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YOUR GUIDE TO AEROSPACE-GRADE ALUMINUM EXTRUSIONS

In this comprehensive guide to aerospace-grade aluminum extrusions, we'll take a look at a number of factors that may influence your next aircraft extrusion purchase.

Aluminum alloys for aerospace have come far since the Wright brothers used aluminum in the engine of the plane for their first manned flight in 1903. Now, alloys are used throughout airplanes, especially in their infrastructure. In fact, aluminum aerospace extrusions form the main structure of today's planes.

Today's aerospace metals are vastly superior to the aluminum that the Wright brothers used in terms of performance and properties. Aluminum aerospace extrusions come in countless shapes and sizes and withstand the stress and pressures of flights that are higher, faster, and longer than even the Wright brothers may have imagined.

The future of aerospace aluminum extrusions is bright, exciting, and will be even more dynamic as technology continues to advance and markets keep evolving.

However, before delving any further, it is important to look at what exactly is an extrusion.

WHAT EXACTLY IS AN EXTRUSION?

The word “extrusion” comes from the Medieval Latin “extrusio.” “Extrusion” was first used in the 16th century to describe something “extruding,” that is forced, pressed, or pushed out.

Extrusion has since come to be used to describe materials formed through the extruding process, in which substances like metal or plastic are shaped by forcing them through a die. Aluminum extrusions are among the most common. They are used extensively in construction and manufacturing.

Aluminum aerospace-grade extrusions alone come in dozens of shapes, sizes, and grades. Aerospace manufacturers suit each extrusion to a particular purpose, whether it is as a support, joint, hinge, or something else.

No longer limited to airplanes, aluminum is used in spacecraft as well, like the Orion spacecraft that NASA is building for deep-space exploration. The Orion spacecraft includes aerospace extrusions formed from an aluminum-lithium alloy. Though aluminum-lithium alloy costs more, aerospace manufacturers are using it more frequently because of the advantages that it offers in terms of performance and properties.

COMMON APPLICATIONS FOR AEROSPACE-GRADE ALUMINUM EXTRUSIONS

As semi-finished parts, extrusions can be machined into any custom shape and adapted for any use. Here are just a few examples of aerospace extrusions by their designations and uses.

AND (ARMY NAVY DRAWING) EXTRUSIONS

ANDs are the most common shapes. They can be used on any plane as parts for anything from simple racking requirements (e.g. building shelves to house kitchen appliances in the cabin) to structural repair to flight-critical purposes.

AND parts can be made in any alloy/temper the end user wishes. There are no restrictions and the drawings do not specify any grade of aluminum. The different nomenclatures can call out many different types of shapes. For example, they can be 90-degree angles, bulb angles, tee shapes, and zees.

BAC (BOEING AIRCRAFT) EXTRUSIONS

Boeing parts come in a multitude of shapes and sizes. And, like the ANDs, they can be made in any alloy/temper. Though the drawings were originally published with designated grades, Boeing has since lifted restrictions. For example, they can be Roll form, drawn tubing, aluminum extrusion, rubber or plastic, or titanium extrusion.

LS (LOCKHEED MARTIN) EXTRUSIONS

Lockheed extrusions always start with the same prefix (“LS”) and three to five digits follow. The extrusions come in Roll-form, rubber, plastic, and extruded shapes. The alloys/grades are designated by the designer drawings. These can be made in a wide assortment of unique shapes that are all specified by the drawing itself. LS Shapes are typically in support of military applications such as the C-130 program.

GS (GRUMMAN AEROSPACE) EXTRUSIONS

Grumman parts are similar to Lockheed extrusions except that they are coded. Each suffix at the end of a Grumman part calls for the alloy and temper. The actual part is the same but the suffix variation denotes the grade needed.

S (MCDONNELL DOUGLAS) EXTRUSIONS

McDonnell Douglas parts follow the same suit as the Lockheed parts. Designer drawings specify all callouts and they come in Roll forms as well as extrusions. It will always start with an “S” and then have several digits after that.

With a solid foundation for common applications for extrusions in place, the next question becomes: what does each part number represent?"

ALUMINUM ALLOY SERIES – WHAT DO THE NUMBERS MEAN?

Alloys have four-digit numbers that begin with a digit that represents a general class, or series, characterized by its main alloying elements. Though there are 531 aluminum alloys with more being developed on a consistent basis, a quality supplier of aluminum aircraft extrusions can help a manufacturer choose the right alloy based on how it will be used.

Here are three common aluminum alloy series that are used around the aerospace industry:

2024 ALUMINUM

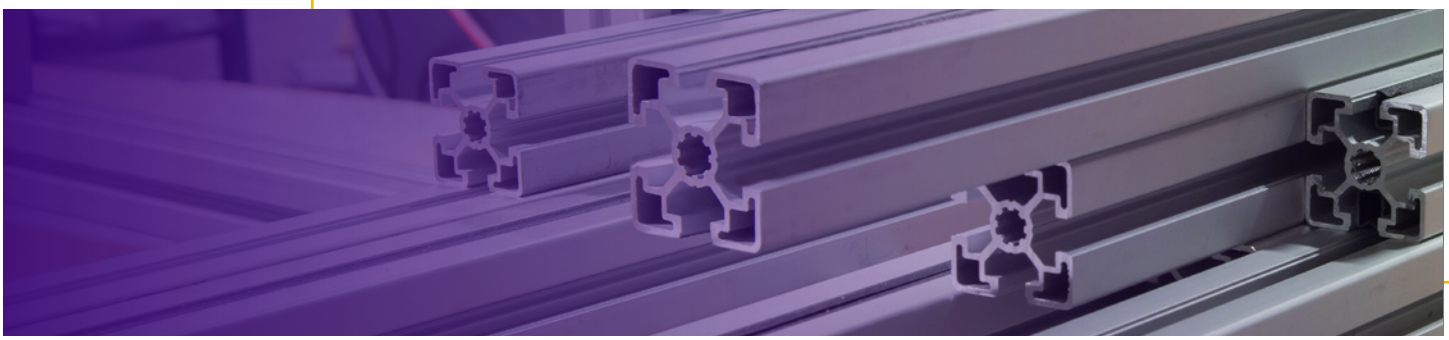
Copper is the main alloying element in the 2xxx series of aluminum alloys. 2024 aluminum is widely used for the high strength that comes from solution heat treating.

In solution heat treating, an alloy is heated to a specific temperature so that elements, in this case, copper and aluminum, mix. Then the metal is cooled in a solution that keeps the elements together. The alloy's strength is then increased through an "aging" process in which the compounds created through heat treatment bond with the aluminum's microstructure.

There are different types of 2024 aluminum. The designations of the different 2024 aluminum alloys denote their "tempers," which are based on how they were heat treated and aged.

With tempered 2024 aluminum, a "T" follows the alloy number. Then a digit that indicates the heat treatment method comes after the "T." Additional numbers may follow that first digit to convey manufacturing qualities. For example, in temper 2024-T42, the "4" means the alloy is strengthened with solution heat-treating and natural aging while the "2" signals that a buyer needs to heat-treat the metal.

Known for high strength, good workability, and excellent machinability, 2024 aluminum is commonly used in structural aircraft parts. Cladding it can make it resist corrosion as well.



6061 ALUMINUM

Silicon and magnesium are the primary alloying elements in the 6xxx series of aluminum alloys. The digit that follows the “6” in this series indicates the degree of impurity control for the base aluminum, with “0” signifying that the alloy is mostly commercial aluminum with its existing impurity levels and that controls do not need to be tightened. The third and fourth digits in a 6xxx series represent individual alloys.

6061 aluminum is easily formed, weldable, good at resisting corrosion, and heat treatable, according to Thomasnet.com. Its mechanical properties differ according to its heat-treatment method.

Values measure the alloy’s resistance to deformation, which is also known as its “stiffness.” Generally, this alloy is easy to join via welding and readily deforms into most desired shapes, making it a versatile manufacturing material,” Thomasnet.com says.

6061 aluminum tempers vary in the following types of strength.

Yield strength - Amount of stress needed to deform the part elastically

Ultimate strength - How much stress the alloy can take without fracturing

Shear strength - Resistance to being sheared by opposing forces

Fatigue strength - Ability to handle a small load repeatedly

6061 aluminum is used for its corrosion resistance as well. Together with its high strength, 6061 aluminum’s corrosion resistance makes the alloy a common choice for materials used in building aircraft frames, according to Thomasnet.com.

One of the most common types is 6061-T6 aluminum, which is formed by using high temperatures to increase the yield strength of aluminum through a process known as “precipitation hardening.” Its hardness and durability are increased.

7075-T6 ALUMINUM

Zinc is the primary alloying element in the 7xxx series of aluminum alloys. Magnesium, chromium, and copper also may be used. The 7xxx series of alloys are heat-treatable and have very high strengths.

7075-T6 aluminum is also very machinable and has a low density. It is often used for structural parts that are highly stressed.

The “T6” temper indicates that the alloy has been treated with solution heat to produce an alloy with peak strength. Comparable in strength to steel, it also resists corrosion and is often used by aerospace manufacturers due to its favorable strength-to-weight ratio.

Finally, what makes aluminum aerospace extrusions superior over other metals?

THE BEST CHOICE FOR AEROSPACE APPLICATIONS

Aluminum extrusions are often the best choice for aerospace applications because of the advantages they offer over components made of metals like nickel, steel, or titanium.

There are two distinct advantages that aluminum extrusions offer for aerospace manufacturers that other metals simply cannot match.

BUYING ADVANTAGES AND YOUR RETURN ON INVESTMENT

Aerospace manufacturers often prefer aluminum extrusions for the flexibility and affordability that they offer buyers. In terms of flexibility, the versatility for which aluminum extrusions are known is rooted in the multiple uses they can serve. For example, they can be used for strength and structural purposes, for their corrosion resistance, or their weldability.

TECHNICAL ADVANTAGES PROVIDES A VERSATILE METAL

As if the buying benefits that aluminum extrusions offer were not enough, the most distinguishing factor could be the technical advantages that aluminum offers as a metal. The design benefits of aluminum extrusions include the following:

- Lightweight
- Strength
- High strength-to-weight ratio
- Resilience
- Corrosion resistance
- Excellent thermal and electrical conductivity
- Non-sparking
- Non-magnetic
- Seamlessness
- Sustainability

The continuous evolution of aluminum aerospace extrusions also promises future benefits. For example, through the advancement of aluminum-lithium alloys the life of an aircraft could be improved through their increased strength and toughness. High-performance alloys for aerospace and defense deliver greater value through their better performance.

NEW SOURCE
CORPORATION

CORPORATE OFFICE

7500 TPC Blvd, Suite 1
Orlando, FL 32822
(407) 977-8488

WEST COAST OFFICE

555 S. State College Blvd.
Fullerton, CA 92831
(714) 626-0063

SALES@NEWSOURCECORP.COM

NEWSOURCECORP.COM