

ATI 6-4 ELI™ (ATI Ti-6Al-4V-ELI, Grade 23)

Extra Low Interstitials Alloy

(UNS R56407)

INTRODUCTION

ATI Ti-6Al-4V-ELI, Grade 23 alloy (Extra Low Interstitials, UNS R56407) is a higher purity grade of ATI Ti-6Al-4V alloy. This grade has lower oxygen, carbon, and iron content. It is used in biomedical applications such as surgical instruments, orthopedic implants, and is the preferred grade for marine and cryogenic applications, and some important aerospace components.

This titanium grade is produced by vacuum arc primary melting followed by a second vacuum arc remelting operation.

SPECIFICATIONS

- AMS 4930 - Bar, Wire, Billet, and Rings (annealed)
- AMS 4931 - Bar, Billet, and Rings
- AMS 4996 - Billet
- ASTM F 136 - Surgical Implants

PHYSICAL PROPERTIES

Melting Range: 2,800-3,000°F (1,538 - 1,649°C)

Density: 0.160 lbs/cu. in.; 4.47 gm/cc

Beta Transus Temperature: 1,790°F (± 25°); 976.7°C (± 3.9°)

HEAT TREATMENT

ATI Ti-6Al-4V-ELI, Grade 23 alloy is normally used in the annealed condition.

1. Anneal: 1,300 -1,350°F; (704.4 - 732.2°C), 1 to 8 hours, air cool
2. Stress Relieving: 900 -1,200°F; (482.2 - 648.9°C), 1 to 4 hours, air cool

HARDNESS

Typical hardness in the annealed condition is Rockwell C 30-34.

FORMABILITY

The formability of ATI Ti-6Al-4V-ELI, Grade 23 alloy is better than standard grade ATI Ti-6Al-4V alloy, although it is still difficult to form at room temperature in the annealed condition. Severe forming operations such as bending or stretching can be performed on annealed material at temperatures up to 1,200°F; (648.9°C) without affecting mechanical properties. Hot sizing or shaping can be done by creep forming in the 1,000 -1,200°F; (537.8 - 648.9°C) temperature range.

FORGEABILITY

ATI Ti-6Al-4V-ELI, Grade 23 alloy is finish-forged from 1,750°F; (954.4°C) with a finishing temperature of 1,450°F; (787.8°C). Minimum

reductions of 35% are recommended to obtain optimum properties.

MACHINABILITY

ATI Ti-6Al-4V-ELI, Grade 23 alloy can be machined using practices for austenitic stainless steels using slow speeds, heavy feeds, rigid tooling, and large amounts of non-chlorinated cutting fluid.

WELDABILITY

ATI Ti-6Al-4V-ELI, Grade 23 alloy is easily welded in the annealed condition.

Precautions must be taken to prevent oxygen, nitrogen, and hydrogen contamination. Fusion welding can be done in inert gas filled chambers or using inert gas welding of the molten metal and the adjacent heated zones using a trailing shield. Spot, seam, and flash welding can be performed without resorting to protective atmospheres.

Properties of ATI Ti-6Al-4V-ELI, Grade 23 alloy welds such as ductility, impact strength and fracture toughness are significantly better than welds of standard grade ATI Ti-6Al-4V alloy.

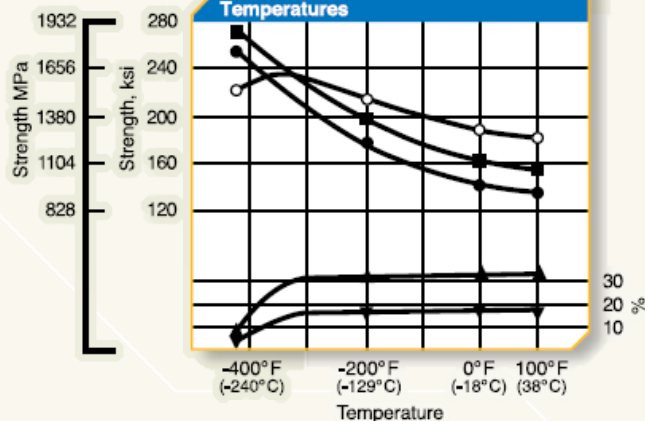
SPECIAL PRECAUTIONS

ATI Ti-6Al-4V-ELI, Grade 23 alloy can be subject to hydrogen contamination during improper pickling and by oxygen, nitrogen, and carbon pickup during forging, heat treating, brazing, etc. This contamination results in a deterioration in ductility which could adversely affect notch sensitivity and forming characteristics.

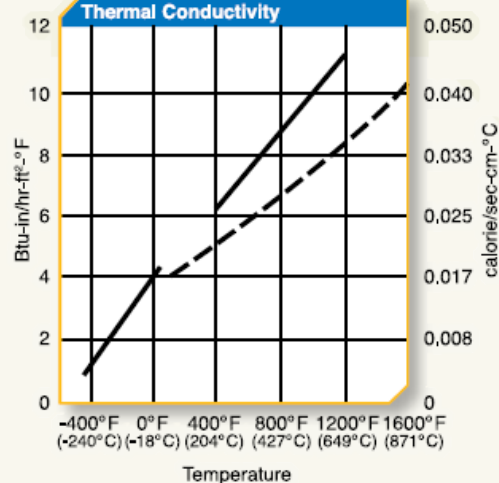
Chemical Composition

	N	C	H	O	Fe	Al	V	Ti	Other Elements
% w/w, min.	-	-	-	-	-	5.50	3.50	-	-
% w/w, max.	0.05	0.08	0.0125	0.13	0.25	6.75	4.50	Bal	0.30 Total 0.10 Each

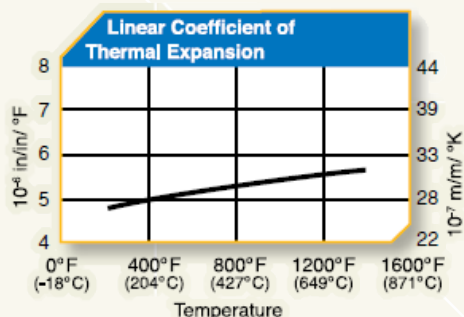
Typical Tensile Properties at Cryogenic, Room, and Elevated Temperatures



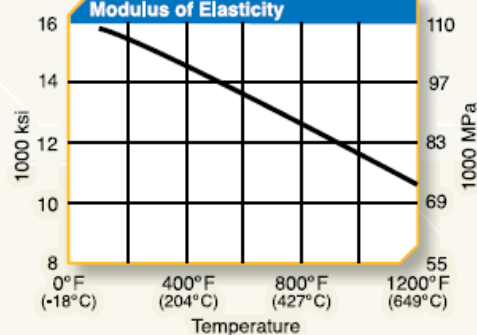
Thermal Conductivity



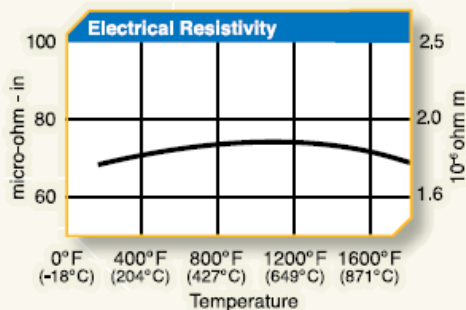
Linear Coefficient of Thermal Expansion



Modulus of Elasticity



Electrical Resistivity



Fracture Toughness

