

The Traub TNL18 machine is well-suited to machining micro-parts in the tough material Oscor uses, including titanium and special steel alloys. The Traub allowed Oscor to run a key medical part from bar stock rather than milling blanks, saving a great deal of processing time on those parts. Oscor can also decide not to use the bar feeder when producing shorter runs and extreme tolerances to 0.02 μm .

To Swiss or Not to Swiss?

Choices lead to machining solutions for most small complex parts

Jim Lorincz
Senior Editor

Swiss-style CNC automatic lathes have long been synonymous with high-volume production of complex precision engineered parts, especially for the medical industry. Medical parts, both instruments and implants, that are machined on Swiss-style machines are long up 12–20" (305–508 mm) and slender with a 12–15 \times length to diameter ratio (L:D) from bar 10 to 32-mm diameter. Parts of this type require support with a guide bushing along their entire machining length to allow removing a large amount of material in a single pass.

Long slender parts typical of those for medical and even automotive applications account, however, for only about one-third of all the small complex parts that are available to be machined on CNC automatic lathes. The balance of these parts are short and can be machined closer to the headstock without either a guide bushing for support or ground or precision-drawn barstock needed with a guide bushing for consistent machining results. Most important, these small precision parts fit into the work envelope of CNC automatic lathes and benefit from the speedy cycle times, quality surface finishes and quick changeovers that are characteristic of Swiss machining technology.

Sizing Up Swiss Machine Advantages

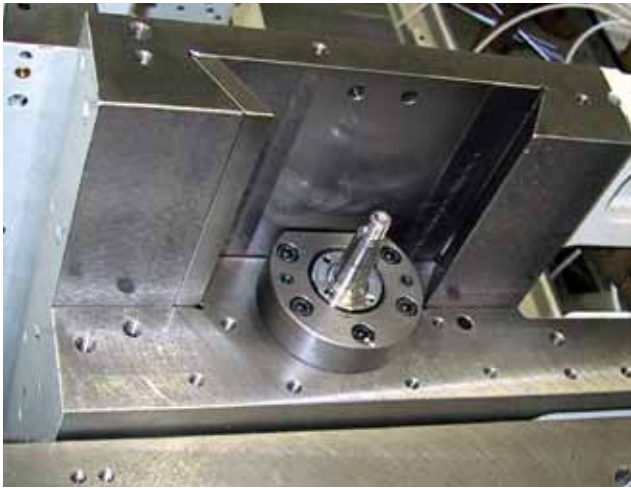
Job shops are increasingly becoming aware of the opportunities that CNC automatic lathe machining offers. Key considerations in making a machine selection include the complexity of parts, tolerances expected, and production

volume required. Swiss-style machine trends include being able to put multiple tools in the cut simultaneously using quick-change gang-tooling slides or multiple turrets. In either case, using turret or gang-style tooling, Swiss machines can be tooled up with enough tools for untended machining of the most complex parts and the toughest materials.

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Programming and setup, once thought to be barriers to adopting Swiss-style machining, have all but been eliminated by advances in software and machine design. What builder CNC controls and software can't supply is often, like 3D modeling and simulation, provided by third-party software. Machines can be equipped with readily available tools supplying a variety of machining capabilities including angular drilling (*B*-axis), deep-hole drilling, milling, tapping, thread whirling, and hobbing, high-pressure coolant systems, mist collectors, and other important productivity enhancing devices.

CNC automatic lathes with powerful main and subspindles and a mix of live and fixed front and back-working tools provide fast cycle times, dropping parts off complete. Standard tooling is readily available from suppliers today, making setup and changeover quick and easy compared with cam-driven screw machines. No grinding form tools are needed for these machines. With the variety of precision-engineered parts available for machining on Swiss-style machines, it's understandable why so many of the major machine builders offer variations of the technology with or without guide bushings and sliding headstock. Another group of machine builders have devel-



Construction features of the Nomura CNC automatic lathe improve tool life and surface finish in harder materials.

oped their own variations of machines that often have niche and special industry applications as their targets.

What Sets Swiss Machining Apart?

"The distinguishing characteristic of a Swiss-style turning machine is the sliding headstock that feeds bar stock through a guide bushing. This feature enables the precise, high-volume machining of many parts, especially those with small diameters. Because of the importance of accurate guide bushing positioning and spindle performance, how these components are crafted is vitally important to process stability," said Mark Walker, president, Gosiger High-Volume (Dayton, OH), which supplies Nomura CNC automatic lathes.

"The Nomura CNC automatic lathe isn't a broad-market machine. It's designed for two distinct kinds of applications: one in which the customer is running long production runs and must hold the tightest tolerances possible; and the other in which the customer is machining harder materials. Our advantage is that we can machine part features with accuracy, holding surface finishes that can replace grinding," said Walker. "The combination of heavy-duty ballscrews, propri-

etary heat-treating of the inside and outside of the spindle, dovetail construction of the guiding system and application of scraping techniques reduce vibration, improve precision and reduce wear," said Walker.

"The nature of Swiss-style machines requires a durable and true spindle. Because the integrated spindle is hollow, Nomura uses SCM415 chrome molybdenum steel. When precisely machined, the outside of the spindle is heat-treated for durability, while the inside is conditioned to a different degree of hardness. A fully integrated spindle without belt drive and a sliding headstock that employs a linear guide with preloaded roller pads, enables the headstock to move smoothly and accurately on a thin film of oil, minimizing vibration," said Walker.

Converting Swiss to Non-Swiss is Easy

Index Corp. (Noblesville, IN) offers Traub TNL series machines in both sliding-headstock and fixed-headstock automatic lathe versions, with and without guide bushings. The Traub TNL18-7B, which features a vertical bed design, has seven linear axes and an extra *B* axis. With the additional *B* axis in the upper tool carrier, which can pivot 100°, highly complex parts and complicated contour elements that also require additional operations such as milling, drilling, lateral drilling or threading can be machined at any angular position.

"The Swiss machine is the optimum for machining parts with a huge length-diameter-ratio. Besides this advantage, the Swiss machining has some disadvantages. One disadvantage of a Swiss machine is that you have to adjust the guide bushing with the right surface pressure from the bush to the bar," said Hans Koschig, Index Corp. (Noblesville, IN). "When I say the right pressure, I

mean the pressure from the guide bushing to the bar, which has to be adjusted properly for consistent machining performance. In the past, sliding headstock or Swiss machines were used for small precision parts, irrespective of the length-diam-

eter ratio. There were no small non-Swiss machines available. With the Traub TNL series machines, the operator can change over from Swiss to non-Swiss in 15 minutes and use the guide bush only when necessary for medical and automotive or other long parts,” said Koschig.

“It takes just a few steps to convert the Traub TNL series lathes from sliding-headstock to fixed-headstock turning mode and vice versa. The extremely long Z travel distance of the headstock ensures proper positioning of the main spindle. The powerful main spindle is equipped with a C axis as standard which delivers high torque to achieve large cutting volumes,” said Koschig.

Complex Parts Machined Complete is the Standard

“The B0326 32-mm Swiss-type machine can be quickly and easily converted from direct-drive guide bushing bar-fed operation to nonguide operation when fitted with the chucker kit option, making it well-suited for short or prismatic part

machining,” said Ron Gainer, Tsugami/REM Sales. The chucker option is increasingly popular for relatively short parts like hardware, fasteners, electrical connectors, and even medical parts like spinal hooks and short instrument products. The B0326 is equipped with modular live tooling for quick changeovers and a large, easily accessible tool zone. A dual path Fanuc 32i-B CNC reduces cycle time further by permitting true simultaneous operation of the main and subspindle.

“Complex parts machined complete in the Swiss world is nothing new,” said Gainer. “Software functions have made the machines easier to use, making much more complex parts easier and eliminating secondary operations. A lot has to do with advances in the machine platform, making them more modular, more capabilities that you can pick off the shelf and plug into the machine. Programming with Tsugami software and third-party software that offers solid modeling where required is easier and quicker,” said Gainer.

“Once you get a customer in front of the Swiss machine and remove the guide bushing they can see that you’re processing the part just like a lathe. In a gang-style machine, the tool is moved into position rather than a turret indexing. A tool indexes into position and you still go around with the same axes as a lathe with a Y axis. Tooling is arranged according to standards. Turning tools have a standard projection length, but they can be set with a small set gage, or there are features on the machine that allow you to set them right off the bar stock diameter. Everything is on a standard tool-point plane so that if all the tools are set the same, they have a zero offset, enabling the tools to be set very quickly,” said Gainer.

More Small Parts than Meet the Bushing

“Traditional Swiss is only one part of small-parts machining,” said Willie Eichele of the Ganesh Technical Center (Cuyahoga Falls, OH), which will provide complex turnkey and automation systems for Ganesh CNC automatic lathes. “When you say Swiss machining everybody wants to assume the utilization of guide bushings, but on the Ganesh Cyclone CS32 machine we’re sliding headstock we’re not Swiss. We don’t utilize a guide bushing. We typically feed the part out to length from the bar and then the headstock slides back and forth providing the Z1 axis. With traditional Swiss machining your collet or clamping device is located behind the bushing and you’re basically pushing and pulling your barstock through the bushing so there’s a difference,” said Eichele.

For long slender parts traditional Swiss machining with a guide bushing is absolutely a must, because you are bringing your cutting tool right up to the bushing providing the added support required for long slender parts. That said, Ganesh doesn’t build a bushing-style Swiss machine. If you go back 10 years or so, people started buying Swiss machines, because they have small work envelopes and gang tooling making them very fast acting. Twin-spindle machines that can drop parts off complete very quickly, the Swiss with the bushing was the only thing out there that could give them a fast cycle time. Today, most of the parts out there in screw machine shops don’t have the length versus diameter ratios that require the bushing approach. They’re parts that can support themselves and can be machined complete without a guide bushing,” said Eichele.

“So then everybody backed up and said let’s take the Swiss-designed machine with that small compact work envelope, use gang tools, get everything really tight in there so we can make

parts fast, get rid of the bushing, and that's basically where Ganesh started, making parts 1 3/8" [37.5 mm] and smaller without a guide bushing therefore not requiring ground bar-stock or long wasted bar remnants," said Eichele.

Medical Parts Get Precision Machining

Hardinge Inc. (Elmira, NY) is well-known for its Swiss turning components including Swiss-type headstock collets, pickoff collets, carbide guide bushings, bar loader collets and custom

manufactured solutions for Swiss turning. The Quest Super-Precision GT27 gang-tool turning center is well-suited for machining medical components for neurological, orthopedic, spinal/bone fixation, dental implants, drug infusion, catheter connectors, optical, maxillofacial, micro/minimally invasive, surgical instrument applications.

The GT27 is designed for machining small diameters, complex and tight-tolerance parts, and other challenging requirements, offering continuous machining accuracy of 0.0002" (0.005 mm) on diameter, part roundness variation of 0.000015" (0.00038 mm) and part surface finish of 8 µin. Bar work up to 1 1/16" (27 mm) and chucked parts up to 4" (102 mm) in diameter (using a step chuck) can be machined on the GT27.

The GT27 features Hardinge's interchangeable top plate and quick-change collet-ready spindle. The top plate secures to the dovetailed cross slide and is interchangeable for quick and accurate tooling changes that can be performed in under a minute. Pre-tooled top plates can be quickly interchanged within 0.0002" repeatability to produce a new part or family of parts. Hardinge's patented collet-ready spindle provides maximum rigidity and gripping power because the collet seats directly in the spindle with minimum overhang from the spindle bearings. In this design the spindle accuracy is transferred directly to the workpiece.

The SR-20RIV from Star CNC Machine Tool Corp. (Roslyn Heights, NY) features additional tool positions and



Swiss Turning for Medical

As many as 41 tools can be accommodated on the 27-position toolstation of the Star SR-20RIV, providing a variety of tools for any machining requirements such as: deep-hole drilling, full B-axis machining, with C axis on main and subspindle.

full B axis on cross working (three-spindle attachment) for machining of very complicated components in one operation. As many as 41 tools can be accommodated on its 27-position toolstation, providing a variety of tools for any machining requirements such as: deep-hole drilling, full B-axis machining, with C axis on main and subspindle. A specially designed tool-

post for back-working and Y-axis control function with eight tool positions and main and subspindles using built-in motor and sensor for improved indexing accuracy are featured. The result is reduced machining time and improved capability in an accurate rigid machine.

The new SW-20 Swiss-type automatic lathe from Star is equipped with software that enables complex components to be manufactured in the fastest possible times. This evolutionary new model was built to transform the productivity in complex machining, with mechanical and control systems designed to minimize noncutting time to the utmost level. The end result is improved production output, as well as greater profitability. The SW-20 also offers new functions such as manual handle retracing, program check, code and alarm help, among others, to assist the system operator. By giving the motor on the subspindle power equal to the main spindle, the SW-20 also enhances the freedom to program efficiently. Features include eight-spindle toolpost with Y-axis control function for back-end working and simultaneous machining by opposing gang slides (two tool turning-two tool milling/drilling). Electric drive eliminates hydraulic pressure, reducing idle time, and collets can be opened/closed even during high-speed operation. **ME**

Want More Information?

Ganesh Machinery Inc.
Ph: 888-542-6374
Web site: www.ganeshmachinery.com

Gosiger Inc.
Ph: 800-888-4188
Web site: www.gosigerautomation.com

Hardinge Inc.
Ph: 607-734-2281
Web site: www.hardinge.com

Index Corp.
Ph: 317-770-6300
Web site: www.indextraub.com

Star CNC
Ph: 516-484-0500
Web site: www.starcnc.com

Tsugami/REM Sales
Ph: 860-687-3400
Web site: www.remsales.com