Understanding Steel Material Specifications on New Jobs

By Miles Free – Director of Industry Research and Technology

One of the most important aspects of successfully quoting and running a new job is to fully understand the material specifications of the material to be machined and its impact on your operations.

What is it We're Going to be Machining, Exactly?

Sure, we know what it is.

You get a phone call. "Can you run a job in 1045 steel?"

"Sure, no problem!"

"No problem? Really?"

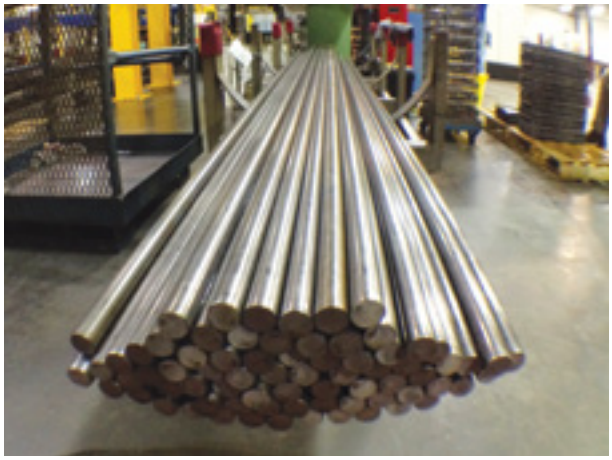
What if the 1045 was hot rolled, not cold drawn? What if it was normalized and covered with a dark, heavy mill scale? What if it was turned and polished, rather than cold drawn?

Material is more than a grade and size. Yes, the grade is the primary determinant of the size and other tolerances, but so is the process and condition/thermal treatment of the steel. For example, hot rolled tolerances are wider than those for cold drawn material. And the tolerances for cold drawn can change depending on thermal treatment as well. The length of the steel bars can determine which straightness specification the material will need to meet, and this can impact your ability to hold tolerances and relationships on the parts you manufacture.

For a 1 1/16 inch round 1045 steel bar, the tolerances for hot rolled product (which you would not want to machine) would be +0.010 inch, -0.010 inch, and 0.015 inch out of round. Try holding that in a collet, even without considering the abrasive scale that covers the bar.

For a cold drawn 1045 bar of the same dimension, the size tolerance would be +0.000 inch, -0.003 inch. And the out of round would be no more than one half the dimensional tolerance, or 0.0015 inch. That is far easier to hold in your equipment.

Bar straightness is also determined by whether or not the material is hot rolled (¼ inch in 5 feet, "about as straight as a pork chop bone," according to one setup man I met back in the day) or whether it is cold drawn and then by length and thermal treatment. That bar of 1 1/16 inch round 1045 steel,



depending on whether it was ordered over 15 feet or less, and whether or not it is thermally treated, could be delivered with straightness of either 3/16 inch in 10 feet or 5/16 inch in 10 feet. You would never be able to run at commercial production speeds with the hot roll straightness tolerance of ¼ inch in 5 feet!

Cold Finished or Cold Drawn

Many folks in our industry use these two terms interchangeably. While it is true that all cold drawn bars are legitimately referred to as "cold finished," not all cold finished bars are cold drawn. A cold drawn bar has been drawn through a die to impart cold working strain, which changes the material's mechanical properties, resulting in generally improved machinability. Turning and polishing will result in achieving the same "cold finished" dimensional tolerances, but will not alter the mechanical properties from the hot rolled condition. This means that the turned and polished (cold finished, but not cold drawn) material will not yield as nice a surface finish and may require more horsepower and result in poorer tool life than a comparable cold drawn bar.

Special note: In some cases, the customer will arrange to furnish material. We are seeing this more now because of the tariff issues making material supply problematic at best. It is critical that you get full disclosure from your customer as

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to the material's condition, hot rolled, cold drawn or turned and polished. You should also ask about length and thermal treatment at a minimum just to be able to understand the machining performance you could expect.

Where Did it Come From and What Does that Mean

Understanding our supply base is another important aspect of being able to successfully quote and run a new job. If our shop traditionally runs materials from electric furnace billet cast suppliers and suddenly gets a lot in from a basic oxygen furnace, bloom cast supplier, they are likely to notice differences in machining performance, or post machining processing such as response to cold work operations, crimping, staking or swaging. Knowing what your shop's baseline for supply is will help you calibrate what to expect when material from a new supplier with different processes is suddenly on your shop floor.

Specifications are Not Only to be Used Against You

You can minimize the pain and distraction on your shop operations by using specifications to assure that you maintain complete control over the incoming steel to your shop. No scaly, crooked hot roll for you! No gummy T&P, "But I ordered cold finished boss," that looks shiny and bright, but actually cuts gummy, slipping in your collets and requires more horsepower to separate the chip.

The customer specification is always written to assure compliance with their needs. But what can you do to ensure that the material is optimized for your shop operations? Here are a couple of thoughts. To ensure best machinability of non-resulfurized steels, ask for 0.020 wt. % minimum sulfur. Your supplier may not be able to deliver that, but asking for it gives you the chance to say, "No thanks," before they apply a heat of 0.005 wt. % sulfur material that will be known as "toolproof" in your shop.

If the job requires subsequent cold work after your machining operations, especially by the customer, you will want to look at holding nitrogen low, and preferring bloom cast over billet cast, and larger reduction ratios (which reflect this bloom versus billet difference) to smaller ratios. These differences will give the best chance for crimping, swaging, staking or other cold work operations subsequent to your machining.

Material specifications are important clues as to the outcome of the processes in your shop and at your customer. Mastering materials specifications is a critical first step to mastering your process and business success.