Technology

How to Improve Your Machine Shop's Grinding Operation

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What You Need to Know:

Because grinding is often the last operation before shipping, a backlog in the grinding department impacts overall throughput, and low efficiency hurts the bottom line.
You will need a spectrum of grinding wheel options for the variety of material type, hardness levels, and different part sizes, shapes and features.
Water-soluble fluid does an excellent job at cooling the workpiece but is not a great lubricant, which is why fluid manufacturers add EP (extreme pressure) compounds such as sulfur and chlorine to the mix.
Grinding is an iterative process. While there's a lot of good advice out there, grinding optimization is about testing and documentation.

Inefficient grinding operations hurt the bottom line. Learn how and where you can smooth out your grinding operation for maximum impact on time and materials.

You may have heard something similar to this over the course of your machining and manufacturing life: Grinding is a black art. No matter how good the equipment, the wheel or the fluids, a certain amount of "wizardry" is needed to produce the desired results. Much has changed over the years in technology and technique, so grinding is not really considered a well-executed magic trick anymore. But there are still aspects of grinding that require research, smart planning and old-fashioned trial and error to reach finished product and delivery objectives.

Unfortunately, unpredictable grinding processes can affect other parts of the shop floor. Because grinding is often the last operation before shipping, a backlog in the grinding department impacts overall throughput. Scrapped parts here mean scrambling to turn and mill replacements. And because CNC grinders are some of the most expensive machine tools in the shop, low efficiency hurts the bottom line.

Embracing Cylindrical Grinding and Grinding Wheels

Take cylindrical grinding: Anyone making shafts, splines, gears or impellers is familiar with this type of grinding. The smart shops are those that are grinding parts in-house, where they have the greatest

control over price and delivery and are on the cutting edge of technology use—such as aerospace and medical device and parts operations. Yet these shops are exactly the type most likely to agree with a "magical" opinion of grinding: Unless in-house grinding is all you do, you probably won't be on the cutting edge. The good news in this case is that there's plenty of low-hanging fruit to improve grinding operations.

The Benefits of Creep-Feed Grinding

Grinding has long been known as a relatively slow metal removal process, often taking just a few "tenths" per pass and therefore reserved for semi-finishing and finishing operations. But what if there were a way to hog out large amounts of metal on a grinding machine? Wouldn't this eliminate a lot of the upfront work done on lathes and machining centers, substantially improving profits and decreasing part lead time?

As it turns out, there is: It's called creep-feed grinding. As you might guess from the name, it involves burying a grinding wheel in the workpiece up to an inch or so deep and then "creeping" along at a feed rate much slower than traditional grinding (but still moving along at a pretty good clip). There's little magic involved—no special abrasives or super-strong wheel bonding (although ***CBN and diamond wheels*** are often used), just a very rigid machine tool and plenty of grinding fluid to carry away the swarf.

Creep-feed grinding competes with traditional machining processes, except that metals such as hardened steel, Inconel, and other superalloys are cut with relative ease, making it a favorite among aerospace manufacturers and others producing complex part shapes in challenging materials. One word of warning, though—don't try this at home. Creep-feed grinders are specialty machines, designed specifically for the heavy spindle loads and precise axial control necessary for this demanding process. But for the right part, creep-feed grinding might be just the ticket.

Start with the ***wheel***. The bewildering array of grit sizes, bond and abrasive types, grain structures, and hardness grades found on any wheel manufacturer's website or catalog is not a bunch of marketing hype. If you grind many different material types, at different hardness levels, in different part sizes, shapes and features, you will need a spectrum of grinding wheel options. With grinding wheels, more than anywhere in manufacturing, there's no such thing as "general purpose."

Keeping Your Grinding Operation Cool with Machine Lubricant

Grinding fluid is equally important. So-called neat oil is the most lubricious, reducing friction and therefore heat, but it does a poor job of removing whatever heat does remain. This can negatively impact part accuracy. Water-soluble fluid does an excellent job at cooling the workpiece but is not a great lubricant, which is why fluid manufacturers add EP (extreme pressure) compounds such as sulfur and chlorine to the mix.

Here again, there is no all-purpose fluid, although water-soluble is probably the closest. Further complicating the discussion is the type of wheel being used—resin-bonded wheels, for example, work

best with oil, whereas a coarse, vitrified wheel almost always thrives on water-based fluid. More important than the type of fluid, however, is how you filter it: If you're pumping muddy water through your grinding machine, you might as well go home for the day.

Keeping Track of Your Grinding Operation: Document What Works and Take Advantage of Technology

Everything you just read applies equally to surface, centerless and internal grinding. Whatever the application, let's assume for a minute that you have the perfect wheel and your grinding fluid is cleaner than a G-rated movie.

Can you answer the following questions?

- What's the proper infeed amount?
- How fast should I traverse?
- What's the right surface speed (that is, rpm) for the grinding wheel and material?
- Do I have enough spindle power?
- How long should I spark out?
- How often and how much should I dress the grinding wheel?
- What did we do last time to make it work?

It's this last question that might be the most important, and it is the easiest to resolve. Grinding is an iterative process. There are simply too many variables to make a best guess and cross your fingers. And while there's a lot of good advice out there, optimization is about testing and documentation.

Keeping track of a job's final operating parameters, as well as what was tried, what worked and what didn't, doesn't have to be a big deal but it is important. You should document it electronically rather than on paper—in a spreadsheet or Word document—so that you can search through your notes. Better yet, ask your grinding machine builder if there's a software package available (often called a management suite) for this task, or see if there's any way to put the information into your company's ERP system (you do have an ERP system, yes?).

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And if by any chance you're looking at a new CNC, ask about its Industry 4.0 and Industrial Internet of Things capabilities. An increasing number of CNC grinders (and all machine tools, for that matter) are getting "smart." Remote monitoring with text and email alerts is fairly common. Onboard sensors to track machine temperature, power consumption, wheel usage and identification—these and other sources of data promise to eliminate process variability, improve part quality and productivity.

There's a brave new grinding world on the horizon. Maybe it's time to explore it.

How do you get the most out of your shop's grinding operation? Share your best practices.