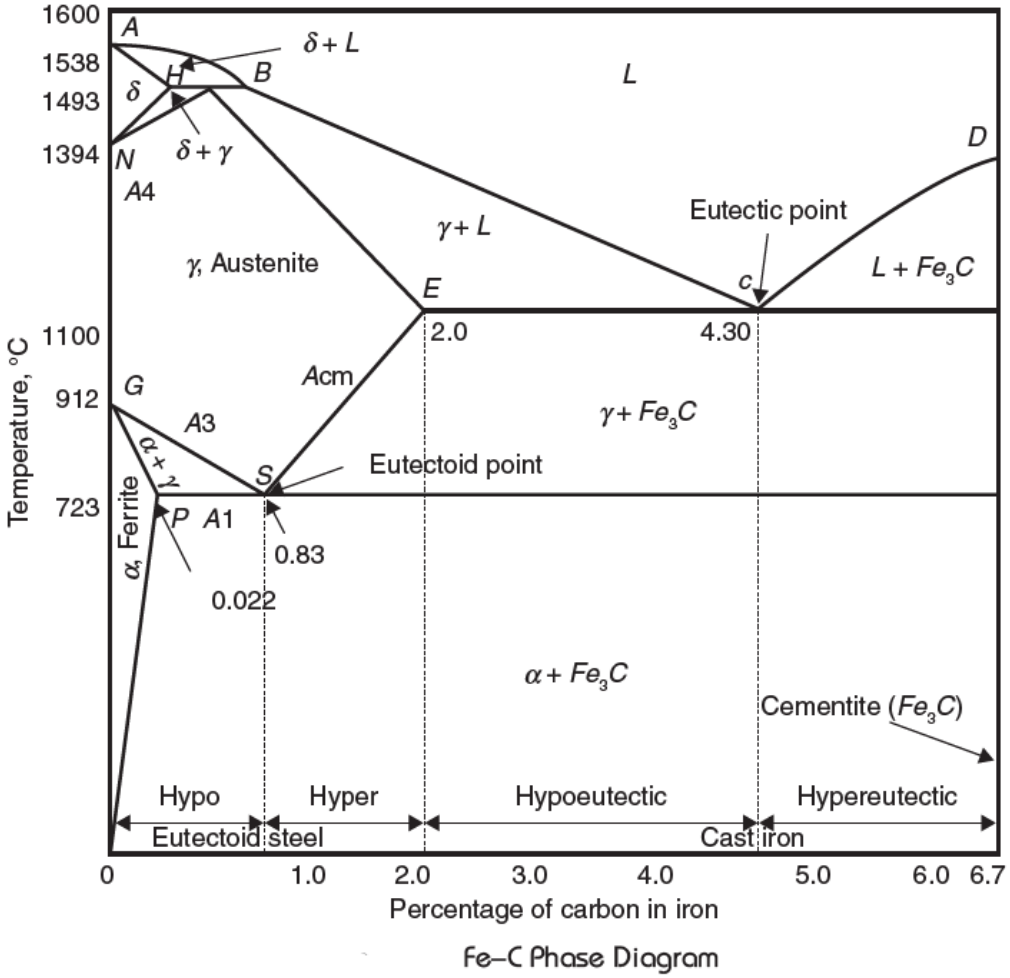
Heat Treatment

- Heat treatment is a process to control the mechanical properties of engineering materials by heating,cooling, and alloying the metal as per requirement. It deals with change in properties by alloying different elements to the metal at various temperatures.
- The various mechanical properties such as hardness, toughness, ductility, machinability, and grain refinement are controlled by heat treatment process.
- In this, we deal only with steel and its properties. Some of the basic heat treatment process such as hardening, normalizing, annealing, tempering, with iron–carbon diagram.

IRON–CARBON PHASE DIAGRAM



Fe–C Phase Diagram

NORMALIZING

- Normalizing is a process of heating about 30–50℃ above higher critical point for the time duration of 15 min and cooling in still air.
- The purposes of the process normalizing are:

  (a) to reduce grain size of steel,

  (b) to remove internal stress caused by working, and

  (c) to improve some of the mechanical properties.

- The products obtained are ferrite and pearlite for hypoeutectoid steel and pearlite and cementite for hypereutectoid steel.
- The normalized structure of these two steels consists of sorbite and ferrite. The properties of normalized steel are higher yield point, ultimate tensile strength, impact strength, and lower ductility. It is advantageous for low and medium carbon steel.
- For alloy steel it is possible with time duration of 2 h cooling in furnace.

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ANNEALING

The purposes of annealing are:

- to soften the metal for easy machining,
- to remove internal stress caused by working,
- to increase ductility,
- to refine grain size, and to modify electrical and magnetic properties.

Normalized steel is less ductile and have more yield point and tensile strength than the annealed steel.

ANNEALING

There are two types of annealing: process annealing and full annealing.

Process Annealing: This is a process of heating the metal below or very close to lower critical temperature, i.e., 650°C for steel and slow cooling to form new grain structure.

The purposes of the process are:

(a) to increase ductility of cold worked metal, and

(b) to remove internal stress.

This is frequently used in wire drawing to increase the plasticity of the metal.

ANNEALING

Full Annealing: The purposes of full annealing are:

(a) to soften the steel, and

(b) to refine grain structure above upper critical limit by 20–30°C for 0.9% C-steel and by the same amount below the critical point for high carbon steel. Carbon-steel is cooled 100–200°C per hour.

It is essential that the steel should not hold less than 4–8 min for heating. To prevent the steel for carburization and oxidization workpiece is closed in metal box and put into the furnace. Austenite changes to pearlite and mixture of pearlite and ferrite.