Aluminum Designations Information Clarification

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For decades industry has used aluminum in the development and fabrication of a wide variety of products and finished goods. Aluminum has many properties and benefits that make it an outstanding material of choice. These include: lightweight (approximately one-third of steel), exceptional reflectivity, high elasticity, tolerance to low temperatures (will not get brittle), excellent conductor of heat and electricity and readily worked and formed into many shapes and thin coils. The metal finishing industry provides many treatments and finishes for aluminum in its many shapes, alloys and castings. These processes would include plating, electroless plating, anodizing, pre-paint, chromating and oxidized coloring, to describe some of the most common. It has been found to be of vital importance that aluminum alloy and casting designations be determined, so as to apply the correct chemical base treatments and conditioning, in the many processing cycles. Let us review some of these designations in a format that can be used for handy reference.

Aluminum alloys

There is a four digit number for classifying alloys by the main element in the particular alloy, also referred to as a wrought alloy. This table, which could be familiar to many, holds an important identification key.

Wrought aluminum alloys

First digit of alloy	Main element in alloy
1XXX	At least 99% aluminum
2XXX	Copper
3XXX	Manganese
4XXX	Silicon
5XXX	Magnesium
6XXX	Magnesium and silicon
7XXX	Zinc

The second number describes impurity limits. The last two numbers indicate the minimum aluminum content.

Cast aluminum alloys have a separate designation table.

Cast aluminum alloys

First digit of alloy	Main element in alloy
1XXX	At least 99% aluminum
2XXX	Copper
3XXX	Silicon, copper, (possibly magnesium)
4XXX	Silicon
5XXX	Magnesium
6XXX	Unused series
7XXX	Zinc
8XXX	Tin
9XXX	Other elements

The first number refers to the main alloying element, added to the aluminum alloy. The second and third numbers are assigned to identify a specific alloy in the series. For example, the A356 designation identifies a modification to alloy 356.0. The number 3 corresponds to the copper and silicon-containing elements. The number 56 identifies the alloy within the 3XX.X series. The .0 indicates the material is a final shape casting.

Descriptions of the common aluminum alloy designations and their applications follow.

1100: Essentially pure aluminum. Excellent workability, as the material is soft and ductile. It is the most weldable aluminum alloy, but not heat treatable. Its excellent corrosion resistance makes it applicable to food and chemical processing.

2011: Excellent mechanical properties, making it the most free machining of the aluminum alloys. It is very good for parts that require heavy machining.

2014, 2017: Excellent machining and high strength.

2024: High strength and excellent fatigue resistance. Can be machined to a high finish. Poor corrosion resistance makes this material a good choice for anodizing. Heavy emphasis for this alloy in aircraft construction (structural components, fittings, hardware). It is also used in truck wheels and parts used in the transportation industry.

3003: The most widely used aluminum alloy. It is pure aluminum, to which is added manganese. This results in surpassing the strength of the 1100 series by approximately 20%. Excellent corrosion resistance. Popular applications include chemical equipment, construction materials (siding, awnings, trim) and cooking utensils.

5005: This alloy is similar to 3003, but is an overall improved version of it. It is a good alloy for anodizing.

5052: Excellent corrosion resistance, along with very high strength. It has many varied applications: food processing, transportation, marine, home appliances and cooking utensils.

5083, 5086: Excellent welding characteristics, very good forming properties and excellent corrosion resistance. Applications include heavy duty trucks and trailer assemblies, boat hulls and superstructures and missile containers.

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5. Compensating for complex part geometries

When designing a racking system for a given part, we need to be aware of current distribution factors. The current distribution on plated parts is influenced by part contour, racking style, part spacing, shielding methods used and use of auxiliary or bipolar anodes.

One of the simplest means of improving coverage in the low current density areas, and decreasing the danger of burning in the high current density areas, is to place a non-conductive (usually plastic) shield (sometimes called a baffle) between the anodes and the high current density area of the part to be plated. The size, location, orientation and shape of shields is typically determined by trial and error, although scale drawings can assist in measuring distances between various spots on a part and the nearest anodic surface.

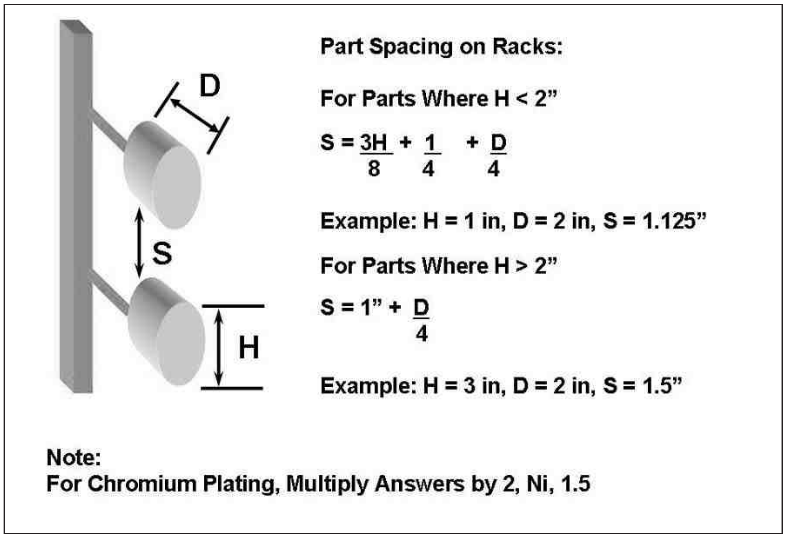

Figure 4—Rack spacing guidance.

For plating complex shapes more uniformly on automated lines, where making contact with auxiliary anodes is not possible, bipolar anodes may be viable. A bipolar anode is not connected electrically to either the anode or cathode. By placing an insulation covered highly conductive metal such as copper near an electrified anode, a negative charge is induced in the copper near the anode and a positive charge is induced at the other end, which typically is made of non-insulated anode material. The anode material is typically configured to follow the contour of the part. A bipolar anode can produce improved deposit distribution in a deep recess, but the degree of control is not as precise as it is with an auxiliary anode, which is similarly constructed, but hard wired to the anode bus.

Single, large parts that are racked and pose geometry problems may benefit from the addition of a “thief” or “robber” to draw current away from high current density surfaces. The robber is typically a wire or rod that “competes” for current in areas that have an excessively high current density. By splitting this high amount of current between the conductive robber and the part nearby, the current density on the surface of the part is at a manageable level. *P&SF*

Finisher’s Think Tank

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6061: An economical alloy that has very good heat treatment characteristics. Good mechanical properties and corrosion resistance. Applications include truck bodies, automotive wheels and various structural components.

6063: Also called the architectural grade. It is an extrusion alloy with high tensile properties and very good corrosion resistance. It is an excellent choice for anodizing in clear or colored finishes. Applications include interior and exterior architecture items, doors, windows and frames.

7075: One of the highest strength aluminum alloys. It retains superior strength-to-weight ratio. Applications include materials for high strength requirements.

Heat treatable alloys are those that gain strength through heat treatment. 2000, 6000 and 7000 alloys are heat treatable. The 4000 series consist of heat treatable and non-heat treatable alloys. Temper designations identify the status of whether the particular alloy has been heat treated.

Temper designations

F: This is the as fabricated condition. There has been no thermal treatment or hardening procedure.

O: Annealed. Heat treated to improve ductility and dimensional stability.

H: Strain hardened. A cold working procedure was used to strengthen the material. Additional strain hardening may follow, reducing strength.

W: Solution heat-treated. An unstable temper which applies to alloys that have been aged spontaneously at room temperature after solution heat treatment.

T: Thermally treated. Alloys that have been heat treated with supplementary strain hardening. This produces a stable temper.

There are subdivisions of the above designations which identify additional treatments, such as annealing, cold working, stress relieving, artificial aging and lacquering. *P&SF*

Test Your Plating I.Q. #435

By Dr. James H. Lindsay

Electricity in electroplating

1. Electricity is produced in a conductor by moving that conductor through ______________.
2. AC power is an efficient way of transmitting power over long distances, but pure AC cannot be used for plating. “Why?”
3. Name some situations where insoluble anodes are appropriate.
4. Cathode current density is important in determining deposit properties. Anode current density is primarily critical to ___________?
5. Which ions are characterized by high conductivity? Poor conductivity? Chloride, sulfate (in dilute acid), sulfate (in concentrated acid), nitrate, ammonium, phosphate, bromide, acetate, potassium

Answers on page 37.