

Ti 6Al-4V ELI

One of the most commonly used titanium alloys is an alpha-beta alloy containing 6% Al and 4% V. This alloy, usually referred to as Ti 6Al-4V, exhibits an excellent combination of corrosion resistance, strength and toughness. Typical uses include medical devices or implants, aerospace applications and pressure vessels. In the case of medical applications, stringent user specifications require controlled microstructures and freedom from melt imperfections. The interstitial elements of iron and oxygen are carefully controlled to improve ductility and fracture toughness. Controlled interstitial element levels are designated ELI (extra low interstitials). Hence the designation Ti 6Al-4V ELI.

Chemistry		
	FWM Avg. Wt. %	ASTM F136
Nitrogen, max.	0.011	0.05
Carbon, max.	0.015	0.08
Hydrogen, max.	0.0058	0.012 ^A
Iron, max.	0.12	0.25
Oxygen, max.	0.11	0.13
Aluminum	6.06	5.5-6.50
Vanadium	3.97	3.5-4.50
Titanium	Balance	Balance

FWM chemistry is for reference only, and is not to be used for specification purposes.

^A Material 0.032" (0.813mm) and under may have hydrogen content up to 0.0150%.

Surface Conditions

Ti 6Al-4V ELI has a tendency to stick, fret or cold weld with drawing dies during processing. Common industry practice to avoid this condition usually employs heavy etching or pickling at finish size resulting in a coarse or very textured surface. Fort Wayne Metals has developed processing techniques with enhanced surface treatments which require minimal etching at finish size to remove residual oxide, yielding a cleaner and smoother surface finish.

Diameter Tolerances

Enhanced surface treatments and processing techniques allow Fort Wayne Metals to offer tighter and more controlled tolerances. The chart in the right column details standard diameter tolerances for Ti 6Al-4V ELI in wire and coil forms. Most diameters can be produced to tighter tolerances.

Applications

Fort Wayne Metals manufactures Ti 6Al-4V ELI in straightened and cut bar, coil, strands and cables, flat wire and wire form to support a variety of critical medical and industrial based applications. End uses include:

- Orthopaedic pins and screws
- Orthopaedic cables
- Orthodontic appliances
- Springs
- Surgical staples
- Ligature clips

Mechanical Properties per ASTM F136			
Size in. (mm)	U.T.S. minimum ksi (MPa)	Y.S. min. (0.2% offset) ksi (MPa)	% Elongation minimum
Under 0.187 (4.75)	125 (860)	115 (795)	10%(2" gage length)
0.187 to 0.250 (4.75) to (6.35)	125 (860)	115 (795)	10% (4D)

Approximate FWM Mechanical Properties		
Condition	U.T.S. ksi (MPa)	% Elongation (2" gage length)
Cold Worked	190-210 (1310-1448)	3%-7%
Cold Worked/ Stress Relieved	170-190 (1172-1310)	5%-10%
Annealed	145-170 (1000-1172)	10% min.

Values are typical and may not represent all diameters. Test method will affect results.

Ti 6Al-4V ELI in centerless ground bar, coil, and wire can be offered in annealed or cold worked conditions.

Physical Properties

Density	0.160 lbs/in ³
Modulus of Elasticity	16.5 psi x 10 ⁶
Electrical Resistivity	1.71 μohms-m
Thermal Conductivity	6.6-6.8 w/mK

Diameter in. (mm)		
Including	Under	Std. Tolerance +/-
0.0010 (0.0254)	0.0048 (0.1219)	0.0001 (0.0025)
0.0048 (0.1219)	0.0080 (0.2032)	0.0002 (0.0051)
0.0080 (0.2032)	0.0120 (0.3048)	0.0003 (0.0076)
0.0120 (0.3048)	0.0240 (0.6096)	0.0004 (0.0102)
0.0240 (0.6096)	0.0330 (0.8382)	0.0005 (0.0127)
0.0330 (0.8382)	0.0440 (1.1176)	0.0008 (0.0203)
0.0440 (1.1176)	0.2510 (6.3754)	0.0010 (0.0254)

Product Capability

Wire

Fort Wayne Metals utilizes state-of-the-art equipment and processing techniques to provide precision drawn Ti 6Al-4V ELI. Wire is typically provided on standard FWM spools (see packaging and spooling data sheet). Custom packaging or spools will be considered based on our equipment capabilities.

Diameter Range

0.001" (0.0254mm) to 0.062" (1.5748mm)

Coil

Fort Wayne Metals provides precision loose wound coils for many critical applications, coil weights can reach a maximum of 100 pounds, nominal 50 pound weight depending on diameter.

Diameter Range

.040" (1.016mm) to .250" (6.35mm)

Packaging (coil I.D.)

0.040" (1.016mm) to 0.125" (3.175mm) = 20"

(508mm) nominal

.100" (2.54mm) to 0.250"(6.35mm) = 28"

(711mm) nominal

Centerless and Precision Ground Bar

Fort Wayne Metals provides straightened and cut bar product in centerless and precision ground conditions. Customers can order discrete lengths, however, material is typically manufactured in 10' (3048mm) to 12' (3657mm) random lengths. Most diameters can be produced to tighter tolerances.

Diameter Range

.0787" (2.0mm) to .250" (6.35mm)

	Standard Tolerance	Surface Roughness (RMS)
Centerless Ground Bar	+/- 0.001" (0.0254mm)	24 or better
Precision Ground Bar	+/- 0.0005" (0.0127mm)	16 or better

Other Titanium & Titanium Alloys Available

- CPTi Gr.1 · Ti 6Al-4V ELI
- CPTi Gr.2 · Ti 6Al-7Nb
- CPTi Gr.3 · Ti 3Al-2.5V
- CPTi Gr.4 · Ti 3Al-8V-6Cr-4Mo 4Zr (Ti Beta C)

Other titanium and titanium alloys will be considered upon request.