Ti 6Al-4V is the most widely used of all the alpha-beta titanium alloys. It is typically used in the annealed condition, at service temperatures through 750°F. However it may be heat treated for high strength in sections under 4" thick. Hardenability is limited and sections over one inch may not develop full properties. Ti 6Al-4V is welded with either matching or ELI (Extra Low Interstitials) filler wire.

Mill anneal: 1300-1450°F 2 hours, air cool. Recrystallization anneal bar for better ductility and fatigue strength, 1750°F 2 hours, furnace cool. **For maximum fracture toughness and SCC resistance:** Beta anneal 1950°F 1-2 hours, water quench. Then age 1150-1300°F 2 to 4 hours, air cool. **For maximum strength:** solution-treated and aged (STA) condition is: For sheet, 1675-1725°F 5 to 25 minutes, water quench. Age 975°F 4 to 6 hours, air cool. For bars and forgings, 1675-1725°F 1 hour, water quench. Age 975-1025°F 3 hours, air cool. **For increased fracture toughness, but lower tensile strength:** precipitation treat (overage) 1150-1250°F 4 hours, air cool. **Stress relief:** annealing is commonly 1000-1200°F 1 to 4 hours, air cool.

Ti 6Al-4V is resistant to general corrosion but may be quickly attacked by environments that cause breakdown of the protective oxide. These include hydrofluoric (HF), hydrochloric (HCl), sulfuric and phosphoric acids. Inhibitors may help for the last four but not for HF. Ti 6Al-4V resists attack by pure hydrocarbons, and most chlorinated and fluorinated hydrocarbons (provided water has not caused formation of small amounts of HCl and HF).

Ti 6Al-4V is susceptible to chloride stress corrosion cracking (SCC), although being among the better of the titanium alloys in this regard. For marine environments silver plated bolts are not used, as silver bonds easily with chlorine in this environment. Ti 6Al-4V is also susceptible to SCC in environments such as methyl alcohol, red fuming HNO_3, and N_2O_4. In the case of red fuming nitric acid, the problem is limited to environments containing less than 1.5% water, or more than 6% NO_2. Failure in N_2O_4 has occurred when oxygen and chlorides were present as impurities.

Specifications

UNS: R56400 **W. Nr./EN:** 3.7164, 3.7165 **AMS:** 4911, 4928, 4967, 4935, 4920, 4965, T-9046
ASTM: B 265, B 348, B 861 **ASME:** SB-265, SB-348, SB-861 **MIL:** T-9047

Chemical Composition, %

	Al	V	C	N	O	H	Fe	Y	Others, Each	Others, total	Ti
MIN	5.5	3.5	–	–	–	–	–	–	–	–	–
MAX	6.75	4.5	0.08	0.05	0.2	0.0125	0.3	0.005	0.1	0.4	balance

Features

- High strength to 600°F
- Excellent general corrosion resistance
- High strength-to-weight ratio

Applications

- Turbine blades, discs and rings
- Aircraft structural components
- Weapons structural components
- Fasteners
- Medical and dental implants
- Hand tools
- Sporting equipment
- Chemical process equipment

Physical Properties

Density: 0.160 lb/inch³ **Melting Range:** 2929-3020°F **Beta Transus:** 1825±25°F

Temperature, °F	70	200	400	600
Coefficient of Thermal Expansion, in/in°F x 10^{-6}	–	5.3	5.4	5.5
Thermal Conductivity, Btu • Ft/Ft² • Hr°F STA	4.0	4.3	5.2	6.1
Modulus of Elasticity, psi X 10^{6} STA	16.7	16.0	15.0	14.0

Mechanical Properties

Specified, AMS 4911, annealed sheet & plate

Size up to, inch	> 0.025 ≤ 0.063	> 0.063 ≤ 0.1874	> 0.1874 ≤ 4.000
Tensile Strength, ksi	134	134	130
0.2% Yield Strength, ksi	126	126	120
Elongation in 2", %	8	10	10

Typical Range, Room Temperature Bar Tensile Properties

	Anneal 1300°F, Air Cool	Anneal 1300°F, Solution anneal 1750°F , Age 1000°F
Ultimate Tensile Strength, ksi	138-155	150-172
0.2% Yield Strength, ksi	128-147	137-156
Elongation, %	15-20	15-17
Reduction of Area, %	38-51	41-46

Typical Tensile Strength and Fracture Toughness, Various Heat Treatments for Flat-rolled Products (MCIC-HB-02 1985 reprint)

	0.2% Yield Strength, ksi	Fracture Toughness K_{1C}, ksi √in
Annealed (Continuously Rolled Sheet)	132 142 (transverse[a])	128 140 (transverse[a])
Beta Annealed (plate)	131	134
Beta STA 1250°F[b]	128	150
Beta STA 1000°F[b]	143	120
STA 1250°F[c]	137	105
STA 1000°F[c]	159	80

(a) Directional variations,
(b) Beta heat treated followed by solution treating and overaging 1250°F, or aging 1000°F
(c) Solution treating and overaging 1250°F, or aging 1000°F

INTERNATIONAL TRADE WINDS LLC
Exclusive Representative of Rolled Alloys®, Inc.

CLAUDIO CZARNOBAI
COMMERCIAL MANAGER
ClaudioCzarnobai@intwinds.com
F +55 11 3825 2966
C +55 11 99112 2703

ROLLED ALLOYS