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Turning to CNC

Overview of what's available in CNC lathes.

Let's say that your opportunity to increase shop capacity or replace high-maintenance equipment has come. Now you're looking at purchasing your first CNC lathe. Then the question becomes: "What type of lathe or turning center do I need?" It depends on the types of parts you produce.

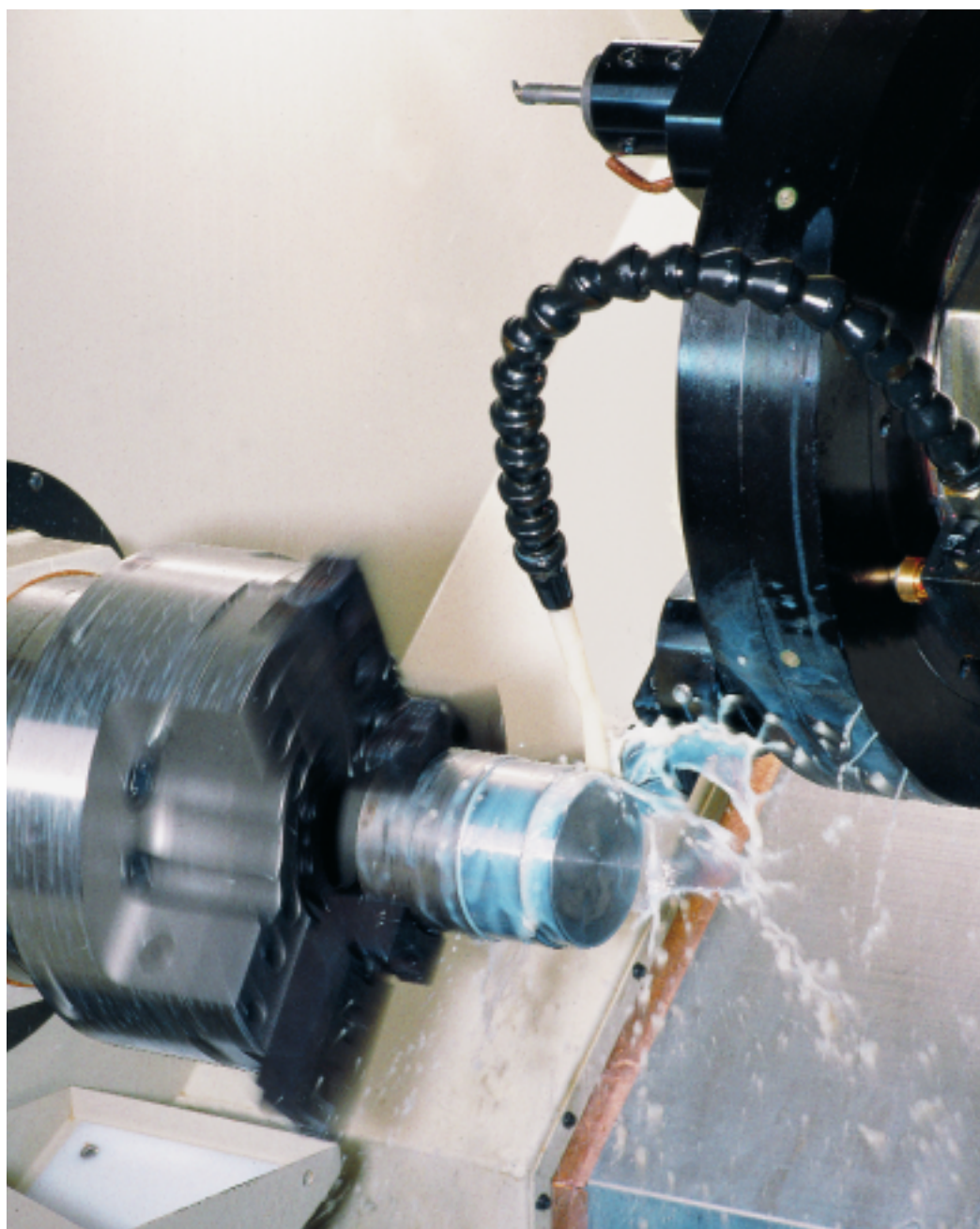
If you are machining prototype parts or small lots, for example, you may want to consider a combination lathe. Generally, they are for one-offs and short production runs. They offer a great deal of flexibility and are easy to set up.

But if your workload includes long production runs, a CNC turning center may best meet your needs. CNC turning centers also offer flexibility and ease of setups, but they are designed for low- to high-production runs.

There are many styles of lathes from which to choose. In the following pages, we review some of them.

Combination Lathe

A combination, or semiCNC, lathe can eliminate setups for threading, chamfering and profiling—operations that are generally time consuming on manual lathes. It is ideal for making the transition to CNC lathes since most training for a combination lathe



can be done in a day at your facility, including training workers in conversational programming.

The combination lathe resembles a manual lathe. It has handwheels for manual operation of the X and Z axes, a jog handle for manual power feed, a full splash enclosure on the backside and a limited-size, movable-front splash guard. A display screen provides a digital readout for positioning.

The toolpost can be a single, quick-change model, a 4-position turret or even an 8-position octagon turret. Tool-room lathes often fall into this category. Size for size, combination lathes are usually less expensive than their full CNC counterparts.

A combination lathe allows manual operation in the teach mode, conversational programming and full G-code programming. By allowing manual operation, operators have a sense of familiarity and control. While in the teach mode, the operator jogs the cutter into position manually, presses the set or input button, and the control records and stores that movement.

The conversational programming feature does not require the operator to know code to program a part. With pre-programmed cycles, operators can generate a part program. Typical cycles are for roughing and finishing profiles, grooving, threading, tapping and drilling. These cycles prompt the operator to input various commands to generate the proper paths.

A full G-code programming capability is available for offline programming by those who have the requisite knowledge. Typically, the machine tool dealer or builder offers the necessary programming classes.

CNC Turning Center

The term “CNC turning center” applies to several different types of machines. These units are totally enclosed and more expensive than combination lathes. Let’s look at several of them, moving from the simplest to the most sophisticated.

Bar machine or cutoff lathe. These units chamfer, form and groove, as well as cut off tube, pipe and bar stock. They are ideal for short and long runs and allow quick setups and changeovers. Typically, automatic feeders are stan-

dard on bar machines, so you can place large bundles of pipe, tube or bar stock in the feeder and run the machine unattended if desired.

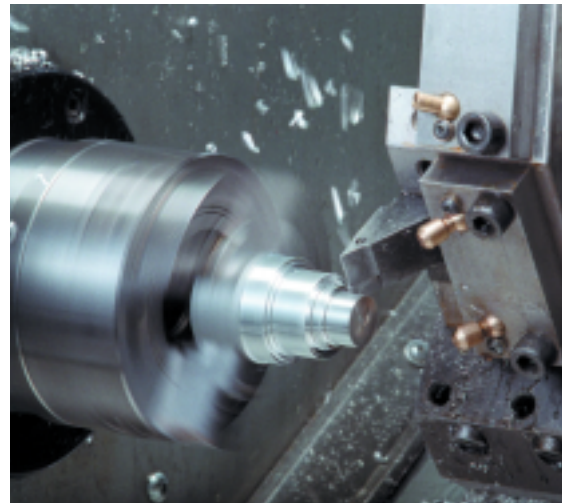
Swiss style. This type of machine uses a sliding headstock with stationary tooling to machine parts. A bar constantly feeds out of the spindle as a stationary cutting tool removes metal. By cutting as close to the spindle as possible, maximum workpiece and cutting tool rigidity are maintained.

The Swiss style provides a large number of tool stations and allows high rpm and feed rates. Therefore, certain parts can be machined more efficiently than on a traditional CNC turning center. The best candidates for Swiss turning are parts less than 1" in diameter and at least four times longer than their largest diameter.

Slant-bed turning center. The slant-bed machine is a high-performance unit—a marvel of technology. It offers positioning accuracy and repeatability in the millionths of an inch, with rapid-traverses exceeding 1,100 ipm on several models. In addition, some units come with 30-, 40- or even 50-hp spindles. They can rotate a workpiece at up to 6,000 rpm, depending on chuck size. Standard acceleration is from zero to full-rapid in 0.01 sec., with the turret indexing in less than 0.01 sec.

Slant-bed turning centers allow fast setups by incorporating precision turrets and indexable tooling. The turrets have eight to 12 tool positions and accommodate both ID and OD tools. The slant beds generally have a larger turning diameter than the same size flat-bed machine.

Twin-spindle turning center. This version of the slant-bed turning center is designed for longer production runs and is especially useful when machining the faces and backsides of parts. Upon completion of the first operation, the sub-spindle—instead of a tailstock—moves forward with its chuck in the open position and clamps onto the part. The main spindle releases the part, which is retracted to its new machining location. The rear of the part is then machined. This type of setup reduces op-



Heas Automation Inc.

The type of lathe you buy should depend on the type of parts you produce.

erator intervention.

Twin-spindle/twin-turret machine. Similar to the twin-spindle arrangement, this type of turning center has a second turret that allows you to simultaneously machine both ends of a part.

Turn/mill center. This machine, also known as a turning center with live tooling, was designed for part runs of 100 to 1,000. It may be equipped with a C-axis or Y-axis for cross-drilling, key-slot milling, producing bolt-hole patterns and other operations. It can produce very complicated parts.

Depending on the part configuration, a turn/mill center can eliminate secondary operations. It comes with a hefty price tag, though, so it is not for the faint of heart. These units can be very efficient and lead to high profits, but the performance-to-cost return should be weighed carefully. And, successful operation of a turn/mill center requires a functional knowledge of machine tool programming language.

Because of this requirement, turning center builders offer training in conversational programming, G-code programming and offline programming systems. Most builders, because of the level of machine sophistication, recommend up to a week of training at their facilities. Additionally, some include training in the base price of the unit; others sell it as an option. Of course, the buyer covers travel, hotel and meal expenses for trainees.

CNC Lathe Options

Choosing the right option(s) for your

CNC lathe is another important aspect of machine selection. Some of the most common add-ons builders offer are described in the following paragraphs.

Chuck. Most CNC turning centers come with a standard chuck. It may be a collet chuck or a simple hydraulic, 3-jaw chuck. Other types of chucks are available.

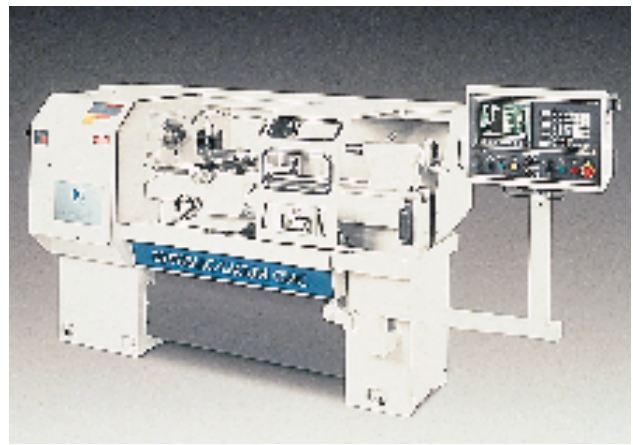
Bore size. Most combination lathes and CNC turning centers come with a standard through-hole. The size is dependent on the manufacturer. Bores larger than standard are usually available.

Touch probe. Touch probes deserve serious consideration. Some machine builders include them as standard equipment, especially with production CNC turning centers. As the touch probe swings in, the operator jogs the tool to the probe in the X and Z axes. Then the touch probe transmits tool length and diameter offsets to the controller, automatically eliminating any operator error. On some turning cen-

ters, the operator simply inputs what tool he wants to probe and an auto-cycle takes care of the movements.

Live tooling. Live tooling allows cross-drilling, key-slot milling, milling flats and so forth—the normal operations of the machining center. The motors that drive the live tooling can range from 4.5 hp to 7 hp or higher. They have a relatively low rpm and torque.

Tailstock. Although some manufacturers consider tailstocks to be standard items, they probably rank at the top of the list of options for both combination lathes and CNC turning centers. Interestingly, they are available in several versions: manual tailstock with manual



Republic-Lagan CNC Corp.

Ideal for small- and high-production runs, a high-performance CNC turning center can remove light to heavy amounts of metal on shafts or chuck-supported workpieces.

quills, manual tailstock with programmable quills, programmable tailstock with fixed quills and programmable tailstocks with programmable quills.

The first three types can be found on some combination lathes, as well as on CNC turning centers; the last one is typically found on CNC lathes. A manual

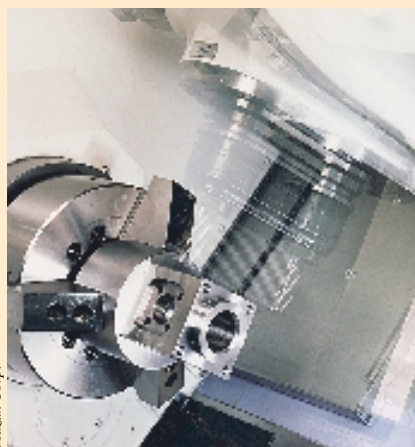
Benefits of a CNC lathe appear after the part is set up

The time needed to set up a CNC lathe may be a little longer than for a manual lathe because of the required programming time. But the benefits quickly become evident once you start producing parts.

With a combination lathe, for example, you still need to load and touch off your tools. But the actual run time increases dramatically. The automatic cycles run until the next tool needs to be changed, allowing the operator to stand back while the part is running. The operator can be deburring his previous part, programming the next part or getting other tooling ready. This can't be done with a manual lathe.

With a CNC turning center, you have programming requirements, but now the tools are preset in the turret. The machine can operate unattended if you are running bar stock with a bar feeder. The operator does not have to constantly be at the machine. He can be performing secondary operations or setting up and running another machine.

With a CNC turning center, there is less operator fatigue, since there are no handwheel operations in semiproduction or production runs, and the operator doesn't have to change



Mazak Corp.

A multitask machine with Y-axis capability offers the ability to produce complex parts, allowing a shop to broaden its customer base.

tools all the time. In addition, operator errors drop dramatically because he is not dependent on an indicator on the handwheel, and the machine has a high level of repeatability on subsequent parts.

Part productivity is another factor. With combination lathes and CNC turning centers, you can count on higher part yields and more consistent parts, because there is less non-cutting time than with a conventional lathe.

As a byproduct of this technology, you can machine more complicated parts in less time. A new CNC turning center can replace up to four conventional lathes. At the shop where I work, we have a combination lathe that has replaced four conventional machines. And some of the work we perform on it cannot be performed on a standard lathe without grinding form tools.

Newer and more productive equipment also allows you to broaden your customer base. Complex parts that you couldn't be competitive on before are now within your reach. This also allows you to charge a higher shop rate for your new CNC turning center, since it requires a higher level of expertise. All of this, in turn, allows you to take on more business so you can afford another CNC machine. And the cycle continues.

—M. Deren

tailstock with a manual quill is similar to the standard equipment on a conventional lathe. The manual tailstock with a programmable quill is slightly different. As with a conventional lathe, the operator slides the tailstock into position—some units can be pulled into position with the cross-slide—then he presses a feed button in the teach mode to program the required location.

A programmable tailstock with a fixed quill works the same way, except when programming the tailstock position, the quill remains extended and at a constant distance from the tailstock. The programmable tailstock/quill is programmed for position and, similarly, the quill is programmed to extend into the center-drilled hole. As a result, the tailstock and quill maintain a constant position in relation to the part.

Manual and programmable steady rests. These items limit deflection in long shafts. Combination lathes typically have manual steady rests, while the CNC turning centers have programmable units.

High-pressure coolant delivery system. With this option, you can use the latest coolant-through-the-spindle drills for deep holes and deliver coolant to the cutting edge for faster feeds, heavier cuts and better finishes.

Bar feeder. This is a popular option when floor space is at a premium. Full-length bar feeders handle 10' to 12' bars

and shorter units typically handle 4' to 5' lengths. These units—pneumatic or servo-drive models—feed the bar into the spindle. They can be programmed to feed a specific length or feed the bar into a hard stop for long run times without operator intervention. Some models handle round stock up to 5" in diameter.

Part unloader. With this option, the finished part drops into a little basket or tray and passes through a door in the machine as the machining cycle continues. More complicated models incorporate a gantry and picker arm.

Chip conveyor. This can be a convenient item. It is built to remove chips automatically, dumping them directly into a disposal container. A conveyor eliminates the operator having to stop the machine and shovel out chips.

Obtaining Quotes

The preceding information is meant to help you determine which machine and option(s) suits your present needs and projected growth. After a review of vendor literature, you can narrow the field to between three and five models. Contact the vendors



An automated part loader is a popular option. Shown here is a multitask machine and a part being picked up by one of the machine's loaders (insert).

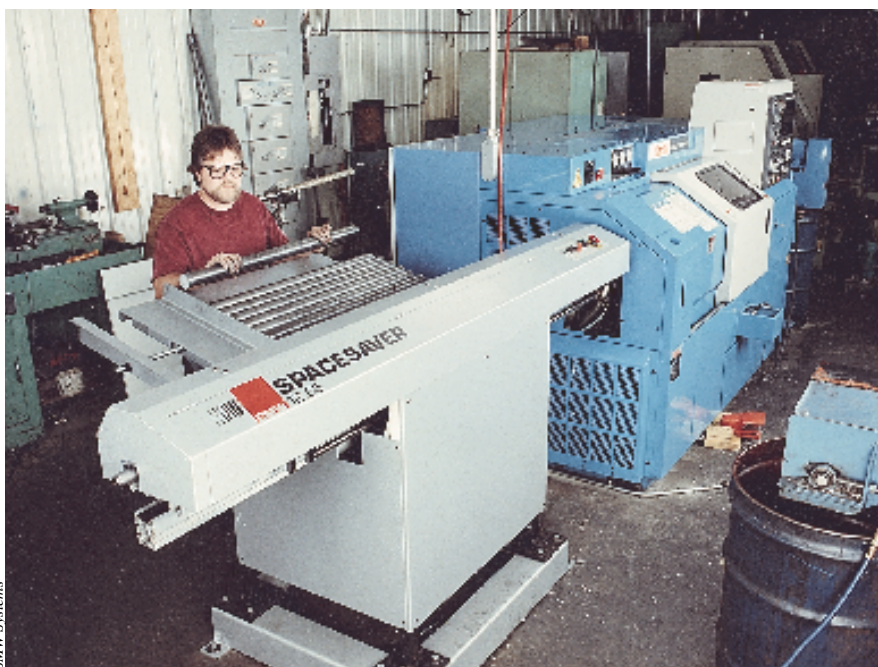
and have them quote the base machine and options separately.

As the quotations come in, enter the information on a spreadsheet. Across the top row, enter the descriptive information on the quoted makes and models you have collected. Then, list the standard features and specifications in the column below each model that's under consideration. On the next row put the base prices. At this point, you might think the base prices indicate which machine you should buy. But wait.

Next, list the options and highlight which ones you know you'll need and include the prices. You'll probably find that some items are standard on some machines and not on others. And you just might find that when all the costs are totaled, your "dream machine" isn't the one with the lowest base price.

About the Author

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Short-bar feeders generally feed bars up to 5' long.