

## Guide to Aluminum, Physical and Mechanical Properties

Next to steel, Aluminum is the most commonly used and commercially available metal. Its light weight and high strength-to-weight ratio make it a good choice for everything from aircraft to flashlights to jigs to just about anything else you can make out of metal.

Pure aluminum, primarily seen in the 1xxx series of wrought aluminum alloys, has little strength, but possesses high electrical conductivity, reflectivity, and corrosion resistance. For this reason, a wide variety of aluminum alloys have been developed.

### Here is six alloys of aluminum in various shapes and sizes:

<b>2011 Aluminum</b>	available in Hex, Round)
<b>2024 Aluminum</b>	available in Plate, Rectangle, Round, Sheet, Square, Tube
<b>5052 Aluminum</b>	available in Sheet
<b>6061 Aluminum</b>	available in Angle, Channel, I-Beam, Pipe, Plate, Rectangle, Round, Sheet, Square, Tube
<b>6063 Aluminum</b>	available in Angle, Channel, Rectangle Tube, Square Tube
<b>7075 Aluminum</b>	available in Plate, Round, Sheet

### **2011 Aluminum,**

\*2011 is the most machinable of the commonly available aluminum alloys. Machining this alloy can produce excellent surface finishes on your product, and small, broken chips.

\*Weldability, strength, and anodizing response are all rated as average at best, and this alloy does not have a high degree of corrosion resistance.

\*If the ability to make your part quickly is important to you, and strength is not the primary desire, 2011 represents a good choice if you're using aluminum.

<b>2011-T3</b>		
Minimum Properties	Ultimate Tensile Strength, psi	55,000
	Yield Strength, psi	43,000

	Brinell Hardness	95
	Rockwell Hardness	B60
Chemistry	Aluminum (Al)	91.2 - 94.6%
	Bismuth (Bi)	0.2 - 0.6%
	Copper (Cu)	5.0 - 6.0%
	Iron (Fe)	0.7% max
	Magnesium (Mg)	2.1 - 2.9%
	Lead (Pb)	0.2 - 0.6%
	Silicon (Si)	0.4% max

### 2024 Aluminum

\*Copper is the main alloying ingredient in 2024.

\*It is very strong compared to most aluminum alloys, and has average machinability, but the copper component of this alloy makes it susceptible to corrosion (many items in this alloy are produced with a clad surface to protect the underlying material.)

\*In addition, 2024 is not considered to be weldable.

\*Finally, the fatigue resistance of 2024 make it a primary choice when the application is expected to be under stress or strain for prolonged periods. It is commonly used in aerospace applications.

<b>2024-T3</b>		
Minimum Properties	Ultimate Tensile Strength, psi	70,000
	Yield Strength, psi	50,000
	Brinell Hardness	120
	Rockwell Hardness	B75
Chemistry	Aluminum (Al)	90.7 - 94.7%
	Chromium (Cr)	0.1% max
	Copper (Cu)	3.8 - 4.9%
	Iron (Fe)	0.5% max
	Magnesium (Mg)	1.2 - 1.8%
	Manganese (Mn)	0.3 - 0.9%
	Silicon (Si)	0.5% max

### 5052 Aluminum

\*5052 is the alloy most suited to forming operations, with good workability and higher strength than that of the 1100 or 3003 alloys that are commercially available.

\*5052 is not heat-treatable, but is stronger than most of the 5xxx series of alloys.

\*5052 has very good corrosion resistance, and can be easily welded.

\*5052 is not a good choice for extensive machining operations, as it has only a fair machinability rating.

<b>5052-H32</b>		
Minimum Properties	Ultimate Tensile Strength, psi	33,000
	Yield Strength, psi	28,000
	Brinell Hardness	60
Chemistry	Aluminum (Al)	95.7 - 97.7%
	Chromium (Cr)	0.15 - 0.35%
	Copper (Cu)	0.1% max
	Iron (Fe)	0.4% max
	Magnesium (Mg)	2.2 - 2.8%
	Manganese (Mn)	0.1% max
	Silicon (Si)	0.25% max

### **6061 Aluminum**

\*6061 Aluminum is, by most any measure, the most commonly used aluminum alloy.

\*It is specified in most any application due to its strength, heat treatability, comparatively easy machining, and weldability.

\*If that were not enough, it is also capable of being anodized, adding a layer of protection for finished parts.

\*The main alloy ingredients of 6061 aluminum are magnesium and silicon.

<b>6061-T6</b>		
Physical and Mechanical Properties	Ultimate Tensile Strength, psi	45,000
	Yield Strength, psi	40,000
	Brinell Hardness	95
	Rockwell Hardness	B60
Chemistry	Aluminum (Al)	95.8 - 98.6%
	Chromium (Cr)	0.04 - 0.35%
	Copper (Cu)	0.15 - 0.40%

	Magnesium (Mg)	0.8 - 1.2%
	Manganese (Mn)	0.15% max
	Silicon (Si)	2.8 - 3.8%
	Zinc (Zn)	1.5% max

### 6063 Aluminum

\*6063 is often called architectural aluminum for two reasons

\*first, it has a surface finish that is far smoother than the other commercially available alloys.

\*second, its strength is significantly less (roughly half the strength of 6061), making it suited for applications where strength is not the foremost consideration.

\*6063 is rated as "Good" for forming and cold working operations, "Excellent" for anodizing, and "Fair" for machining.

6063-T52		
Minimum Properties	Ultimate Tensile Strength, psi	27,000
	Yield Strength, psi	21,000
	Brinell Hardness	60
Chemistry	Aluminum (Al)	97.5% max
	Chromium (Cr)	0.1% max
	Copper (Cu)	0.1% max
	Iron (Fe)	0.35% max
	Magnesium (Mg)	0.45 - 0.90%
	Manganese (Mn)	0.1% max
	Silicon (Si)	0.2 - 0.6%

### 7075 Aluminum

\*7075 is "aircraft grade" aluminum.

\*Its principal alloying ingredients are Zinc and copper, which make it one of the highest-strength aluminum alloys that are available. In fact, its typical strength in the T6 temper is higher than most mild steels.

\*7075 also has average-to-good ratings for machinability, corrosion resistance, and anodizing response. Like 2024, however, it is not considered to be weldable.

7075-T6		
Physical and Mechanical Properties	Ultimate Tensile Strength, psi	83,000
	Yield Strength, psi	73,000

	Brinell Hardness	150
	Rockwell Hardness	B87
Chemistry	Aluminum (Al)	87.1 - 91.4%
	Zinc (Zn)	5.1 - 6.1% max
	Copper (Cu)	1.2 - 2.0%
	Chromium (Cr)	0.18 - 0.28%
	Iron (Fe)	0.5 max
	Magnesium (Mg)	2.1 - 2.9%
	Manganese (Mn)	0.3% max



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