

Mining Micro

Exploring opportunities in micromachining.

Micromachining is old hat for some highly specialized manufacturers. Many companies have used machining technologies such as EDM and laser to produce miniature details for many years. However, more machine shops appear to be targeting micromachining as market opportunities grow and more machine tools devoted exclusively to micromachining come on the market (see "Got micro?" in the October 2006 issue of CTE).

Still, micromachining may be unfamiliar to shops that have worked only in the "macro" world. For example, many machining centers used in micromachining must be housed in controlled-atmosphere environments because conditions such as temperature can have a larger percentage effect on tolerances when the parts are very small. The use of advanced fixtures and jigs in micromachining is even more important than in conventional machining because imparting fine surface finishes and devising workholding for tiny parts is quite difficult.

As miniature products, such as tiny cell phones and medical implants, have become commonplace, the market for micromachining has grown. The annual value of products requiring a micromachining process or a small part was pegged at \$32.5 billion worldwide in a December 2005 survey by Northern Illinois University's College of Business Experiential Learning Center, DeKalb, Ill. The survey's purpose was to identify manufacturers of small parts from various industry segments.

The NIU/ELC team identified a pool of small parts manufacturers. Researchers screened these companies to identify a survey sample. Companies chosen manufactured small parts (less than 50mm³) as a significant part of their operations and performed micro-

machining as a primary or secondary manufacturing operation, among other factors. About 100 companies were included in the survey.

Major Medical

The medical/dental industry had by far the largest number of participating companies (49 percent). The researchers noted that facilities producing parts for the medical/dental industry often had to invest in highly specialized equipment, such as on-site clean room facilities for final assemblies, inspection and sterilization.

Orthopedic, vascular and dental implants made from titanium and other exotic alloys were the most common products. Turning was the preferred method for producing surgical implants, followed closely by milling. In addition to metal-based medical parts, other important markets identified were precision molds for surgical instruments and production of complex parts from plastics, composites and other nonmetal materials.

Ceramics Key to Communications

In the communications/electronics area (13 percent of the survey companies), the NIU/ELC survey identified two key micromachining markets: molds for metal components and for plastic components used to house sensitive electronics. Manufacturers in this area mill more ceramic material than any other area, the survey noted. Ceramic milling plays a large role in rapid prototyping operations and is also used in components such as magnetic tape guides, cleaner blades, wear discs and insulators. In addition to these applications, the electronics industry uses advanced machine tools for operations such as drilling, tapping, and high-speed contouring of graphite



More machine tools for micromachining, such as Makino's UPJ-2 horizontal wire EDM machine, are coming on the market. The UPJ-2 can handle jobs such as gears for microminiature molds.

electrodes and small molds.

Aerospace Takes Off

In the aerospace/defense category (16 percent of companies surveyed), some of the most important micromachining applications are precision components for navigation, communications and control systems. Both commercial and military aircraft use a variety of hydraulic controls, spools and actuators, and these products are undergoing rapid miniaturization.

Barriers to Entry

While the market is growing, micromachining may not be the easiest market to break into. The study concluded that small parts production has significant barriers to entry because many current suppliers have "significant" economies of scale. Moreover, specialized investment is often necessary.

Still, micromachining in the micron and submicron realm is expected to grow, offering unique challenges and potentially great opportunities to manufacturers that can learn how to handle machines and tools once thought to be impossibly small. △