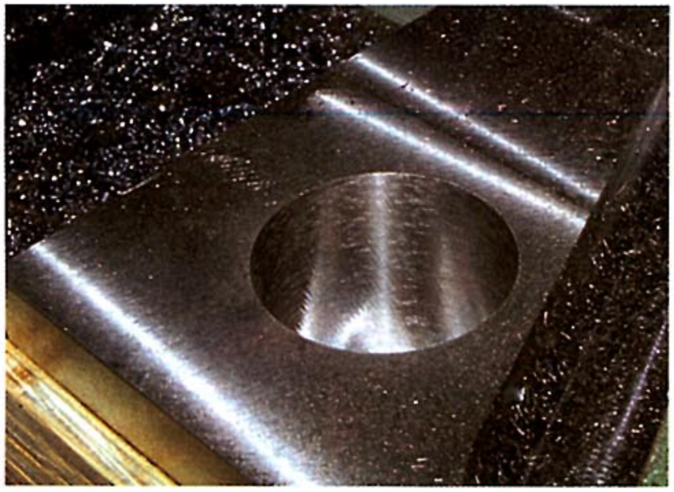
ORBITING BEYOND



Corkscrew milling sinks guide pin holes four times faster – and eliminates errors too.

Konrad Forman, Ingersoll Cutting Tools

Guide pins are indispensable parts of dies and molds used in stamping, plastic molding, forging and diecasting. They ensure that mating halves mate . . . and every guide pin needs a hole for a home.

Sinking large-diameter blind holes into tough hot-work steels isn't easy, but die- and moldmakers often have no choice. They must create guide-pin holes in mating halves of a toolset for forging, stamping and molding. Unless these holes are perfectly round and smooth-sided, the sweat fit with the guide pin won't hold. And if the mating holes don't align exactly, the dieset can seize or be damaged when put to use, endangering the machine and anyone nearby.

This problem is perhaps most extreme in big forging dies, where guide-pin holes run big enough to hide a bagel – 2 to 4-in diameter by more than 4-in deep. Standard indexable mills haven't worked well on guide-pin holes because they cut out-of-round or score the bore, with zigzag tool mark: creating loose sweat fits with the guide pins.

For many tool and die shops, the prevailing practice m doing it the old-fashioned way. Open the hole with a spa drill, finish-bore for final size, roundness, straightness ar finish on one half. Then repeat for the other holes until a four are done. This slow method can take a full day to complete just one toolset, even when all goes well. That's the bad news.

THE GOOD NEWS

The good news is that several forging shops have switcl to a new method that cuts machining time for guide-pin holes by four to one – and eliminates lots of error sources too. They corkscrew-mill the holes with an Ingersoll Hi-P indexable end mill that completes a whole dieset in an hc and a half and produces holes that appear to be bored.

Dimensions are accurate within 0.0005-in. The bottom a true flat, 90-deg square from the wall. No need to move second machine just for holemaking.

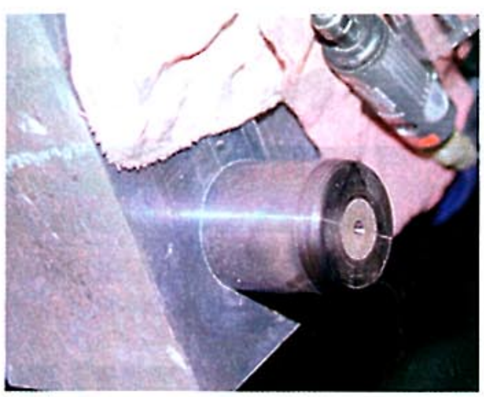
The horsepower required to spade-drill such large hole: can easily stall most modern CNC machines used in fine ity work. This is why many moldmakers move the toolset jig borer or heavy-duty drill press just for the guide-pin h Moving to a second machine slows things down and intr duces another source of error. With corkscrew milling, th no stalling problem – and no shuttling between machine:

BEYOND ORBITAL MILLING

Corkscrew milling involves simultaneously feeding on three axes: advance on the Z-axis while interpolating on t X- and Y-axes to enlarge the hole.

This is a step beyond orbital milling, where the Z-feed i done separately from the X-Y interpolation. The cutter's centerline follows a helix. It's a programming step up fror orbital milling, which plunges to depth on the Z-axis and then interpolates. Since there is only a small contact area between tool and workpiece at any instant, cutting forces are much lower than in spade drilling. Gone is the frictio between drill flutes, chips and sidewall of the hole.

Corkscrew milling with a new Ingersoll Hi-Pos+ indexable endmill cuts hole-making time by more than four to one in forging diesets.



Guide pin being installed.

TRUE HELICAL INSERT GRIND → TRUE SQUARE CORNER

The new indexable mill works h because the edge of the inserts are manufactured to trace a true helix with respect to the cutter's centerli leading to absolutely straight sidev and a 90-deg bottom. Insert geom promotes very free cutting with ur formly low cutting forces. The resu is the kind of finish achieved with a solid carbide endmill. By contras kinematically, conventional squar inserts following a helical path simply cannot create a square corner at the bottom of a blind hole and can't avoid leaving lap lines in the sidewalls.

Customary practice with this new method is to corkscrew-mill both holes to identical diameter and location, then enlarge the holes in the top die by 0.005-in for clearance. Next, turn the guide pin to 0.003-0.005-in larger than the bottom die hole, to create a tight sweat fit. Finally, heat the bottom die to expand the hole enough to accept the guide pin. When everything cools and contracts, the pin locks firmly in place.

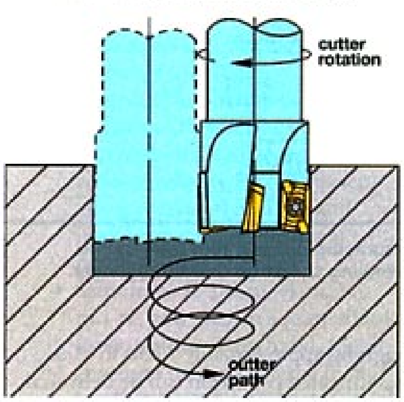
CASE IN POINT

One forging-tool shop using the new method standardizes on 3-in guide pins and high-nickel 4130-type steel, Rc 38, for big dies. A typical die measures 20 x 24 x 12-in. Diemakers mill the holes with a 1½-in Ingersoll Hi-Pos+ indexable endmill at 3000-sfpm and 40-ipm feed. They complete all four holes, produce and 'sweat in' two guide pins in about 1½ hours per dieset.

Based on their current average volume of two diesets per week, the new method saves about $35,000 a year in machining time.

SHORT SLOT HANDLES EXPANSION

A couple of forging tool makers have taken this a step further, correcting for differential thermal expansion that develops over time between the mating halves of a forging die in use. By noontime in many forge shops the bottom die runs 200-deg hotter than the top die because it spends more time contacting hot billets. So its guide-pin holes are 0.005-0.010-in farther apart than those in the top die. This can cause seizing and tool damage.



In corkscrew milling, the cutter orbits into the work as it rotates, opening the hole much faster than drilling. Hole size depends on the program, not cutter size. This reduces drill inventory requirements since a drill isn't needed for every hole size.

Accordingly, mill the hole in the top die as a very short slot rather than a true round. The few thousandths of slot length accommodate the spread of the guide pins as the hot die expands. While you can't readily create a slot with a spade drill or boring tool, it's easy with an indexable mill. FM

Konrad Forman is a product manager for Ingersoll Cutting Tools, 845 S. Lyford Road, Rockford, IL 61108-2749, 815-387-6600, Fax: 815-387-6968, www.ingersoll-imc.com.