Types of steels used in woodwork

What is steel? It is iron with a small amount of carbon, which changes the characteristics of the metal. Mild steel, which is readily available, can have between 0.05 – 0.25% carbon.

Tool Steel

When 0.5 – 1.25% carbon is added, it becomes tool steel, which means it can be hardened by heat treatment. Heat treatment alters the crystalline structure of the steel. In addition to varying levels of carbon, tool steels also contain a number of other additives to improve the properties of the steel. These include manganese, chromium, molybdenum, vanadium, nickel, silicon, cobalt and tungsten.

The process of heat treatment is in two parts: hardening and tempering. The hardening process consists of heating the steel to a set temperature (depending on the type of steel) and quenching it at a suitable rate. The quenching can be at fast rate, with water, medium, with oil or air. If the rate is too fast, it may cause the metal to crack; if too slow, it might lose its hardness. At this point, it is very hard, and brittle. The process of tempering is to reduce the brittleness and make it tougher. Tempering is carried out by heating to a lesser heat, according to the type of steel. To soften or anneal steel, it is necessary to reheat it and cool it slowly, preferably over a matter of days, which can be achieved by burying it in wood ash or some other medium.

In order to make sense of the plethora of trade names for different types, the American Iron and Steel Institute (AISI) members agreed to a standardisation of types, each with a letter prefix and a number.

I will deal with the most common types encountered in woodworking tools. The traditional steel of plane blades and chisels is type O1 or variants of it. It continues to be used in the majority of plane blade and cabinet chisel makers. Hardening requires heating to 790-820º, variously described as cherry red or the colour of cooked carrot and quenching in oil. Tempering for woodworking tools requires heating and holding to about 200º, which gives an oxide colour of light straw. The quality can be further improved by soaking in liquid nitrogen. This referred to as ice tempering.

The next steel type is A2, used by Lie Nielsen and offered as an alternative by Veritas tools. It remains sharp longer than O1, but takes a little longer to sharpen. The main difference from O1 is that the chromium content is increased from 0.5% to 5.0%.

We now move on to a group of alloys known as high speed steels (HSS), used most commonly in drill bits and woodturning tools. The most frequently encountered is designated as M2, the letter signifying a high molybdenum content. I have also encountered T10, a tungsten based HSS, but was unable to compare it directly with M2. HSS has two advantages: firstly, that it can be made harder than other steels, and most importantly that the hardness is not reduced when it is heated. It should remain hard even after being heated to red heat for hours.

Veritas recently introduced a steel they call PM-V11, which tests have shown to outperform A2. It also costs more. PM stands for “powdered metallurgy”. Some tools, such as router bits and masonry bits are tungsten carbide tipped. This is not steel, is hard and tough, and is harder to sharpen, but stands up very well to the job the tools are designed for.