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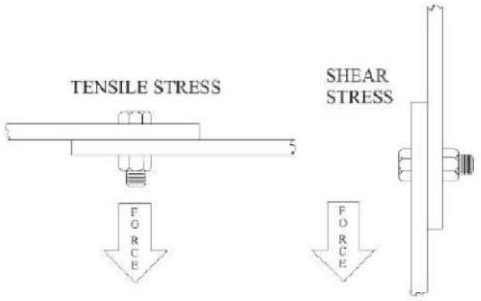
THINGS YOU SHOULD KNOW ABOUT STEEL

A thorough knowledge of the characteristics of steel is as important as knowing how to design and fabricate parts with that material. In fact, those very characteristics are of critical use in the safe production of those parts and the choices of methods and design details to be used. Some of this material may be old hat to veteran rodders but the eager new guys are always looking to add to their knowledge base in search of best practices in the building of their hot rod.

We will only be discussing mild carbon steel in this article. Aluminum, stainless, tool steels and 4130 chrome moly steel are very useful materials, but we don't have the space to cover all of that in this article. The very best sources of advice and reliable info will be experienced and successful fabricators. (This does not mean just anyone with an opinion on a forum.) Another good source is the Experimental Aviation Association (EAA). They have superb articles detailing the selection and use of 4130 steel and the various aluminum alloys.



Most mild steel is termed as SAE 1020, which means that the Society of Automotive Engineers has established that steel with 0.2% carbon content shall bear this designation. This is by far the most common, useful and affordable steel the average rodder will be dealing with. It is used for suspension, frame and body parts, and, occasionally, in slightly different alloys for special purposes. One practical test is that it will be easily filed, while harder alloy steels such as tools steel will be much harder. It's very weldable by any common process and has excellent tensile strength and fatigue resistance.

A quick discussion of tensile, shear and fatigue strength will be useful. The ultimate tensile strength of 1020 mild steel will be around 65,000 pounds per square inch (PSI). That means a bar 1-inch x 1-inch section size can withstand 65,000 pounds of direct pull along its length. Think of that as 18 average cars. As you can see, this is good stuff.

However, many design features will put a shear, or across-the-length stress of your parts. Industry standards assume that shear strength will be about 70% of the tensile strength, or 45,500 PSI. Now we can support about 12 cars total weight in shear, which is kind of like hanging them on a hook.

So if you are using a Grade 5 3/8-inch bolt in ¼-inch-thick mild steel, how much can it hold? Interestingly, and by intentional design, Grade 5 bolts also have tensile and shear strengths very close to those of mild steel. Since a 3/8-inch bolt has a cross section of about 0.11 square inches, a tensile load of 7,150 pounds can be carried. If the load is in shear, say the bolt is holding two plates that slide across one another to hang our load, we can expect to carry about 5,000 pounds.

In the real world, forces are seldom static. Movement causes an acceleration, which is a scientific way of saying that speed multiplies force. You feel this when you swing your hammer harder. You also know that multiple hammer blows can defeat the strength of a part. When that happens you exceeded the fatigue tolerance of the part, which is also known as toughness. Often this toughness is more important than ultimate tensile strength. A good general rule is to assume that shear and fatigue resistant strengths will be about the same. That's why suspension parts are generally held with a Grade 5 fastener to resist the pounding of repeated stress cycles, while engine parts use Grade 8 bolts torqued in place with a static load that exceeds any cyclic forces. Back to our 3/8-inch bolt, we can expect it to reliably carry a maximum 5000 load.

I say maximum because there are many factors involved in fatigue resistance. The design of the joint, tightness of fasteners, torque value used....it goes on and on. You'll also want a safety factor. In reality that becomes an educated guess. A safety factor of 2:1 should work in most cases. Have you noticed that most leaf spring cars will have shackles that use 3/8-inch bolts? Since many cars weigh less than 2,500 pounds, having a single bolt holding that weight is a very safe way to support the car. (This is especially true if it is also assisted by the use of more than one bolt to carry the load, which has its impact reduced by the use of rubber bushings.)

Now, that example can be used to produce a thought process that will help you make a good judgment call when designing your hot rod. It's certainly better than the "TLAR" (That Looks About Right) method!

A similar logic explains why mild 1020 steel is often preferred over 4130 chrome moly steel. In addition to it being more difficult to cut and weld, 4130 can be more brittle than 1020. It may resist more force but it will fail suddenly when it does. Where weight is critical, as in racecars and aircraft, 4130 rules, but for the average hot rod it will be overkill.

Mild steel can be bought in hot-rolled or cold-rolled forms. Hot-rolled will generally have a fairly heavy scale and be much easier to find and less expensive than cold-rolled. Cold-rolled will have a much cleaner exterior and will be more dimensionally precise. Hot-rolled can have inclusions (stuff in the steel) that reduce strength and reliability. However, well-made hot-rolled will be fine for general chassis work.

Cold-rolled steel is what you will see in most tubing. There is a form of truly seamless steel tubing where a hot ingot is forced over a pointed mandrel to pierce the steel, then the exterior is rolled to finished size. That is just as expensive as it is difficult and its use generally not justified. We could spend hours discussing the other types of steel tubing, which are all in one way or another rolled into a tubular shape and then welded by an electrical process. You can pay extra for a rerolling for more precise dimensions, but really that is often unnecessary unless saving 1 pound or so in your NASCAR roll cage is a big deal. For the rest us in the real world, good old DOM (drawn over mandrel) 1020 steel tubing will do all you will ever need. It is readily available from a good steel supply or racecar shop and is very affordable.

Finally, when it comes to sheet metal work, forget all about hot-rolled steel. It does not work easily and looks awful. Regular cold-rolled sheet is far better and readily available. For floors you'll want 18-gauge, which may not even require beading for strength if the unsupported span is small enough. Racecars will use 20- or even 22-gauge but it is not sturdy enough for a street car. Formed body panels can be made in 20-gauge, but even that's a little light for pre-1965 cars. A special steel called AK or sometimes DQ (detoxified/Aluminum Killed or Drawing Quality) is far easier to form. You owe yourself the pleasure of working with this on body panels. You'll want 19-gauge, which can be purchased in UPS-able 24- x 48-inch pieces online. You'll seldom need a bigger piece.