



TITANIUM INDUSTRIES, INC.

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AEROSPACE

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Superior, Reliable and Cost-Effective for Critical Aerospace Applications

The aerospace industry is a large market for titanium products primarily due to the exceptional strength-to-weight ratio, elevated temperature performance, creep resistance and corrosion resistance. Titanium applications are most significant in jet engine and air-frame components that are subject to temperatures up to 1100°F as well as other critical structural parts. Titanium usage is widespread in most commercial and military aircraft, and is also used in spacecraft where its many benefits are effectively utilized.

Titanium has proven to be technically superior, highly reliable and extremely cost effective in many critical aerospace applications. Titanium usage for both civil and military aerospace continues to grow with each new generation of aircraft and space vehicles.

Company & Product Line

Titanium Industries is a manufacturing distributor whose service centers maintain one of the world's largest inventories of titanium products for the aerospace industry. Both alloy and commercially pure aerospace grades are readily available in bar, billet, sheet, plate and wire. Specialty products — such as rings and other forged shapes — can be processed to extremely close tolerances. All materials are fully certified to AMS, MIL-T and many other aerospace customer specifications.

Titanium Industries supplies products of the highest quality standards. Complete chemical and mechanical property test reports accompany each shipment.

Inventory is 100% traceable from melt source through processing to maintain quality-control requirements.



Qualifications & Approvals

Titanium Industries has earned qualified and approved vendor status from the following corporations (partial list)...

- ISO 9001-2000
- AS 9100B
- 3I Implant Innovations
- Aerospatiale Hemmingford, Inc.
- Bijet, Inc.
- Biomet
- Bombardier Aerospace
- Bombardier De Haviland
- Cessna Aircraft Co.
- Conair Aviation Ltd.
- D.L.A. (Defense Logistics Agency)
- DC Fabricators (MIL-I-45208A)
- Depuy/Ace Medical
- E & W Aerospace
- E & W Manufacturing
- Electric Boat
- Fleet Industries
- General Dynamics
- GKN Westland Aerospace
- Heroux Aerospace
- Howmedica
- HTD Aerospace
- Ingersoll Dresser Pump (MIL-I-45208A)
- Jet Engineering
- Johnson & Johnson
- Litton/Ingalls Shipbuilding (MIL-I-45208A)
- Lockheed Martin
- Lucas Aerospace (Boeing)
- Medsource-Brimfield
- Medtronic Sofamor Danek
- Miniature Ball Bearings
- Newcomb Spring of Texas
- Northrup Grumman
- Osteonics
- Palmer Manufacturing (MIL-I-45208A)
- Portsmouth Naval Shipyard
- Pratt & Whitney (LCS)
- Precision Metal Products (PMP)
- Raytheon Airborne Systems
- Shaw Aero Devices, Inc.
- Shur-Lok Corporation
- Smith & Nephew
- Spar Aerospace
- Specialty Metals Corporation
- Stealth Engineering
- Sulzer Medica
- Superior Tube Co.
- Thiokol Aerospace & Industrial Technologies
- Timken Aerospace
- Young Engineers Co.
- Zimmer



TITANIUM INDUSTRIES, INC.
ISO 9001:2000 REGISTERED

International Titanium & Titanium Alloy Specifications Forms Available

Grade Ref#	Forms Available	ASTM	DIN	British Standards TA	Aerospace American AMS	Aerospace American MIL-T 9046	Remarks
GR-1	BPSTWF	1	3.7025	1		CP4	
GR-2	BPSTWFC	2	3.7035	2, 3, 4, 5	4902, 4941, 4942, 4951	CP3	Commercially pure titanium, used primarily for corrosion resistance. Strength increases with Grade #.
GR-3	BPSWFC	3	3.7055		4900	CP2	
GR-4	BPSWFC	4	3.7065	6, 7, 8, 9	4901	CPI	
GR-7	BPSTWFC	7, 11					Industrial alloys with superior corrosion resistance.
GR-12	BPSWF	12					
GR-5	BPSWFC	5	3.7165	10, 11, 12, 28, 56, 59	4911, 4928	AB1/As Comp AB2	Popular alloys of medium strength for airframe and engines.

AMS-T9046

Commercially Pure Titanium (CP)	
Code Designation	Composition
CP - 1	(70 KSI-YS)
CP - 2	(55 KSI-YS)
CP - 3	(40 KSI-YS)
CP - 4	(25 KSI-YS)
Alpha Titanium Alloys (A)	
Code Designation	Composition
A - 1	5Al - 2.5 Sn
A - 2	5Al - 2.5 Sn (ELI)
A - 3	6Al - 2Cb - 1Ta - 0.8Mo
A - 4	8Al - 1Mo - 1V
Alpha-Beta Titanium Alloy (AB)	
Code Designation	Composition
AB - 1	6Al - 4V
AB - 2	6Al - 4V (ELI)
AB - 3	6Al - 6V - 2Sn
AB - 4	6Al - Sn - 4Zr - 2Mo
AB - 5	3Al - 2.5V
AB - 6	8Mn
Beta Titanium Alloys (B)	
Code Designation	Composition
B - 1	13V - 11Cr - 3Al
B - 2	11.5Mo - 6Zr - 4.5Sn
B - 3	3Al - 8V - 6Cr - 4Mo - 4Zr

Remarks on Fabrication for 6Al-4V & 6Al-4V ELI

TECHNICAL DATA	6Al-4V	6Al-4V ELI
Beta Transus	1830F ± 25F	1830F ± 25F
Cutting	Readily cuts with saw or abrasive wheel	Readily cuts with saw or abrasive wheel
Machining	Rigid set-up, slow speed, heavy feed, sharp tools, adequate coolant	Rigid set-up, slow speed, heavy feed, sharp tools, adequate coolant
Forming	Formed at room temp. whenever possible; hot forming recommended for complex structures	Formable: Warm forming useful with solution-treated material
Joining, Welding	Sound moderately ductile welds if protected by inert gas	Sound moderately ductile welds if protected by inert gas

Remarks on Heat Treatment for 6Al-4V & 6Al-4V ELI

TECHNICAL DATA	6Al-4V	6Al-4V ELI
Initial Forging	1805F, no higher than 1775F to finish.	1800 - 1820F, no higher than 1750F to finish.
Annealing	1300 - 1550F 1 - 8 hr. slow cool to 1050F, AC	1300 - 1550F 1-8 hr., AC
Solution Treating	1700-1750F 1 hr., water quench (bar) 1660 - 1725F, 5 - 20 min. WQ (sheet and plate)	Not applicable
Aging	1000F, 4 hr., AC	Not applicable
Stress Relief Annealing	900 - 1200F 1 - 4 hr., AC	900 - 1200F 1 - 4 hr., AC

Other Technical Data for 6Al-4V & 6Al-4V ELI

TECHNICAL DATA	6Al-4V	6Al-4V ELI
Principal Uses	Airframe and turbine engine parts (blades, discs, wheels, spacer rings), ordnance equipment, pressure vessels, rocket motor cases	Principal uses: Surgical applications & implants, orthopaedic implants, pressure vessels, airframes, etc.
Available Forms	Sheet, strip, plate, bar, billet, wire, extrusions	Sheet, strip, bar, billet, wire, extrusions, tubing
Nominal Composition	0.08% max C, 0.05% max N, 0 - 0.15% max H (sheet), 0.25% max Fe, 5.75 - 6.75% Al, 3.5 - 4.5% V, 0.20% max O	0.08% max C, 0.05% max N, 0.015% max H (sheet) - 0.13% max O, 5.5 - 6.5% Al, 3.5 - 4.5% V, 0.25% max Fe
Type Structure	Alpha-Beta	Alpha-Beta