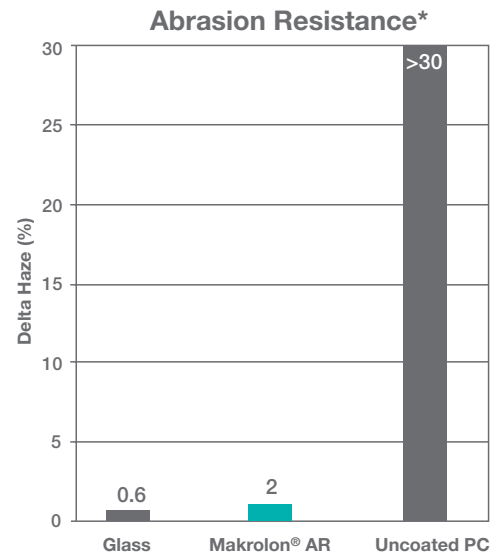
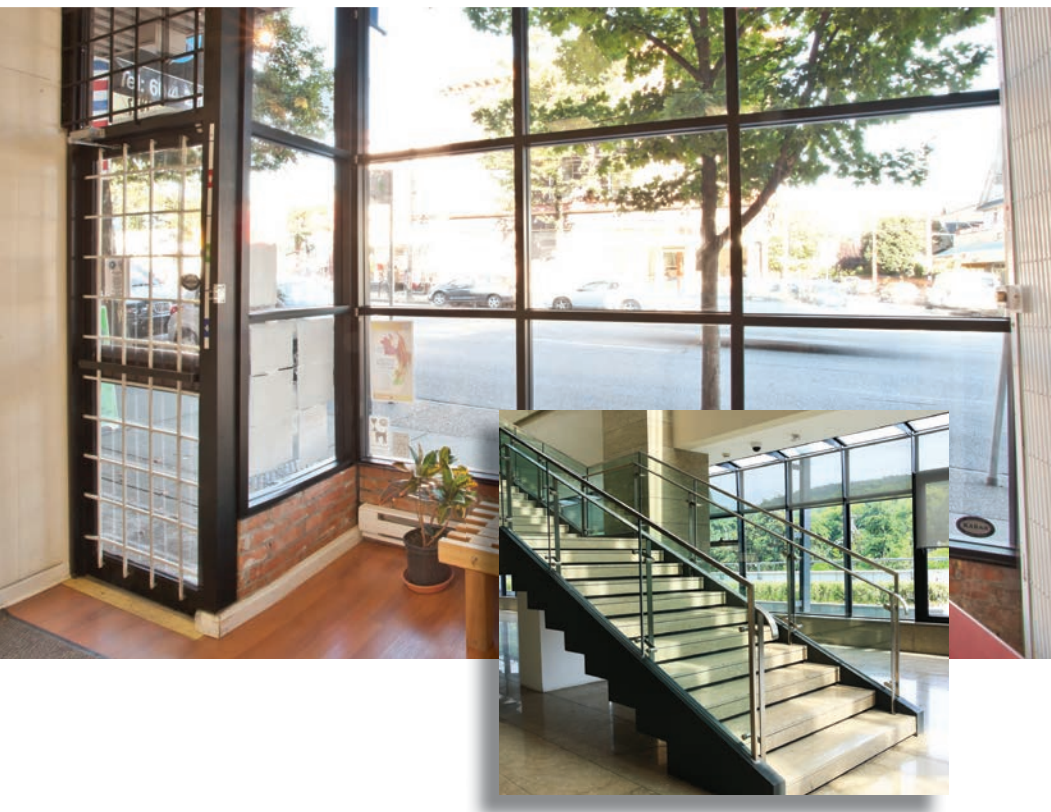


# Performance for abrasion and UV resistance

## Makrolon® AR abrasion resistant sheet for high traffic interiors

- Superior toughness in damage prone and secure areas
- Exceptional level of abrasion and mar resistance to withstand routine abuse and cleaning
- Easy removal of graffiti from billboard and signage covers
- Ideal for interior partitions, entry areas, stair railings, and clean rooms

Glass door is protected with bars – windows are Makrolon polycarbonate sheet



\*Taber Abrasion per ASTM D 1044, 100 cycles using CS-10F wheels at 500 g load

### Chemical Resistance\*

| Chemical Tested         | Resistance Time    |
|-------------------------|--------------------|
| Acetone                 | > 24 hrs           |
| Ethylene Dichloride     | > 24 hrs           |
| Unleaded Gasoline       | > 24 hrs           |
| Hydrochloric Acid (10%) | > 24 hrs           |
| Isopropyl Alcohol (IPA) | > 24 hrs           |
| Kerosene                | > 24 hrs           |
| Methyl Alcohol          | > 24 hrs           |
| Methylene Chloride      | > 24 hrs           |
| Methyl Ethyl Ketone     | > 24 hrs           |
| Nitric Acid (100%)      | >1 hr but < 24 hrs |
| Sodium Hydroxide (10%)  | >1 hr but < 24 hrs |
| Sulfuric Acid (1%)      | > 24 hrs           |
| Toluene                 | > 24 hrs           |

\* Tested in accordance to ASTM D 1308

Values for Makrolon AR and Makrolon 15

## Regulatory code compliance and certifications

ICC-ES Evaluation report ESR-2728

Miami-Dade NOA #10-0329.03  
Florida Building Code 2007

CPSC 16 CFR 1201 Category I and Category II: Safety Standard for Architectural Glazing Materials

ANSI Z97.1-2004: American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

UL 972: Burglary Resistant Glazing Materials, UL File #BP2126

Code compliance and certifications for Makrolon AR and Makrolon 15

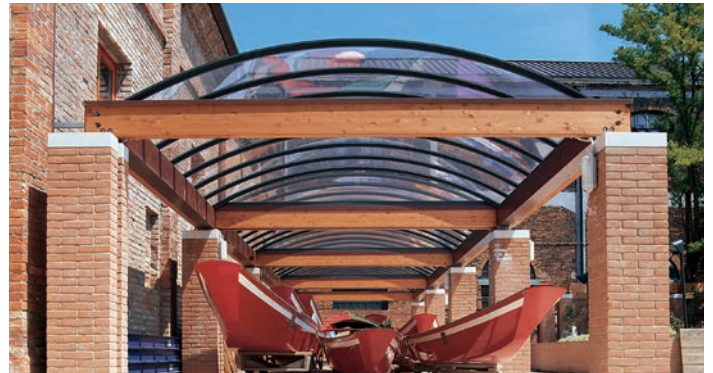
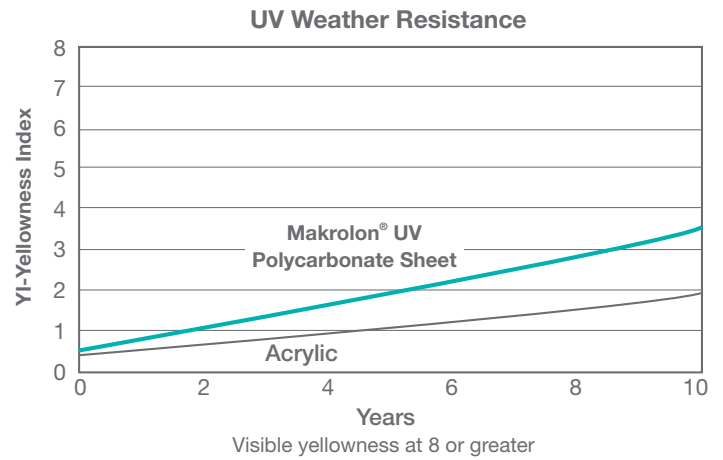




# Makrolon® UV sheet for overhead glazing

## Provides long term UV and impact resistance

- Provides lasting protection for entrance canopies, covered pedestrian walkways, shelters, sky lights, and transportation terminals
- 10-year limited product warranty against loss of light transmission
- Cut and cold form on-site for cost effective installation versus preformed glass
- Cold bend to tight radii versus acrylic for more design versatility

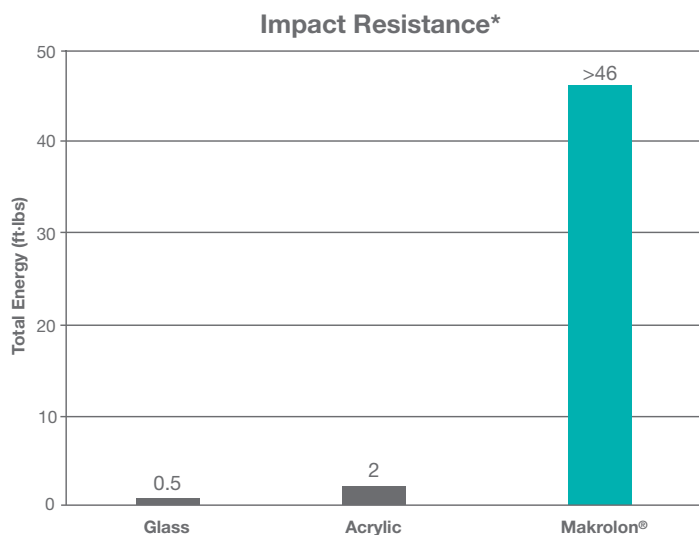


# Makrolon® GP Pebble

Light transmitting texture for break resistance, aesthetics, and privacy

## Makrolon® GP Pebble for curved and protective glazing

- Rated “Burglar Resistant” per UL 972
- Pebble finish hides scratches and offers visual privacy with good light transmission
- Can be cold-formed for economical on-site installation
- Bronze tint helps maintain lasting appearance for overhead glazing, walkways, and shelters
- Provides both visual and physical security as window over-glazing for vulnerable areas



\*Instrumented Impact per ASTM D 3763, sample thickness is 0.125" nominal

## Glazing Materials Comparison

| Property                                  | Polycarbonate                    | Acrylic                          | Glass                           |
|---|----------------------------------|----------------------------------|---------------------------------|
| Impact Resistance, Drop Ball Test, 0.5 lb | No Break                         | 1.75 ft·lbs                      | 0.7 ft·lbs                      |
| Cold Bend, Bend Radius                    | 100x material thickness          | 180x material thickness          | Not possible                    |
| Sheet Weight, 0.125"                      | 0.78 lb/ft <sup>2</sup>          | 0.75 lb/ft <sup>2</sup>          | 1.60 lbs/ft <sup>2</sup>        |
| Thermal Expansion Rate                    | 3.75 x 10 <sup>-5</sup> in/in/°F | 4.10 x 10 <sup>-5</sup> in/in/°F | 5.0 x 10 <sup>-6</sup> in/in/°F |
| Shading Coefficient, 0.236" clear sheet   | 0.97                             | 1.01                             | 1.03                            |
| U Factor – Summer, 0.236"                 | 0.85 BTU/hr·ft <sup>2</sup> ·°F  | 0.83 BTU/hr·ft <sup>2</sup> ·°F  | 0.92 BTU/hr·ft <sup>2</sup> ·°F |
| U Factor – Winter, 0.236"                 | 0.92 BTU/hr·ft <sup>2</sup> ·°F  | 0.91 BTU/hr·ft <sup>2</sup> ·°F  | 1.02 BTU/hr·ft <sup>2</sup> ·°F |



# Hygard® CG and Hygard® BR

## Withstands extreme threat with no compromises to performance

### Hygard® CG institutional and correctional facility containment laminates

- Three levels of protection proven to resist the most rigorous physical attack
- Meets or exceeds standard containment test agency standards
- Hard-coat surface technology resists weathering, abrasion, and graffiti



### Hygard® BR bullet resistant laminate

- Four levels of protection against multiple threat types
- Multi-shot resistance against 9 mm submachine gun – UL Level 6 listed
- Hard-coated surface technology resists weathering, abrasion, and graffiti

### Hygard® MS 1250 multi-shot protection

- UL 752 Level 6
- High speed multi-shot 9 mm (uzi)
- Hard-coated surface technology resists weathering and abrasion

### Security Tests & Product Ratings Overview

| Product | Forced Entry Test, Ratings |                            |                            |                   | Ballistics Tests, Ratings |              |                |
|---------|----------------------------|----------------------------|----------------------------|-------------------|---------------------------|--------------|----------------|
|         | Gauge Inches               | ASTM F 1233 Class Achieved | ASTM F 1915 Security Grade | HPW TP-0500 Level | HPW TP-0500 Level         | UL 752 Level | NIJ 0108 Level |
| AR      | .500                       | 2.0 BP* / 1.4C*            | 3                          | I                 |                           |              |                |
| CG 375  | .390                       | 2.8 BP / 1.4 C             | 3                          | I                 |                           |              |                |
| CG 500  | .530                       | II                         | 2                          | I                 | A                         |              |                |
| CG 750  | .780                       | III                        | 1                          | II                | A                         |              |                |
| BR 750  | .780                       |                            |                            |                   | B                         | 1            |                |
| BR 1000 | 1.05                       | 5 BP / 2.4 C               | 1                          | IV                |                           | 2            |                |
| BR 1250 | 1.30                       | 5.0 BP / 2.5 C             | 1                          | IV                |                           | 3            | II / IIIA      |
| MS 1250 | 1.30                       |                            |                            |                   |                           | 6            |                |

\* BP - Body Passage; C - Contraband

As with any security glazing, performance of HYGARD products is based on use in appropriate framing systems. For information on glazing system suppliers and full details on performance, test results and agency listings, visit [www.sheffieldplastics.com](http://www.sheffieldplastics.com).



# Hygard® EX Series

## Makes windows tough enough to meet requirements for blast hazard mitigation

### Hygard EX high performance series of blast resistant glazing

- Meets and exceeds U.S. Department of Defense Unified Facilities Code for Anti-Terrorism Standard for Buildings
  - Unified facilities criteria 4-010-01 DoD Minimum Antiterrorism Standards for Buildings February 9, 2012
  - Charge weight I & II at conventional construction standoff distances
- GSA / ISC Qualified
  - Security design criteria of new federal office buildings or major modernizations
  - Building classification levels C, D & E
- User defined performance
- Reduced standoff situations
- Ballistic, forced entry, and severe storm protection options



### UFC Approved for Blast Resistant Glazing in New and Existing DoD Buildings

#### Hygard EX 250 Dual Glazed System - Window Size 48" x 66"

| Pressure | Impulse     | Test Method     | Qualified               | ATFP  |
|----------|-------------|-----------------|-------------------------|-------|
| 6 psi    | 42 psi-msec | GSA/ISC-GSATS01 | Performance Condition 2 | Meets |
| 6 psi    | 42 psi-msec | UFC 4-010-01    | Protection Level Medium | Meets |
| 6 psi    | 42 psi-msec | ASTM F 1642     | No Hazard Level         | Meets |
| 6 psi    | 42 psi-msec | AAMA 510.06*    | Complies                | –     |

\*The window was tested in accordance with the Voluntary Guide Specifications for Blast Hazard Mitigation for Fenestration Systems AAMA 510-06.

#### Physical Performance Data

| EX 525 Performance                                      | Standard / Test Method                           | Protection Level                |
|---|--|---------------------------------|
| Blast Resistance EX 525<br>6 psi / 42 psi-msec          | UFC 4-010-01 ASTM F 1642<br>GSA / ISC - TS01     | No break<br>Condition 1         |
| Blast Resistance EX 525 System*<br>10 psi / 89 psi-msec | UFC 4-010-01 ASTM F 1642<br>GSA / ISC - GSA-TS01 | No hazard<br>Condition 2        |
| Containment / Forced Entry                              | H.P. White TP 0500.03                            | Level 1 Sequence 8              |
| Forced Entry<br>and Containment                         | ASTM F 1915<br>ASTM F 1233-08                    | Grade 3<br>Class 2 Body Passage |
| Flammability  | International Building Code                      | CC1                             |

\*Dual Glazed System with Glass

### Bayer MaterialScience computer modeling optimizes window design

FEA computer modeling along with extensive shock tube and live explosives testing help define Hygard laminate thickness and frame design required to withstand defined blast conditions.



| EX 1100 Performance             | Standard / Test Method                | Protection Level                |
|---------------------------------|---------------------------------------|---------------------------------|
| Blast Resistance                | ASTM F 1642                           | Blast Performance: Up to 40 psi |
| Blast Resistance – GSA D*       | GSA/ISC TS201                         | Performance Condition 2         |
| Blast Resistance – 21 psi*      | ASTM F 1642                           | No Hazard                       |
| Ballistic Resistance            | UL 752                                | Level II                        |
| Ballistics – Forced Entry       | ASTM F 1233-08                        | Class 5                         |
| Forced Entry<br>and Containment | ASTM F 1915<br>H.P. White TP 0.500.03 | Grade 1<br>Level IV Sequence 43 |

\*Dual Glazed System with Exterior Lite of Glass.

| EX 1300 Performance             | Standard / Test Method                                 | Protection Level  |
|---------------------------------|--|---|
| Blast Resistance                | Exceeds GSA, DoD (UFC) DoS                             | Extreme Performance: Above 40 psi                           |
| Ballistic                       | UL 752<br>NIJ  | Level 3<br>Level II, Level IIIA                             |
| Forced Entry<br>and Containment | ASTM F 1233-08<br>ASTM F 1915<br>H.P. White TP 0500.03 | Class 5.0 + Class 2.5<br>Grade 1<br>Level IV Sequence 43-44 |

The series of windows tested in accordance with the Voluntary Guide Specifications for Blast Hazard Mitigation for Fenestration Systems AAMA 510-06.





## Bayer MaterialScience

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