

CARE

SAFETY CONCERNS

Acrylic sheet is a combustible thermoplastic, it will ignite and burn if placed in open flame or in contact with any other source of ignition. When storing or working with acrylic sheet, please be aware of the thermoplastic properties and consider fire precautions.

STORAGE

PLASKOLITE acrylic sheet is best stored horizontally, on the supplied flat bulk skids, in a well ventilated, consistent temperature area. Avoid storing acrylic sheet where extreme temperature variations occur, and areas above 100°F. Extreme temperature fluctuations can reform flat sheet as it can expand or contract.

A-frames or special racks can be used to store sheet vertically. Construct the racks allowing the acrylic to lean approximately 10°.

HANDLING

PLASKOLITE acrylic sheet is covered with a polyethylene film or paper masking for protection during storage and fabrication. Avoid sliding sheets across work surface debris. Chips and dirt can penetrate the masking, scratching the sheet.

MASKING REMOVAL

When removing the film and/or paper masking from the acrylic, it is best to start at a corner and peel away from the sheet. If removal is difficult, combine 50% rubbing alcohol with water in a squirt bottle; begin spraying at the edges as you pull away from the sheet.

CLEANING

Clean PLASKOLITE acrylic sheet with a mild soap solution, or a commercially available plastic cleaner, such as PLASKOLITE PLASTIC CLEANER, and a lint free cloth. To remove grease, oil, or tar deposits, use hexane or kerosene, followed by a soap solution. Avoid cleaners containing ammonia or alcohol.

NEUTRALIZING STATIC ELECTRICITY

PLASKOLITE acrylic sheet can be neutralized with an anti-static cleaner such as PLASKOLITE PLASTIC CLEANER, or ionizing air guns, and bars.

CUTTING/MACHINING

SCRIBING & BREAKING

For PLASKOLITE acrylic sheet up to 1/4" thick, score repeatedly along a straight edge with a plastic

cutting tool, or Fletcher Terry Knife. Score to penetrate 1/3 through the sheet. Align the score with the edge of the table and apply gentle pressure to break the sheet along the score line (See Fig. 2).

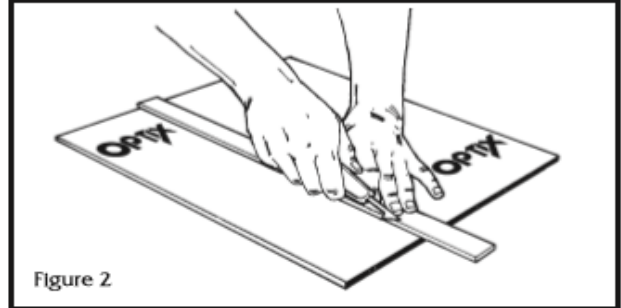


Figure 2

CUTTING

PLASKOLITE acrylic sheet can be cut with a variety of equipment. The selection of blades is critical with regards to the quality of the edge finish.

Table, and Panel saws are the best options for high volume straight cuts. Material can be stacked to cut several sheets at one time. When cutting, the saw blade should protrude through the sheet approximately 1/4" (See Fig. 3). Saw blades, specifically designed for cutting acrylic sheet, are commercially available.

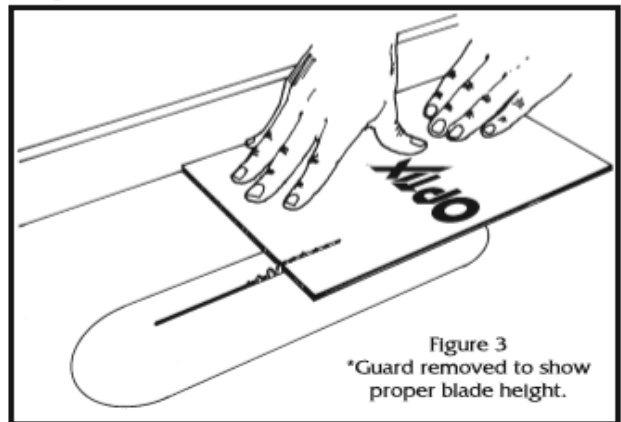


Figure 3
*Guard removed to show proper blade height.

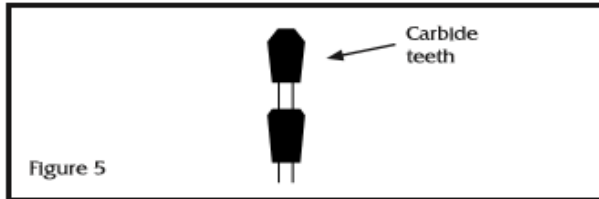
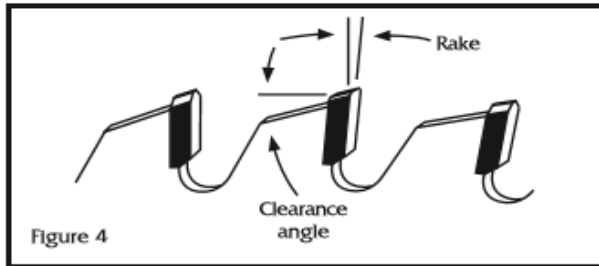
CIRCULAR SAW BLADE SPECIFICATIONS (See Fig. 4):

- Rake angle 0 - 10°
- Clearance angle 10-15°
- Blade teeth 80 per 10" blade

Blade	
Diameter	RPM
6"	6400
8"	5000
10"	4000
12"	3000
14"	2800
16"	2400

Tooth design (See Fig. 5)

Band, scroll, and sabre saws are best for cutting intricate shapes and curves. Again, blade



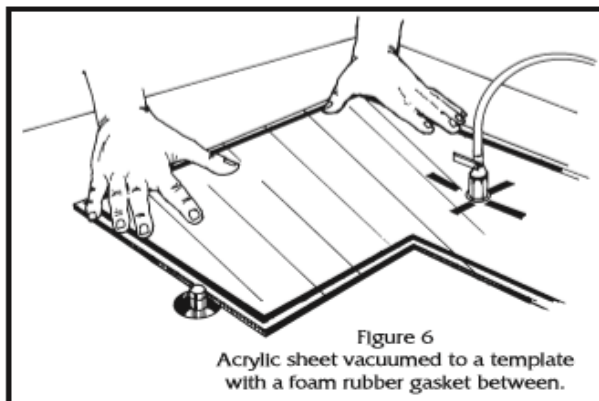
selection and proper feed rate is important to minimize melting or chipping. These saws are excellent for creating templates for vacuum or hand routing, and trimming off excess scrap material.

Routers are one of the most versatile pieces of equipment available to trim PLASKOLITE acrylic sheet. Bit selection is important, and tools specifically designed to rout acrylic are commercially available. Use a downward spiral router bit to prevent masking from fraying. Routers produce a high quality machined edge, ready for finishing, provided the following formulas are followed:

$$\begin{aligned} \text{Chip Load} &= \text{Feed Rate} / (\text{RPM} \times \# \text{ cutting edges}) \\ \text{Feed Rate} &= \text{RPM} \times \# \text{ cutting edges} \times \text{chip load} \\ \text{Speed (RPM)} &= \text{Feed Rate} / (\# \text{ cutting edges} \times \text{chip load}) \end{aligned}$$

Hand routers are best used for low volume work. With a bearing-mounted, flush trim bit, the router can trim around a clamped template.

Pin, table and vacuum routers (hand routers mounted under a table) are more convenient to rout around intricately shaped templates (See Fig. 6).



Circle routers can cut round parts by securing the acrylic sheet to a turntable, then rotating the sheet around the stationary router.

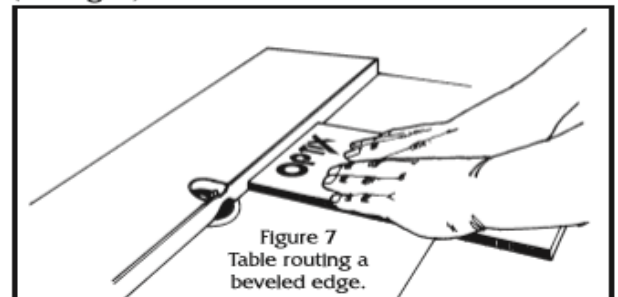
Computer Numerically Controlled (CNC) routers are used for high volume, intricate, precise acrylic parts. The part is designed on a CAD/CAM system and geometry is programmed directly into the CNC machine. Many of the variables; feed rate, RPM, bit diameter, depth of cut are adjustable for optimum cutting performance.

CNC laser cutters are used to cut virtually any shape part from PLASKOLITE acrylic sheet. This form of cutting produces a clean, polished edge without saw chips. It is well suited for cutting small intricate parts that are difficult to hold down with other cutting processes. Paper masked, or sheet with 3 mil laser cuttable film perform best for this operation.

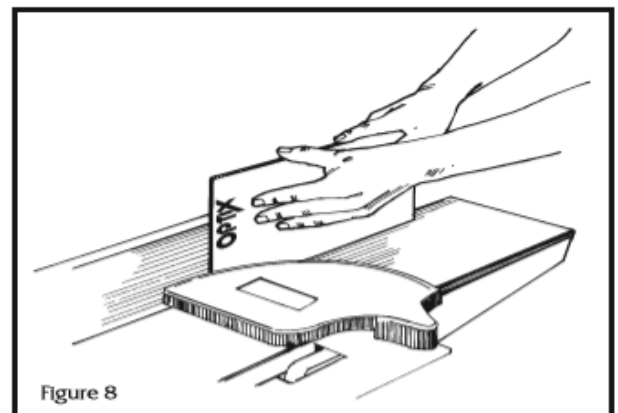
MACHINING

Many methods are used to produce a desirable edge finish.

Shapers and table routers can machine square, beveled, bull nose, ogee, and other decorative edges (See Fig. 7).



Jointers are used to square and prepare edges for cementing or hand finishing. Multiple sheets can be stacked to increase efficiency (See Fig. 8).



Edge finishing machines with diamond cutting wheels, produce an edge with a polished look, excellent for cementing.

Mills can be used to create precisely machined parts.

DRILLING

Drilling holes is performed best on a drill press with commercially available plastic cutting drill bits. Guidelines for drilling include:

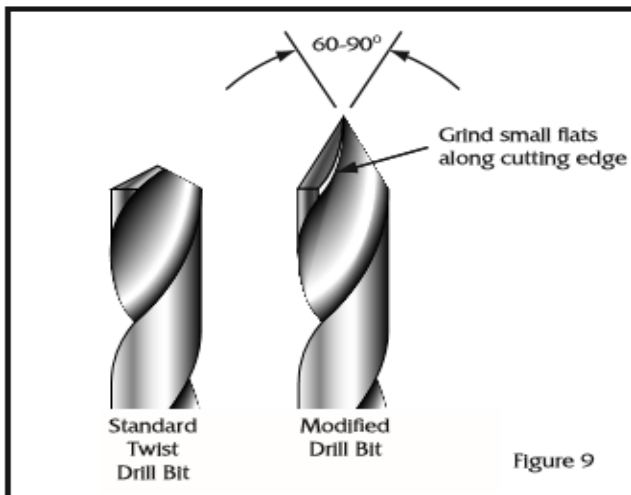
Drill bit Diameter	Speed (RPM)
1/8"	3500
3/16"	2500
1/4"	1800
3/8"	1200
1/2"	900
5/8"	700

The bit should enter the PLASKOLITE acrylic sheet at a slow feed rate, then a steady rate producing two continuous spiral chips, finally exiting through the acrylic slowly, eliminating chipping.

To reduce heat build up, and removal of material, peck feeding may be necessary when drilling thick acrylic sheet.

Place a scrap piece of acrylic or plywood beneath the sheet to be drilled. This will eliminate chipping as the bit passes through.

Standard twist drill bits can be used, provided modifications to the bit are performed. These modifications will allow the bit to scrape rather than cut through the acrylic sheet (See Fig. 9).



CUTTING/MACHINING TIPS

For optimum cutting and machining quality, certain guidelines should be followed.

Always use sharp tools/blades reserved for cutting acrylic sheet.

Whenever possible use tools/blades specifically

designed with proper geometry for cutting acrylic sheet.

Use proper and constant feed rates, and RPMs. To prolong tool/blade life, apply the fastest feed rate that gives a satisfactory edge.

Eliminate vibration of the acrylic sheet through clamping or other hold-down methods.

Align all fences and tables parallel to the cutting device.

Machine PLASKOLITE acrylic sheet with a conventional cut rather than a climb cut.

Machine off as little acrylic as possible. Two passes may be necessary for thicker acrylic; one to rough out the part, then a final skin cut. For jointers and shapers, trim a maximum of 1/32" per pass.

When necessary, direct compressed air or an atomized spray of a water soluble coolant toward the tool/blade.

If all of the above suggestions are followed, heat buildup will be held to a minimum, melting and chipping should not occur, and the edges of the PLASKOLITE acrylic sheet will be ready for finishing or further fabrication.

ANNEALING

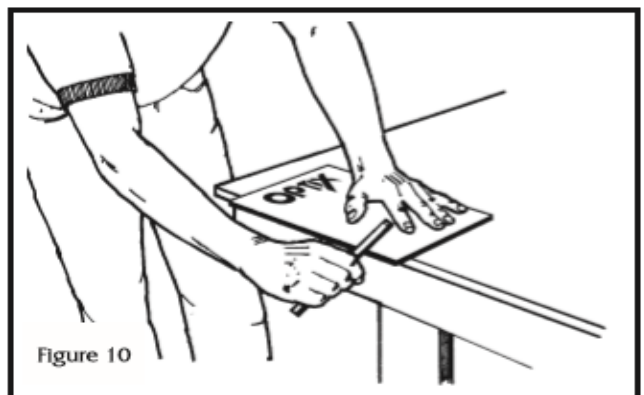
After all cutting and machining, internal stresses occur. To reduce the possibility of crazing, (small hairline fissures) during cementing, bending, and forming, annealing is recommended.

Heat PLASKOLITE acrylic sheet for 5 to 6 hours at 130 to 150°F in a forced air oven. Cool the sheet slowly to at least 110°F.

FINISHING

SCRAPING

Scrapers are sharp tool steel devices used to eliminate machining marks and ease sharp edges (See Fig. 10).



SANDING

All methods of sanding will result in the removal of machining marks, and produce a matte finish. The choice of hand, palm, random orbit, disc, belt, or drum sanding, depends on the quantity, size and shape of the acrylic sheet. Like sanding wood, work from coarse to fine paper. Use light pressure, and keep the part or sander moving to avoid heat build up (See Fig. 11). After sanding, the edge is ready for buffing or flame polishing.

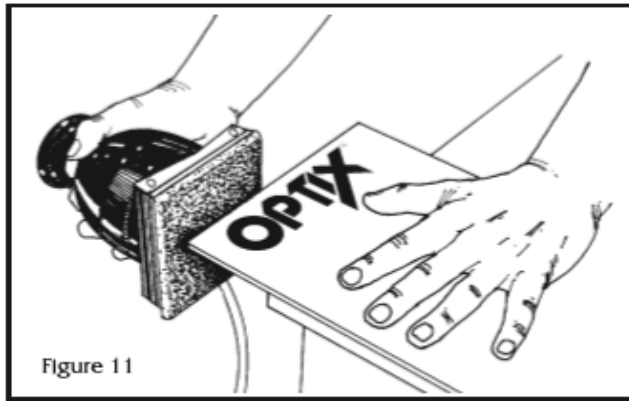


Figure 11

FLAME POLISHING

A hydrogen-oxygen torch, with a #4 or #5 tip, gently melts the sanded or machined edges of PLASKOLITE acrylic sheet, providing a smooth glossy look. Low line pressures create a torch flame that is 2-3" long, bluish, nearly invisible, and narrow enough to prevent overshooting onto the face of the acrylic sheet (See Fig. 12).

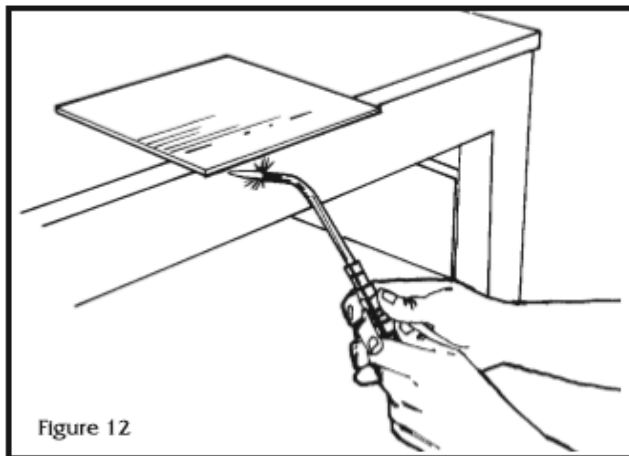


Figure 12

Remove the masking from the acrylic sheet, and guide the torch along the edge at a rate of approximately 3-4" per second. As with other cutting and machining processes, avoid excessive heat build up. Bubbles, stress, and crazing will occur if the flame is moved too slowly. Do not cement a flame polished edge.

BUFFING

A well machined edge is required to polish without additional sanding. Preferably, use stationary machines with polishing wheels dedicated to buffing acrylic. Wheels 8-14" diameter, 2-3" wide, of bleached muslin with bias strips, run cooler than ones fully stitched. With light pressure, keep the PLASKOLITE acrylic sheet moving across the wheel to prevent excess heat build up (See Fig. 13).

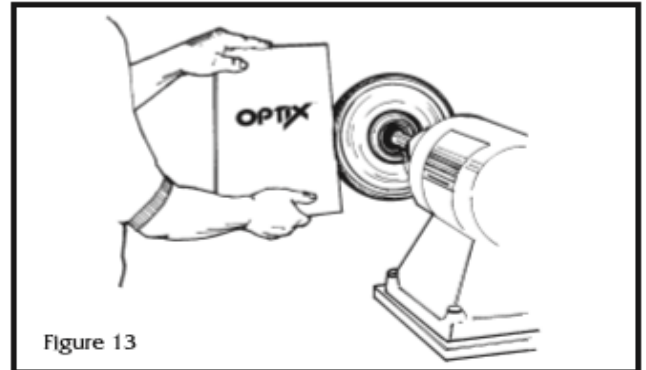


Figure 13

Finish quality depends on the polishing compounds used. A medium cutting compound will result in a good finish in one operation. A high luster finish can be achieved by first applying a fast cutting compound, to remove machining and sanding marks, followed by a fine compound on a finishing wheel.

CEMENTING/FASTENING

Cementing PLASKOLITE acrylic sheet must begin with well machined parts. A square flush fit, without using excessive force, is required to produce a strong, attractive joint and to minimize the chance of "blushing". Cementing should be performed at room temperature in a well ventilated area. A low humidity environment will prevent cloudy joints. Parts to be bonded should not be flame or buff polished.

TYPES OF CEMENTS

Solvent cements - Water thin solvents that soften the acrylic, diffuses and evaporates, allowing the parts to harden together.

Mixed solvent cements - Solvent cement thickened with an acrylic polymer to slow cure times, and fill small voids.

Polymerizable cements - Methyl methacrylate monomer and a catalyst mixed to produce a cement for strong, long lasting museum quality joints.

CAPILLARY CEMENTING

This technique allows solvent cement to flow into the joint and melt the parts together.

Apply cement with a syringe, solvent applicator, or eyedropper. Use small weights, fixtures, and fences to hold the parts in place (See Fig. 14). Initial bonding occurs within 5-10 seconds. A three hour cure time is sufficient to allow further fabrication, and 24-48 hours for maximum bond strength.

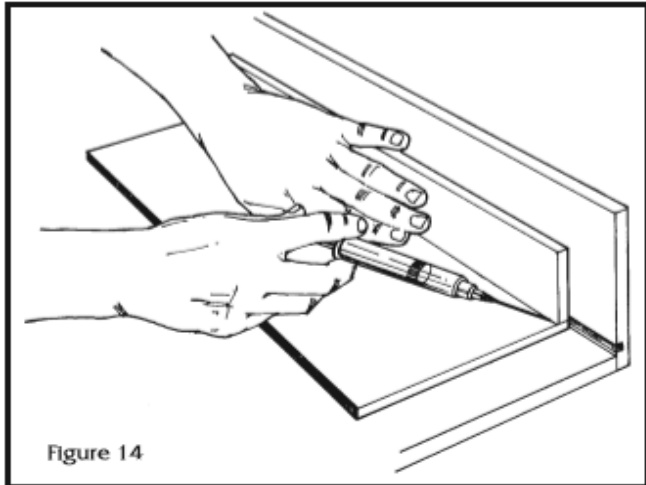


Figure 14

DIP/SOAK CEMENTING

Place small wire brads in a level, shallow tray, pour in solvent to cover the brads. Rest the edge of acrylic on the brads for 1-5 minutes, depending on thickness, allowing the material to soften. Remove the acrylic, drain excess solvent, then quickly and precisely place the edge onto the other part. Hold the parts in place with fixtures or light weights, being careful not to apply pressure. After initial bonding occurs (30 seconds), steady slight pressure can be applied to remove any air bubbles. Allow the joint to cure for 5-20 minutes before moving, and 8-24 hours before conducting further machining or finishing.

ADHERING TO OTHER MATERIALS

Care must be taken when attaching PLASKOLITE acrylic sheet to other substrates. Different coefficients of thermal expansion exist between the two pieces to be fastened, placing large stresses on the bond. To overcome the inherent stress along the joint, keep the dimension of the adhesive area as small as possible, and use elastic cements that remain flexible, such as caulks, polysulfides and rubber based adhesives. Pressure sensitive, double-faced tape, depending on the end use, may also be suitable for joining acrylic to other materials.

MECHANICAL FASTENING

Attaching PLASKOLITE acrylic sheet to itself or to other substrates can be accomplished with screws, nuts and bolts, rivets, or other mechanical fasteners. However, when the acrylic is exposed to fluctuating temperatures, allowances for expansion and contraction must be provided. Drilling oversized holes or slots, using washers and spacers, and not overtightening the fasteners, will allow the acrylic sheet to move (See SHEET SIZE on page 14).

ULTRASONIC WELDING

Sonic welding: the use of electrical energy that is converted to mechanical vibration to melt acrylic sheet, can be used to press parts together.

DECORATING

PREPARATION

PLASKOLITE acrylic sheet can be easily decorated using paints produced specifically for acrylic or vinyl. Follow paint manufactures guidelines for thinners, viscosity, methods, and volumes for optimum results. Proper machining, forming, and fabricating techniques should be followed to reduce the chance of crazing. After handling and fabricating, clean the acrylic sheet. Remove dust, masking residue, and static charges prior to painting or vinyl application.

Painting acrylic sheet reduces it's impact resistance. Design considerations should be taken into account to minimize potential breakage.

MASKING

Areas not to be painted can be covered with a liquid maskant, or taped off. If the acrylic sheet is supplied with a paper masking, trim the paper to expose the area to be painted. For excellent results using a liquid maskant, apply a thickness of 10-12 mils wet (3-5 mils dry), allow the maskant to thoroughly dry, and do not expose to UV light (See Fig. 15).

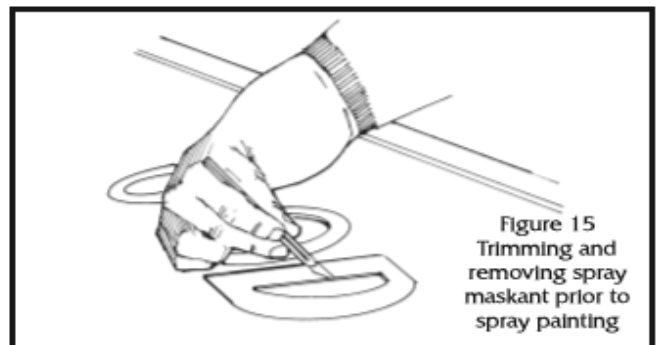


Figure 15
Trimming and
removing spray
maskant prior to
spray painting

SPRAY PAINTING

Use an atomizing spray gun system that will uniformly distribute paint free of water and oil. The use of backlighting will aid in determining the uniformity of paint application (See Fig. 16).

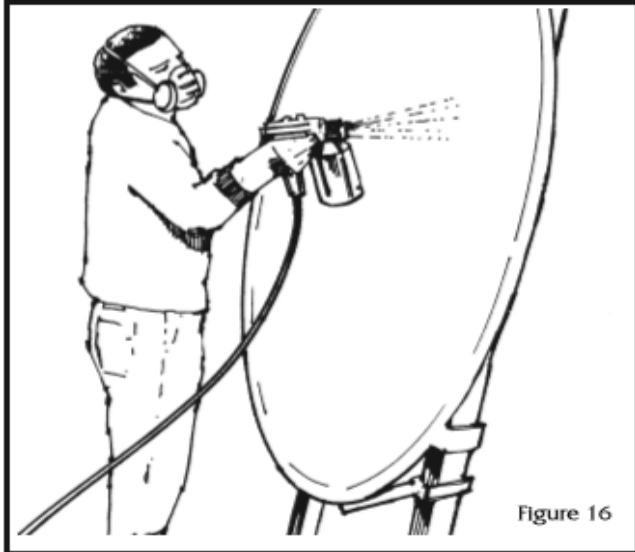


Figure 16

SCREEN PRINTING

For volume production, screen printing is fast and economical. Paint is applied with a squeegee in a uniform motion. Paint passes through a screen and transfers to the acrylic sheet. Using a screen in good condition, with a fine mesh size, in conjunction with paint of proper viscosity, will produce painted parts with good detail.

PAINT REMOVAL

When paint removal is necessary, immediately remove the paint from the acrylic using the paint manufacturer's recommended remover. Paint removers contain organic solvents harmful to acrylic sheet. Time in contact with the acrylic sheet, especially on high stress areas of thermoformed parts, should be minimized to reduce the chances of crazing.

VINYL FILMS

Lettering and intricate designs made with vinyl films, can be adhered to PLASKOLITE acrylic sheet. Vinyl films can be used as a masking during painting operations. Depending on the size of the graphic, apply the film using either the dry or wet method. Choose the proper vinyl film for the application desired (See Fig. 17).

Thermoforming acrylic with vinyl already applied

can be accomplished. Certain restrictions, such as heating temperature and time, depth of draw, and thickness of vinyl affect the quality of the end product.

Refer to Vinyl film manufacture's guidelines for more detailed information.

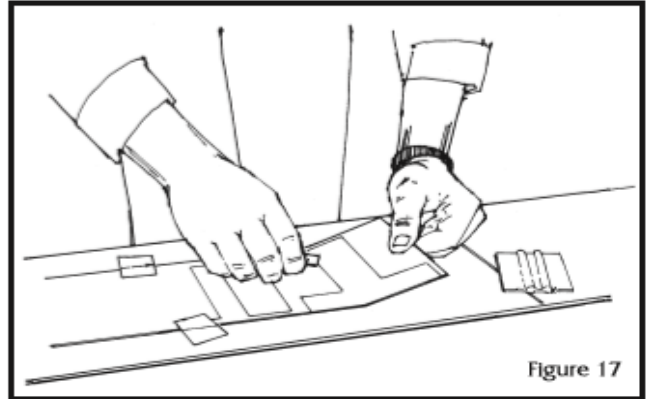


Figure 17

FORMING

COLD FORMING

A bend in PLASKOLITE acrylic sheet can be accomplished without applying heat. A minimum radius of 200 times the thickness of the acrylic is required to avoid stress cracking.

LINE BENDING

Line bending is a method of forming a sharp bend in the acrylic sheet. The radius of the bend can be controlled by adjusting the width of the heated area. Routing a V-groove into the acrylic prior to bending will produce a very sharp bend. Heating elements such as nicrome wire, infrared, rods, or wide strips can be used. Heat the area to be bent to a pliable state then place the sheet in a fixture to cool (See Fig. 18 & 19).

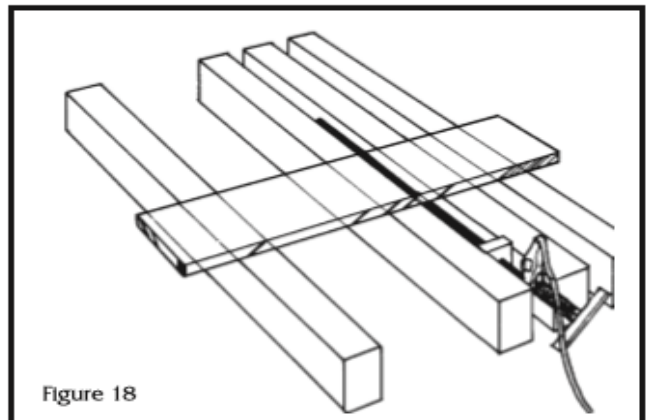


Figure 18

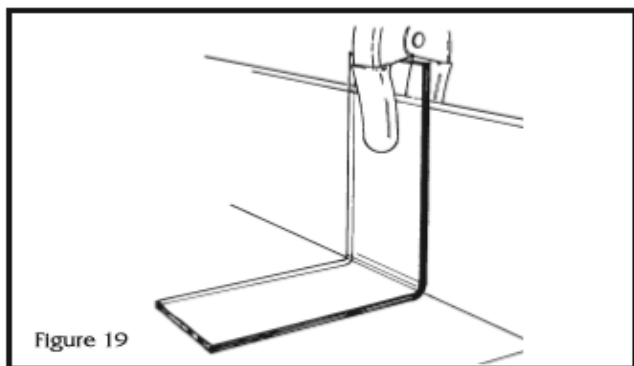


Figure 19

Adjust heating time, element temperature, and distance from the heating element, dependant on acrylic thickness, to eliminate scorching and bubbling, or stress and crazing. Bend the acrylic sheet away from the heat source. Accelerate the cycle time by placing heating elements above and below the acrylic sheet. Visible bowing of the acrylic sheet may occur on bends that are longer than 24". To reduce the amount of warpage, minimize the width of the heated area, heat the entire bend evenly, perpendicular to the sheet's manufacturing direction, and clamp the sheet in place while being heated and cooled.

OVEN HEATING SHEET

An entire sheet of PLASKOLITE acrylic can be heated to forming temperature in an oven. Acrylic sheet can be hung in a vertical oven, or clamped around all four edges and placed in a horizontal oven. Manufacturing orientation of the sheet, shrinkage, and heating uniformity are important factors when determining heating and forming methods.

Sheet temperature is critical. If not heated enough, the sheet will not acquire good part definition, too hot and the acrylic will pick up mark-off from minor imperfections in the mold.

Mold temperature is important for good part definition, and to provide gradual cooling to minimize stress and crazing.

DRAPE FORMING

After reaching forming temperature, the acrylic sheet is draped over a mold covered with flocked rubber or flannel.

FREE BLOWN FORMING

By clamping heated acrylic sheet beneath a forming template, and applying compressed air through an orifice, the sheet can be blown up similar to blowing a bubble. This method can be reversed by drawing the sheet into a chamber using vacuum pressure.

THERMOFORMING

PLASKOLITE acrylic sheet is heated to its forming temperature, placed over a mold, creating an air-tight seal. Vacuum is drawn through the mold, pulling the sheet to it. Once the part takes the shape of the mold, it is slowly cooled, then released.

Typical for signage, Figure 20 shows a method for low volume production. The acrylic sheet is heated while on the mold, vacuum applied. Angle iron presses out any webbing or wrinkles on the flange, and prevents any vacuum loss during cooling. Since the sheet is not clamped in this method, allow for shrinkage in the machine direction.

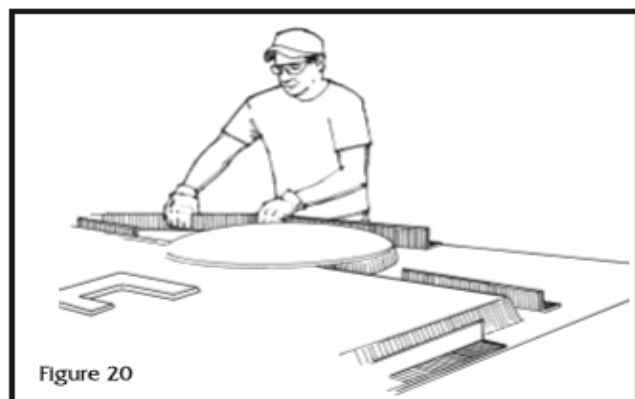


Figure 20

OPTIX THERMOFORMING CONDITIONS

.100" to .375" thickness

PROPERTY	OPTIX & OPTIX SG
Optimal forming temp.	320°F
Forming temp. range	270-350°F
Heating time (two sided Infrared)	1-10 min.
Cooling time	.5-4 min.
Optimal mold temp.	180°F
Free shrinkage at forming temp.	
Machine direction	1-3%
Transfer Direction	0%

DURAPLEX IMPACT MODIFIED ACRYLIC THERMOFORMING CONDITIONS

.100" to .375" thickness

PROPERTY	DURAPLEX	
	SG-05	SG-10
Optimal forming temp.	315°F	310°F
Forming temp. range	270-350°F	270-350°F
Heating time (two sided infrared)	1-10 min.	1-10 min.
Cooling time	.5-4 min.	.5-4 min.
Optimal mold temp.	175°F	170°F
Free shrinkage at forming temp.		
Machine direction	1-3%	1-3%
Transfer Direction	0%	0%