

MACHINING AND POLISHING OF PLASTIC SCINTILLATORS

SAFETY:

Always exercise safety precautions appropriate to the machines to be used. Always wear adequate eye and body protection.

HEAT AND MECHANICAL STRESS:

Avoid procedures that would introduce significant stress in the materials such as overheating during the machining and polishing or tight clamping with metal jaws on the plastic. The protective adhesive paper should be left on during room-temperature fabricating and finishing of edges. Use diluted soapy water and cotton or very soft flannel cloth to clean finished surfaces. Avoid exposure to all kinds of solvents except water or alcohol; isopropyl alcohol (isopropanol) is preferred.

SAWING:

Band sawing is preferred among the many varieties available. Saw blades must be sharp, and four-pitch buttress type band saw blades are recommended. Since overheating at the cut is unavoidable, allow for the machining removal of at least 0.25 in (6 mm) of scintillator from the cut for sheets up to 0.5 in (13 mm) thick. Larger margins may be required for thicker material. Use spray water or wax stick lubricant where possible, particularly on thicknesses above 1 in (25 mm). The following table may serve as a beginning guide. Sawing on table saws or panel saws with carbide-tipped blades may also be done.

| Thickness | Blade Speed (per min.) | Saw Teeth Per Inch |
|------------------------|------------------------|--------------------|
| < 1/8 in (3mm) | 1800 ft (500 m) | 14 |
| 1/8 - 1 in (3 - 25 mm) | 1800 ft (500 m) | 4 |
| > 1 in (25 mm) | 1000 ft (300 m) | 4 |

MACHINING COOLANTS:

Do not use metal cutting oils. Fine soapy water sprays are recommended. Where metal corrosion

may be a problem, some diluted water-soluble oils may be used, but avoid prolonged exposure of the scintillator to them. Do not soak the masking paper on the sheet stock. When drilling, use only water or soapy water coolants.

CLAMPING:

Avoid sharp pressure points. For turning and milling, clamp lightly using suitable wood or plastic blocks to spread out the pressure. Avoid trapping dirt between the scintillator and other surfaces.

MACHINE TURNING:

Standard metal cutting lathes can be used. Refer to the following tables as a starting guide.

| Diameter | RPM |
|------------------------|------------|
| < 2 in (50 mm) | 1000 |
| 2 - 5 in (50 - 125 mm) | 500 - 1000 |
| > 5 in (125 mm) | 200 - 500 |

Prevent vibrations and use feed rates in the range of 0.0015 - 0.004 in (0.04 - 0.2 mm) per revolution. Use sharp, smooth ground, high speed, steel tools with large clearances and slight negative rakes. The following parameters are recommended:

| | |
|----------------------|---------------------------|
| End Cutting Angle | 20° |
| Side Cutting Angle | 10° |
| Back Rake Angle | -2° |
| End Clearance Angle | 12° |
| Side Clearance Angle | 10° |
| Nose Radius | Up to 0.18 in (4 mm) |
| Tool Location | Up to 2° above centerline |

MILLING:

Use fly cutters where possible with cutter speeds and feed rates similar to those recommended for turning. When using end mills, use a two wing sharp helix



ELJEN TECHNOLOGY

1300 W. Broadway, Sweetwater, TX 79556

www.eljentechnology.com • eljen@eljentechnology.com

Toll Free (USA & Canada): (888)-800-8771 • Tel: (325)-235-4276 • Fax: (325) 235-0701



cutter with a compressed air blower to keep chips free.

DRILLING:

For shallow or small diameter holes (below 1/8 in (3 mm)) the drill should have a point angle of 60° – 90° instead of the standard 118°. It should have wide flutes and a low helix angle with lip clearance at the periphery of 12°. Take great care to avoid overheating by using soapy water coolant. Do not clean the hole with a low alcohol as the evaporation cooling may start crack formation. Recommended drilling speeds are as follows:

| Diameter | RPM |
|-----------------------------|-----------|
| 1/16 - 5/16 in (1.5 - 8 mm) | 500 - 700 |
| 3/8 - 1/2 in (10 - 13 mm) | 300 |

SANDING:

Remove turning lines by hand, rubbing at right angles using #240 grit silicon carbide waterproof paper with water. Follow with #400 and #600, also with water. Each step should be at right angles to the previous one until all previous lines are removed.

HAND POLISHING:

Use polishing aluminas on small areas and holes. Finishing with a particle size of 9 microns. Form a paste with water on a flannel cloth. Rinse away the alumina and use a general purpose non-abrasive plastic polishing liquid available from most plastic supply companies for final cleaning. Use a clean,

soft flannel cloth in this final step. Generally avoid using polishing liquids on drilled holes or heat-bent pieces.

MACHINE POLISHING:

Avoid lingering on any one spot and keep buffer speeds and pressures down in order to minimize surface heating. A suitable buffer wheel surface speed is 1400 - 1800 (400 - 500 m) per minute corresponding to about 750 RPM for an 8 in (200 mm) diameter buffing wheel. Avoid rounding of the sheet edges by clamping a small strip of plastic on each side.

1. First Operation: Use a 1" wide unstitched ventilated-type buffing wheel with a brown #150 grade relatively dry compound bar.
2. Second Operation: Use a separate but similar buffing wheel as above with a dry aluminum oxide compound bar.
3. Final Operation: Polish with a clean, soft, unstitched flannel wheel using no compound.

CLEANING:

Clean water and soapy water are the best solvents to use. These are the only fluids to be used when cleaning bored and drilled holes and on scintillators having extensive machining and polishing. Wipe or pat dry with clean, soft, non-abrasive cloths or tissues. The lower alcohols may also be used. Isopropyl alcohol is preferred because of its slower evaporation rate. Avoid industrial grades of alcohols which may contain harmful impurities.

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