What Machinability Means Depends on Where You Are

By Miles Free – Director of Technology and Industry Research

I lived in northern Georgia for five years, and whenever questions of distance came up, the answer was always "miles." Sometimes, it was qualified by, "as the crow flies." When I returned to Ohio after my Georgia assignment, I was amused to learn that questions of distance were almost always answered in terms of time, such as "that's about a half an hour away." That is a typical Ohio response.

I am often asked my opinion about a material's machinability, and I have found that I have to assess the person's motivation, job title and location before I can answer the question. I often find, when listening to managers and estimators here in the U.S and Canada, that they tend to answer the machinability question with "cycle time," which, since it is derived from both material and the configuration of the part to be produced, can lead them to a conclusion that is not 100 percent correct.

Some engineers are satisfied with surface feet per minute, as they can compare that to other materials and jobs they have run. Others ask, in the case of steel, as a percentage of 1212, or in the case of brass, compared with C36000 (360 Brass). Surface feet per minute is one factor in calculating cycle time and distinct for each material, but it is surely not the whole picture.

On some of the more difficult-to-machine alloys, the question of, "What is its machinability?" is best interpreted as, "How bad will my tool life and downtime be?" That is, unless it is an actual machine operator. The most experienced machine operators always ask, "What are the chips like? How will they behave?"

So what do we mean when we say machinability? What is it that others mean? What is the truth that we really seek? What do we really want to know, and where can we find that?

In this case, how we answer is dependent on our location, just as being located in Georgia or Ohio gave us clues as to how to best describe distance.

Purchasing

If you're located in the purchasing office, machinability is a presumed attribute of the material required and of no apparent consequence. Price per pound and delivery are the sole concerns. And yet, purchasing decisions can have a profound effect on machining performance. Changing suppliers in search of lower cost per pound or faster delivery

changes the material and the way it performs in your shop processes. Different suppliers use different recipes, processes, practices and technologies to deliver a bar that meets the broad requirements of the specification. But your shop may be optimized in one narrow band of that specification. Shopping for price rather than aiming for supplier stability throws the variation of the entire world at your shop people to deal with. Limiting suppliers for each item is the best way that purchasing can assist the shop in achieving its goal of consistent, efficient machining.

Shop Supervisor

If you are the shop supervisor, you don't just have one material to deal with. You have many. You are looking for simplicity and stability in a complex world. For the shop supervisor, it is the ability of the material to travel through the shop, starting as bars and ending as parts with the least amount of aggravation and trouble needed! While that implies the machining performance of the material, for the supervisor, a host of other deliverable attributes can, if not properly provided, sabotage his version of machinability. If the packaging is wrong, if tags are missing, incomplete or illegible, then the amount of aggravation and trouble increase and the supervisor loses production. Are missing, incomplete or illegible tags a factor for machinability? Unexpected downtime is not a positive for machinability in the shop. Dimensional variance, lack of straightness and deformed ends of bars are not machinability issues, per se, and yet, they cause the operation to slow down, be delayed or take extra time to produce, not counting the extra efforts needed for inspection and product validation.

Continues on page 20

Continued from page 17

What Machinability Means Depends on Where You Are

On the Machine

In my experience, the machinist has a more expected definition of machinability, and that is ease of producing a chip with consistent dimensions and surface without leaving a burr, while making a part to print. This is characterized by higher speeds, feeds, efficiency and shorter cycle times and consistent tool life. When discussing machinability with the machinist, surface feet per minute is usually one of the first ideas to be discussed, but if the depth of cut and feed per revolution are wrong for the material, excessive downtime for tool adjustment, regrind or replacement will affect their ability to make conforming parts at the rate quoted. At the machine, the SFM, feed rate (IPR) and depth-of-cut factors enter the conversation, as they are considered against the particular demands of the operation and their interaction with the tooling selected (base material, coatings and geometry), the metalworking fluid used, and the level of maintenance on the machine and its workholding.

In the Estimating/Engineering Office

This is where making sense of the material has to take place if the shop wants to be successful. The engineer/estimator gets out the calculator and determines, using those speed, feed and depth-of-cut factors, the machining time needed to produce each and every feature on the part. It's simply how many revs at what removal rate per rev is needed to create this feature. Move to next feature and repeat. If only it were so simple! The reality is the estimator/ engineer has the experience and tribal knowledge to apply pragmatic adjustments based on their experience with all of the above.

The estimator/engineer might think, "If the material comes in from supplier A, the bars are straighter and the dimensions are consistent, so we can use the high side speed and feed," or, "That runs on the machine that has the sloppy spindles, so we can't push it. If we had better workholding, we might be able to get that job running even faster, but the order quantity is too small to justify higher precision collets."

And frankly, that is just to quote. If the customer accepts the quote, now we have to make it work!

The Boss's Seat

As a supplier of bars to thousands of customers, I've seen the view from the boss's seat. "Your bars are burning up my tools, which is bad machinability," is the view from the boss's seat. The fact that his new machine operators hadn't changed a rough form in two weeks and only changed the finish form tools when they were close to failing were somehow a machinability factor of my product. Or, the fact that his team had been used to machining an inexpensive, high-nitrogen, mini-mill steel, but because of delivery or price incentives, his buyer chose to buy my low residual, low nitrogen BOF steel, which cuts totally different. Well, somehow that is a machinability problem, not one of purchasing or engineering. But the message was still important. The boss wants to see those bars turned into conforming parts in the time we quoted with minimum fuss throughout his operations.

What is the proper definition of machinability for our organizations, or the definition that applies wherever we are in our organization? I would suggest that machinability is promoted by the decisions that best align the properties of the material with the priorities of the operation to assure minimum issues with unexpected variation, providing consistent predictable performance and minimized downtime. It is not necessarily the cheapest, nor must it be the most expensive material. It is, I am certain, a product of consistent sourcing from companies with consistent and in-control processes and practices. And it is not just speed, surface feet per minute, or the percentage of 1212, though those can be factors. But if the tooling, workholding and machine maintenance are merely up to standard, tell me, how can you expect better than standard performance from the material and from your machinists? Aligning every position in our companies to make decisions that optimize production, reduce variation and minimize downtime is the real job of the person in the boss's seat. I hope this article gives you some ideas regarding the conversations you need to have.