ALUMINUM ALLOYS

Playing The Numbers And Letters Game

text and illustrations by Lee Green

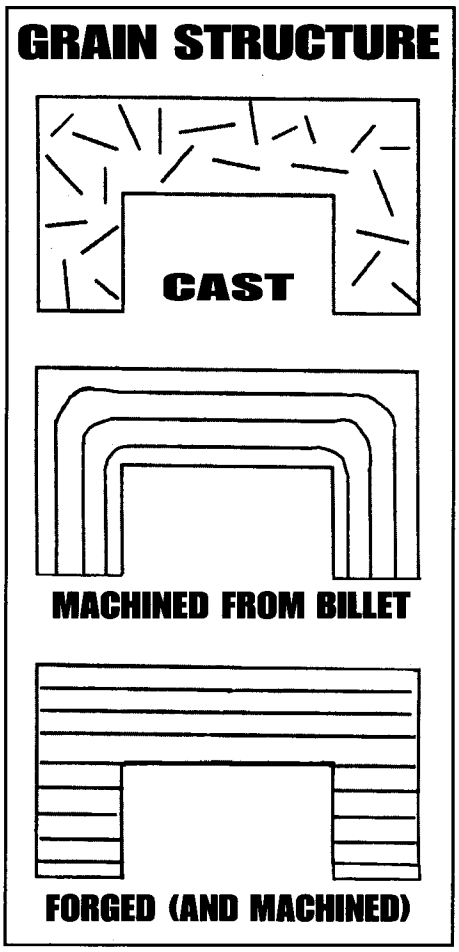
If you've ever looked at ads for cycle parts or accessories, you've seen words like "billet," "forged," "cast" and a load of mysterious alloy numbers. If you're not sure what the terms and numbers mean, don't feel bad. Most people don't.

To understand the terminology, it helps to learn something about aluminum itself. It's a common element in the earth's surface, but until 1886, when Charles Hall invented a process for extracting aluminum from its ore economically, it was so difficult to obtain in metallic form that it was considered a precious metal. One of the first applications for aluminum, aside from jewelry, was in making horseshoes for racehorses. They were made by Tiffany.

These horseshoes highlighted aluminum's major advantage over most other metals: light weight. Aluminum weighs in at about 165 pounds per cubic foot, as compared to 488 pounds per cubic foot for steel. Its major disadvantage, in its pure form, is that it's a soft, not-too-strong metal. Pure aluminum simply isn't suitable for structural parts, although it is used for electrical wiring and for non-structural applications like storage tanks where corrosion resistance is more important than strength.

To make aluminum hard and strong enough for engine parts, frame components and the like, it must be alloyed, or combined, with other metals, such as copper, zinc, magnesium, silicon and manganese.

Aluminum alloys can significantly improve many of the metal's physical properties, though often at the expense of others. There's no such thing as the "best" alloy — each is designed to provide a specific range of properties, and what's best for one application can be terrible for another. In addition to the improvements that can be made by alloying, many alloys can be further tailored to a specific application by work hardening, heat treatment or some combination of the two. The numbers that are used to identify the different types of aluminum reflect the alloying metals and the treatment that's been used in making the alloy.



These diagrams show how the grain structure in cast, billet and forged parts are organized.

BY THE NUMBERS

The current numbering system for aluminum alloy was adopted by the aluminum industry in 1954. It consists of a basic four-digit number to identify the alloy, followed by a letter/number combination to indicate the degree of temper, or hardness.

The first digit identifies the principal alloying metal that's added to the aluminum; the second digit indicates the degree of control of other impurities. Most alloys have very small amounts of other impurities, so it's not usually necessary to control their concentrations. Such alloys, such as 2024, 6061 and 7075, have a zero as their second designation digit. The final two digits simply identify the particular alloy: as new ones are adopted, the next two-digit number is used. There are seven principal alloy types.

The 1000 series is essentially pure aluminum, with an aluminum content of 99 percent or more. While physical properties of alloys in this series can be varied slightly by adding traces of other metals, they're all soft, low-strength, easily workable alloys with good corrosion resistance and high electrical conductivity. The 1000-series alloys are not used for structural applications.

Copper is the principal alloying element in the 2000 series. These alloys are heat-treatable, and when properly tempered are very strong, with mechanical properties comparable to mild steel. This series suffers from poor corrosion resistance and may tend to be more brittle than other alloys. The 2000-series alloys, most commonly 2014, 2024 and 2219, are widely used for structural components.

Alloys in the 3000 series use man-