Technical Data Sheet

ATI 425® Alloy, (Grade 38)

Titanium Alloy

(UNS R54250)

INTRODUCTION

ATI 425® alloy is a high strength, high ductility, titanium alloy available in a variety of product forms, including cold-rolled coil or sheet. Originally developed by ATI for ballistic armor applications, it has recently been characterized for aerospace and industrial applications, including publication of design allowables in the MMPDS handbook.

ATI 425® alloy is an alpha-beta titanium alloy that uses iron and vanadium as beta stabilizers as well as aluminum as an alpha stabilizer. The lower aluminum and vanadium contents and higher oxygen and iron contents give ATI 425® alloy a unique combination of ductility and tensile strength.

The combination of strength and ductility found in ATI 425® alloy makes it useful for titanium applications that require cold forming, such as roll-forming and bending, while still providing superior strength compared to low alloy grades of titanium.

ATI 425® alloy in the cold-rolled titanium coil or sheet product forms provide advantages that come from continuous processing that are not available in pack-rolled sheet. For example, ATI 425® alloy cold-rolled product has better gauge tolerance and surface finish than pack-rolled sheet and is available in lengths ranging from cut sheet to coil. Coil length products are generally not available in other titanium alloys with tensile strengths exceeding 130 ksi (896 MPa) and ductility exceeding 10% elongation.

SPECIFICATIONS AND CERTIFICATES

AMS 6946B – Cold-rolled sheet and coil and hot-rolled sheet and plate in the mill annealed condition.

ATI 425® alloy is designated titanium grade 38 by ASTM and covered by ASTM specifications B265, B338, B348, B381 and B861.

ATI 425® alloy has been Board Approved for use in the ASME Boiler and PV Code to 650°F, making ATI 425® alloy the highest temperature ASME code approved titanium alloy in the B&PV code. ASME Boiler Code Case 2532-2 states that ATI 425® alloy can be used for parts requiring strength up to 700°F (371°C).

ATI 425® alloy can be welded using ERTi-38 weld wire, which is produced in accordance with AWS 5.16/A5.16M.

Additional industry and customer specifications are being developed.

PRODUCT FORMS

ATI 425® alloy is available in a variety of titanium product forms, including: sheet, coil, strip, Precision Rolled Strip® and foil, plate, seamless tube, shapes and rectangles, ingot, and castings.

FORMABILITY

ATI 425® alloy can be both hot and cold worked. The excellent ductility permits forming at room temperature. Material produced to AMS 6946 routinely meets at least a 3T bend factor.

WELDABILITY

ATI 425® alloy is easily welded in the annealed condition using methods typically applied to titanium, such as TIG, MIG, EB, and plasma. 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 shielding of the molten metal and the adjacent heated zones. Spot, seam, and flash welding can be performed without resorting to protective atmospheres.

CORROSION RESISTANCE

ATI has evaluated the corrosion resistance of ATI 425® alloy in a variety of media. ATI 425® alloy performs similarly to Ti-6Al-4V (6-4 titanium) and Ti-3Al-2.5V (3-2.5 titanium) in marine environments and many media of the chemical process industry.

SUPERPLASTIC FORMABILITY

ATI 425® alloy coil or sheet can be processed so that it has good superplastic formability at 1425ºF – 1650°F (774ºC – 899ºC).

SPECIAL PRECAUTIONS

ATI 425® alloy can be subject to excessive contamination by hydrogen during improper heat treatment or pickling and by oxygen, nitrogen, and carbon pickup during forging, heat treating, brazing, etc. This contamination could adversely affect mechanical properties and formability.

POTENTIAL APPLICATIONS

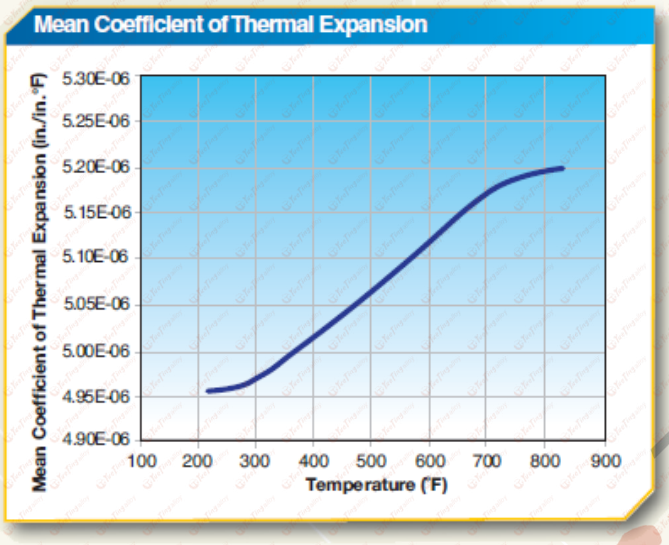
The unique combination of high tensile strength and high ductility of ATI 425® alloy makes it a potential candidate for a wide variety of aerospace, defense, or industry titanium applications. High ductility is beneficial when bending or cold drawing is required. Good hot workability combined with high strength makes ATI 425® alloy a candidate for near net shape forgings. The availability of ATI 425® alloy cold-rolled titanium sheet and coil in long lengths facilitates its use in manufacturing methods such as roll forming and may allow structures to be designed with fewer joints and fasteners. The tight gauge tolerance of ATI 425® alloy cold-rolled titanium sheet and coil compared to pack-rolled sheet offers opportunities for weight reduction through use of nominally lighter gauge product. The excellent surface finish and corrosion resistance makes ATI 425® alloy sheet and coil a candidate for use in an uncoated condition.

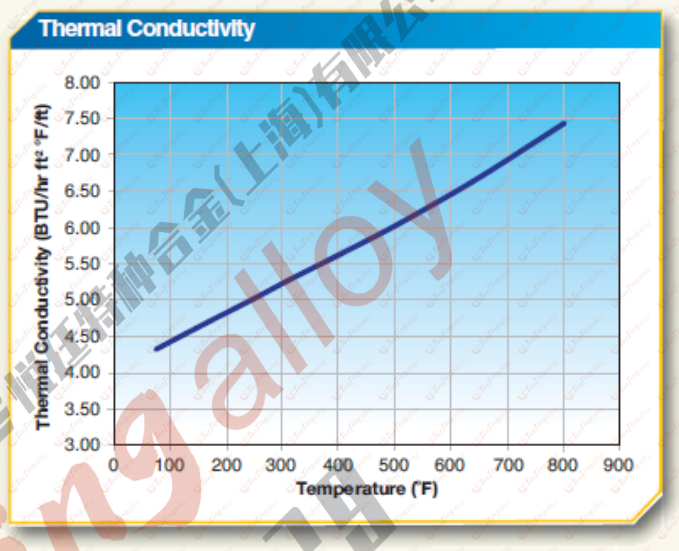
TYPICAL COMPOSITION

Element	Al	V	Fe	O	C	N	H	Other (each)	Other (total)	Ti
Min (wt.%)	3.5	2.0	1.2	0.2	–	–	–	–	–	Bal.
Max (wt.%)	4.5	3.0	1.8	0.30	0.08	0.03	0.015	0.10	0.30	

PHYSICAL PROPERTIES

Density: 0.161 lb/in^3 (4.452g/cm^3)
Beta Transus Temperature: 1780ºF ± 25º (971ºC ± 14º)





COLD-ROLLED COIL AND SHEET TYPICAL MECHANICAL PROPERTIES – MILL ANNEAL CONDITION

Test Direction	Tensile Stress (ksi)	Tensile Stress (MPa)	Yield Stress (ksi)	Yield Stress (MPa)	Elongation (%)
Longitudinal	152	1048	132	911	13
Transverse	163	1123	158	1090	14

From product with a range of thickness from 0.01 – 0.143 in. (0.25 – 3.6 mm)

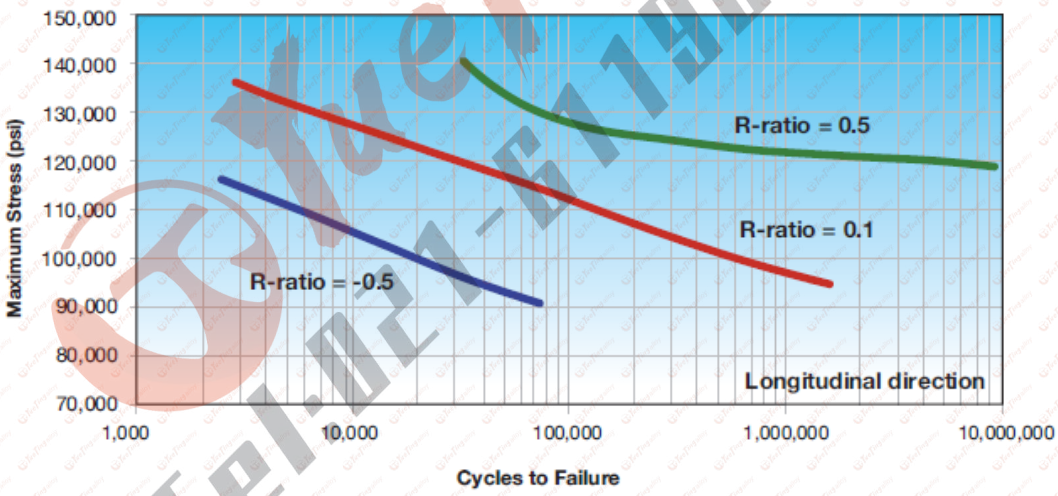
Test Direction	Bearing Ultimate Strength e/D=1.5		Bearing Ultimate Strength e/D=2.0		Bearing Yield Strength e/D=1.5		Bearing Yield Strength e/D=2.0	
	ksi	MPa	ksi	MPa	ksi	MPa	ksi	MPa
Longitudinal	224	1545	227	1907	197	1357	227	1562
Transverse	248	1713	310	2136	201	1387	252	1736

Test Direction	Compression Yield Strength		Ultimate Shear Strength		Compression Elastic Modulus		Tension Elastic Modulus	
	ksi	MPa	ksi	MPa	Msi	GPa	Msi	GPa
Longitudinal	139	958	95*	659	16.3	113	15.3	105
Transverse	187	1292			18.8	129	18.5	128

*Shear Strength measured in L-T direction

Data from product with a range of thickness from 0.04 – 0.133 in. (1 – 3.4 mm)

Room Temperature Uniaxial Fatigue Cold Rolled Coil



HOT-ROLLED SHEET & PLATE TYPICAL MECHANICAL PROPERTIES – MILL ANNEAL CONDITION

Test Direction	Tensile Stress (ksi)	Tensile Stress (MPa)	Yield Stress (ksi)	Yield Stress (MPa)	Elongation (%)
Longitudinal	147	1013	135	933	18
Transverse	149	1025	139	956	18

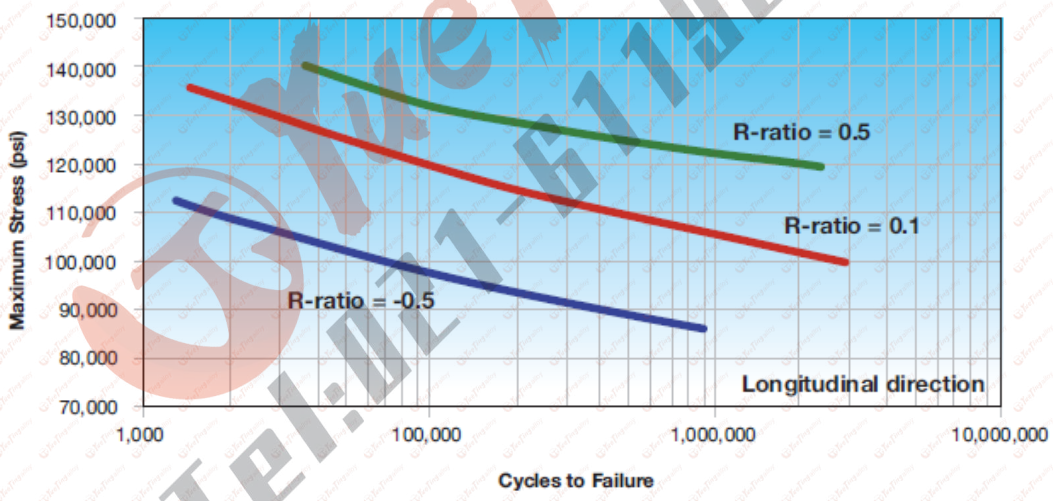
From product with a range of thickness from 0.188 – 2.0 in. (4.8 – 51 mm)

Test Direction	Bearing Ultimate Strength e/D=1.5		Bearing Ultimate Strength e/D=2.0		Bearing Yield Strength e/D=1.5		Bearing Yield Strength e/D=2.0	
	ksi	MPa	ksi	MPa	ksi	MPa	ksi	MPa
Longitudinal	242	1671	300	2071	207	1426	246	1699
Transverse	250	1720	316	2176	209	1443	255	1759

Test Direction	Compression Yield Strength		Ultimate Shear Strength		Compression Elastic Modulus		Tension Elastic Modulus	
	ksi	MPa	ksi	MPa	Msi	GPa	Msi	GPa
Longitudinal	139	960	107*	740	17.6	121	17.2	119
Transverse	151	1039	109*	754	18.3	126	18.2	126

*Shear strength tested in L-T and T-L directions
From product with a range of thickness from 0.188 – 2.0 in. (4.8 – 51 mm)

Room Temperature Uniaxial Fatigue Hot Rolled Sheet and Plate



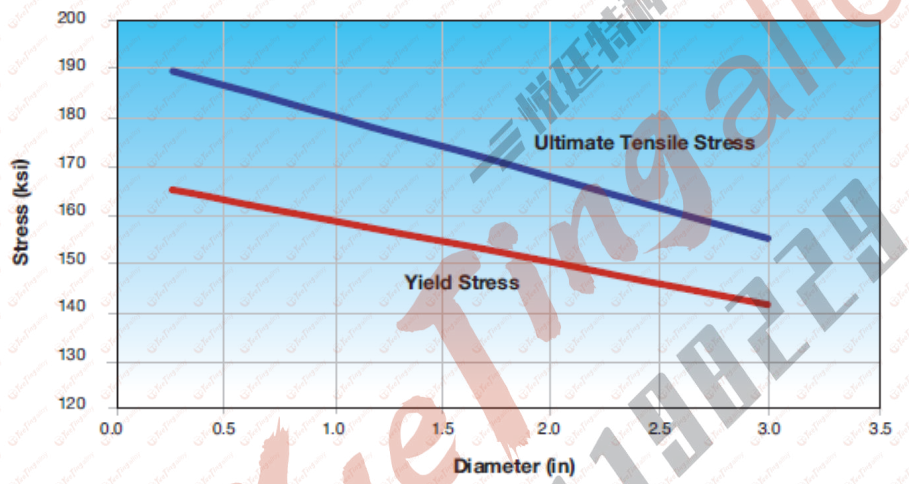
HOT WORKED BAR AND BILLET TYPICAL MECHANICAL PROPERTIES – MILL ANNEAL CONDITION

Test Direction	Tensile Stress (ksi)	Tensile Stress (MPa)	Yield Stress (ksi)	Yield Stress (MPa)	Elongation (%)
Longitudinal	146	1007	135	931	21
Transverse	153	1055	147	1014	18

From product with a range of thickness from 0.188 – 2.0 in. (4.8 – 51 mm)

HOT WORKED BAR AND BILLET TYPICAL MECHANICAL PROPERTIES – SOLUTION TREATED AND AGED CONDITION

Typical Tensile Properties of Solution Treated and Aged Bar



Typical Elongation Properties of Solution Treated and Aged Bar