

LEXGARD® Laminates

Fabrication and Installation Guide



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LEXGARD®

Bullet Resisting Laminates

LEXGARD bullet resisting laminates are composites of LEXAN® polycarbonate sheet, acrylic, and LEXAN mar-resistant polycarbonate sheet. These sheets are laminated together with a proprietary interlayer system. LEXGARD laminates contain UV stabilizer additives to prevent yellowing or discoloration with aging. All laminates are warranted for 5 years (see LEXGARD warranty for complete details).

AGENCY & STANDARDS

LEXGARD laminates, a full family of bullet-resisting products, are recognized as bullet resisting and are listed Level 1 through 4 by Underwriters Laboratories, Inc., per Standard UL 752. LEXGARD laminates also meet various forced entry and ballistic requirements per ASTM F-1233 and HP White TP 0500.00.

LEXGARD Bullet Resisting Laminates vs. Glass

LEXGARD SP-1250 bullet resisting laminates are 1-1/4" thick and weigh 8 pounds per square foot. A standard 3' x 5' window will, therefore, weigh only 120 pounds. Bullet resisting glass must be 1-3/4" thick, weighing nearly three times as much as the thinner LEXGARD laminates.

®Registered Trademark of GE

FABRICATION

LEXGARD laminates can be cut with a variety of common woodworking equipment. Protective masking should be left in place to prevent marring when performing any machining operation, but should be removed after installation (two weeks maximum). Prolonged exposure to sunlight and moisture could make removal difficult.

Cutting and Sawing

Proper procedures must be followed when cutting and fabricating LEXGARD laminates to insure its mechanical integrity and long-term ballistic performance. **Remember, take care to protect yourself from injury. Use appropriate eye and ear protection when operating cutting equipment.**

Keep all cutting tools sharp and well maintained. Use a slow and even feed rate to prevent overheating. Do not force any cutting appliance. All rough saw marks should be scraped or sanded for ultimate performance.

Circular Saws

Panel saws are ideal for cutting LEXGARD laminates. Table saws and hand-held circular saws may also be used. The blade should be a carbide tooth of a triple-chip design with approximately three teeth per inch.



*Triple-Chip Grind

The triple-chip cut designed for cutting plastics, produces three chips which tend to stabilize the cut by reducing side pressure.

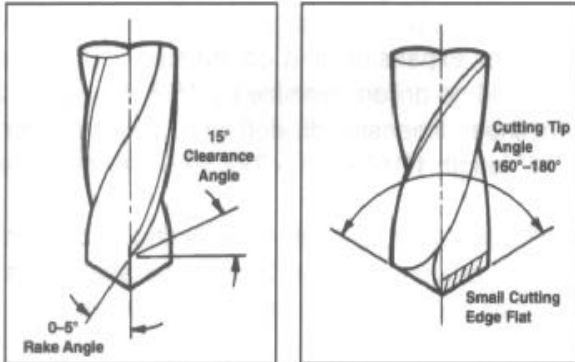
*Same as square and advance

Band Saws and Reciprocating Saws

LEXGARD laminates can be cut satisfactorily with band saws with blades having 10–18 teeth per inch and blade speeds of 2500–3000 feet per minute. Cutting may also be accomplished using a hand-held sabre saw (reciprocating saw) with blades designed for wood or composition board having 10–18 teeth.

Drilling

LEXGARD laminates can be drilled using standard high-speed steel or carbide twist drills. To minimize the drill's tendency to pull into the material, the cutting tip angle should be reground to at least 160° or a small flat can be ground on the cutting edge.



NOTE: Do not use drills that have been ground for use on acrylic sheet. They will overheat the material, and cause unwanted stresses.

When drilling, it is important to keep the drills sharp and to clear the hole frequently of chips. Avoid over heating the material which can result in unwanted mechanical stress which can weaken the material and cause it not to perform to standards. Drilled holes should be a minimum of two times the diameter of the screw from the edge of the LEXGARD laminate.

Suggested Speed/Feed Rates

Hole Diameter (in.)	Minimum Speed (rpm)	Feed (mils/rev.)	Time (sec.)
1/8	1750-2000	1-1/2 to 3	25-30
1/4	1000-1500	1-1/2 to 3	30
3/8	550-1000	1-1/2 to 3	30
1/2	325-650	3	45-50
3/4	350	3	50-60

Milling and Routing

Routing may be accomplished using two- or three-fluted carbide bits. The use of right- or left-handed spiral cutters will minimize material chatter and help hold the LEXGARD against the router surface.

When milling or routing speaker holes and currency slots, it is best to rough cut the area using a sabre saw and then perform a cleaning cut operation by using a router.

For best results, when using a hand-held router, make a template of the opening and set the

cutter to remove approximately 1/16" of material around the hole making sure to remove any machine marks produced by the initial saw cut. This should produce a smooth cut edge that is low in stress.

This procedure can also be accomplished using a three axis CNC router by simply programming the tool path to remove 1/16" of the material around the holes or slots.

The use of liquid lubricants or coolants is not recommended. Clean, compressed air is the recommended coolant technique.

Edge Finishing and Polishing

NOTE: The following procedures should be carried out in a well-ventilated area.

Edge Preparation

Step 1

- Remove any cutting tool marks produced by a saw or router by manually scraping the edge of the part or sheet with a 90° standard paint scraper.
- Tool should be sharp and free of any burrs or indentations.

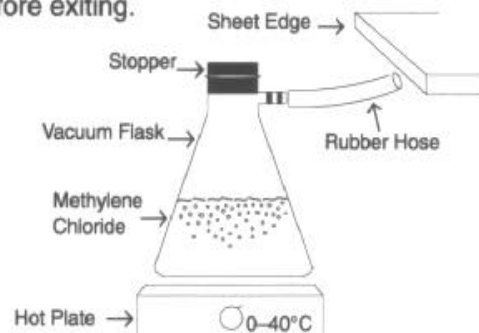
Step 2

- Sand the edges, typically starting with 220 grit "wet and dry" abrasive.
- Keep the pad wet to avoid buildup.
- An orbital or reciprocating sander can be used.
- Proceed to a finer grit abrasive (320 grit "wet or dry", as an example).
- Finish sanding with 600 grit abrasive.

Edge Polishing

Step 1

- Set up a small electric heater and a vacuum flask (or other modified vessel) as shown below.
- A 3-foot length of hose is most convenient. If the hose is too short, maneuverability is restricted; if too long, the vapors will condense before exiting.



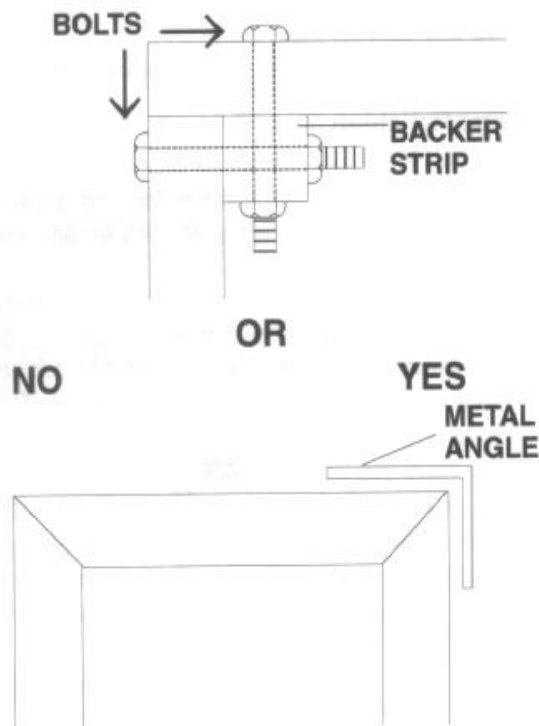
Step 2

- Boil a suitable amount of methylene chloride.
- Keep the hose approximately 2 inches from the part's edge.
- Slowly and steadily direct the vapor along the edge.
- The surface will very quickly become glossy.
- It is always better to return to an area for touch-up than to apply too much vapor at one time.
- After air drying for about 1 minute, reapply vapor if necessary to achieve a uniform surface.

Joint Design

Joint design is very critical in bullet resisting applications. Since the bullet will travel the path of least resistance, the LEXGARD laminates should, whenever possible, be joined together with the use of metal channels. Any metal channel or angle iron used should have ballistic protection (U.L. Listing) at least as good as the LEXGARD laminates being used.

Mitered corners should never be used alone, especially facing the direction of possible assault. Overlap joints should not be positioned with the joint opening facing the direction of assault. Metal channels are best, but if joints are used, they should be backed up with a backing strip of LEXGARD laminate and bolts as shown in the diagram.



Mechanical Fastening

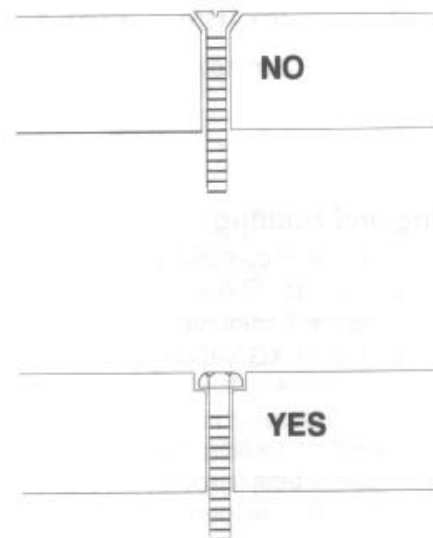
To maintain the excellent ballistic characteristics of the LEXGARD laminates, it is imperative to adhere to the following guidelines.

If the product is going to be used **outdoors** or where the temperature may fluctuate more than +15°F, any bolt or rivet hole must be drilled allowing for expansion and contraction. The holes should be drilled oversize by 1/16" for each 12" of linear dimension divided by 2. Example: for a 48" length $1/16" \times (48 \div 2) \div 12 = 1/8"$ oversize.

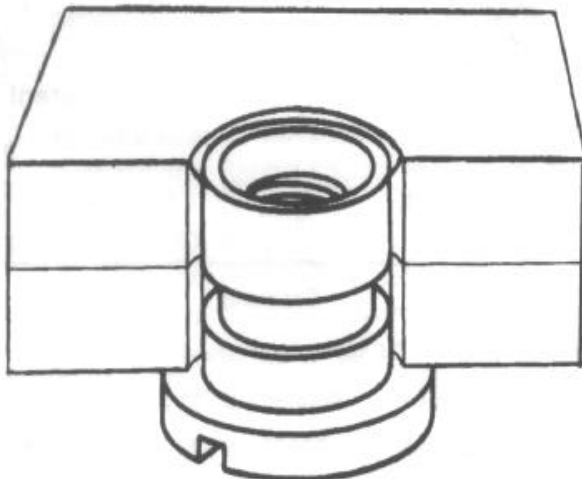
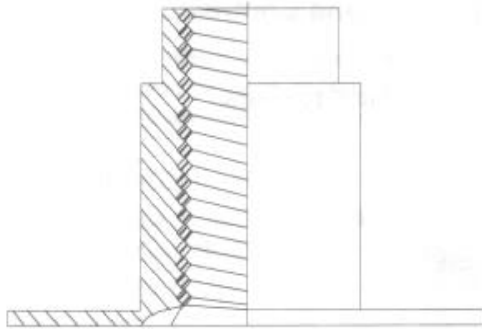
All holes used for rivets or bolts should contain a small amount of clear GE silicone sealant as a sealer and coating on exposed surfaces.

All rivets should be aluminum. Care must be exercised to minimize stress during the fastening operation. The rivet head should be 1-1/2 to 3 times larger than the shank diameter. Rivets should be backed with plates or washers, and all sharp edges on the rivet, washer, and hole in the material should be slightly rounded.

Heads of rivets or bolts should never be counter-sunk. If they are to be located below the sheet surface, they should be counter-bored to allow for proper load distribution (see diagram below).



Tapping or threading LEXGARD laminates for use with mechanical fastening is not recommended. Consider the use of threaded inserts for application requiring this type of fastening.



Bonding

Solvents, epoxies, or solvent-based adhesives **CANNOT** be used with LEXGARD bullet resisting laminates. These products produce brittle bonds which could adversely affect product performance.

The outer surfaces of LEXGARD laminates are coated to minimize scratching and abrasion. To achieve a good bond with approved elastomeric adhesives, the coating must be removed by sanding.

Recommended Adhesives

The following elastomeric adhesives may be used with LEXGARD laminates. However the MR5 coating should be removed to insure maximum adhesion.

Polyurethane Adhesives

Morton Chemical Company
110 North Wacker Drive
Chicago, IL
(312) 807-2000

- Mor-Ad #337, #336
 - Cure Mode: Moisture 24 hours
 - Color: Translucent Red

Hartel Enterprises, Inc.
12970 E. Branford
Pacoima, CA 91331
(818) 767-0861

- Hartel Enterprises HE17017
 - Cure Mode: Heat 150°F 4 hours or overnight room temperature for handling strength, 5-7 days ultimate
 - Color: Water clear, some discoloration with UV exposure

IPS
Box 379
Gardena, CA 90248
(800) 421-2677
or (310) 366-330

- Weld-On #55

Summary of Fabrication

Guidelines for LEXGARD Laminates

- Drill all holes slightly oversize.
- Use proper sawblade to maintain a smooth edge on LEXGARD laminates surface.
- Keep all tools sharp.
- Always use washers with bolts and rivets.
- Bolts should be just snug, not torqued tightly.
- **DO NOT** screw directly into the LEXGARD laminates.
- Use GE clear silicone caulk in all fabricated holes.
- **DO NOT** expose edges of LEXGARD laminates to incompatible cleaners, solvents, epoxies, or solvent-based adhesives, etc. that attack LEXAN sheet. Cover with silicone or seal glazing with silicone as recommended.
- Whenever possible the LEXGARD laminates should be retained in metal channels instead of being held by mechanical fasteners. The channel should be deep enough to retain the sheet under impact. A one-inch edge engagement is generally recommended.
- Failure to follow the steps in this guide may impair the integrity and performance of the LEXGARD laminate and may void all express or implied warranties.

INSTALLATION

Glazing

The glazing of LEXGARD laminates should be considered a finishing operation in new construction and should be scheduled as a final step in the completion of a building.

- Care should be taken to avoid surface marring during storage, cutting, transportation, and installation.
- After installation and removal of masking, LEXGARD sheet should be protected from paint, plaster, and other splashes by polyethylene, or other covering, taped to framing members.

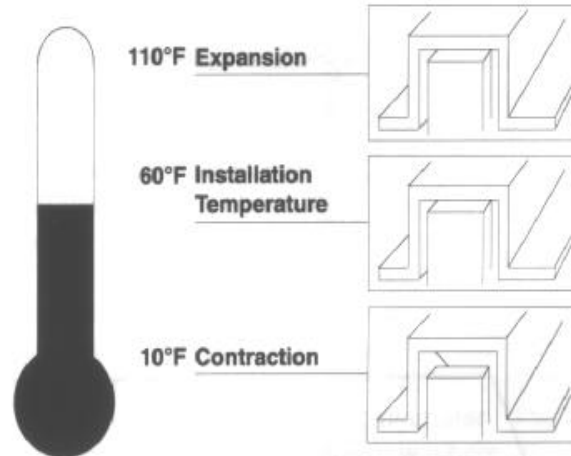
Interior Glazing

For interior ballistic and security applications where temperatures are relatively constant, both wet glazing and dry glazing systems can be used providing the frames can accommodate a minimum 1" rabbet depth.

Exterior Glazing

For exterior glazing applications, the installer must consider the additional thermal movement of the LEXGARD laminate and insure a minimum edge engagement of 1" during the application's coldest temperature condition (see the following table for calculations).

Expansion and Contraction



$$.0000375 \times \text{Temperature Span} \times \text{Length}$$

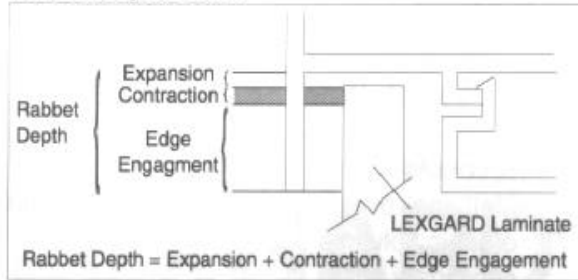
Example

48" X 96" Sheet	
Expansion	= .0000375 X 50° X 96" = .18"
Contraction	= .0000375 X 50° X 96" = .18"
Edge Engagement Based on 40 psf	= 1"
Total Rabbet Depth	= 1.36"

Quick Reference Chart Edge Engagement, Expansion Allowance, and Rabbet Depth (based on ± temperature shift from installation temperature)

Glazing Dimensions	Up	25°	37°	49°	61°	73°
	to 24"	to 36"	to 48"	to 60"	to 72"	to 96"
Recommended Edge Engagement for LEXGARD Laminates	1"	1"	1"	1"	1"	1"
Expansion	1/32"	1/16"	3/32"	3/32"	1/8"	3/16"
Contraction	1/32"	1/16"	3/32"	3/32"	1/8"	3/16"
Total Rabbet Depth	1-1/16"	1-1/8"	1-3/16"	1-3/16"	1-1/4"	1-3/8"

Rabbet Depth Detail



NOTE: Any metal framing used in bullet-resisting applications should be rated at least as good as the LEXGARD laminates being used.

Bomb Blast Applications

- For applications involving extreme pressure loads of short duration like those produced by a detonated explosion, the glazing frames, mechanical attachments, sheet thickness, size of the window, and edge engagement must all be designed to meet the specific application criterion.

Installation Procedures

1. Prepare sash. Clean sash surface and prime if necessary. Rabbet should be free of burrs.
2. Prepare LEXGARD laminate. After measuring sash opening carefully, determine recommended edge engagement and expansion allowance. Cut sheet to exact size required. Edges should be clean and free of notches.
3. Glaze LEXGARD laminate. The use of compatible sealant or gasket material is recommended, with flexible material on both sides of the laminate.
4. EPDM rubber or Santoprene† 101-87 are acceptable for dry gasketing.
5. Santoprene 101-87 is recommended for edge blocking and setting blocks. **PVC gaskets typically are not compatible with polycarbonate** and are not recommended for use in contact with LEXGARD laminates.
6. Remove masking after installation is complete. Do not expose the protective masking to high humidity and direct sunlight. Prolonged exposure can make masking removal difficult.

Recommended Sealants, Gaskets, and Tapes for Window Systems

For information on recommended window systems, contact your preferred window manufacturer or your local LEXGARD laminates sales office.

Type	Manufacturer	Product Name
Silicone	GE Silicones Waterford, NY (800) 255-8886	LEXSIL® SPS2900 Sealant
Silicone	GE Silicones Waterford, NY (800) 255-8886	SILPRUF® Sealant
Silicone	GE Silicones Waterford, NY (800) 255-8886	CONSTRUCTION 1200® Sealant
Silicone	GE Silicones Waterford, NY (800) 255-8886	CONTRACTORS 1000® Sealant
Gasket/Tape	Norton Company Granville, NY (800) 724-0883	<ul style="list-style-type: none"> • NORRENE® Foam • V-2100 Urethane Series
Gasket	Tremco Columbus, OH (800) 321-7906	<ul style="list-style-type: none"> • Silicone (70 Durometer) • EPDM (60, 70 Durometer)
Tape	Tremco Columbus, OH (800) 321-7906	440 Tape
Butyl Tape	PTI Dayton, OH (800) 543-7570	303, 606
Butyl Tape	Schnee-Morehead Irving, TX (214) 438-9111	Isocryl 5600 Series

*Registered Trademark of Norton Company

†Registered Trademark of Monsanto Company. For pricing and availability contact G&J Extruders at (216) 753-0162.

CLEANING AND MAINTENANCE OF LEXGARD LAMINATES

LEXGARD bullet resisting laminates are manufactured using GE's mar-resistance coating on each exposed surface. Proper cleaning procedures and chemically compatible cleaners are important in maintaining sheet performance.

Cleaning Procedures

1. Wash with a mild solution of soap or detergent and lukewarm water.
2. Using a soft cloth or sponge, gently wash the sheet to loosen dirt and grime and rinse well with clean water.
3. To prevent waterspotting, thoroughly dry with chamois or cellulose sponge.
4. Avoid the use of abrasive cleaners and/or cleaning implements that may mar or gouge the coating.

Compatible Cleaning Agents

- **Aqueous Solutions of Soaps and Detergents**

Windex*	Top Job**
Joy**	Mr. Clean**
Fantastik***	Formula 409****

- **Organic Solvents**

Butyl Cellosolve	Hexcel F.O. 554
Kerosene	Neleco—Placer
VM&P Naphtha	Turco 5042

- **Alcohols**

Methanol or Isopropyl Alcohol. All residual organic solvents should be removed with a secondary rinse.

Graffiti Removal

- (A) Butyl Cellosolve (for removal of paints, marking pen, inks, lipstick, etc.). The use of masking tape, adhesive tape or lint removal tools work well for lifting off old weathered paints.
- (B) To remove labels, stickers, etc., the use of kerosene or VM&P Naphtha is generally effective. When the solvent will not penetrate the sticker material, apply heat (hair dryer) to soften the adhesive and promote removal.

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** Registered Trademark of Procter & Gamble

*** Registered Trademark of Texize, Division of Norton Norwich Products, Inc.

**** Registered Trademark of the Clorox Company

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