

'Bad' steel — the ultimate scapegoat

BY ART HEDRICK

What the heck is "bad" steel? It seems like every time there is a problem making a good part, the steel is blamed. Cracking problems? It's bad steel. Wrinkling problems? It's bad steel. Springback problems? It's bad steel. Cold and rainy outside? It's bad steel. You get the idea.

As a tool- and diemaker, I, too, used to blame the steel for many problems. However, as I learned more about the processes of stamping and metal forming, I quickly came to the conclusion that the steel is not always to blame.

When I'm asked to consult for steel suppliers, the usual scenario is that they are being accused of selling

of the time nothing is wrong with the steel. Often the root problem is the process used to cut and form the steel — the combination of the die, the press, and the lubricant.

I'm not suggesting that there is never a problem with the steel. Stampers have most certainly received steel that was out of spec. What I am suggesting is that you take a hard look at the data before you make a rash decision.

Variables That Drive Tolerance

All things manufactured, including steel, have tolerance. When steel is ordered to a certain specification, its

In steel production, three main variables must be monitored and controlled carefully: chemistry, temperature, and time (see **Figure 1**). Think of making steel like baking a cake. To have a tasty cake, the ingredients must be the correct type and amount. The oven must be at the proper temperature, and the baking time must be carefully monitored.

Keep in mind that correct ladle chemistry does not guarantee the steel's performance. Even if a cake's ingredients are correct, if I bake it in a 500-degree oven for two hours ... the result is not a good cake.

Controlling the ingredients in steel-making is reasonably easy. However, controlling time and temperature is much more difficult. Different types and thicknesses require different temperatures. The time it takes to roll a coil of steel can affect the end result. Mother Nature herself affects the end result.

Checking Steel Performance

If you're like most stampers, chances are that the only time you have steel tested is when you have problems. But in that testing, what are you comparing it to? Are you seeing if it is in spec? Just because the steel is within a given specification is no guarantee that it is going to run in the dies. To have a robust stamping operation, the steel must be suited to the process, or the process must be suited to the steel. For the process to be suited to the steel, the dies must have the ability to run the entire mechanical range of the material successfully (see **Figure 2**).

When the dies originally were built, were they tested so that they could run the entire specification range? Did the die building shop use only a single batch of tryout material? Where did the tryout material fall within the specification? Was it at the high end or the low end?

For instance, let's say that I am designing and building a deep-drawing die for you. After I complete the die



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bad steel to their customer, and they want me to go into the stamping facility and defend their honor. To be perfectly honest with you, most

properties must fall within a certain range to meet that specification. No coil of steel has the same mechanical properties from beginning to end.

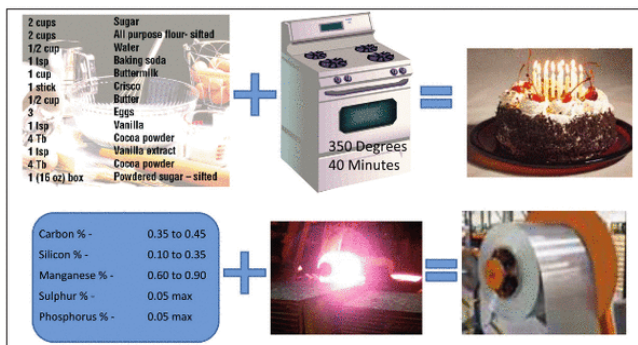


Figure 1

DIE SCIENCE

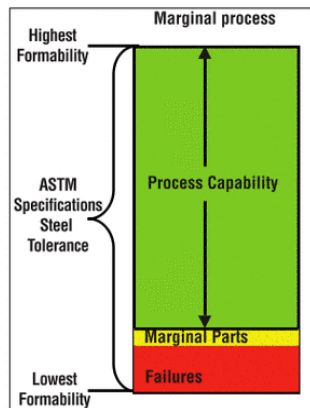


Figure 2

assembly, I need some tryout stock to prove out its performance. You send me material that was verified as being "in spec." I don't have the material tested because you gave me paperwork showing that it is within the part design specifications. The first time I use this material and try to draw it in my die, it splits grossly. I make some adjustments to the die and each time I do, the split gets smaller and smaller. Finally I make one last adjustment: I polish all of the radii. As a result, I make a successful part.

Because I didn't have the material tested, I don't know if it was on the high end of the material specs (greatest formability) or the low end of the spec (lowest formability). If it was on the high end, let's say, I didn't know it and you didn't know it. We only knew that it was "in spec."

So you pay me for this die, take it back to your stamping plant, and install it into your press. The first time you run the die, it runs great. There's no splitting, and the parts look good. The second time you run it, a few splits occur. The third time you run it, every part splits. Immediately you call your steel supplier and blame it on bad steel.

Statistically, though, chances are it's not bad steel. The steel probably is within part design specifications. The root cause is that the dies were margin-

al, meaning they will run only material on the high end of the material specifications.

The Solution

Now you have three options:

1. You can live with the fact that you have a marginal process and just deal with the scrap that is generated.

2. You can ask your material supplier to send you only steel that is on the high end of the spec. To determine the high end of the spec, have your steel tested when you are making good parts. (If you are a die builder, have the material tested before attempting a die tryout.) Record the steel's elongation, n value, tensile strength, and yield strength. Over time you will develop a sense of what your process will and will not accept, and you can give your steel supplier specific mechanical property limits.

3. Change the process to suit the entire tolerance range of the material. Keep in mind that although changing the dies may seem like the obvious solution, doing so is not always easy or even permissible. Often critical stations are omitted in the interest of fitting the die in the press, resulting in a marginal process. When you build a die, use thinning strain and circle grid analysis to help measure the forming severity of the parts produced by the die.

Some of the problems that exist begin with the product design. Products often are designed with features and tolerances that exceed the physical limitations of the material.

Remember, when sheet metal meets physics, physics always wins. Don't blame the steel until you know that it is out of spec. Work with your material supplier to help resolve the problem. Most of them will jump through hoops to keep you as a customer.

Until next time ... Best of luck! 

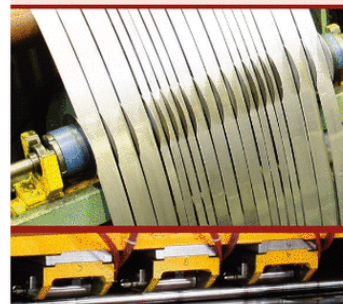
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