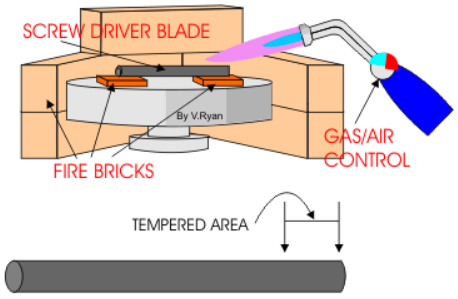
Heat treatments

Hardening and tempering:

Heating medium/high carbon steel to a given temperature, rapidly cooling via quenching, and then heating to a set temperature to remove excess hardness

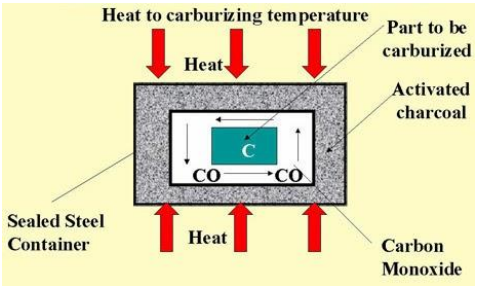


Advantages	*Disadvantages*
• Improved tensile strength • Very hard • Reversible process (via annealing)	• Less ductile • More likely to crack/damage in worked area • Metal becomes brittle

Uses: Screwdrivers, Wrenches, Hardened steel

Case hardening:

Hardens the surface of steels with less than 0.4% carbon content

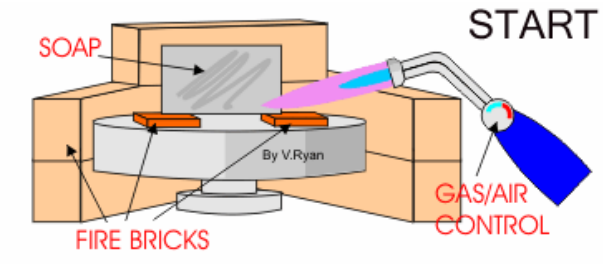


Advantages	*Disadvantages*
• Greater hardness for outside surface • Improved wear resistance • Resistance to surface indentations • Lower coefficient of friction	• Depth of hardness is less • Difficult to machine metal after process

Uses: Firing pins in guns, rifle bolts, engine camshafts (CAMs to move pistons)

Annealing:

Used to make work-hardened metal easier to work. The metal is heated and allowed to cool very slowly



Advantages	*Disadvantages*
• Makes metal less brittle • Makes metal more ductile	• Time consuming process

Uses: Reduce hardness and increase ductility in metals such as steels

Normalising:

Heated to critical temperature and held there for a set time, then allowed to cool slowly in air

Advantages	*Disadvantages*
• Metal becomes easier to machine • Relieves internal stress on metal • Decrease in hardness/improved ductility	• Can't normalize non-ferrous metals • Decrease in hardness

Uses: To relieve stress on metal after cold working process for better physical properties