BY KIP HANSON

Roll Your Own

Thread rolling can save time and money—and lead to the production of better parts.

Ask a typical machinist what he or she knows about thread rolling and the answer probably will be "not much."

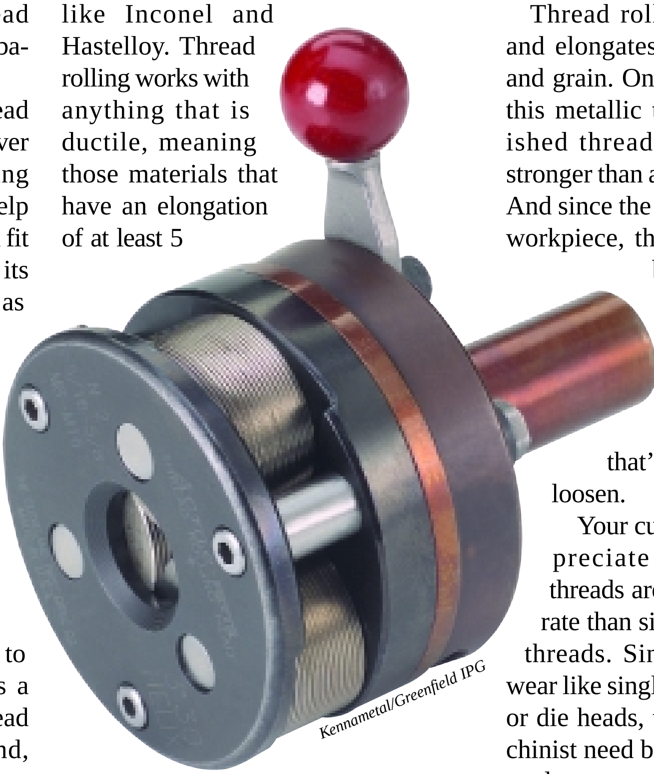
That's unfortunate, because thread rolling offers several advantages over more conventional, chip-generating methods of producing threads. To help you decide if thread rolling is a good fit for your shop, let's look at some of its benefits—and drawbacks—as well as the equipment needed to perform the operation.

What It Is

Thread rolling is a cold-forming process in which metal is displaced—formed—at room temperature. The material is formed into a helical shape, creating a strong, smooth and accurate thread.

There are a number of advantages to thread rolling. First, because it is a forming operation, the resultant thread is stronger than a cut one. Second, there are no chips produced, relieving shops of the need to collect and dispose of them. Third, and most importantly, thread rolling produces threads fast. In some cases, 10 to 100 times faster than more traditional methods. No kidding.

In addition, thread rolling can generate a variety of both right- and left-hand threads, including Acme, knuckle and taper-pipe styles. You can roll thread diameters from 1/16" to 9" in a variety of materials—stainless and carbon steels, brass and aluminum—even nasty stuff like Inconel and Hastelloy. Thread rolling works with anything that is ductile, meaning those materials that have an elongation of at least 5 percent and a tensile strength below 246,000 psi.


Kennametal/Greenfield IPG

While I'm no metallurgist, I can tell you that about the only materials you *can't* thread-roll are hardened steels (greater than 40 HRC), certain brittle cast irons and full hard brass and copper.

The reasons are simple. As mentioned earlier, thread rolling works by shaping metal like a potter molds clay, which is why any metal suitable for thread rolling needs to be somewhat elastic.

Thread rolling also compresses and elongates the metal's structure and grain. One of the benefits of all this metallic torture is that the finished thread is up to 30 percent stronger than a single-pointed thread. And since the tool's rolls burnish the workpiece, the surface finish is far better than what is achievable with single-point threading. The smooth finish results in a part with a better-fitting thread that's easier to tighten and loosen.

Your customer should also appreciate the fact that rolled threads are generally more accurate than single-pointed or chased threads. Since thread rolls don't wear like single-point threading tools or die heads, the only thing the machinist need be concerned with from a tolerance perspective is controlling the preroll size. A 0.001" difference in the preroll diameter will change the finished-pitch diameter by around 0.003"—a 3:1 ratio.

What You Need

So what do you need to roll threads? One option is to buy a dedicated thread-rolling machine. If you already own one, you can stop reading right now, because you probably know all you need to about the operation.

If you don't own such a machine and can't cost-justify one, you can equip an existing automatic screw machine or CNC lathe with a rolling head.

Three basic types of heads are available: tangential, radial and axial. Each is unique and has pros and cons.

Thread rolling with a tangential head is similar to knurling. As the spindle turns, the part's preroll diameter is progressively raised to its final shape over the course of 20 to 30 spindle revolutions. A tangential head rolling a ¾"-long, ⅜-16 thread at 1,200 rpm would take about a second. Single-point turning the same thread, by the way, could easily take 10 times as long.

Radial heads are similar to tangential heads in that the workpiece is usually approached from the side, perpendicular to the long axis of the thread. And, both radial and tangential heads are limited to thread lengths no greater than the width of the thread rolls.

The primary difference between radial and tangential heads is that radial heads form the finished thread in one revolution—not 20 or 30 revolutions. This makes them the fastest of all the rolling heads. With the spindle turning at 1,200 rpm, a ⅜-16 thread is formed in less than 0.5 seconds.

Axial rolling heads engage the workpiece along the machine's Z-axis. Their action is analogous to a threading die or thread chaser, traversing from one end of the workpiece to the other. They are the only rolling heads capable of making very long threads.

Also, the axial head supports the workpiece during the threading operation. This eliminates the need for tailstock support.

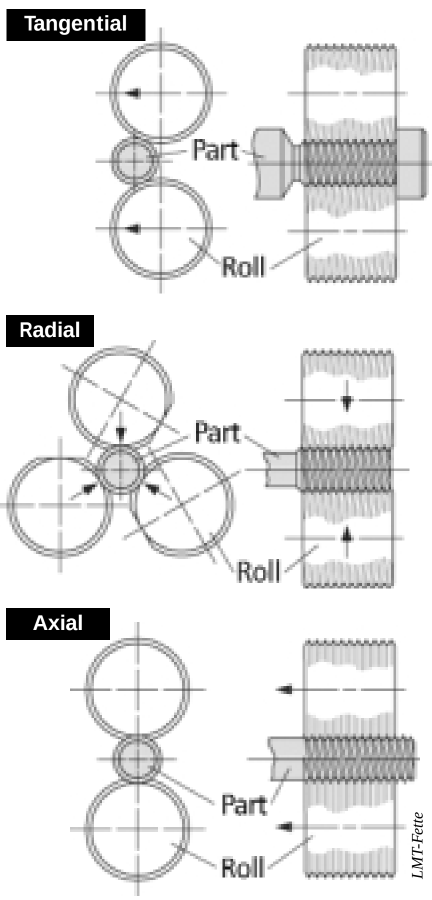
The Catch

OK, thread rolling is very quick and leads to the production of good threads. So what's the catch?

Well, for starters, thread-rolling heads have a high upfront cost. Starting in the $1,500 to $2,500 range, they can represent a hefty investment. However, as will be shown later in the article, that money can be recouped with the right job.

Secondly, because rolling heads have a limited range, they're not one-size-fits-all tools. Thread-roll insert sets start out at around $200 each and, like a die or tap, you need one set of rolls for every size thread. So even if you buy a shiny new head for cranking out 20,000 widgets with a ¼-20 thread, you'll need to buy a bigger head for the ⅝-16 threads on the 10,000-piece order for supersize widgets you've got to fill next week.

(There's a bright spot to the rolling head's changeable nature, though. In addition to rolling threads, a head can also knurl and spline by simply changing out the rolling inserts for, say, knurling ones. So if this week you're making ⅜-16 threads, next week you can make straight knurls, and the week after that you can roll-mark—all with the same head.)



Tangential thread rolls are fed from the X-axis, at a tangent to the workpiece. When the centerline of the rolls line up with the centerline of the workpiece, the process is complete. Radial rolls are spring-loaded. When they are brought over the workpiece, the tension is released, causing the rolls to rotate and produce a thread in one revolution. Flats on the rolls allow for work to be inserted and removed. Axial thread rolls approach the workpiece from its front, along the centerline.

What other potential stumbling blocks lie ahead for would-be thread-rollers? Power. All three methods of thread rolling require substantially more power—on both the spindle and axes drives—than single-point threading.

In response, thread-roll-equipment manufacturers publish tons of spindle- and axial-thrust formulas in their technical manuals to help you determine if your machine is up to snuff. But, usually, a quick perusal of the examples sprinkled throughout these manuals is enough to give you a good idea if your machine can do the job.

One manual, for instance, reported that a radial head rolling a ⅝-16, ¾"-long thread in steel would require roughly 5 hp at the spindle. This is well within the capabilities of most spindle motors. But be careful. Even if your machine could produce such a thread, it might not be able to roll a 1"-long Acme thread in Hastelloy.

The point here is that it's a good idea to evaluate your machine's capabilities before plunking down a couple grand for a rolling head or quoting a job based on false assumptions.

Here's another thing to consider: Most heads have to "open up" after the threading operation is completed. This means that a reset procedure is required after every part. While this can be as simple as the operator reaching into the machine and tripping the dog, stopping the machine after every cycle defeats the purpose of automated machining.

One fix to this problem would be to mount a doohickey of some kind—a piece of angle iron will do—somewhere in the machine, then program the thread roller to swing over and bump up against it, thereby resetting the dog. It's crude, but effective.

Of course, a more elegant solution would be to mount an air cylinder in the machine and activate it at the appropriate time with an M-code, causing the cylinder's piston to extend and reset the dog.

The Payback

With all these thread-rolling cons seemingly outweighing the pros, why even consider rolling threads?

Let's return to our hypothetical order for 20,000 widgets. Assume it takes 10 seconds to single-point-turn a ¼-20 thread. At a shop rate of $60 per hour, the spindle time to thread those widgets would cost you over $3,300. Changing worn threading inserts every 200 parts means you would need 100 inserts at, say, $9 a pop. That adds $900 to your costs. Plus, it takes 5 minutes to change an insert—stopping the machine, measuring the thread and making offsets—which adds over 8 hours of run time to the job. The grand total comes out to $4,680 to single-point-thread those 20,000 widgets.

Now, let's conservatively assume it takes 1 second to thread-roll each of those parts. The spindle time for the operation equals 10 percent of that for single-point turning, or $330. A set of ¼-20 thread rolls, which should last the entire job, costs around $200. The rolling head itself comes in at $2,000. And since thread rolling is usually just a set-up-and-forget-it operation, there's no downtime for insert changes. The total thread-roll investment is $2,530, a savings of over $2,100. And, you've paid for the head. Thread rolling wins!

Sure, this may be an oversimplified example, but it shows you the money-saving potential that thread rolling offers. That, coupled with better part finishes and a rolling head's versatility, make thread rolling an attractive alternative.

About the Author

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