Better than breaking even

END USER
Yates Tool Inc.

CHALLENGE
Optimize the machining process to turn a break-even job into a profitable one.

SOLUTION
Applying a cutoff tool, counterbore and drill.

One reality of a job shop is that it is often stuck running some break-even jobs along with the profitable ones. The trick, then, is to transform more of those "so-so" jobs into money makers.

Craig Yates did exactly that on a bearing-sleeve machining job in his Medina, Ohio, shop. Machined from 2⅛" 316 stainless steel bar stock, the part runs on a Daewoo Puma 230 bar-feed horizontal turning center. The finished housing measures 2.375" in diameter × 1.625" long and requires a 1.343" counterbored through-hole in the center plus a 2.0000"-dia. recess to hold the bearing. To accommodate a shrink-fit bearing, the accuracy of the finished 2.0" hole must be within ±0.0006". The final assembly goes into the drive train of a recreational vehicle.

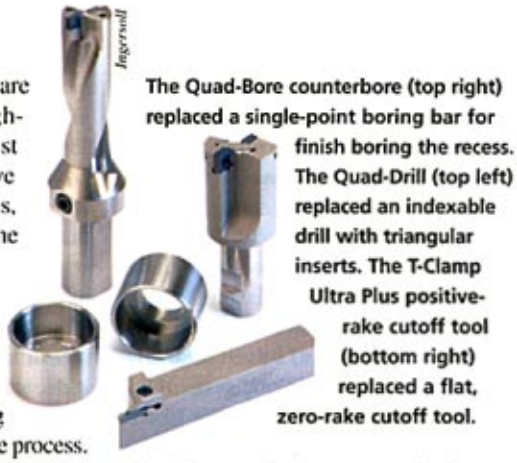
While the bearing sleeve was still at the prototype stage, Yates engineered the machining process to perform seven operations in 4 minutes: rough-turn the OD and face the cutoff surface; drill the 1.343" through-hole; bore the 2.0000" recess in four passes; face the bottom of the recess in two passes to square it up; finish-bore the through-hole; and cut off. Finally, rest the part for 24 hours to relieve any induced machining stresses, then finish-bore the recess to the required ±0.0006" tolerance.

At the prototype stage, process optimization was secondary to quality. Then, after more and more reorders came in, Yates was too busy turning out parts to stop and optimize the process. "I realized that if each 1,500-piece lot wasn't perfect, the customer could find another source," said Yates.

One day, Rockford, Ill.-based Ingersoll Cutting Tools' Bob McAlindon was in the shop working on correcting an application where a zero-rake cutoff tool generated such high cutting forces that it distorted the part. McAlindon solved the problem by applying a TaeguTec T-Clamp Ultra Plus positive-rake cutoff tool.

Yates asked McAlindon to look at the bearing-sleeve job for much the same reason. The cutoff tool he was using produced a part geometry barely within squareness tolerance and imparted a barely acceptable "glazed" surface finish. The tool also created a burr that had to be removed by hand, and it needed replacement after only 100 parts.

They tried the same T-Clamp Ultra Plus cutoff tool, and it worked. Finish and squareness tolerance improved, with tool life rising to 400 or more parts. And no more burrs. Cutting off takes 15 seconds, the same as before.



The Quad-Bore counterbore (top right) replaced a single-point boring bar for finish boring the recess. The Quad-Drill (top left) replaced an indexable drill with triangular inserts. The T-Clamp Ultra Plus positive-rake cutoff tool (bottom right) replaced a flat, zero-rake cutoff tool.

At the time of McAlindon's visit, annualized volume was approaching 20,000 parts, ordered in 1,500-piece lots, but it was still a break-even job. It was high time to focus on efficiency and profitability.

McAlindon suggested counterboring the recess in a single step rather than single-point boring it in a four-pass operation. That reduced the operation from 75 seconds to 10 seconds. The recess is machined with an Ingersoll 2" positive-rake Quad-Bore counterboring tool run at 950 rpm and a 0.01-ipr feed.

"We first tried a zero-rake counterbore," said Yates. "It did the job, but I was concerned about overloading the machine at such a high cutting rate on gummy stainless steel. So Bob came in with a higher-rake counterboring tool to reduce cutting forces and break up the chips better."

Finally, McAlindon looked at opening the 1.343" through-hole faster without destroying the tool. The original ★ 3-insert indexable drill literally burned up in the middle of a cut. The inserts failed when cutting at 1,350 rpm and a 4.05-ipm feed, and the drill body literally melted. Even when the drill lasted through a cut, opening the hole took 30 seconds.

McAlindon's diagnosis was that the cutting forces were too high for the triangular inserts, so he suggested a thicker, square-insert Ingersoll Quad-Drill. Running at 1,650 rpm and 6.4 ipm, it opens the hole in just 15 seconds.

"Square inserts are fundamentally stronger than triangles because there is more material to support the cutting edge and a lower stress-raising effect," explained McAlindon. "And the positive chipbreaker and extra cutting edge contribute to longer tool life."

Facing and turning operations were left unchanged, representing 2 minutes of the original 4-minute cycle. Retooling the hole, recessing and cutting off eliminated 80 seconds from the cycle time.

All told, some timely outside thinking transformed a break-even job into a profitable one at Yates Tool. The reduced cycle time took 60 cents out of the cost of each part, adding $12,000 to the bottom line.

"Running a job shop can be lonely at times, and without some outside thinking there's a natural tendency to do new things the same old way," said Yates. "Although we're just a small shop, Bob and his application engineers back in Rockford provided full support. They brought me a new way of thinking, as well as more productive tooling. The fresh thinking is probably the more valuable part. It will stay with me long after this job is over."