ALUMINUM SOLUTION HEAT TREATMENT

Alloys
Some Aluminum Alloys are classified as heat treatable. Heat treatment is performed to change or improve mechanical properties. It should be noted that annealing can be performed on both types of alloys. When we speak of heat treatment we usually refer to “Precipitation or Solution Heat Treatment”. Briefly, the heat treatable alloys are generally Al / Cu alloys.

Heat Treatment
When Al / Cu alloys are heated above a certain temperature, the Cu in the alloy goes into what is known as “Solid Solution”. When held at this temperature long enough for the thickness of material all of the Cu will have gone into “Solution”. Hence “Solution Heat Treatment”. At this point the alloy is soft and malleable. Left in this state the alloy will, over time, undergo a “Precipitation” of the solid solution, or “Natural Aging”. Some alloys do not need more than 4 to 5 days to attain most desirable properties.

In many processes and alloys it is desirable and necessary to introduce a third heat treatment process in order to obtain a controlled “Aging”.

Summary
These are the processes in short form:

1. Solution Heat Treatment with these variables:
   a. Temperature
   b. Time
   c. Load temperature uniformity

2. Quenching with these variables:
   a. Speed of transfer from furnace to quench tank
   b. Quenching media
      i. Water
      ii. Polymers
      iii. Water / Polymer mixtures
      iv. Quench media temperature
      v. Quench media temperature uniformity
      vi. Quench media temperature rise during quench

3. Aging with these variables:
   a. Temperature
   b. Time
   c. Load temperature uniformity
Equipment
The most common types of batch processing equipment are:

Solution Treatment and Quench:

**Bottom Drop Furnace**
This integrates solution heat treatment and quenching into one controllable operation.

**Aging Oven**
This usually takes the form of a Walk-In, Circulation Type oven.

Heat Treatment Specifications
As most Aluminum or Magnesium products are used in Aerospace or Automotive applications which demand precise control of material properties, a number of Material Specifications have been developed. These specify the exact heat treatment procedures that have to be followed in order to attain desired material properties. Some examples are;

**AMS 2750 – Aerospace Material Specification** – Developed by Society of Automotive Engineers
AMS 2770D – Aerospace Material Specification – Developed by SAE
BAC 5602 – Boeing Process Specification – Developed by Boeing
MIL-H-6088 – Military Specification – Developed by Naval Air Engineering Center

These specifications have many details in common and do provide a definitive guide for the capabilities of the heat treatment equipment and for the heat treatment programs to be followed for a great variety of alloys and material thicknesses and configurations.