Difficulty Machining: Shop or Office Problem?

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Machining difficult materials is a challenge that shops are increasingly facing these days as traditional free machining materials are not being selected for the higher-performance, higher-engineered applications in technology today.

When difficulty arises on the shop floor as a result of the change to these more difficult-to-machine materials, do we rush to judge the problem as being operations' fault? Or do we have the organizational depth to understand that the issue, while up to the folks in the shop to solve, may in fact be the result of a compounding of errors and lack of knowledge from the office that took the order?

Was the quote right?

When the engineers made the estimate, they used the best factors available. That does not mean that they were the correct factors, just that they were the best available. For some materials, like carbon and alloy steels, unit-horsepower values are a function of both feed rate and Brinell hardness. At 0.005 inches-per-revolution of feed, alloy steels typically require 0.86 of a horsepower-per-cubic-inch of removal per minute. At 160 Brinell, they need about 1.02 horsepower-per-cubic-inch per minute. At 240 Brinell, that horsepower-per-cubic-inch per minute figure jumps to 1.25. However, for other materials, such as austenitic stainless steels, hardness does not provide a reliable means of estimating speeds or horsepower required.

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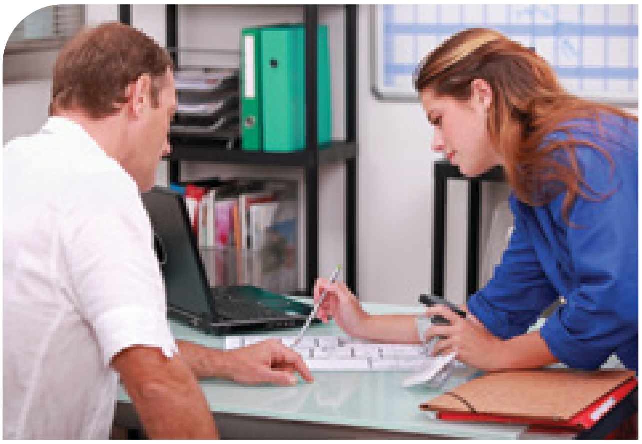

How did the estimate for the cycle time compensate for the horsepower requirement for the new material? While it may have been the best available estimate, that does not mean that it is accurate or correct.

Is it tooled right? What about the work holding? Is it on the "right machine?"

My definition of machinability, and probably that of most shop owners, is "the ability of the material to travel through the shop, starting as bars, ending as parts, with the least amount of aggravation and trouble to the machine operator." I am proud of my production bias.

However, the folks in the office are often measured to a different standard. Often that standard is created by accountants and involves the constant reduction in the price paid for tools and supplies purchased for use in the shop. We understand not wanting to overpay for tools and supplies. But we can also see that the pressure to reduce costs could also be a contributing factor to the failure of the shop to get the number of parts produced because of lower efficiencies and increased downtime for tool replacement, or putting the job on the wrong machine. Many buyers are measured, and rewarded, by this standard: "Lowest price that meets specification. If it meets my spec and costs less,

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that's what they're going to get to work with." If we can make it on a cheaper machine, do we really make more money?

We understand the need for cost controls, but who is charged with determining the increased efficiency, uptime or productivity gains by upgrading tooling, work holding or machining? I can tell you when I visit a leading shop that someone there is a "profitability engineer" who is making exactly that case to engineering, purchasing and management. They act as the voice of the process. Do you have one? If you had one, would you listen, or would you fight them and let them go? Who is your profitability engineer?

"There is no doubt that the shop people are closer to the problem. But is it their problem?"

Was the material purchased right for your process?

I travel across North America giving presentations about metallurgy for machinists. I focus on steel, but I don't spend a lot of time talking about ferrite, or pearlite, or martensite or other technical terms. What I try to share is an understanding of how to characterize material when being cut or cold worked as either "ductile" or "brittle." And then I discuss all of the process steps in the material's history from original melt, casting, hot rolling, cold finishing and processing that can "tip" the material into behaving in a more brittle or ductile fashion. And what that can mean for machinability in shop processes.

It is true today that we have lost options in North America to source bar steels from basic oxygen process shops. There can be significant differences between the remaining electric furnace shops and the way that they provide steel bars. There can be chemical differences at the residual element level between all other melt shops, as well as differences in nitrogen levels. Differences in deoxidation practice and capability, bloom or billet size, and the resultant differences in hot work during hot rolling and reduction ratio. Cold finishers' processes can differ in cold-working practices (light, standard or heavy draft) and in how they straighten the bars which can also influence a material's mechanical properties and behavior while being machined.

It's not necessarily better or worse, just different.

When the material today behaves differently than the material from a different batch machined previously, who knows what the implicit process differences might be in the new batch that can explain the different response to your machining method? Even if the material came from the same vendor, such as a service center, who knows if it was produced to an identical process path as the earlier batch? Was it the same melt shop, bloom size, reduction ratio, residual scrap practice, nitrogen level, cold finisher? Was it also produced from straight bar or coiled hot roll, same or different draft and straightening method?

There is no doubt that the people in the shop have to solve the production problem that each new batch of "difficult" material presents them. That does not mean that they caused the problem. It certainly does not make the shop the problem. If we can look honestly at the systems of procurement and estimating and creating shop process layouts, we can find plenty of opportunity to improve "what we know" and deploy it better to reduce the downtime and tool failures in the shop while improving uptime and efficiencies and lowering the cost per conforming part produced.