

ACRYLITE® extruded sheet (FF)

#11 Machining

This brief gives advice for:

- **Equipment**
- **Procedures**
- **Trouble Shooting**

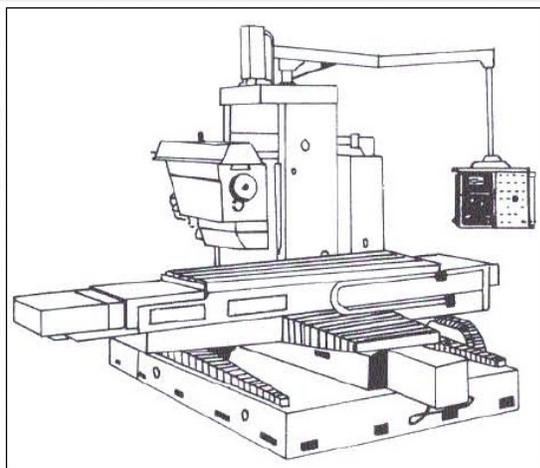
Equipment

Many types of machining equipment are used in fabricating ACRYLITE® products. Some include millers, grinders, thread cutters, engraving equipment, files, and reamers.

Most equipment used in machining ACRYLITE® was originally designed for wood or metal. Notching or overheating sheet due to inadequate equipment or improper cutting tools may cause failure of the fabricated item. To prevent this, make sure equipment is right for ACRYLITE® sheet.

Milling Machines

Various kinds of machines are available for milling ACRYLITE® sheet. Machines with a heavy base and reliable balance are needed to control vibration and



assure clean cuts. Equip all units with vacuum devices or compressed air to clear chips and cuttings from the blade area, and to control heat generation.

Milling Tools

Milling cutters vary widely, depending on the application. Cutting edge rake angle should be 0–5° and clearance angle 2–10°. You can machine ACRYLITE® sheet with high speed steel, carbide, or diamond-tipped tools.

Carbide tools, though they have a higher initial cost than steel, maintain a sharp edge longer, producing a high-quality machined edge for a longer time. Diamond-tipped tools produce a superior cut and last even longer than carbide-tipped tools. Pigments in ACRYLITE® sheet colors may shorten tool edge life.

Filing-Shaving

You can use most normal files, hand routing files, and rasps with ACRYLITE® sheet. The tool depends on the desired effects and the application. Use these tools for producing a rough surface, not for fine finishing.

Engraving Equipment

For artistic work, use flexible shaft engravers rotating at least 1000 rpm and air operated pencil milling and grinding tools rotating about 6000 rpm.

Reamers

Use normal reamers for deburring drilled holes. Be sure all tool edges are fault-free, preventing grooves or furrows in the drilled surface.

Thread Cutters

Use normal taps and dies to cut internal and external threads in ACRYLITE®. Most machine cutters are suitable.

Procedures

Safety

When using machining equipment, wear a protective face shield or safety goggles. Wear hearing and respiratory protection if you will be operating equipment for a long time.

Follow normal workshop safety practices when machining ACRYLITE®. Eye, ear, and respiratory protection may be appropriate, depending on the operation.

Be sure to follow manufacturers' safety recommendations for equipment and materials used with ACRYLITE® sheet.

Direction of Travel

To achieve a smooth cut, feed the sheet in the proper direction as required by the tool rotation. Feed material into the rotating edge of the cutter.

Dimensional Changes

Stresses inherent in ACRYLITE®, as well as stresses imparted to fabricated articles by machining, may cause dimensional changes when sheet is heated to the forming temperature (300°F) after machining.

Anneal the part to eliminate stresses. See Fabrication Tech Brief #12, Annealing.

Lathe Operation

To use a single-edged cutter, carefully balance the chuck with adjusting screws to eliminate chatter marks. Edge quality will depend largely on the machine's stability.

Milling Tools

Use a multi-edged milling tool. The cutter's rotation speed should be as fast as possible, at least 3300 feet per minute.

As most blades are designed for machining wood or metal, modifications may be necessary. The rake angle should be 0°, reducing chipping by providing a scraping, rather than cutting, action. The clearance angle should be at least 2°, usually more, to minimize frictional heat buildup. If you're using a standard milling tool, provide cooling.

Cooling

Plastics, including ACRYLITE®, are much more susceptible to heat distortion than metals. Use coolants such as compressed air, water, emulsions, etc., to minimize heat distortion effects and produce a polished surface. If cooling is not provided, decomposition and irregularities at the cut edge may produce high-stress areas, leading to crazing (numerous tiny cracks in the material).

If you use emulsions, have them tested for compatibility with acrylic. Incompatible emulsions may cause crazing.

Filing-Shaving

If necessary, use a scraper made of high-speed steel to smooth sawn edges, eliminating notching. Flat-ground triangular files with a maximum edge width of 8 mm (3/10") are also effective. The file surface must not be hollow ground, as this will produce chatter marks due to the rake angle. A flat-ground file should have a 0° rake angle. As with sanding, use water for a smooth finish and less stress buildup from frictional heat.

Engraving

Use hand-held tools for artistic applications and fixed-tracing engravers for precise work. Adjust the engraving tip's travel speed to avoid melting (whitening of the surface) from slow travel and chipping from fast travel. If melting persists, use a liquid coolant or air cooling.

Thread Cutting

Due to the notch sensitivity of acrylics, don't machine threads with sharp edges. To reduce stresses, use rounded threads. Note, too, that threads should not be intended to bear loads. If threaded connections will often be unscrewed, reinforce the internal thread with a metal insert.

Use a cutting emulsion or oil to produce a polished surface. Regularly remove chips from internal holes, and don't allow the tap to "bottom out."

Trouble Shooting

Problem	Cause	Solution
Chatter Marks	Dull tool	Replace or sharpen tool
	Feed rate too fast	Reduce feed rate
	Unbalanced chuck	Balance chuck with adjusting screws or replace chuck and spindle
	Vibration	Stabilize platform
	Bearing wear	Replace when runout exceeds 0.002"
	Incorrect rake angle	Use tool with 0° rake angle
Melted Edges	Dull tool	Replace or sharpen tool
	Slow feed rate	Increase feed rate
	No cooling	Add compressed air, water, mist, or emulsion cooling
	Chip buildup	Use vacuum system or compressed air to clear chips
	Incorrect rake angle	Use tool with 0° rake angle
	Incorrect clearance angle	Use tool with 2–10° clearance angle

Fire Precautions

ACRYLITE® sheet is a combustible thermoplastic. Precautions should be taken to protect this material from flames and high heat sources. ACRYLITE® sheet usually burns rapidly to completion if not extinguished. The products of combustion, if sufficient air is present, are carbon dioxide and water. However, in many fires sufficient air will not be available and toxic carbon monoxide will be formed, as it will when other common combustible materials are burned. We urge good judgement in the use of this versatile material and recommend that building codes be followed carefully to assure it is used properly.

Compatibility

Like other plastic materials, ACRYLITE® sheet is subject to crazing, cracking or discoloration if brought into contact with incompatible materials. These materials may include cleaners, polishes, adhesives, sealants, gasketing or packaging materials, cutting emulsions, etc. See the Tech Briefs in this series for more information, or contact your ACRYLITE® sheet Distributor for information on a specific product.

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