POPULAR ALUMINUM ALLOYS

	Composition (%)					Ultimate Tensile Strength (psi.)	Yield Strength (psi.)	Elong (%E)	Brinell Hardness (Std. Ball)
Alloy	Copper	Silicon	Manganese	Magnesium	Chromium				
1060-H1	0.12	-	-	-	-	14000	13000	12	26
2014-T4	0.8	4.4	0.8	0.5	-	62000	42000	20	105
2014-T6	0.8	4.4	0.8	0.5	-	70000	60000	13	135
2024-T4	-	4.4	0.6	1.5	-	70000	50000	18	120
3003-H1	-	0.12	1.2	-	-	22000	21000	12	40
4032-T6	12.2	0.9	-	1.1	-	55000	46000	9	120
5056-H3	-	-	0.12	5.1	0.12	60000	50000	15	100
6061-T4	0.6	0.27	-	1	2	35000	21000	23	65
6061-T6	0.6	0.27	-	1	2	45000	40000	14	95
7075-T6	-	1.6	-	2.5	0.3	76000	67000	11	150

ganese as the principal additive. There are relatively few alloys in this series, since manganese isn't very soluble in aluminum, limiting alloying concentrations to under 1-1/2 percent. The 3003 alloy is the most popular, combining moderate strength and good workability.

The 4000 series uses silicon as its main alloying metal. Silicon is soluble enough to permit concentrations of up to 12 percent or so, resulting in low melting point alloys that are not brittle. The 4000-series alloys are widely used for welding rod and wire, and 4032, which feature high wear resistance coupled with a low rate of thermal expansion, is used for pistons.

Magnesium is the principal alloying metal in the 5000 series, which features moderate to high strength, good weldability and good corrosion resistance. Some members of this series should not be used in temperatures of 150 F and over, or in applications requiring frequent flexing or vibration to avoid stress corrosion. The 5056 alloy is one of the more popular ones in this series.

The 6000 series contains silicon and magnesium. Members of the series are heat treatable, and reasonably strong, though less so than the 2000 and 7000 series. The 6000-series alloys have good formability and corrosion resistance, and can respond well to heat treatment. The major alloy in this series, 6061, is one of the most versatile of the aluminum alloys.

The 7000 series of aluminum alloys uses zinc as the major alloying element. When a small amount of magnesium is also added, the resulting alloys exhibit very high strengths, particularly after heat treatment. A notable member of this series is 7075, which is one of the highest-strength lightweight alloys available, and is used for highly stressed structural parts and airframe structures.

ALPHABET SOUP

Generally, an alloy designation will have a letter and (in most cases) some numbers following the four digits. These indicate the degree of temper or hardness of the alloys, and how the material was treated to achieve that hardness. Letter suffixes such as -F (untreated after fabrication) and -O (annealed, or dead soft) don't have numbers. Others, such as -H (strain-hardened) will have a 1, 2 or 3 following to show how this work-hardening was achieved. The letters you'll see most often are the T numbers, describing how heat-treatable alloys have been treated, with grades of -T2 (annealed, and dead soft) to -T6 (heat treated and artificially aged to maximum hardness). Many other numbers are used to describe many other treatments and combinations of treatments used to prepare alloys for specialized applications.

Some manufacturers advertise that they use alloys with a numbering system that's different from this four-digit-plus-a-suffix one. Such numbering systems are best viewed as advertising ploys, something like the "secret ingredients" that you encounter now and then in products ranging from cough drops to hand cleaners. They don't give you any information.

CASTING, FORGING AND MACHINING

When aluminum alloys are manufactured, the alloying elements are dissolved in the molten aluminum, forming a uniform liquid. When this liquid is cooled, it "freezes" into a solid, which is composed of microscopic crystals. Because the alloying metals are less soluble in cold aluminum than they are in heated aluminum, some of them come out of solution as the alloy cools. Crystals can consist of pure aluminum, pure alloying metal(s) and mixtures of the two. The properties of the solid alloy depend largely upon the size, composition and shape of these crystals, and how they are organized (or disorganized).

Casting an aluminum alloy provides the least control over its crystal (or grain) structure. Typically, casting is the least expensive method of producing a complex part, but the cast parts tend to be brittle and have low strengths. This is because the crystals are distributed in a helter-skelter fashion, and tend to be very small. Heat treating will tend to cause some of the smaller crystals to re-dissolve and re-form as longer crystals, increasing the part's strength in much the