

Acrylite Plus[®]

A C R Y L I C S H E E T

a whole new animal



FABRICATION
MANUAL

CYRO



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SECTION 1

Introduction

ACRYLITE PLUS® acrylic sheet can be fabricated with the same machinery used with ACRYLITE® acrylic sheet. Fabrication techniques are nearly the same.

Minor modifications may be necessary due to ACRYLITE PLUS sheet's unique properties. ACRYLITE PLUS sheet's greater impact resistance and special formulation require special care in certain machining operations.

In general, equipment should be stable, vibration free, and show a minimal amount of tool wobble (run-out). For best results, follow the recommendations provided in this manual.

Acrylite Plus
— acrylic sheet —
a whole new animal



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SECTION 2

Availability

ACRYLITE PLUS sheet is available in colorless and glass green. It is manufactured in standard sheet size 48" x 96". Colorless is available in thicknesses of 1.5 mm (0.060") to 6.0 mm (0.236"); glass green is available in thicknesses of 2.0 mm (0.080") to 6.0 mm (0.236"). Custom sizes are available on request.

ACRYLITE PLUS sheet is sold in skid and case quantities and masked with colorless 3 mil thick polyethylene masking. The polyethylene masking provides good sheet surface protection and can be left in place during line bending operations, further protecting the surface of the sheet.

SECTION 3

Storage, Handling and Cleaning

ACRYLITE PLUS sheet should be stored indoors only, in a horizontal or a 10°-from-vertical position. Full support during storage prevents warpage and buckling. For extended storage periods, we recommend keeping the 6 mil thick outer polyethylene overwrap in place. This will help slow down the sheet's moisture absorption.

Dirt and dust can be removed using a soft cloth and a solution of mild soap or liquid detergent and water. Do not rub the sheet with a dry cloth. This may lead to surface scratching. It will also set up a static charge causing dust particles to stick to the surface. Static can be reduced with commercially available anti-static cleaners. However, such cleaners may leave behind an invisible film or residue that can interfere with the adhesion of paints. Alternately, pneumatic static eliminators will help neutralize sheet surface-charge as well as remove dust. They will not leave the surface static free indefinitely. It is best to treat surfaces just prior to silk screening, painting, thermoforming, or any other process affected by the presence of dust-attracting static.

Grease may be cleaned from the surface with VM&P Naphtha, followed by a rinse with mild soap and water.

SECTION 4

Cutting

Conventional panel or table saws are recommended to cut ACRYLITE PLUS sheet. ACRYLITE PLUS sheet can be cut one sheet at a time or stack cut, up to the limit of the saw. Saw blades should be carbide tipped with the triple-chip-grind design for plastics (see illustrations below). When table saw cutting, the blade protrusion should be 1/2" - 1" above the top of the sheet. Steady, moderate feed rates (10-20 feet per minute) will insure a proper cut. Slowing the feed rate when exiting the material during manual cutting prevents chipping or blow-out of the exit edge, especially with thinner material, <math><0.118''</math> (3.0mm).

Whatever machine type is used, sheet vibration should be kept to a minimum. This is accomplished with the hold down bar found on many horizontal and vertical panel saws. With table saws, the operator provides pressure to the sheet to inhibit vibration. Both support and pressure near the cutting blade will help to eliminate sheet chatter, which will help prevent cracking and chipping of the cut edge. Additional steps that should be taken to minimize vibration include:

- Ensure the total run-out (or wobble) of the saw blade does not exceed 0.002".
- Keep the throat plate gap (table kerf) to a minimum. Zero clearance throat inserts are available for many table saws and should be used whenever possible. On panel saws, a "false" tabletop can sometimes be fastened to the panel saw surface to provide a narrower throat gap.
- Use saw blade dampeners or stiffeners. They can greatly reduce blade vibration. Best results are usually obtained by selecting a stiffener 1/2 to 2/3 the diameter of the saw blade.
- Use a narrow kerf blade to reduce the force of the blade on the sheet.
- On panel saws, ensure the hold down bar is holding material securely and that gasketing on the bar runs the entire length of the cut and is in good condition.

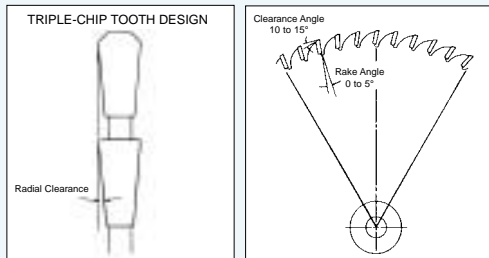
Bandsaws

Bandsaws are used for rough-cuts and for cutting out shapes. For quick, rough cutting, use blades with 10-14 teeth per inch in the raker style. If a smoother edge is desirable, the use of a raker style blade with more teeth per inch may be necessary and a coolant may be needed to prevent gumming at the cut. Satisfactory coolants include shop air or a water mist directed at the cut.

For an acceptable sheet edge, feed rates should range 5-15 feet per minute.

Jigsaws

Hand held jigsaws cut shapes well. To obtain the cleanest cut, clamp the sheet tightly to inhibit chatter and vibration. Jigsaw blades with 8-13 teeth per inch with a wavy set leave a fairly smooth edge. Feeding the saw at a rate of 6-10 feet per minute is the best range for an acceptable edge. Blades with less than 8 teeth per inch result in jagged, white stressed edges because they grab and pull the sheet edge, even if adequate clamping is provided. It is important to ensure the blade is sharp - do not use a blade that has already been used for cutting metal or other materials.



Laser Cutting and Engraving

ACRYLITE PLUS sheet can be successfully laser cut and laser engraved. Typically CO₂ lasers are employed in sizes ranging from 25 watts to 400 watts per laser head. The primary benefit of using a higher powered laser is to increase cutting speed. Additionally, larger lasers often come equipped with an air or gas assist and a vacuum table. Both of these options help to remove vapors generated during the cutting operation leading to improved results.

When laser engraving ACRYLITE PLUS sheet, start with the same operating parameters as used with continuously manufactured or extruded acrylics. The resulting engraved designs will have a relatively clear appearance (the same as with continuously manufactured and extruded acrylic sheet). The engraved images will not be as white as those achieved when engraving cell cast acrylic sheet.

When laser cutting ACRYLITE PLUS sheet it is especially advantageous to have a vacuum table and gas assist option. The gases generated during the laser cutting operation can deposit on the edges of ACRYLITE PLUS sheet and form a tacky film. Efficient removal of vapors minimizes this problem. The tacky deposits can be removed by wiping the laser cut edges afterwards with VM&P naphtha, which can be obtained at most hardware stores.

Scribing and Breaking

Although the impact resistance of ACRYLITE PLUS sheet is much greater than standard acrylic, it is still notch sensitive, allowing ACRYLITE PLUS sheet to be scored and snapped in the same manner as conventional acrylic sheet. Mark out where the scribe needs to go. With the aid of a straight edge, pull the scribing tool across one side of the sheet surface several times until approximately one third of the sheet's thickness is removed. Lay the scribed line at the edge of a table, scribed side facing up. Firmly hold the side resting on the table while applying quick, steady pressure to the free end. The sheet will snap along the scribed line. Straight scribe cuts can be done on sheet thicknesses of 0.098" (2.5 mm) or less.

Die Cutting

A viable option for blanking out shapes of 0.060" and 0.080" (1.5 mm and 2.0 mm) thick ACRYLITE PLUS sheet is the use of die cutting. Die cutting knives with a double-beveled edge on one or both sides are recommended when cutting ACRYLITE PLUS sheet. Double-beveled knives provide a straight cut edge on the sheet. If a cutting knife having a double-beveled edge on only one side is used, position the knife so that the finished edge of the part faces the flat side of the cutting knife. The flat edge of the knife puts less stress on the material resulting in a cleaner cut.

The knives cut through only about the first fifty percent of the sheet thickness leaving the remainder with a whitened appearance. **It is recommended that sample cuts be made to determine if the edge is acceptable.**

Presses that operate in the 10-20 ton range are adequate to successfully die cut ACRYLITE PLUS sheet. A backing material of polypropylene is rigid enough for sheet cutting and sufficiently soft so the knives do not dull as quickly. The use of sharp knives is important as dull or nicked knives will result in poor edge cuts and a higher probability of unacceptable parts.

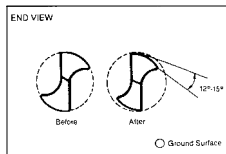
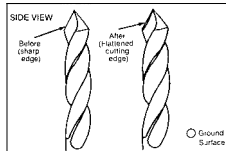
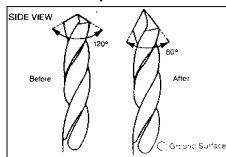
SECTION 5

Drilling

Because ACRYLITE PLUS sheet is not as stiff as conventional acrylic sheet, it has a tendency to lift off the machining table when drill bits exit the hole. To compensate, clamping devices need to be placed as close as possible to the hole being drilled, carefully allowing for clearance of the rotating spindle and cutter. Several hold-downs may be required to firmly hold thinner stock flat to the machining table.

Wherever possible, ACRYLITE PLUS sheet should be drilled on stationary equipment. Portable electric hand drills should only be used as a final option and for small diameter holes only.

Modification of metal working drill bits for plastic.



Twist Drills

ACRYLITE PLUS sheet drills cleanly with high-speed steel (modified for plastic) twist drills (see illustrations on left). On large diameter holes, it is recommended to pilot drill first before enlarging the hole to the final dimension. Adjust speed and feed rates so that a controlled chip is produced with no melting of the plastic. Continuous chips are not readily produced when drilling ACRYLITE PLUS sheet, nor are they required for excellent drilled-hole finishes.

Rotational speeds in the 500 -1000 rpm range, combined with feed rates in the 3-12 in/min range will usually give good results.

Standard twist drills can also produce satisfactory holes in ACRYLITE PLUS sheet. To avoid sheet notching, securely clamp the material to the machine table and apply slow entry and exit feeds.

Proper backing material such as plywood or another piece of acrylic should be used when drilling ACRYLITE PLUS sheet. The backing material will help prevent chipping of the bottom surface. When drilling stacks of sheet, it is a good idea to utilize a coolant such as water or kerosene. This will minimize heat build up and create holes with smooth walls.

Spade Bits

Spade bits with side spurs (i.e. IRWIN 2000 Speedbores) produce satisfactory holes in ACRYLITE PLUS sheet. The drilling is done in two steps with reduced machine speed for large diameter bits. Step one: Drill one face of the sheet to lightly score the perimeter of the hole. Step two: Flip the material and complete drilling from the opposite face of the sheet.

CAUTION: The original Speedbores, without side spurs, are not recommended for drilling ACRYLITE PLUS sheet.

Circle Cutters

Circle cutters can be used for cutting large diameter holes in ACRYLITE PLUS sheet. Sharp cutters along with multiple hold-down devices are essential. A single clamping device is inadequate for circle cutters; should the cutter grab, the sheet can pivot and dangerously kick-out towards the operator. For thinner gauge material (.098" or less), lightly score the perimeter of the hole from one face, then flip the material to complete drilling from the opposite face of the sheet. This practice will eliminate notching on the edges and grabs, to which thinner stock is prone.

Hole Saws

Hole saws also produce acceptable holes in ACRYLITE PLUS sheet. Although less smooth than other hole cutting means, best results are achieved with sharp hole saws tipped with carbide. Because of the high friction produced by these cutting tools, a coolant solution of detergent and water or kerosene will help to minimize melting of the material.

Countersinking

Countersinking in ACRYLITE PLUS sheet is best done with a non-fluted (Weldon) countersink design. The large land of this cutter combined with the oblique hole forming the cutting edge of the tool, results in a controlled cut with little chatter and plenty of chip clearance. Pilot drilling is necessary when using the countersink design. The pilot hole should be oversized with reference to the shank of the fastener.

SECTION 6

Routing

Hand Held and Table Routers

ACRYLITE PLUS sheet can be routed with the same equipment used for routing standard acrylic sheet. Because ACRYLITE PLUS sheet is not as stiff as conventional acrylic, particular care must be taken to eliminate the vibration of the work piece during the routing operation. If vibration is present, it can result in a chipped edge. To support thin material, 0.060" and 0.080" (1.5 mm and 2.0mm) thick, during routing, sandwich the material between stiffer plastic sheets.

When compared to feed rates for routing standard acrylic sheet, ACRYLITE PLUS sheet's feed rates are noticeably faster. ACRYLITE PLUS sheet is less prone to chipping than standard acrylic sheet, particularly when entering and exiting a cut. Both materials are notch sensitive. Any notches in an edge can propagate into a crack under load conditions.

During plunge cutting, the cutter has a tendency to grab as it penetrates through the sheet. Take special care to hold the sheet firmly. Exit the material slowly to avoid chipping or cracking during plunge routing. A safer option to plunge routing is to drill an adequately oversized hole and begin routing at this location.

Carbide tipped, 1/2" diameter, two-flute, straight bits are recommended.

CNC Routing

As with all routing, it is important to ensure that the material is firmly held and supported to prevent vibration. This is even more critical with CNC routing because tool speeds and feed rates are usually much higher than with handheld or hand-fed routers.

In general, much higher feed rates are possible with ACRYLITE PLUS sheet than with standard acrylic sheets. When using bits 1/4" in diameter or larger, rotational speeds of 18,000 RPM and feed rates of 200 in/min will produce good results on most equipment. On large, stable, well maintained machines with very solid fixturing, feed rates of up to 600 in/min are possible.

For smaller diameter bits (1/8" and 1/16"), rotational speeds of 20,000 RPM coupled with feed rates in the 150 – 200 in/min range are recommended provided that the router bits are cooled. Coolants such as compressed air or mist cooling systems can be used. In addition, consideration must be given to the depth of cut. For best results the cut depth should be no more than 1.5 x the bit diameter. For deeper cuts, multiple passes should be made. Using coolant and minimizing cut depth helps to reduce melting caused by heat build-up and/or inadequate chip removal.

Two-flute, spiral-up and O-flute design bits made from solid carbide are recommended for most applications.

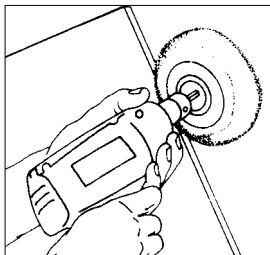
SECTION 7

Edge and Surface Finishing

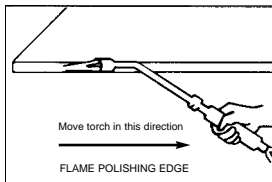
Jointing

Jointing of ACRYLITE PLUS sheet will produce a smooth edge. The jointer knives can be high-speed steel or carbide tipped. To ensure a smooth edge, the knives must all cut in the same plane. Hold the sheet firmly to the fence, advancing through the cut with a steady, even feed rate. Blade height should be set to remove approximately 1/32" from the sheet.

CAUTION: Due to the flexible nature of ACRYLITE PLUS sheet, it is not recommended to joint single sheets in thicknesses of less than 0.118" (3.0 mm).



Edge polishing with a hand drill



Edge Finishers

Edge finishers will produce very smooth edges on ACRYLITE PLUS sheet. Use the same depth of cut and feed settings as ACRYLITE® FF acrylic sheet. Fast feed rate may result in chipping while slow feed rates can cause slight melting.

Buffing

Buffing can change edge appearance from a matte to a glossy look. For the best edge result, perform an initial wet sanding or scraping operation. This will remove any saw cut marks. Buffing is performed with a stationary or portable-polishing head. Portable heads usually consist of buffing wheels that are chucked into a standard drill. Loose stitched, bleached muslin wheels work best and will result in a high luster edge. Medium to fine cutting compounds help produce a highly polished edge in a very short time.

Flame Polishing

Another acceptable method for obtaining a highly polished edge is flame polishing. Most acrylic fabrication shops are equipped with a hydrogen/oxygen set-up. This equipment works well with ACRYLITE PLUS sheet. Use the same set-up and flame speed as with continuously manufactured acrylic sheets like ACRYLITE FF sheet. The flame should be bluish, almost invisible, approximately 3" long and narrow. Hold the torch at an angle and "drag" the flame along the edge of the sheet.

For the best polished-edge results, wet sand or scrape the edge prior to flame polishing to remove any apparent saw marks. Beginning with a smooth edge will result in a better flame polished edge.

Removal of Whitening

Whitening within ACRYLITE PLUS sheet occurs under extreme impact or if the material's edge or face is mechanically stressed. This whitening can be removed by heating both sides of the affected area at approximately 185°F. Apply heat evenly and long enough for the full thickness of sheet to reach the desired temperature. Overheating will cause distortion. A heat gun or an industrial oven can be used for eliminating whitening. Heating ACRYLITE PLUS sheet with a torch is not recommended.

Note: Hazing is noticeable during the heating cycle. When the sheet returns to room temperature, the hazing disappears.

SECTION 8

Line Bending

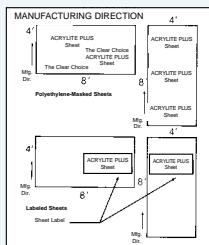
ACRYLITE PLUS sheet is quickly and easily line bent using traditional line bending equipment, including nichrome wire, quartz, and infrared heaters for narrow areas. As a rule, line-bending equipment used in forming standard acrylic sheet can also be used on ACRYLITE PLUS sheet. ACRYLITE PLUS sheet's lower forming temperature allows for quicker heating cycles during line bending.

Initial softening of ACRYLITE PLUS sheet occurs at approximately 220°F. Line bending should be performed when the core of the material reaches 270-290°F. Line bending at lower temperatures could introduce internal stress into the heated area of the material, which causes crazing (small stress cracks). Overheating the material can cause blistering on the heated surface of the sheet.

As ACRYLITE PLUS sheet's temperature rises, the heated region will temporarily turn a milky white color. The sheet will regain its high light transmission, losing the milky white appearance, as it returns to room temperature.

ACRYLITE PLUS sheet has a manufactured direction much like ACRYLITE® FF acrylic sheet. When heated to forming temperature, ACRYLITE PLUS sheet will shrink parallel to the manufactured direction. This property may become evident when forming long bends (36 inches and longer) causing a slight bow along the length of the bend. To minimize this effect, orient long bends perpendicular to the manufactured direction. Identification of the manufactured direction is easily accomplished by examination of the material label. As you read the ACRYLITE PLUS sheet label from left to right, the manufacturing direction will run from top to bottom.

Note: ACRYLITE PLUS sheet has a lower forming temperature than is typically associated with acrylic sheet products, resulting in slightly shorter heating cycle times.



SECTION 9

Cementing

Methylene chloride-based solvent cements, typically used for acrylic sheet fabrication, work well with ACRYLITE PLUS sheet. These cements produce strong joints that will meet the needs of most display applications. Where additional strength is required, “wickable” cyanoacrylate-based cements will produce even stronger cement joints.

ACRYLITE PLUS sheet will easily bond to standard acrylic sheet because both materials are attacked by the same cements, permitting the use of acrylic, including acrylic profiles in conjunction with ACRYLITE PLUS sheet.

ACRYLITE PLUS sheet’s excellent craze resistance allows it to be used in many situations where normal cementing would result in crazing. This provides significant benefits in applications where line bends, or cold bends are adjacent to a cemented edge.

Typical acrylic fabrication techniques for edge preparation can be used with success with ACRYLITE PLUS sheet. Edge finished, jointed or clean saw cut edges are all suitable for cementing. In some instances, saw cut edges may work better because the edge roughness allows more space for the cement to flow into the joint.

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These guidelines can improve results:

To achieve the best results when capillary cementing with typical methylene chloride-based solvent cements or cyanoacrylate based cements, the following recommendations should be followed:

- Insure a smooth, clean, low stress edge.
- Apply cement along the *entire length of the cement joint*. Unlike with standard acrylic sheet, the cement will not flow to the ends of the cement joint if the application of cement is started or finished more than 1/4" - 1/2" from the ends. Failure to fill the entire length of the cement joint greatly reduces strength.
- Apply a generous amount of solvent cement to the surfaces being joined by: tipping the vertical piece slightly so that its edge can accept more cement; using a larger diameter applicator tip for increased cement flow; or providing space at the joint by shimming (0.002" - 0.004")

Joint set-up time will vary depending on the exact formulation of the cement and the temperature and humidity of the cementing environment. Cement joints made with ACRYLITE PLUS sheet will obtain initial soft strength approximately 30 minutes after application of the cement. They will begin to harden about 3 hours after cement application, but will not approach full strength for 24 - 48 hours. As a general rule, set-up time will be slightly longer than is normally required with conventional acrylic sheet.

With cyanoacrylate-based cements, the chemical reaction that hardens the cement joint is triggered by moisture in the acrylic sheet and the atmosphere. Therefore, the rate of the curing process is dependent on the rate at which moisture in the air and in the sheet can diffuse to the cement joint. Usually 48 hours is required for the cement joint to reach full strength at which point it will be as strong as the material itself. Extra care should be taken when handling parts to avoid cement smudges. The resulting white marks can usually be removed by wiping with kerosene followed by rinsing with mild soap and water.

SECTION 10

Painting and Silk Screening

Acrylic-based paints and silk-screening inks work well in painted or silk-screened applications on ACRYLITE PLUS sheet's surface.

ACRYLITE PLUS sheet requires the same preparation as conventional acrylic surfaces for the acceptance of paint and inks. Remove dirt and grease and if static is a problem, use a static eliminating air gun to neutralize the surface. Leave the protective masking in place or use a peelable spray mask, to protect the sheet from overspray. Although silk-screened lettering or open patterns work very well on ACRYLITE PLUS sheet, it is important to use paints or inks that have high extensibility when painting solid designs.

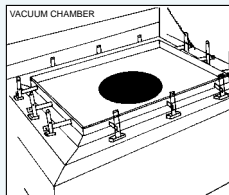
Note: Thick, brittle, well-adhered paints or coatings can substantially reduce the impact resistance of the finished product. These materials will crack when impacted or when placed under tension. CYRO's Technical Service Engineers can provide assistance in selecting the best paints or inks for your application.

SECTION 11

Thermoforming

ACRYLITE PLUS sheet can be thermoformed into a variety of finished parts ranging from a shallow radius curve to more intricately formed parts. Its low forming temperature range (270-350°F) offers quick cycle times. During the heating cycle, the sheet will turn to a translucent white color, noticeable when the sheet temperature reaches 120°F or higher. After thermoforming is complete and the sheet cools to room temperature (60-80°F), it returns to its original colorless, high light transmitting appearance.

Heating time test results for 0.118" (3.0mm) thick ACRYLITE PLUS sheet indicate approximate time taken for the sheet's core to reach a particular temperature. Testing was done using a thermoformer equipped with ceramic heaters, heating from only the top side, positioned 2.5" from the sheet. Actual times vary for each individual thermoformer due to various parameters: heat source type, distance from sheet, single or double-side heating, etc.



	TIME (sec)	TEMPERATURE (°F)
Test results for 0.118-inch (3.0mm) thick ACRYLITE PLUS sheet indicate approximate time taken for the sheet's core to reach a particular temperature.	120	260
	180	310
	210	350

Part design will dictate the proper forming temperature. A shape that is only a subtle change from flat, such as a shallow dome or a large radius curve, can be formed when the sheet's core temperature is at the low end of the forming range (270-300°F). Parts that contain more detail or have a deep draw need to be formed at the higher end of the forming range (320-350°F). Parts should be left in the mold or under pressure until they have reached 160-180°F, regardless of forming temperature, so that the part will not lose its shape. For lower stressed parts, cover parts removed at the 160-180°F range with a wool blanket. This will provide a slower cool down period and will help in relieving stress.

Various types of thermoforming methods, including pressure or vacuum, plug assist, drape, and snap-back are all used when thermoforming ACRYLITE PLUS sheet. If a mold is used during thermoforming, pre-heat it to 160-180°F prior to contacting the sheet. Draft angles of 2-3 degrees will allow for easy part removal.

Sources of Supply

Handling

210 Plastic Cleaner & Polish/210

Plus Cleaner

Sumner Laboratories, Inc.

186 Lincoln Street

Boston, MA 02111

(617) 542-8656

(617) 482-9001 Fax

Crystalclean

Discovery Plastics

3700 Western Way, N.E.

Millersburg, OR 97231

(541) 926-2900

(541) 967-8441 Fax

www.discoveryplastics.com

Scotch-Brite High Performance Cloth

3M Stationery & Office Supplies Div.

3M Center

St. Paul, MN 55144-1000

800-255-4026 / (877) 362-0382

(651) 733-0382 Fax

www.mmm.com

Anti-Static Air Guns

The Simco Company

2257 North Penn Road

Hatfield, PA 19440

800-203-3419

(215) 822-3795 Fax

www.simco-static.com

Cutting

Tablesaw Blades

Forrest Manufacturing Co.

457 River Road

Clifton, NJ 07014

(973) 473-5236 / 800-733-7111

(973) 471-3333 Fax

www.woodmall.com

North American Products Corp.

Northpoint Park

40 Londonderry Turnpike

Hooksett, NH 03106

(603) 622-0164

(603) 622-0636 Fax

www.naptools.com

Bandsaw Blades

Blackstone Industries, Inc.

The Olson Saw Co.

16 Stony Hill Road

Bethel, CT 06801

(203) 792-8622

(203) 790-9832 Fax

www.foreedom.com

Jigsaw Blades

Local Hardware Store

Stiffeners

Forrest Manufacturing Co., Inc.

457 River Road

Clifton, NJ 07014

(973) 473-5236 / 800-733-7111

(973) 471-3333 Fax

www.woodmall.com

Laser Cutting

Laser Machining, Inc.

500 Laser Drive

Somerset, WI 54025

(715) 247-3285

(715) 247-5650 Fax

www.lasermachining.com

Universal Laser Systems, Inc.

16008 N. 81st Street

Scottsdale, AZ 85260

(480) 483-1214

(480) 483-5620 Fax

www.ulsinc.com

TSL Luminumics Corp.

8401 Jefferson Highway

Maple Grove, MN 55369

(763) 315-1780

(763) 315-1781 Fax

www.tsiluminumics.com

Manufacturers of Cutting Dies

Curtin-Hebert, Inc.

11 Forest Street

Gloversville, NY 12078

(518) 725-7157

(518) 773-3805 Fax

Manufacturers of Presses & Cutting Dies

Bruno Machinery Corp.

1 Madison Street

Troy, NY 12181

(518) 271-0551

(518) 271-0220 Fax

Drilling

Drill Bits - Plastic

American Tool Co., Inc.

92 Grant Street

Wilmington, OH 45177

(937) 235-3811 / (800) 866-5740

(937) 382-8199 Fax

www.american.com

Craftics, Inc.

2701 N. Pulaski

Chicago, IL 60639

(773) 235-3307

(773) 235-7204 Fax

Drill Bits - Standard

Spade Bits, Hole Saws

Local Hardware Store

Woodworking Industry Magazines

Circle Cutters

Stanley Tools

Div. of the Stanley Works

New Britain, CT 06053

(860) 225-5111 / 800-648-7654

(860) 827-5926 Fax

www.stanleyworks.com

Countersinks

Weldon Brand

Sold through J&L Industrial Supply

31800 Industrial Rd.

Livonia, MI 48151-1820

800-521-9520

800-525-6817 Fax

www.jlindustrial.com

Routing

Router Bits

Onsrud Cutter, Inc.

80 Liberty Drive

Libertyville, IL 60048

(847) 362-1560

(847) 362-5028 Fax

www.onsrud.com

Great Lakes Carbide Tool Mfg., Inc.

101 N. Old Peshtigo Rd.

Peshtigo, WI 54157-0157

(715) 582-3884

(715) 582-4373 Fax

Paso Robles Carbide, Inc.

731-C Paso Robles Street

Paso Robles, CA 93446

(805) 238-6144

(805) 238-4263 Fax

Wisconsin Knife Works

2505 Kennedy Drive

Beloit, WI 53511

800-225-5959

800-336-1254 Fax

www.wkwincc.com

Toolmasters LLC

1400 Railroad Avenue

Rockford, IL 61104

(815) 968-0961

(815) 968-5559 Fax

www.toolmastersllc.com

Trend Lines, Inc.

100 Justin Drive

Chelsea, MA 02150

800-767-9999 / 800-735-3825 (617)

889-2072 Fax

www.trend-lines.com

Woodworkers Supply

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