➤BY ALAN RICHTER, MANAGING EDITOR

MIDDLE GROUND

Heavy-metal boring bars are for finishing holes too deep for lower-cost steel bars but not deep enough to justify the expense of carbide ones.

Heavy-metal boring bars are made from a sintered alloy comprised of 90 to 95 percent tungsten with a nickel-copper-iron matrix. They are recommended for boring holes when the depth-to-diameter ratio is around 6:1. Steel boring bars generally are used for depth-to-diameter ratios up to 4:1, and carbide bars are recommended when the bore length is at least eight times the bar diameter. Of course, a carbide bar can effectively bore midlength and shallower holes, but it costs more.

Bob Wahlstrom, sales manager for Criterion Machine Works, Costa Mesa, Calif., said a carbide bar costs around $300, whereas a comparable steel bar runs $75 and a comparable heavy-metal one is in the $125 to $150 range. "The main objective with a heavy-metal bar is to give the manufacturer the opportunity to bore a slightly deeper hole," he said. "It's an economical way of doing it versus going right to carbide."

Wahlstrom added that it's possible to avoid buying a carbide bar for boring holes deeper than a heavy-metal bar's recommended depth-to-diameter ratio. "There are a few people who can push the limits under the right circumstances and take a heavy-metal bar as deep as a carbide bar," he said.

Chris Wills, turning products specialist for Irvine, Calif.-headquartered Mitsubishi Materials U.S.A. Corp., concurred that some people exceed the 6:1 ratio with heavy-metal bars, and emphasized the importance of clamping the bar properly when doing so to promote chatter-free boring. "Most manufacturers just allow their people to use setscrews," he said, "but if they do full-contact clamping around the entire circumference of the bar, they'll help themselves out with vibration issues."

A heavy-metal boring bar is able to bore deeper holes than a steel one because of its higher modulus of elasticity, which is the relationship of linear stress to linear strain in tensile materials commonly known as Young's Modulus. This means heavy metal is stiffer than steel and, therefore, better able to absorb the vibration generated when boring.

Richard Manberg, product manager for H.C. Starck Inc., an East Rutherford, N.Y., supplier of heavy-metal parts for boring bars, explained that steel has a modulus of elasticity of 30 million psi, whereas the tungsten alloys used for boring bars have a modulus of elasticity of about 45 to 50 million psi. "So it's approximately 1½ times stiffer than steel," he said.

"Dense" is another adjective commonly used to describe heavy metal. "Tungsten is very dense, so it absorbs the harmonics that are created in a long-bore applica-

H.C. Starck

As illustrated by these 1-lb. cylinders, tungsten (left) is significantly denser than steel (middle) and aluminum (right).

Attracting chatter-free boring with dimples

Mitsubishi Materials U.S.A. Corp. used computer simulation to design a lightweight, rigid heavy-metal boring bar. Its head incorporates a large dimple to reduce chatter. Therefore, it called the Dimple Bar.

"When you're trying to fight harmonics and vibrations, these bars tend to work extremely well," said Chris Wills, turning products specialist for the Irvine, Calif.-based toolmaker. He noted that the dimple reduces the weight of the boring bar's head, which increases the bar's dampening properties.

In tests comparing a Dimple Bar fitted with a 49.7g head to a conventional bar with a 70.1g head, Mitsubishi reports that the dampening time for the lighter bar was 15.8 milliseconds vs. 20 milliseconds for the other bar.

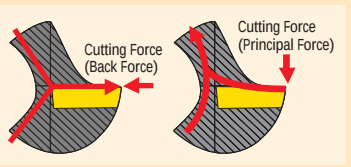
Another improvement is chip disposal, because there are two channels for evacuating chips.

Wills explained that the patented dimple design balances the principal and back forces generated during boring and reduces deflection up to 17 percent. Tests showed that when machining a bore with a depth-to-diameter ratio of 5:1 at a 0.05mm/rev. feed and a 0.5mm DOC, the Dimple Bar deflected 28.3µm compared to 34µm for a conventional bar.

The heavy-metal boring bars come standard with oil holes, and the diameter range is from 5/16" to 5/8".

—A. Richter

Mitsubishi Materials



The Dimple Bar balances the principal and back forces and reduces deflection up to 17 percent when boring.

tion," said Tony Alvarez, product manager for Triad Tooling Inc., Wheat Ridge, Colo. "But it's not as dense, obviously, as carbide."

In addition to its density, Criterion's Wahlstrom noted that the dissimilar metals—heavier tungsten in a lighter nickel-copper-iron matrix—help a heavy-metal bar resist chatter by breaking up harmful harmonics. "If you envision it as a sound wave, that vibration, or harmonic, hits different densities so the heavy-metal bar doesn't have a chance to chatter quite as quickly as a steel bar would," he said.

Wahlstrom noted that a heavy-metal bar is also effective for boring holes with a small keyway or other interruption, regardless of the bore length. "A heavy-metal bar's greatest impact and success is for customers who have a slightly interrupted cut," he said. "With a steel bar, that interrupted cut has caused some vibration and that vibration is dampened with heavy metal."

Criterion Machine Works

Heavy-metal boring bars absorb vibration to allow machining of deeper bores with finer finishes than steel bars.

An advantage from the heavy-metal-tooling manufacturer's perspective is that tungsten is easier to reconfigure than carbide. "You can machine it, whereas with carbide you have to grind it with diamond," Triad's Alvarez said.

Although hardly new to the market, heavy-metal boring bars seem to be gaining renewed interest. No one seems to know why. "In the last 2 years, our sales of heavy-metal products have increased at least 50 percent faster than the steel bars have," Wahlstrom said. "I don't know if it's the application or if people have just finally heard that we have them."

The following companies contributed to this report:

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