

7075 Aluminum Alloy Plate, Properties, Applications, and Advantages

Original link: <https://gengfeisteel.com/knowledge/7075-aluminum-alloy-plate/>



7075 Aluminum Alloy Plate: Properties, Applications, and Advantages



7075 aluminum alloy plate is widely regarded as one of the highest-strength aluminum alloys available for commercial use. Renowned for its superior performance in aerospace, automotive, and structural applications, 7075 aluminum offers a combination of light weight, toughness, corrosion resistance, and machinability. It is often chosen as a strong alternative to titanium or mild steel where weight reduction is critical.

What Is 7075 Aluminum Alloy?

7075 aluminum alloy is a high-strength, heat-treatable wrought aluminum alloy. It is part of the 7000 series of aluminum alloys, which are primarily zinc-based. The 7075 alloy is best known for its excellent strength-to-weight ratio and fatigue resistance, making it ideal for highly stressed structural parts.

The alloy was first developed by the Japanese company Sumitomo Metal in 1936 and later adapted by the U.S. aviation industry during World War II. It remains one of the most trusted aerospace-grade aluminum alloys in use today.

Composition of 7075 Aluminum

- Aluminum (Al): Balance
- Zinc (Zn): 5.1 – 6.1
- Magnesium (Mg): 2.1 – 2.9
- Copper (Cu): 1.2 – 2.0
- Chromium (Cr): 0.18 – 0.28

Tempers of 7075 Aluminum Plate

- **7075-O** – Annealed, softest state
- **7075-T6** – Peak strength condition, most common
- **7075-T651** – Stress-relieved T6
- **7075-T73** – Overaged for enhanced corrosion resistance
- **7075-T76** – Offers slightly better corrosion resistance and toughness than T6

1. Introduction

7075 aluminum alloy plate is widely regarded as one of the highest-strength aluminum alloys available for commercial use. Renowned for its superior performance in aerospace, automotive, and structural applications, 7075 aluminum offers a combination of light weight, toughness, corrosion resistance, and machinability. It is often chosen as a strong alternative to titanium or mild steel where weight reduction is critical.

2. What Is 7075 Aluminum Alloy?

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3. Composition of 7075 Aluminum

The alloying elements in 7075 are carefully balanced to achieve high strength and good corrosion resistance. Here’s a typical breakdown:

Element	Content (%)
Aluminum (Al)	Balance
Zinc (Zn)	5.1 – 6.1
Magnesium (Mg)	2.1 – 2.9
Copper (Cu)	1.2 – 2.0
Chromium (Cr)	0.18 – 0.28
Others (Fe, Si, etc.)	≤ 0.5

The high zinc and magnesium content contribute to the alloy’s exceptional strength after heat treatment.

4. Key Mechanical Properties

7075 aluminum alloy plate is characterized by its high tensile and yield strength.

Property	7075-T6	7075-O (annealed)
Ultimate Tensile Strength	~572 MPa (83,000 psi)	~220 MPa (32,000 psi)
Yield Strength	~503 MPa (73,000 psi)	~103 MPa (15,000 psi)
Elongation at Break	11% (T6)	18% (O)
Brinell Hardness	~150 HB	~60 HB
Modulus of Elasticity	71.7 GPa	71.7 GPa

The T6 temper is the most commonly used, offering an ideal balance of strength and machinability.

5. Physical and Chemical Characteristics

Property	Value
Density	2.81 g/cm³
Melting Point	477–635°C
Thermal Conductivity	130 W/m·K
Electrical Conductivity	33% IACS
Thermal Expansion Coefficient	21.2 µm/m·K
Corrosion Resistance	Moderate to Good

Note: While 7075 offers decent corrosion resistance, it is not as good as 5052 or 6061 and may require surface treatments in marine environments.

6. Tempers of 7075 Aluminum Plate

Common tempers include:

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7. Comparison with Other Aluminum Alloys

Property	7075	6061	2024
Strength	Very High	Medium	High
Corrosion Resistance	Moderate	High	Low

Property	7075	6061	2024
Machinability	Good	Excellent	Fair
Weldability	Poor	Good	Poor
Cost	High	Moderate	Moderate

8. Advantages of 7075 Aluminum Alloy Plate

- **Superior Strength:** Comparable to some grades of steel.
- **Lightweight:** Excellent strength-to-weight ratio.
- **Good Fatigue Resistance:** Suitable for cyclic loading conditions.
- **High Machinability:** Especially in T6 and T651 conditions.
- **Aerospace-Grade Quality:** Compliant with MIL and ASTM standards.

9. Disadvantages and Limitations

- **Poor Weldability:** Prone to cracking during fusion welding.
- **Lower Corrosion Resistance:** May need anodizing or cladding.
- **High Cost:** More expensive than 6061 or 5052.
- **Limited Formability:** Especially in T6 condition due to hardness.

10. Common Applications

7075 aluminum alloy plate is widely used in high-performance and critical-strength applications:

Aerospace and Aviation

- Wing skins
- Fuselage frames
- Structural bulkheads

Automotive and Racing

- Chassis components

- Suspension arms
- Engine parts

Military and Defense

- Armor plating
- Missile parts
- Gun components

Sports and Recreation

- Bicycle frames
- Climbing equipment
- Hunting bows

Industrial Use

- Robotics arms
 - Fixtures and jigs
 - Hydraulic components
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11. Machinability and Weldability

Machinability

7075 is known for excellent machinability in T6 and T651 tempers. It allows for tight tolerances and high-speed cutting, making it suitable for CNC milling, drilling, and turning.

Weldability

Fusion welding is not recommended due to cracking susceptibility. If welding is necessary, **resistance welding** or **friction stir welding** may be used. Post-weld heat treatment is often required.

12. Heat Treatment and Aging

7075 aluminum responds well to **solution heat treatment** followed by **artificial aging**:

1. **Solution Heat Treatment** (~480°C)
2. **Quenching** (Water quench to lock microstructure)
3. **Artificial Aging** (T6: ~120°C for 24 hours)

This process enhances strength and hardness significantly.

13. Surface Finishing Options

- **Anodizing** – Improves corrosion resistance and surface hardness
 - **Alclad Coating** – Thin layer of pure aluminum for corrosion protection
 - **Powder Coating** – Provides decorative and protective finish
 - **Chemical Conversion Coating** – Chromate conversion for electrical conductivity
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14. 7075 vs. 6061 Aluminum

Feature	7075	6061
Strength	Higher	Moderate
Cost	Higher	Lower
Corrosion Resistance	Lower	Higher
Weldability	Poor	Good
Applications	Aerospace, defense	Structural, marine

15. Market and Industry Usage

The global market for 7075 aluminum is driven by:

- **Aerospace growth**
- **Military modernization**
- **Electric vehicles and drones**
- **Lightweight consumer electronics**

Countries like the U.S., Germany, Japan, and China dominate the demand for aerospace-grade aluminum, including 7075.

16. Environmental and Sustainability Factors

- **Recyclable:** 7075 aluminum can be recycled without significant loss of properties.
 - **Energy Saving:** Lightweighting in transportation reduces fuel consumption.
 - **Processing Waste:** Careful machining is needed to reduce waste due to high material cost.
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17. How to Select the Right 7075 Plate

When selecting a 7075 plate:

- **Define Required Strength:** Use T6 or T651 for peak performance.
 - **Consider Machinability Needs:** Choose stress-relieved tempers.
 - **Check Corrosion Exposure:** Opt for T73 or apply protective coatings.
 - **Evaluate Forming Requirements:** Use O temper if complex shapes are needed.
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18. FAQs

Q1: Is 7075 aluminum stronger than steel?

Yes, in some tempers, 7075-T6 can approach the strength of mild steel while being significantly lighter.

Q2: Can 7075 aluminum be welded?

It is not ideal for welding. If necessary, use friction stir welding and post-treatment.

Q3: Is 7075 suitable for marine use?

Not directly. It requires anodizing or Alclad coating for marine environments.

Q4: What is the best temper for machining?

7075-T651 offers excellent dimensional stability and machinability.

19. Conclusion

7075 aluminum alloy plate stands out as a top-tier engineering material when strength, light weight, and fatigue resistance are paramount. Although it has limitations like weldability and corrosion susceptibility, these can be addressed through proper treatment and design. Whether you're building the next generation of aircraft or optimizing high-performance machines, 7075 aluminum offers the performance edge needed in today's competitive environments.