Aluminum Alloys

Aluminum Alloys can be divided into nine groups.

Designation	Major Alloying Element
1xxx	Unalloyed (pure) >99% Al
2xxx	Copper is the principal alloying element, though other elements (Magnesium) may be specified
3xxx	Manganese is the principal alloying element
4xxx	Silicon is the principal alloying element
5xxx	Magnesium is the principal alloying element
6xxx	Magnesium and Silicon are principal alloying elements
7xxx	Zinc is the principal alloying element, but other elements such as Copper, Magnesium, Chromium, and Zirconium may be specified
8xxx	Other elements (including Tin and some Lithium compositions)
9xxx	Reserved for future use

1xxx Series: These grades of aluminum are characterized by excellent corrosion resistance, high thermal and electrical conductivities, low mechanical properties, and excellent workability. Moderate increases in strength may be obtained by strain hardening. Iron and silicon are the major impurities.

2xxx Series: These alloys require solution heat treatment to obtain optimum properties; in the solution heat-treated condition, mechanical properties are similar to, and sometimes exceed, those of low-carbon steel. In some instances, precipitation heat treatment (aging) is employed to further increase mechanical properties. This treatment increases yield strength, with attendant loss in elongation; its effect on tensile strength is not as great.
The alloys in the 2xxx series do not have as good corrosion resistance as most other aluminum alloys, and under certain conditions they may be subject to intergranular corrosion. Alloys in the 2xxx series are good for parts requiring good strength at temperatures up to 150 °C (300 °F). Except for alloy 2219, these alloys have limited weldability, but some alloys in this series have superior machinability.

3xxx Series: These alloys generally are non-heat treatable but have about 20% more strength than 1xxx series alloys. Because only a limited percentage of manganese (up to about 1.5%) can be effectively added to aluminum, manganese is used as major element in only a few alloys.

4xxx Series: The major alloying element in 4xxx series alloys is silicon, which can be added in sufficient quantities (up to 12%) to cause substantial lowering of the melting range. For this reason, aluminum-silicon alloys are used in welding wire and as brazing alloys for joining aluminum, where a lower melting range than that of the base metal is required. The alloys containing appreciable amounts of silicon become dark gray to charcoal when anodic oxide finishes are applied and hence are in demand for architectural applications.

5xxx Series: The major alloying element is Magnesium an when it is used as a major alloying element or with manganese, the result is a moderate-to-high-strength work-hardenable alloy. Magnesium is considerably more effective than manganese as a hardener, about 0.8% Mg being equal to 1.25% Mn, and it can be added in considerably higher quantities. Alloys in this series possess good welding characteristics and relatively good resistance to corrosion in marine atmospheres. However, limitations should be placed on the amount of cold work and the operating temperatures (150 degrees F) permissible for the higher-magnesium alloys to avoid susceptibility to stress-corrosion cracking.

6xxx Series: Alloys in the 6xxx series contain silicon and magnesium approximately in the proportions required for formation of magnesium silicide (Mg2Si), thus making them heat treatable. Although not as strong as most 2xxx and 7xxx alloys, 6xxx series alloys have good formability, weldability, machinability, and relatively good corrosion resistance, with medium strength. Alloys in this heat-treatable group may be formed in the T4 temper (solution heat treated but not precipitation heat treated) and strengthened after forming to full T6 properties by precipitation heat treatment.

7xxx Series: Zinc, in amounts of 1 to 8% is the major alloying element in 7xxx series alloys, and when coupled with a smaller percentage of magnesium results in heat-treatable alloys of moderate to very high strength. Usually other elements, such as copper and chromium, are also added in small quantities. 7xxx series alloys are used in airframe structures, mobile equipment, and other highly stressed parts. Higher strength 7xxx alloys exhibit reduced resistance to stress corrosion cracking and are often utilized in a slightly overaged temper to provide better combinations of strength, corrosion resistance, and fracture toughness.