



Technical Data Sheet

ATI Tiadyne™ 3510 (Ti-35Zr-10Nb)

Titanium Alloy

INTRODUCTION

ATI Tiadyne™ 3510 Titanium Alloy is a unique titanium base alloy that offers attractive properties for a wide range of applications. It exhibits a martensitic microstructure at room temperature after being quenched from 850°C (1562°F) (beta transus approximately 635°C(1175°F)).

After aging at 425°C–550°C (797°F–1022°F), the tensile and yield strengths are increased significantly. It also exhibits a low modulus of elasticity, excellent castability, and superplasticity at elevated temperatures. It is readily weldable and machinable before and after hardening.

An extraordinary characteristic of ATI Tiadyne™ 3510 titanium is the capability of being surface hardened to depths that produce very high wear resistance. The hardened layer is highly adherent rendering it excellent for wear applications. The primary elements in the alloy, titanium, zirconium, and niobium, are all non-toxic and non-carcinogenic. The alloy is produced by traditional metallurgical processing, requiring no special costly treatment.

PRODUCT FORMS

- Plate
- Sheet
- Rod
- Pipe
- Bar
- Castings

FORMABILITY

ATI Tiadyne™ 3510 titanium is very amenable to hot or warm forging, particularly closed die forging. Sharp corners, indentations and other details can be accurately produced. This is made possible by the fact that the alloy exhibits superplasticity at about 732°C (1350°F). Oxidation during forging can be greatly reduced by the use of high temperature coatings.

ATI Tiadyne™ 3510 titanium exhibits excellent detail reproduction in investment castings. No appreciable segregation is present and surface quality is very good.

POTENTIAL APPLICATIONS

Although this alloy exhibits excellent characteristics for biomechanical uses such as prosthetic devices, it has distinct potential in other areas; such as high impact parts where weight, strength, and wear resistance are important. Due to this alloy's low stiffness, it can be used for strong lightweight springs.

Another potential use is large hand tools. Shipwrights, millwrights and others may welcome large hand tools that are 40% lighter to handle than steel. The initial cost would be higher, but the hardened surface of the ATI Tiadyne™ 3510 tool would greatly extend the tool's life span.



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TYPICAL COMPOSITION

Table 1. Chemical Composition (Typical) for ATI Tiadyne™ 3510 Titanium	
Element	Weight %
Zirconium	34.0 - 36.0
Niobium	10.7 - 11.7
Oxygen	0.07 - 0.13
Titanium	Balance
Carbon	≤ 0.0120 (≤ 120 ppm)
Hydrogen	≤ 0.0025 (≤ 25 ppm)
Nitrogen	≤ 0.0100 (≤ 100 ppm)

MECHANICAL PROPERTIES

Table 2. Mechanical Properties (Typical) for ATI Tiadyne™ 3510 — Tensile Strength (Room Temp)						
Condition	UTS		0.2 YS		% Elongation	E ₀ , psi
Fully Hardened	160 ksi	1103 MPa	150 ksi	1034 MPa	12	10.4 x 10 ⁶ psi
Beta Quenched	120 ksi	827 MPa	65 ksi	448 MPa	25	9.5 x 10 ⁶ psi

PHYSICAL PROPERTIES

Table 3. Other Properties (Typical) for ATI Tiadyne™ 3510 — Property Value at Temperature (C°)				
Property	Units	23	100	500
Coefficient of Thermal Expansion	mm/mm • C ⁻¹	7.6 x 10 ⁻⁶	7.6 x 10 ⁻⁶	1.3 x 10 ⁻⁵
Thermal Diffusivity	cm ² /s	0.033	0.039	0.058
Thermal Conductivity	W/cm • K ⁻¹	0.0758	--	0.1807
	BTU per hr • ft ² • F	52.6	--	125
Heat Capacity	W • s/g • K ⁻¹	0.423	--	0.584
Vickers Hardness	HV (200 g wgt)	250	--	--
Density	g/cm ³	5.25	--	--
	lb/in ³	0.189	--	--

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IMPACT ENERGY TESTING

Results of Impact Energy Testing (Charpy V-notch) are represented by the graph pictured at the right. The curves indicate no ductile-to-brittle transition. Scanning electron microscopy shows ductile fracture at all temperatures to -196°C (-320°F)

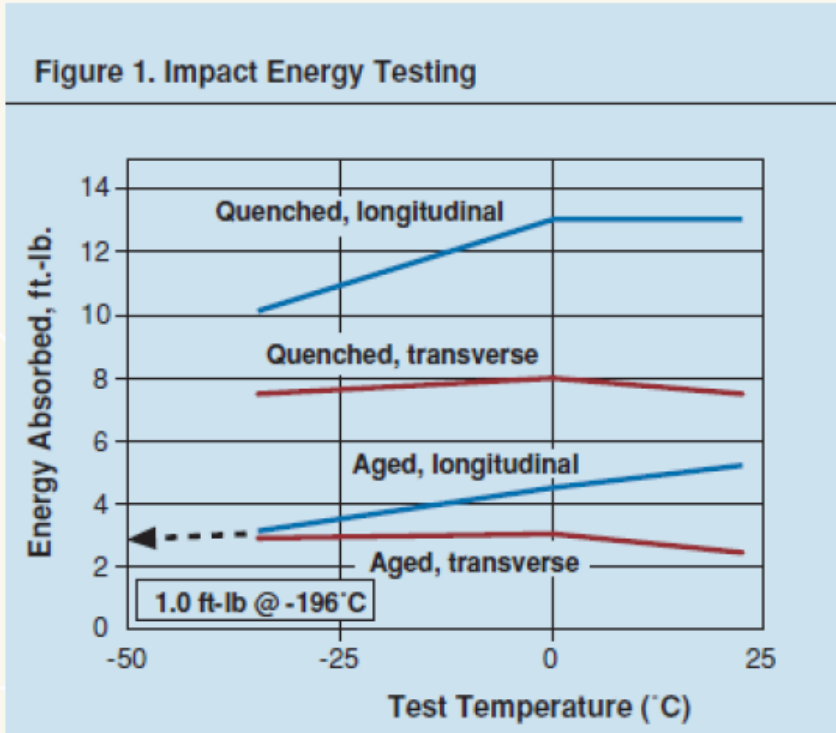

CORROSION RESISTANCE

Table 4. Corrosion Rates in Various Media					
Corrosive Media	Temperature	Corrosion Rate			
		ATI Tiadyne™ 3510	Ti-2	Zr702	Nb
Seawater	Ambient	<1	<1	<1	<1
20% HCl	106	>200	>200	<5	50
20% HCl + 200 ppm Fe ⁺³	106	>200	>200	Pitted/SCC	<5
100% Acetic	118	<1	<1	<1	<1
70% HNO ₃	116	<1	5	<1	<1
65% H ₂ SO ₄	150	28	>200	<2	150