HEAT TREATING: Carbon steel is the process of first heating the metal high enough to force the iron crystal structure to open up and allow carbon atoms to enter; then cooling the metal (quenching) fast enough to trap that carbon inside the crystals before it can flow back out as the metal cools; then reheating (tempering) the metal to allow some of the carbon to escape, yielding the desired balance of strength and hardness.

1. **If the metal has been worked extensively, it may need to be annealed to relieve stresses caused by deformation of the crystal structure. See separate document.**

2. **To begin hardening, you must heat the metal to 500-1000°F past the critical point (see temp chart). The critical point is the temp at which the crystal structure of iron changes from body-centric to face-centered.**

3. **The critical point varies by alloy. However, there is another important temp called the Curie point. It is the point at which iron becomes non-magnetic. This temp, 1414°F, does not vary by alloy. It also just happens to be around 800°F above the critical temp of most common steel alloys, this makes it convenient to use a magnet to check to see if your metal has passed the critical point, and is hot enough to heat treat.**

4. **Don't take the metal too much past the critical temp, higher heats increase the rate at which crystals grow, larger crystals are more brittle, prone to cracking and splintering.**

5. **At 100°F above the critical temp, carbon atoms will fully saturate the iron in a fraction of a second. There is no need to hold this temp.**

6. **Your iron must contain at least 0.4% carbon, or there will not be enough saturated crystals to harden.**

7. **Quenching is the process of cooling the metal fast enough to "lock" the carbon within the crystal structure; before it has time to escape as the crystals collapse back to the smaller, body-centric cubicle structure.**

8. **Quenching high carbon steel (>0.8%) too quickly will trap too much carbon, making it dangerously stressed. Quenching in oil instead of water allows more carbon to escape.**

9. **Tempering raises the temp enough to allow some carbon to escape.**

10. **Martensite body-centric cubic structure contains crystals under stress due to "impressed" trapped carbon.**

11. **Austenite a crystal structure composed of a cube of iron atoms with an additional iron atom in the center of each face of the cube. The center of the crystal is large and open, allowing carbon atoms to drift inside. Carbon is soluble in austenite.**