CNC Reduces Cost and Delivery Time of Progressive Dies

New Die Detail Manufacturing System Puts CNC to Work by Combining VMC's, Tooling and Software for Speed and Cost Savings.

As customers for progressive dies increasingly demand a cut in delivery times from 20 to 6 weeks with corresponding cost reductions, die makers are scrambling for solutions. Traditionally, CNC solutions have been rejected because the ratio of programming and setup time to machining time was lopsided. It was neither time efficient nor economical for machining die details. However, a new high speed manufacturing system for die details, the Revolutionary Die Manufacturing (RDM) system, based on macros and software developed by R.C.M. Manufacturing, Inc. of Romeo, Michigan, in conjunction with Fadal VMCs, is enabling reductions in machining time of up to 68% and delivery times as short as four to six weeks.

A progressive die is made up of a die shoe (frame) and from a few to 300 or more details, which essentially are heat-treatable steel blocks squared on four or six sides. The details are then machined with features, such as drilled, counterbored, tapped and/or jack screwed holes, as well as pockets. After heat treating, excess material is removed during a final grinding and EDM operation. Finally, the details are assembled into the shoe. Traditionally, a manual mill is used to machine die details because manually programming a CNC control or using an offline CAM system can require 30 to 60 minutes for a part that will only run 20 minutes to one hour on the machining center.

Using a manual mill requires each detail to be repositioned for operations on all six sides, which means there are at least six setups and often as many as nine. Every time the part is manually repositioned accuracy is jeopardized, which impacts the quality of the die and can increase grinding and final assembly time. In addition, manually repositioning details on the mill's table significantly increases machining time. Because

a skilled die maker is required to ensure quality and accuracy, costs are high and production capacity is limited.

Mr. Robert Quinn, president, R.C.M., said, “I discussed using CNC with every progressive die maker I know. Basically, they told me not to waste my time thinking about CNC, because cycle time for machining details is short and requires multiple setups and the programming time can be two or three times as much as the machining time. But based on my programming experience with a 2-axis CNC mill, I knew I could make it work.”

Progressive Die Design

The RDM software can be used to create geometry for details or the geometry can be imported using DXF or IGES files. Typically, a designer will make individual prints of each detail. On each print, every hole has to be dimensioned and called out. However, the RDM system includes automatic feature recognition which eliminates the time it takes to manually dimension and call out features. Jim Boelstler, general manager, Modified Technologies, who has been using the system for a few months, said, “We no longer have to detail any of our dies, once they’re drawn, the automatic feature recognition eliminates detailing prints, eliminating about 30% of our total design time. It also eliminates errors caused by manually giving information to machinists.”

Setup

The RDM system has optimized the tools to be the most commonly used tools throughout the die machining process. Typically, the Fadal VMCs are available with a 21 or 30 pocket automatic tool changer (ATC), featuring change times of as low as 1.9 seconds. The number of tools used in most die making operations totals approximately

90, so the most commonly used tools are loaded into the ATC. The rest of the tools are set up offline in a standard tool rack.

When an offline tool is required, the system prompts the operator to insert the proper tool number in the spindle. Because the RDM system uses macros loaded onto the Fadal control for capturing and maintaining tool offsets, once the tool offset is set it never has to be reset, even when part thickness varies. Traditionally, an operator would have to manually reset the length of the tools when the part thickness changes. However, the RDM system automatically adjusts the tool offset and keeps track of changes using an absolute instead of incremental system, eliminating any possible errors.

According to Mr. Quinn, "We use a Kurt vise for fixturing. Once the system is setup, a zero point established, one time with that vise, we automatically adjust that zero point for each detail. On the Fadal VMC, we have a CNC controlled automatic positive stop that enables any size part to be loaded onto the vice without changing or re-picking up corners or zero points. The system saves 5 minutes off every setup spent picking up a reference point on a part, such as a zero corner or a hole in a part. By using the Fadal VMC, the six setups for squaring the detail and other setups for reorienting the detail for drilling, pocketing, chamfering and other operations have been reduced to just two setups."

CNC Control

Mr. Quinn cites one of the major factors in building the RDM system around Fadal VMC is, while other machines change the controller every time there's a new model, Fadal's CNC control is consistent from year to year. Mr. Quinn said, "I don't have to figure out what was changed on the control to make the system work. Because Fadal keeps the control functions consistent, the die making program works no matter what

Fadal VMC we're using. Also, the Fadal control is easy to learn. The gentleman we trained from Modified Technologies, had no CNC machining experience and very little computer experience. At the end of the first day, he was milling details on his own. The combination between the ease of use of the Fadal VMC's and what we've done makes it possible for somebody to be up and running almost immediately. On day one, they are doing things more efficiently than they have ever done them before."

Accuracy

The first two RDM systems were built around the Fadal VMC 4020 and VMC 6030. Both VMD's utilize heavy ribbed castings and cast iron box ways. Box ways provide maximum surface area contact for the greatest vibration damping, stiffness and rigidity characteristics. The hardened and ground box ways utilize virtually friction-free non-metallic liners on all way surfaces and gibs, ensuring consistently closer tolerances for more years of heavy machining. By incorporating positive displacement lubrication over the full length of the way surface machine stickslip is virtually eliminated, preserving accuracy and extending machine life.

Mr. Quinn said, "Because of the accuracy of the Fadal VMC's, we're holding squareness to within plus or minus 0.0002" instead of depending on whether the operator had a good day or not."

Running lengthy machining operations, such as with details on a progressive die, for many machines might require a cool-down period, in order to minimize thermal growth. However, Fadal VMC's feature a unique refrigerated cooling system that controls thermal growth and repeatability problems. By circulating a high-performance heat transfer agent through the spindle nose, around the spindle cartridge and head stock and through the center of the gun-drilled ball screws in a closed-loop system, it is isolated from chips and other contaminants. The temperature of the heat transfer agent

is monitored and chilled as required, maintaining the temperature of positioning components within ± 1.0 degree of the VMC's ambient temperature. This minimizes thermal expansion, ensuring consistent positioning accuracy whether machining details at the beginning or end of the shift.

Mr. Quinn said, "We have had no problems with thermal expansion. We might machine 20 details in a day. But we never have had an issue with thermal growth."

The obvious reason accuracy is important is for ensuring the accuracy of parts stamped with the progressive die. However, accuracy is also important because it reduces the time spent in the grinding department after the details have been heat treated, saving additional time and costs. Mr. Quinn said, "Because of the accuracy of the Fadal VMC's, details are chamfered consistently and automatically. That saves time in the grinding department. Traditionally on a die detail, the machinist will allow 0.010" to 0.015" per side for grind stock. Because we're doing it more accurately, we are able to leave less grind stock, i.e. 0.005" to 0.008". And because the holes are located exactly right in relation to the edges of the part, that saves time in the grinding process as well, because the operator knows that everything is central to the block. There's no error, less checking, so he can go through the grinding process much quicker."

Faster die assembly time can also be attributed to holding tighter tolerances. Mr. Quinn said, "We don't need to hold 0.0002", but it aids the process downstream, making assembly much quicker, because there is less manual intervention. When we put a die together, we do less fitting. We can assemble an entire die in two days, which used to take us a week due to all the manual intervention required."

Conclusion

The RDM die detail manufacturing system makes it not only feasible, but profitable to use CNC machining for progressive die details. The system has brought a

production level of efficiency to the process of making progressive dies. Mr. Quinn said, “With the combination of Fadal VMCs that have all the essential features to tie to and work cooperatively with our die detail manufacturing system, the real value is together we’ve opened a new application for CNC machining.”

Mr. Boelstler summed it up by saying, “The Fadal VMCs and RDM die detail manufacturing system is about three to four times faster than a manual mill. It’s the equivalent of four die makers. Basically, what it all comes down to is not only cost savings, we are getting hammered on delivery dates. We used to get 18-20 weeks to build a die. Now we’re getting 8-12 weeks. With this system, we can make the delivery dates.”