Efficiency Is Key to Competing Globally ■ Creative Turmoil Will Benefit Manufacturing

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Inc. (Hauppauge, NY) Bystronic has cut holes as small as 1.1 mm on their waterjet cutting system, Byjet. In recent tests, they cut a 1.2-mm diameter hole in 4-mm thick stainless steel, and a 1.3-mm hole in 5-mm-thick aluminum. Currently, the unit most often used for this work is the Byjet 3015 which features the BJD50 70-hp (52.5-kW) pump.

Cutting fluids. "One of the main advantages is that all the fluids we supply work well together," explains Joseph Gentile, product manager, Hangsterfer Laboratories (Mantus, NJ) "This includes our way oils, tapping oils and cutting oils which are all compatible with each other. The products have a longer life because they contain no solvents or volatile organic compounds that can evaporate in a short time.

"Our oils all have a very light viscosity, which does not change characteristics quickly. Also, there are long-chain chlorinated paraffins which have the benefit of being nontoxic, highly effective

High-Speed Machining with Microtooling

We offer tools for high-speed machining with microtooling operations with a diam of 0.250" (6 mm) or less, when dealing with nonferrous metals and plastics. Spindle speeds are usually 25,000 rpm or more. Conventional CNC equipment using tools smaller than 1/2" (6 mm) diam at 10,000 rpm or less usually results in unfavorable feed rates and costly tool breakage. To attempt machining with microtooling, conventional machines must run very slowly, and have a tendency to easily break the fragile tools.

Smaller tools, on the other hand, are fragile and more susceptible to breakage. Improper chip evacuation is a major cause of tool breakage. In fact, more small tools break because of inadequate chip removal than they do because of incorrect machining parameters.

Chips must be removed from the cutting channel in order to minimize breakage possibilities. Small tools require high spindle speeds, but they need to go even faster to kick the chips out.

The best approach to efficiently machine with small tooling is a threefold process. The three interrelated elements are:

- Micro-tooling design,
- Low-viscosity coolant,
- High-speed machining technology.

Tooling requirements change when tool diam decreases and spindle speed increases. Conventional tooling using inserts is not appropriate for microtooling applications. This is primarily due to the required higher rpm rate rather than the tool diams involved. Increased rpm rates require a properly balanced tool with significantly increased chip room to ensure proper chip removal and to prevent chip burn-up. The geometry of microtooling, together with high-speed spindles and proper coolant, can totally eliminate deburring as a secondary operation.

Microtooling needs a lubricating agent with a viscosity lower than that of water. Lower viscosity is needed because the coolant needs to make it to the cutting edge of the tool at the high spindle speeds involved. Emulsion-based coolants have a higher viscosity than water, and thus are ineffective as a lubricant for high-speed machining with microtooling.

Available microvolume coolant spray systems can use ethanol. Ethanol is ideal for nonferrous metals and some plastics. However, steel-based materials require an oil-based coolant. Thus the advantages of ethanol coolant are not available for ferrous machining. This is because carbide tooling on steel surfaces can cause sparks, which could create a rather highly dynamic situation if exposed to an alcohol-based coolant.

Conventional flood-coolant is petroleum-based. Such coolants need to be properly disposed of, with attendant costs. Ethanol doesn't need to be disposed of or recycled, because it simply evaporates.

High-frequency spindles with speed ranges from 6000 to 60,000 rpm are ideal for milling, drilling, thread milling, and engraving using microtooling. They move fast so there's insufficient time for heat to feed back into the part and cause issues. About 60% of the heat is inside the chip. High-speed machining tries to evacuate the bulk of the heat with the chip, providing for a cleaner cut. The better machining quality is based on cooler tooling, lower machining forces, and therefore less vibration.

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