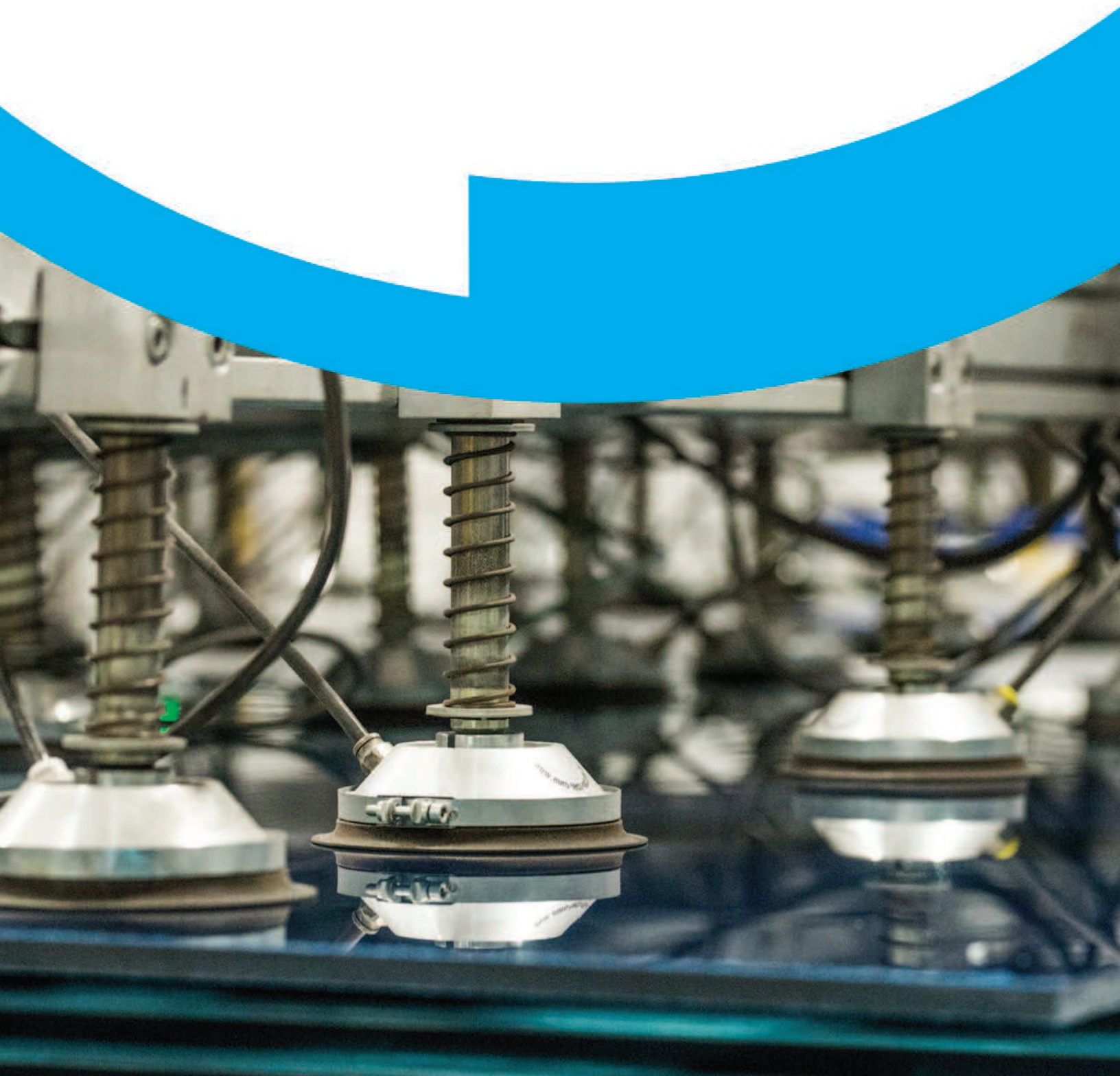
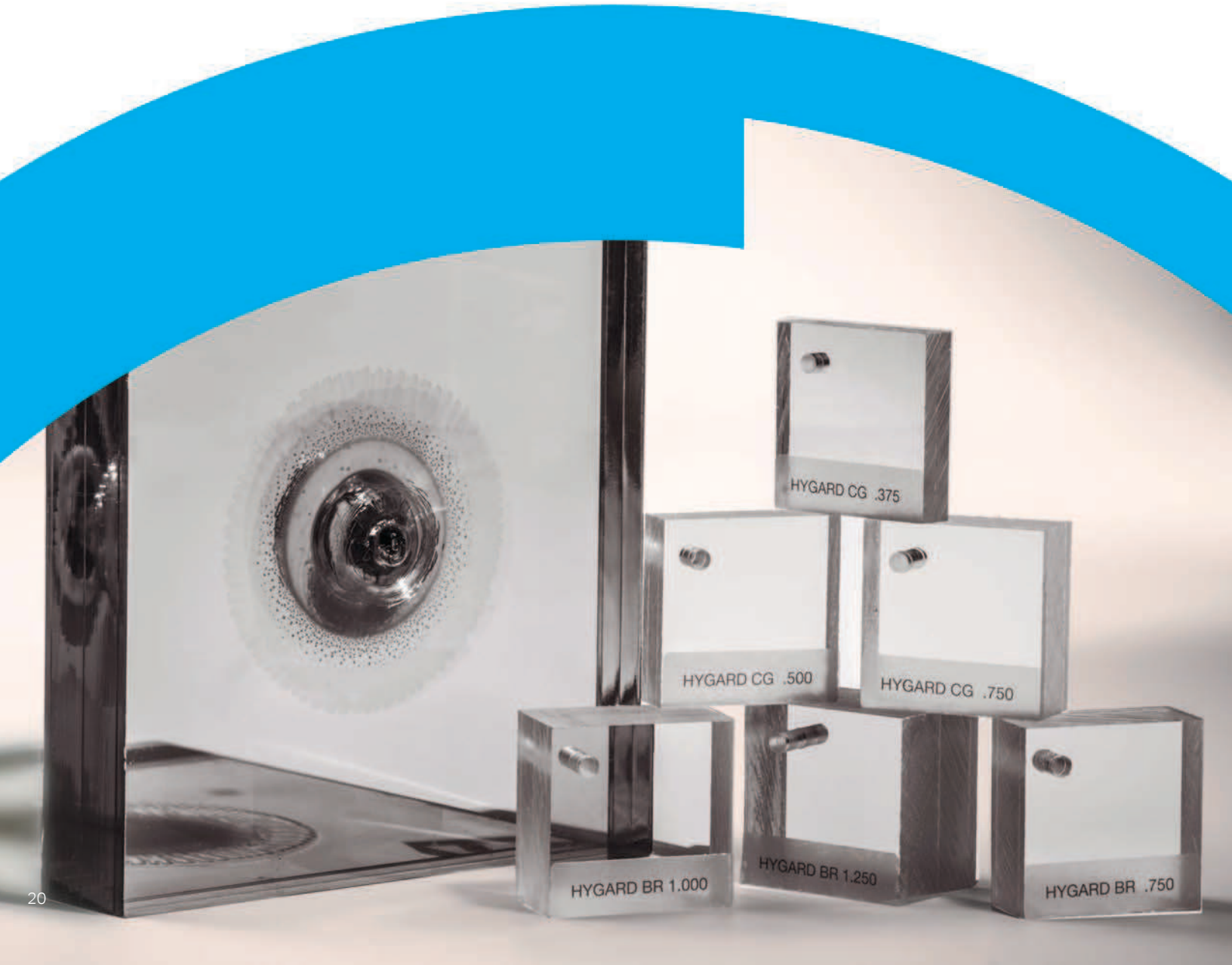
Makrolon® polycarbonate sheet

Fabrication Guide / Technical Manual



Fabrication
– Laminate &
Heavy Gauge Sheet



Fabrication – Laminate & Heavy Gauge Sheet

Hygard laminates a portfolio of security rated polycarbonate and polycarbonate/acrylic systems, and the Makrolon WG and MG plate products engineered for heavy fabrication, tight tolerance part design all easily fabricate using standard cutting tools. Recommended are carbide-tipped cutters that last longer and cut a cleaner edge. Leave the masking on the product while fabricating to protect against surface damage. Remove masking soon after installation; prolonged outdoor exposure degrades the film making it difficult if not impossible to peel off.

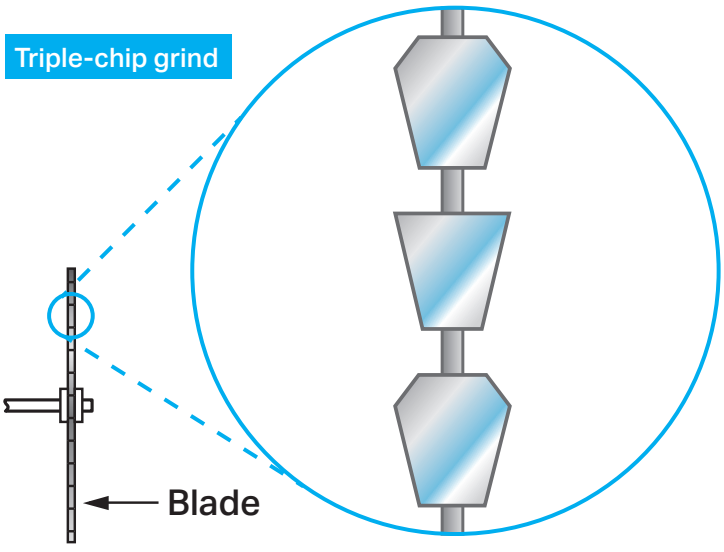
Proper fabricating practices are especially important to follow when cutting parts intended for security applications to ensure product integrity with respect to strength properties and performance ratings. Sharp cutting tools are important as is feed rate control; do not force cutting appliance to avoid material overheating.

Hygard laminate	UL 752 file #BP6864	UL 94 file #E351891
Hygard laminate		
BR750	Level 1	
BR1000	Level 2	
BR1250	Level 3	
MS1250	Level 6	
Makrolon		
WG		V-0
MG		V-0

Circular saw

Circular saw blade carbide tipped, triple chip tooth design cuts clean and lasts longer than high strength steel. Blade is hollow-ground, and slotted for expansion and cooling. Blade cutting speed 5000-6000 ft/min.

Circular saw blade and cutting	
Cutting speed (ft/min)	5000 - 6000
Blade	~3 teeth/inch



Circular saw troubleshooting

PROBLEM: Melting or Gummed Edges

SUGGESTED SOLUTIONS:

1. Increase blade tooth size
2. Reduce saw speed
3. Increase feed rate
4. Use compressed air to cool blade
5. Inspect blade for sharpness
6. Check blade-fence alignment
7. Reduce number of sheets in stack

PROBLEM: Chipping

SUGGESTED SOLUTIONS:

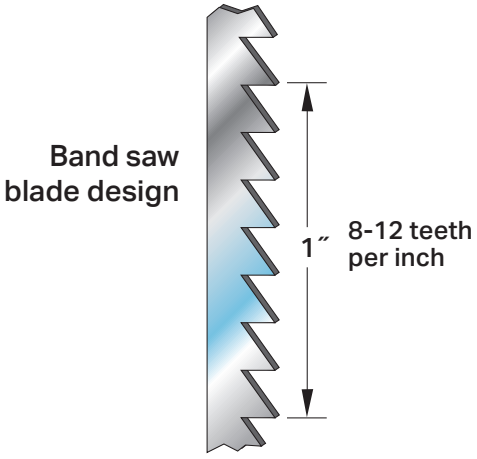
1. Decrease blade tooth size
2. Increase saw size
3. Provide better clamping/support for sheet stack
4. Reduce feed rate
5. Check blade and arbor for wobble
6. Inspect blade for sharpness

Fabrication – Laminate & Heavy Gauge Sheet

Band saw

Hygard laminates, WG and MG products, are able to be band saw cut with blades 8-10 teeth per inch. Carefully choose feed and speed rates avoiding gumming/melting the plastic edge. Blades preferred are those with a set 0.020 to 0.030-inch.

Pitch (teeth/inch)	Band speed (ft/min.)	Blade set (inch)
8 - 10	2500 - 3000	0.020 - 0.030



Drilling

Standard drills and bits fabricate Hygard laminates, WG and MG products; however specially designed drills and bits perform much better. Drills for plastics generally have wide, polished flutes to reduce friction, as well as spiral or helix designs to remove chips quickly.

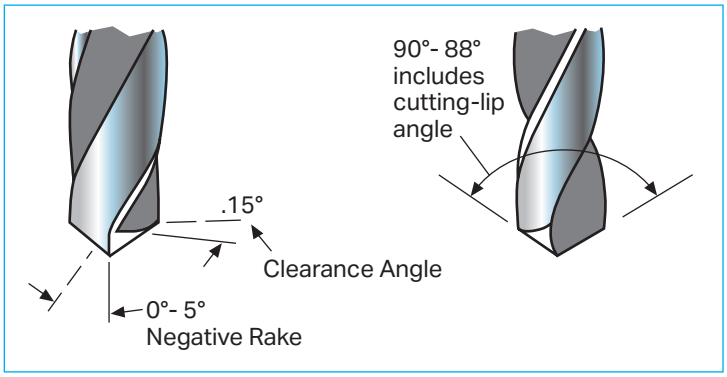
- Use drill-point angles larger than 90 degrees

General guidelines for drilling Hygard laminates, WG and MG:

- Use carbide-tipped drills, they resist gumming and maintain edge sharpness longer than standard drills
- Avoid cutting fluids; most are not compatible with polycarbonate
- Cool work if necessary by forced-air stream

Use sharp drills for cleanest cut and frequently clear the hole of chips. Avoid overheating otherwise stress buildup in the material may have an adverse effect on mechanical properties compromising product performance and reliability. If drilling holes, drill them off the part edge by 1-2 times the diameter. Avoid holes in parts intended for ballistic rated applications.

Drill bit design



Hole diameter	Drill speed (rpm)
1/8″	1750
1/4″	1050 -1500
1/2″	350 - 500

Milling/routing

Two or three fluted carbide-tipped router bits cut clean edges on Hygard laminates, WG and MG. Feed sheet against the router bit rotation and use a fence for sizing when making straight cuts. Router speeds 20,000–25,000 rpm, use straight 2-3 fluted carbide-tipped or high-speed bits. Feed product at a controlled rate to avoid overheating, minimizing vibration producing a smooth part edge.

Summary on cutting:

- Use only sharp cutters
- Holes drilled slightly oversized
- Holes drilled off sheet edge by distance at least 1-2 times diameter of hole
- Drill counter-bore hole, do not countersink
- Forced air stream only as cooling medium; use no cutting fluids
- Material overheating causes speed/feed rates, dull cutter, cutter design
- Cut edges must be smooth; sand coarse surfaces and chatter marks
- Leave masking on product during fabrication, remove soon after installation
- Use cleaners compatible with polycarbonate, confirm with manufacturer if unsure

Resource on drilling and router cutting:

https://www.onsrud.com/plusdocs/Doc/list.html?pg=0&sf=code&sd=d&model.category=TECH

Fabrication – Laminate & Heavy Gauge Sheet

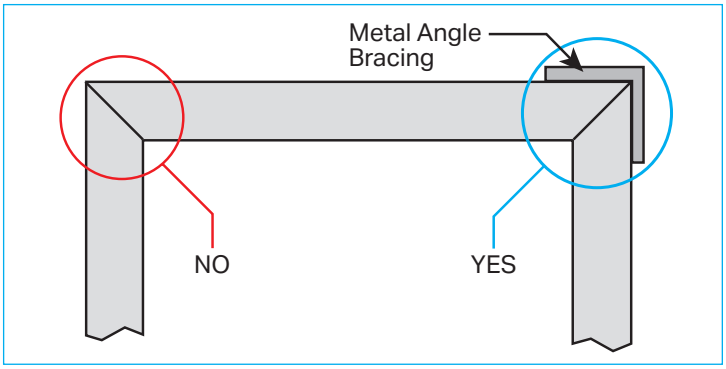
Frame design

Frame design requires careful consideration for glazing intended to provide security rated protection. **Be mindful in selecting a metal frame that matches the same protection level as the specified Hygard laminate.**

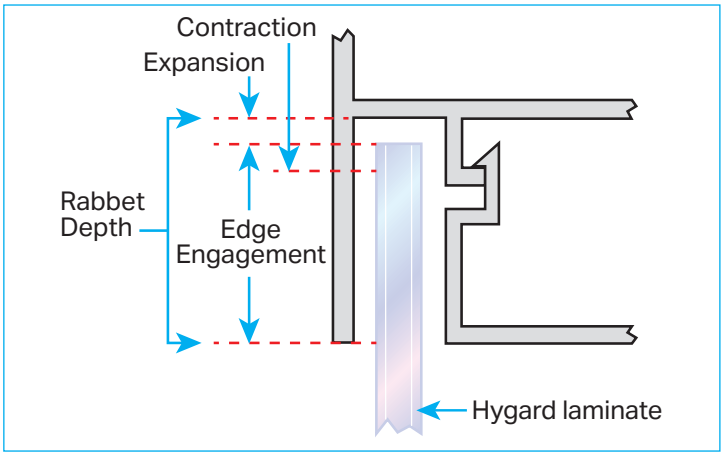
Corner design

Mitered corners require added bracing usually attaching angle sections at these locations are enough in strengthening the overall frame.

A continuous metal extrusion is a better frame design.



Product performance relies a great deal on method of attachment, with importance on the assembly and thermal expansion taken into account.



Glazing recommendations

- Frame system must have rating equal to the Hygard laminate specified
- Hygard laminate dimension must have allowance for at least 1 inch edge engagement and frame has adequate rabbet for sheet thermal expansion movement (0.060 inch per 12 inches linear dimension)
- Use only gaskets, tapes and sealants compatible with polycarbonate
- Setting block use strips of polycarbonate or Santoprene* rubber
- Remove protective masking soon after completing the installation, prolonged exposure to the outdoors will degrade the film making it difficult if not impossible to remove

*Santoprene trademark of Exxon Mobil Corporation