ATI™ 425 Titanium Alloy (Ti-4Al-2.5V-1.5Fe-0.25O_2)

APPLICATIONS

ATI™ 425 titanium is an innovative new titanium product that is an alternative to the most common high-strength titanium alloy. ATI 425 titanium offers strength comparable to Ti-6Al-4V; yet, unlike Ti-6Al-4V titanium, ATI 425 titanium is both hot and cold workable. ATI 425 titanium is produced by ATI Allegheny Ludlum, ATI Allvac and ATI Wah Chang in a variety of forms, including sheet, coil, strip, Precision Rolled Strip™ product, plate, seamless tube and pipe as well as cast and engineering products.

Markets for the proprietary ATI 425 titanium include aerospace, defense, industrial, medical and recreation in applications where high-strength, lightweight materials are required. In addition, the alloy's corrosion resistance to saltwater environments (similar to that of Ti-6Al-4V) makes it a candidate material in marine-related applications.

One of the key strengths of ATI 425 titanium is that it is comparatively easy to produce and form due to its workability during the production and forming processes. Tests have shown that ATI 425 titanium can be fabricated more easily than Ti-6Al-4V. Duplex annealed ATI 425 titanium plate exhibited good fracture toughness; cold rolled and annealed ATI 425 titanium sheet has been bent to radii of 2.5 times its thickness. ATI 425 titanium is also heat treatable and can be solution-treated and aged to higher strength levels. The alloy is readily weldable with TIG and EB technology; annealed welds in light plate are capable of 4T bends.

MECHANICAL PROPERTIES

Ballistic Armor Plate:	0.5” – 1.8” meets/exceeds requirements MIL-DTL-46077F .30 cal. APM2, .50 cal APM2, 20mm FSP, 14.5mm B32

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Typical Mechanical Properties

Duplex Annealed (T - 50/100ºF. ~ 1 hr. + "Mill Anneal")*

Longitudinal			*Transverse*		
Yield (KSI)	Ultimate (KSI)	Elongation (%)	Yield (KSI)	Ultimate (KSI)	Elongation (%)
127	140	16	134	146	16
STA Condition					
148	166	12	155	171	12

Fracture Toughness for HR Plate *Duplex Annealed ~60 - 77K_{1C} Mill annealed ~ K_{1C} 54.6*

Tubular Extrusion: (typical)	**Yield** (KSI)	**Ultimate** (KSI)	**Elongation** (%)
As-Extruded	134	149	17
"Mill Annealed" *	126	139	18
STA	159	177	11
** An average of values resulting from cycles ranging from 1350ºF. to 1450ºF. from one to four hours*			
Bar (0.5" to 1.25" diameter) (Typical)	**Yield** (KSI)	**Ultimate** (KSI)	**Elongation** (%)
Annealed	127	147	18
STA	153	173	16

Cold Rolled Sheet Properties (mill annealed)

Longitudinal			Transverse		
Yield	Ultimate	Elongation	Yield	Ultimate	Elongation
(KSI)	(KSI)	(%)	(KSI)	(KSI)	(%)
129	146	14	152	159	13

Elevated Temperature Tensile Properties

Temp. (˚F)	Yield (KSI)	Ultimate (KSI)
800	64	85
1000	47	67
1200	18	34
1400	6	16
1500	3	10

PHYSICAL PROPERTIES Ti-4Al-2.5V-1.5Fe-0.25O_2 Physical Properties

Density	Melting Range	Beta Transus
0.162 lb/in^3	2912-3002° F.	T~ 1765 - 1790ºF.

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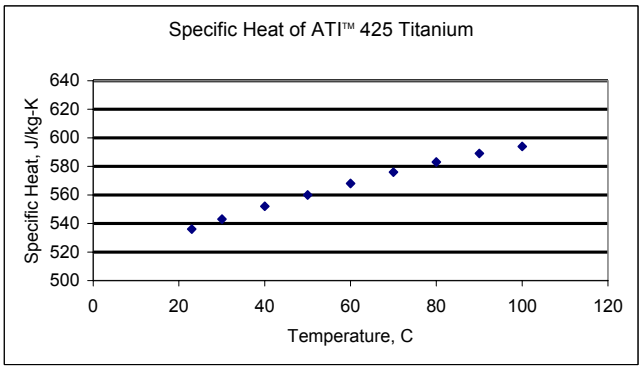

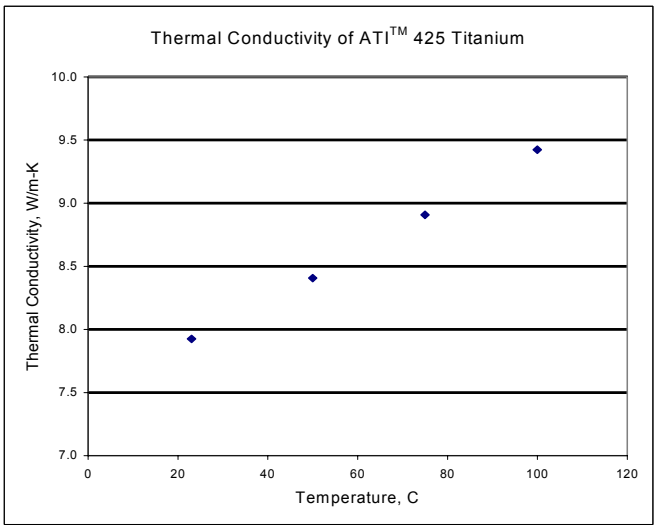

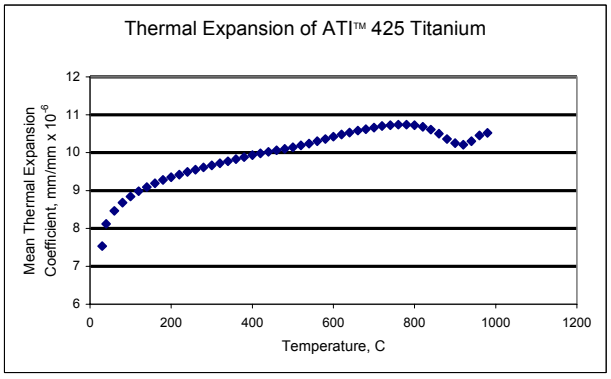

Thermal Diffusivity

0.03290 $cm^2/sec.$	23°C.	3.54 X 10^{-5} $ft^2/sec.$	73.4°F.
0.03340	50°C.	3.59 X 10^{-5}	122°F.
0.03420	75°C.	3.68 X 10^{-5}	167°F.
0.03530	100°C.	3.80 X 10^{-5}	212°F.

Young's Modulus

Overall AVG	**17.07 X 10^6 psi (14.4 - 24.6)**	**117.7 GPa (99.4 - 169.5)**
HR Plate Long.	17	114
HR Plate Trans.	17	119
CR Strip Long.	17	119
CR Strip Trans.	21	143
Extrusion	15	105

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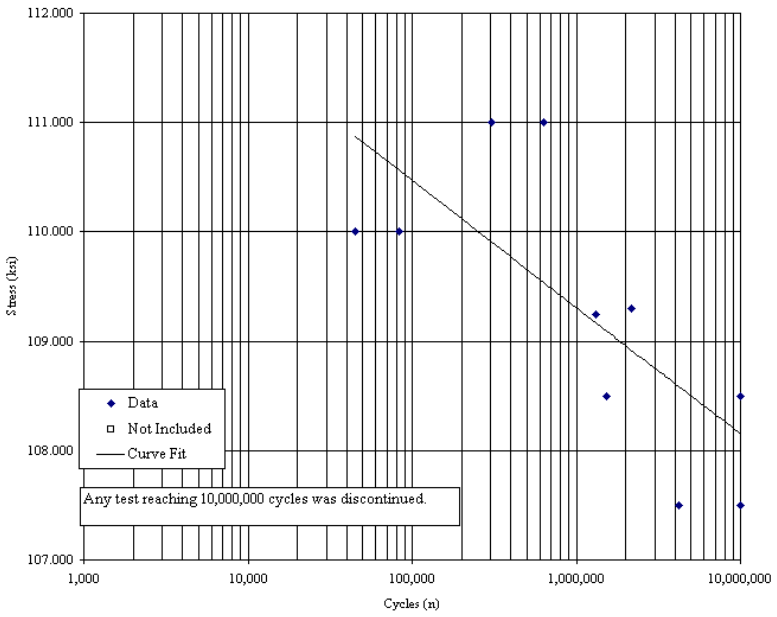
Customer: Wah Chang
Material: Ti-425
Lot: N/A

WMT&R No. 3-36075
R-Ratio: 0.1
Test Temperature: Room

Stress Life Data Curve



$$\text{stress in ksi} = e^{A+B\ln(\text{cycles})+C(\ln(\text{cycles}))^2}$$

If D is less than the largest cycle life, then the above equation applies to cycles between the lowest cycle life and D. For cycles between D and the highest cycle life, stress = E.

If D is equal to the largest cycle life, the above equation applies to cycles between the lowest cycle life and the highest cycle life.

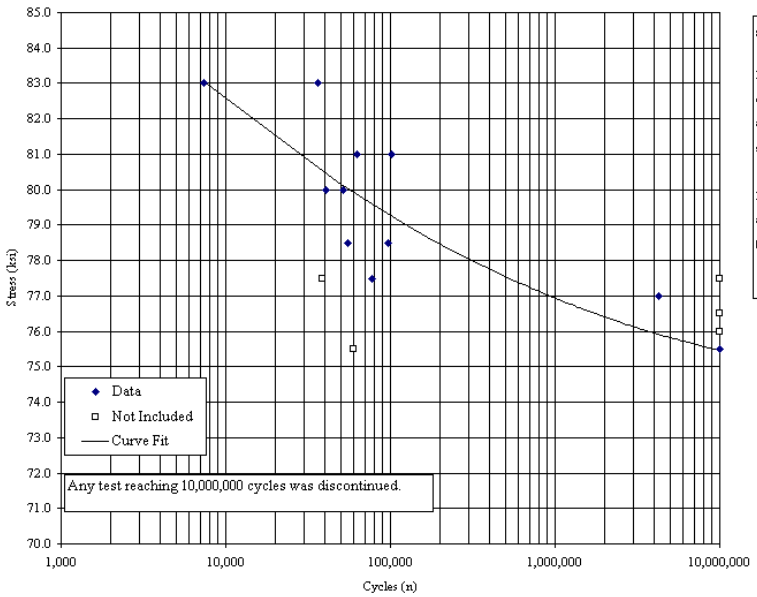
Coefficients:

A:	4.7577
B:	-0.0046
C:	0.0000
D:	10,000,000
E:	108.154
Lowest Life:	44,896
Highest Life:	10,000,000

Customer: Wah Chang
Material: Ti-425
Lot: N/A

WMT&R No. 3-36075
R-Ratio: -1.0
Test Temperature: Room

Stress Life Data Curve



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If D is equal to the largest cycle life, the above equation applies to cycles between the lowest cycle life and the highest cycle life.

Coefficients:

A:	4.6812
B:	-0.0383
C:	0.0010
D:	10,000,000
E:	75.465
Lowest Life:	7,389
Highest Life:	4,227,358

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CORROSION DATA

ATI Wah Chang has evaluated coupons of ATI 425 titanium in a variety of media. Detailed information is available upon request. ATI 425 titanium performs similarly to Ti-6Al-4V and Ti-3Al-2.5V in marine environments and many media of the chemical process industry.

FORMABILITY

Mill annealed, cold-rolled sheet can be bent to radii down to 2.5T in thickness of 0.100" and under. Light plate, nominal 0.250" and 0.375" thickness can be bent to radii of 3.5T. In all cases, surface must be free of defects that would act as stress risers and also free of all alpha case.

WELDABILITY

A limited amount of work has been performed with TIG and EB welding. Autogenous welds which have been annealed can be bent to radii of 5 – 6T in sheet and light plate gauges. Additional welding parameters are in development. Otherwise, performance is anticipated to be similar to Ti-6Al-4V and Ti-3Al-2.5V.

FOR SALES AND TECHNICAL SERVICE FOR THIS PRODUCT, PLEASE CONTACT:

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