Understanding Aluminum Alloys

As the use of aluminum in precision metal fabrication continues to grow, it is increasingly important for fabricators to have a basic understanding of the wide variety of aluminum alloys that are available.

The Aluminum Association Inc. maintains the International Alloy Designation System. There are currently over 700 aluminum alloys registered. Over 500 of these alloys are in the “wrought” category – the type that precision metal fabricators typically utilize. The remaining 200 apply only to castings, which the typical fabricator would not encounter.

Wrought Alloy Designations
All of the wrought alloys are identified by a four digit number: The first digit (Xxxx) identifies the principle alloying element that has been added to the aluminum. As shown in Table 1, the first digit is used to describe the alloy series (1000 series, 2000 series, etc.)

<table>
<thead>
<tr>
<th>Alloy Series</th>
<th>Principal Alloying Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>99.000% minimum aluminum</td>
</tr>
<tr>
<td>2000</td>
<td>Copper</td>
</tr>
<tr>
<td>3000</td>
<td>Manganese</td>
</tr>
<tr>
<td>4000</td>
<td>Silicon</td>
</tr>
<tr>
<td>5000</td>
<td>Magnesium</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
</tr>
<tr>
<td>6000</td>
<td>Magnesium and Silicon</td>
</tr>
<tr>
<td>7000</td>
<td>Zinc</td>
</tr>
<tr>
<td>8000</td>
<td>Other elements</td>
</tr>
</tbody>
</table>

The second digit, if not zero, indicates a modification of the alloy. The third and fourth digits are arbitrary numbers that identify the specific alloy within the series — the only exception to this is in the 1000 series where the last two digits define the minimum aluminum percentage. For example, Alloy 1385 is 99.85% pure aluminum.

**Temper**

In addition to that huge variety of alloys that are available, the temper (or hardness) of each alloy can create considerable differences in their characteristics and how they react to various fabrication processes such as punching, forming, thermal cutting, welding, etc. Within the basic aluminum categories identified in table one, there are two distinctly different varieties - Heat Treatable and Non-Heat Treatable. The 1xxx, 3xxx, and 5xxx series are non-heat treatable (they are strain hardenable only). The 2xxx, 6xxx, and 7xxx are heat treatable. The 4xxx series alloys contain both heat treatable and non-heat treatable varieties.

The temper of an alloy is designated by adding an extension to the alloy number (separated by a hyphen). Table 2 shows the basic temper designations.

**Table 2 - basic temper designations**

<table>
<thead>
<tr>
<th>Letter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>As fabricated</td>
</tr>
<tr>
<td>O</td>
<td>Annealed</td>
</tr>
<tr>
<td>H</td>
<td>Strain Hardened</td>
</tr>
<tr>
<td>W</td>
<td>Solution Heat Treated</td>
</tr>
<tr>
<td>T</td>
<td>Thermally Heat Treated</td>
</tr>
</tbody>
</table>

The strain hardened designation is always followed by two or more numbers. The first number indicates the basic condition:

- H1 - Strain hardened only
- H2 - Strain hardened and partially annealled
- H3 - Strain hardened and stabilized
- H4 - Strain hardened and lacquered or painted

The second number designates the degree of hardening:

- Hx2 - quarter hard
- Hx4 - half hard
- Hx6 - three quarters hard
- Hx8 - full hard
- Hx9 - extra hard

The heat treated designation is always followed by one or more numbers that indicate the level of heat treatment. These indicators are more complex and less self-evident than the H tempers.

The wide variety of aluminum alloys and their tempers create a complex range of materials. Understanding the basic differences can help you be more successful. For more information regarding your unique application or specific recommendations, please call the Wilson Tool sales
Faces of Wilson Tool

Santiago Calvo
Sales Engineer

Years at Wilson Tool: 5

What is your favorite aspect of your job?
There are several aspects that I like, especially helping customers when they experience difficulties in the process. In this area, we have a new challenge every day.

What do you enjoy doing in your free time?
Sports. I play soccer every week. I also enjoy barbecues on the beach with family and friends.

What is something that people would be surprised to learn about you?
I like to work with wood. I built my son’s cradle and I also built several hammocks for my daughter. Actually, I am finishing some wooden games for our garden.

If you had to eat only one food item for the rest of your life, what would it be?
Napolitane milanese (pizza-like veal Milanese) with mashed potatoes!

Where is the most interesting place you have been? Why?
Machu Picchu in Perú, the “Inca Trail.” It was one of the nicest experiences and I would love to do it again.

ALUMINUM FUN FACT
The Name Game

The name aluminum was derived from alum, which was used in ancient Greece and Rome. In 1761, L. B. G. de Moreveau proposed the name alumina. In 1807, English chemist Sir Humphrey Davy proposed that this metal be called aluminum instead. The name was later altered to aluminium (with an extra “i”) to conform to other recently discovered elements such as potassium, sodium, magnesium, and calcium. Aluminium is still the spelling that is used by the majority of the world today. However, in 1925 the American Chemical Society officially decided to revert back to aluminum, which is what it has been called in the United States ever since.

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Upcoming Events

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Wilson Wheel Class
June 25th - SIGNUP

Upcoming Trade Shows

FEIMAFE
June 3-8 in Sao Paulo, Brazil