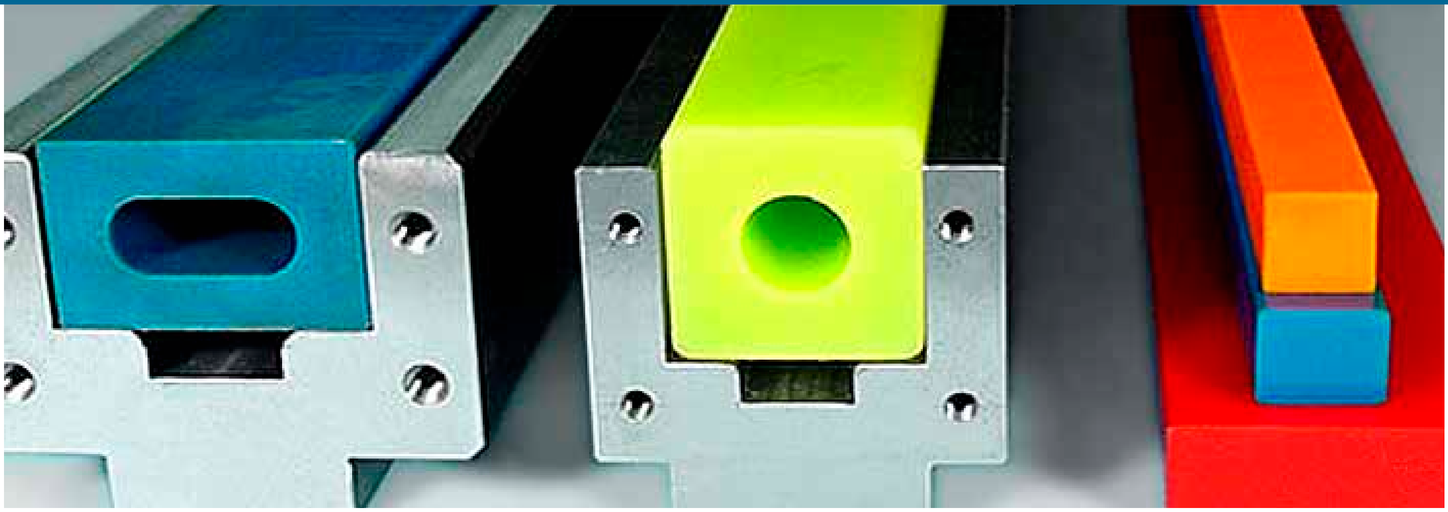

Machining Polyurethanes: Introduction

Cast polyurethanes can be readily turned, sawed, drilled, ground, or milled. These and other secondary operations present many similarities to the machining of metal, but there are also some important differences. This paper is intended to provide some general guidelines for machining urethanes, and also focus on the most common group of machining operations and discuss some specific tools and techniques.

It is important to note the material presented here is a starting point. The wide variety of urethane compounds and their respective physical properties and characteristics creates a wide range of machining situations. Experimentation and experience will tell you what speeds, what feed rates, and what types of tools will work best for the urethanes you machine regularly.

Harder urethanes – 90A and up – have a high degree of machinability. Lathe turning, fly-cutting, grinding, contouring, and more are easily accomplished on conventional metal-working equipment by machinists who are familiar with procedures for handing plastics.

Some different tools and techniques are required for compounds of 80A durometer and lower. These lower modulus compounds are typically machined by knifing, grinding, and sanding. In some cases, however, they can be worked like higher modulus materials by “freezing” them in dry ice or liquid nitrogen environments.

Some Key Points to Remeber in Machining Urethane

- Urethanes have much lower thermal conductively than metals, so heat generated by cutting tools stays close to the tool and raises the urethane temperature rapidly. This heat must be controlled. Melting can occur above 400°F. In addition to possible melting, heat generated by machining causes the part to expand. When that part cools, it shrinks down and can end up undersize.
- Elastic memory - Elastic recovery occurs in urethane both during and after machining. The cutting tool must provide clearance to compensate for this. With compensation, expansion of the urethane as it passes the tool will result in increased friction between the cut surface and the cutting tool. Excess heat build-up will result. Elastic recovery after machining can result in smaller internal diameters and larger external diameters than were measured during cutting.
- Modulus of elasticity - Urethanes are resilient and can easily be distorted. It is possible to alter the shape of a urethane part by clamping or chucking it with too much force. This would cause the final machined shape to be distorted after the cut had been made and the fixturing pressure was released. Care must be taken to hold parts securely, but avoid distortion due to holding or cutting.
- Softening point - Gumming, poor finishes, and poor dimensional control will occur if excess heat is generated and allowed to accumulate. Proper tool geometry, feed rates, and cutting speed, in conjunction with coolants usually overcome these problems. Water soluble cutting oils and/or light machining oils are good coolants for urethanes.