Aluminum 7050: The Thick-Section Toughened Alloy

Metallurgical Profile

Aluminum 7050 was developed to address the shortcomings of 7075, specifically its quench sensitivity in thick sections and susceptibility to stress corrosion cracking (SCC). By altering the Zinc/Magnesium/Copper ratios and, crucially, replacing Chromium (Cr) with Zirconium (Zr), 7050 maintains its mechanical properties even in plates exceeding 3-6 inches in thickness.[12]

Chemical Composition (Weight %)

The presence of Zirconium inhibits recrystallization during hot working, allowing the alloy to retain a desirable unrecrystallized grain structure that improves fracture toughness.

Element	Weight Percentage (%)	Difference from 7075
Zinc (Zn)	5.7 – 6.7	Higher than 7075.[15]
Copper (Cu)	2.0 – 2.6	Higher than 7075.[15]
Magnesium (Mg)	1.9 – 2.6	Slightly lower than 7075.[15]
Zirconium (Zr)	**0.08 – 0.15**	**Replaces Chromium (Cr)**.[15]
Titanium (Ti)	Max 0.06	Grain refiner.[15]
Iron (Fe)	Max 0.15	Strictly controlled.[15]
Silicon (Si)	Max 0.12	Strictly controlled.[15]
Aluminum (Al)	Remainder	Base.[15]

Mechanical Properties

The standard temper for 7050 is **T7451** (formerly T73651), which is overaged to maximize SCC resistance while retaining high strength.

Property	7050-T7451	Comparison to 7075-T6	Unit
Ultimate Tensile Strength	524 (76)	Lower (vs 572)	MPa (ksi) [42]
Yield Strength	469 (68)	Lower (vs 503)	MPa (ksi) [42]
Fracture Toughness (K_{IC})	**~35**	**Superior**	MPa$\sqrt{m}$ [43]
SCC Resistance	**Excellent**	**Superior**	Qualitative [12]
Hardness (Brinell)	140 HB	Slightly Softer (vs 150)	HB [42]
Elongation at Break	11%	Similar	% [42]

Insight: 7050 exhibits lower quench sensitivity. When 7075 is quenched in thick sections (e.g., 6 inches), the core cools too slowly, leading to precipitation at grain boundaries and a drastic loss of strength and toughness. 7050 maintains its properties throughout the thickness, making it the definitive alloy for **bulkheads** and **heavy spars**.[16]

Processing Characteristics

- **Machinability:** Good. Similar to 7075, it machines well but requires robust tooling.
- **Weldability:** Not recommended.
- **Heat Treatment:** Specifically designed for thick section heat treatment.

Applications

- **Aerospace:** Bulkheads, fuselage frames, wing skins, landing gear components.[16]
- **Defense:** Armor plates for military vehicles.