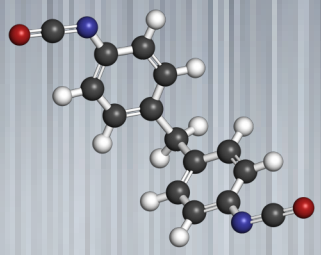
TechSpecs

Machining Polyurethanes



Overview

Thermoset polyurethanes are very tough and durable materials. Due to their properties, it is important that special care be taken when machining them. Polyurethanes harder than 80 Shore A can be machined using processes commonly used for machining metals. Polyurethanes softer than 80 Shore A tend to be too soft for these machining processes and are best machined by methods such as knifing, grinding and sanding. This guide provides some useful information for machining MPC's Durethane® materials or other thermoset polyurethanes.

Safety

When machining polyurethanes, the following personal protective equipment should be used:

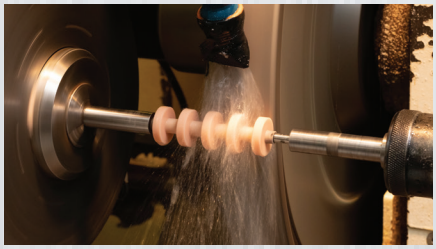
- Eye protection including approved safety glasses with side shields, full goggles or a full-face shield
- Approved dust masks for any processes that may generate polyurethane dust or debris.

Prior to machining polyurethanes fix the material safely and securely. Improper fixturing and machining practices can cause serious injury. If smoke is noticed, stop and correct the process immediately. Avoid breathing smoke or dust from polyurethane machining.

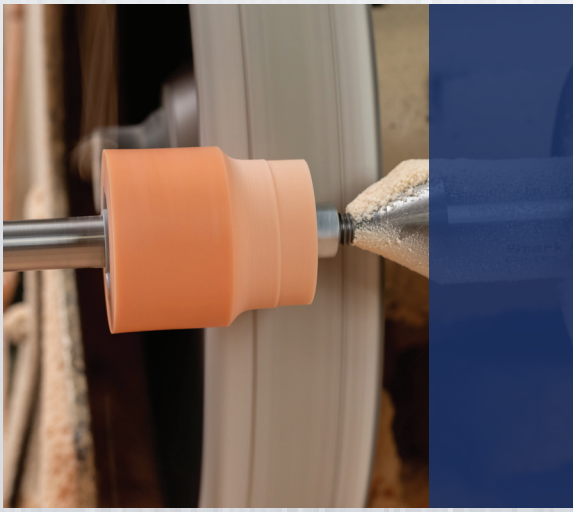
Machining Basics

Due to the material's physical properties, there are some basic considerations to keep in mind:

- **Heat Build-Up** - Thermoset polyurethanes have low thermal conductivity and temperature can rise quickly at the point of cut. Melting can occur at temperatures above 350˚F. Heat generated during machining can cause expansion of the part, resulting in misshapen parts. To prevent heat build-up use proper tool geometry, feed rates and cutting speeds. If necessary, water-soluble oils or light machining oils may be used as coolants.
- **Elastic Memory** – Polyurethane has strong elastic memory. Cutting tools must provide enough clearance to compensate for this elasticity. If not enough clearance is given, friction will increase between the cut surface and the cutting tool, aggravating heat build-up. Elastic recovery can also result in smaller internal diameters and larger external diameters than were measured during cutting.
- **Clamping** – Polyurethanes are pliable and can be distorted by too much clamping force, which can result in the final part to be distorted or misshapen. Grasp the material securely without distorting it.







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Contours

Machining contours, tapers, grooves, and other surface configurations into polyurethane parts is possible. Below are some considerations when machining these features:

- When grooving polyurethanes 85A or harder use a 10˚ to 20˚ front rake with no top rake. Contouring polyurethanes softer than 85A should be done using a tool with 15˚ to 30˚ of top rake.
- Depending on the dimensions of the work piece, higher RPM, light cuts and moderate feed rates produce the best results.
- The best tool position is .025" to .075" below the center of the part being worked. A continuous ribbon coming off is desirable, but care must be taken to avoid it from wrapping around the work piece.

Grinding

Polyurethanes between 55A and 80A can be ground on a lathe using a grinder. Below are some considerations for grinding thermoset polyurethanes:

- Use turning speeds below 150 RPM with the lathe running in reverse and a feed rate set .005" per revolution.
- Slower feeds improve surface finish or allow the removal of more material by taking a deeper grind.
- Use 40-50 grit grind wheels with a slight radius on the leading edge rotating at 2100-3500 RPM.
- Grinder should be equipped with a dust collector and the operator must use proper protection when grinding or sanding urethanes.
- Polyurethanes harder than 80A are best ground using a coolant. Coolants can be applied with a brush, nozzle or fine spray mist.

Drilling

Spiral drills perform best for drilling polyurethanes. Their flute area permits free discharge of debris, reducing binding and heat build-up. Clear discharge frequently as flutes will readily fill. Diagram 1 shows recommended drilling equipment.

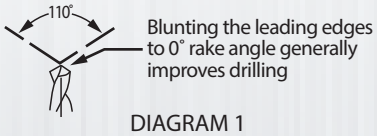


DIAGRAM 1

Knifing

Round polyurethane shapes can be knifed while on a lathe. Tighter tolerances can be achieved when working with polyurethanes between 70A and 95A. Best results are achieved with rapid feeds and turning speeds from 600 to 1000 RPM, using high speed steel blades that are very thin and sharp. Knifing will tend to pull the polyurethane leaving the finished end of the material with a concave texture. This pulling effect can be reduced by taking multiple thin cuts and using lubricants. Diagram 2 shows recommended knifing equipment.



DIAGRAM 2

Milling

Polyurethanes harder than 90A can be easily milled. When milling polyurethane use sharp tools and fix the material securely. For best results use end mills that have large volume chip relief or single-point fly cutters with high speed bits ground to a round nose. Milling is recommended at 830-1350 RPM with a feed speed of 15-20 inches per minute.

Parting

When parting polyurethane it is recommended to use tools 1/16" to 1/8" wide with 20° to 30° front rake and 0° top rake. A small 3/64 radius should be ground into the top of the tool with enough side clearance. See diagram 3.

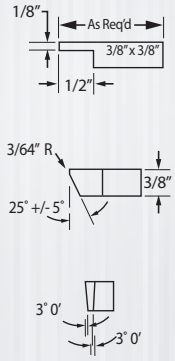


DIAGRAM 3

Sawing

To saw thermoset polyurethane it is best to use a band saw. Use a cutting blade with 4 teeth per inch and significant blade set alternating left and right of center. Run the saw at 2600 feet per minute and let the blade cut at its own speed; do not force the part being cut. When sawing thin and soft sheets support the part underneath with a firmer material, such as cardboard. If needed, use silicone lubricants or water-soluble oil to reduce friction heat and improve cut finish.

Face and Turning

Harder polyurethanes can be faced and turned to size using sharp tools, high turning speeds, and slow feeds. For best results use either carbide or high-speed steel tools. The top of the tool should be very smooth to help reduce chip wrap around the work piece and reduce heat build-up. The cut urethane should come off as a continuous ribbon. See diagram 4 as reference.

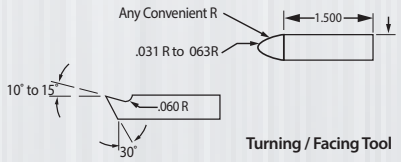


DIAGRAM 4

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