Working Heat Treated Music Wire

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The music wire that we use for landing gear and cabane struts is medium carbon steel that has been heat-treated to a spring temper. It is generally very useful to us in this form.

Spring temper defines a metal hardness that, if measured on the Rockwell hardness scale, would be about Rc 45. At this temper steel is referred to as being in the "tough" hardness range, with a Rc 20 being considered soft and Rc 60 being considered hard.

When in the tough temper state wire can be worked, but not as easily as if it were soft. In this tough condition it can be bent and cut using the proper tools and techniques, however, sometimes this tough state is just too tough for us….

To work steel more easily we can heat it up, and as it heats it becomes softer. While in this softer state we can bend it the way we need it. After we have bent or formed the wire it may cool at an uncontrolled rate. This cooling rate is directly responsible for the hardness of the wire after it is formed. As a result the finished part may be much softer (or harder) than its previous state. Now for some parts that's ok… but for landing gear we just can't leave it in the soft state because on the very first landing the wire would simply bend and not "spring back" to its original position or shape. If we left it in a hard state the next landing would snap the wire. So, to return the steel to its springy condition we must restore that specific spring temper by heat treating the appropriate area.

The steps that should be taken in order to form wire more easily would be to first anneal it (that is to soften it), form or bend to desired shape and then re-heat treat the part back to the spring condition. First the wire should be annealed at the location to be bent. To anneal heat your wire with a torch until it becomes a bright cherry red (this color represents about 1400 degrees F). Let the wire cool completely to the touch. Don't quench it or blow air on it. Just let it cool naturally away from any drafts. The wire should now be in the Rc 25 range. This is considered soft and you will find the wire bends very easily at this hardness. After forming, once again heat your wire with a torch until it becomes the bright cherry red but this time "quench" (rapidly cool) in room temperature water. When plunging the steel into water, do it with a twisting swirling motion to prevent water vapor from insulating the wire from the coolant action of the water. This will insure that a more even quench is therefore obtained.

At this point the wire should be very hard… probably above Rc 60. To test whether this is so attempt to file a mark on the super-hard area. The file should slide off without cutting into the steel at all. If, however, it does not slide off but cuts, you did not heat and quench properly or you do not have high carbon steel… Try the heat and quench cycle again. If your file still cuts then you definitely don't have high carbon steel…. So get another piece of wire and start over because you will not be able to add the necessary carbon to low-carbon steel. If you are successful in getting it very hard do not try to use the wire while it is in this very hard state. It is quite brittle and will snap off.

The next step is to temper the wire back to the desired hardness. Tempering is a form of annealing but is controlled so that the steel "stops" at a specific hardness. Start by shinning the wire with steel wool or emery cloth. Then heat it up gradually using the torch and watching for the following colors as a guide: The first color will be straw (350 degrees), followed by a dark blue (600 degrees), which is followed by a medium blue (750 degrees). At this point remove the wire from the heat source and allow it to cool slowly. DO NOT QUENCH IT OR BLOW ON IT! Just let it stand to cool on its own at room temperature away from any drafts. Once the steel returns to room temperature it should be at the target RC 45 hardness, which is a good spring temper. Perform the file test again. You should be able to make a mark now…. But with some effort. If it passes this test you have tempered your wire to the proper degree. Good luck!

Tempered music wire can also make great special purpose tools. Instead of tempering to the 750 degrees, stop at the straw color stage and you'll have the wire at about Rc 60; it is still very hard, but not so brittle. Wire at this temper makes great drills for wood and plastics and most Aluminum and Copper.