



Titanium - Commercially Pure

Grade 1 - UNS R50250 Grade 3 - UNS R50550

Grade 2 - UNS R50400 Grade 4 - UNS R50700

Chemical Composition¹

Grade	1	2	3	4
Ti	Remainder	Remainder	Remainder	Remainder
C Max.	0.08%	0.08%	0.08%	0.08%
Fe Max.	0.20%	0.30%	0.30%	0.50%
N Max.	0.03%	0.03%	0.05%	0.05%
H^{2,3} Max.	0.015%	0.015%	0.015%	0.015%
O Max.	0.18%	0.25%	0.35%	0.40%

1. Per applicable ASTM specifications. 2. Lower hydrogen values may be obtained by negotiating with the manufacturer. 3. Final product analysis.



"ISO 9001-2008 Certified
ISO Registered Since 1993"

Of the four commercially pure (C.P.) titanium grades, Grade 2 is typically used in applications that require superior corrosion resistance in various aggressive media. Corrosion resistance is similar between these four C.P. grades but mechanical properties vary along with varying oxygen and iron contents.

Typical applications for the "C.P." grades include chemical process, petroleum refining, biomedical as well as heat exchangers in an array of different applications. Continuous service temperatures can reach up to 800°F with occasional, intermittent service at 1000°F.

Resistance to Corrosion

Titanium's C.P. grades corrosion resistance comes from a strongly adherent, stable, protective oxide film, which forms in the presence of oxygen. This film makes the commercially pure titanium grades resistant to most oxidizing, neutral and inhibited reducing as well as mildly reducing environments. Strong reducing media may cause heavy corrosion.

Physical Properties for Grade 2 Titanium

Melting Point, approximate	3020°F
Density @ Room Temperature	0.163 lb/in. ³
Beta Transus	1675°F +/-25°F
Modulus of Elasticity (Tension)	14.9 X 10 ³ ksi
Modulus of Elasticity (Torsion)	6.5 X 10 ³ ksi
Specific Heat (RT)	0.124 Btu/lb•°F
Electrical Resistivity (RT)	56 ohm-cir mil/ft
Coefficient of Thermal Expansion	
68°F to 212°F	4.8 x 10 ⁻⁶ in./in.•°F
68°F to 572°F	5.3 x 10 ⁻⁶ in./in.•°F
68°F to 932°F	5.4 x 10 ⁻⁶ in./in.•°F
Thermal Conductivity @ 68°F	9.5 Btu•in./ft ² •h•°F

Mechanical Properties¹

Annealed Material					
Product (Annealed) Form		Tensile Minimum	Yield (0.2% offset)	Elongation Minimum	Other Requirements
Bar	Grade 1	35 ksi	20 ksi Minimum	24%	30% Minimum ROA
	Grade 2	50 ksi	40 ksi Minimum	20%	30% Minimum ROA
	Grade 3	65 ksi	55 ksi Minimum	18%	30% Minimum ROA
	Grade 4	80 ksi	70 ksi Minimum	15%	25% Minimum ROA
Sheet/Plate ²	Grade 1	35 ksi	20 ksi to 45 ksi	24%	Bend Test: 3T - under 0.070", 4T - 0.070" to 0.187"
	Grade 2	50 ksi	40 ksi to 80 ksi	20%	Bend Test: 4T - under 0.070", 5T - 0.070" to 0.187"
	Grade 3	65 ksi	55 ksi to 95 ksi	18%	Bend Test: 5T - under 0.070", 6T - 0.070" to 0.187"
	Grade 4	80 ksi	70 ksi to 65 ksi	15%	Bend Test: 5T - under 0.070", 6T - 0.070" to 0.187"
Welded & Seamless Pipe	Grade 1	35 ksi	20 ksi to 45 ksi	24%	-
	Grade 2	50 ksi	40 ksi to 80 ksi	20%	-
	Grade 3	65 ksi	55 ksi to 95 ksi	18%	-
Welded & Seamless Tube	Grade 1	35 ksi	20 ksi to 45 ksi	24%	-
	Grade 2	50 ksi	40 ksi to 80 ksi	20%	-
	Grade 3	65 ksi	55 ksi to 95 ksi	18%	-

1. Minimum requirements per applicable ASTM specifications. 2. Bend test not applicable if thickness is over 0.187".

Fabrication and Heat Treatment

Titanium Grade 2 has good ductility, which allows for cold formability. The minimum bend radius for material under 0.070" thick should be 2T while 2.5T should be used for material over 0.070". The material can also be easily machined, hot worked and welded. Hot working should be performed between 400°F and 600°F. Stress relieving should be performed by heating to a temperature between 900°F and 1100°F followed by either forced air or slow cooling.

Welding of Grade 2 titanium can be done using various methods such as MIG and TIG. Inert gas shielding is crucial to prevent oxygen pickup and embrittlement of the weld area. A mixture of argon and helium is typically preferred but should be proven before accepting a procedure. Preheat or post heat treatments are not required.

Aqueous Corrosion Data for Unalloyed Titanium

Media	Common Name	Temperature (°F)	Corrosion Rate (mpy)
5% to 99.7% C ₂ H ₄ O ₂	Acetic Acid	255°F	nil
10% AlCl ₃	Aluminum Chloride	220°F	1.1
25% AlCl ₃	Aluminum Chloride	68°F	0.04
10% H ₃ BO ₃	Boric Acid	Boiling	nil
Cl ₂	Chlorine Gas (dry)	140°F	VERY HIGH
Cl ₂ with >1.5% H ₂ O	Chlorine Gas (wet)	392°F	nil
50% CuSO ₄	Copper Sulfate	Boiling	nil
1% to 30% FeCl ₃	Ferric Chloride	212°F	nil
90% CH ₂ O ₂	Formic Acid (aerated)	212°F	0.05
90% CH ₂ O ₂	Formic Acid (non-aerated)	212°F	118
1% HCl	Hydrochloric Acid	100°F	1.2
5% HCl	Hydrochloric Acid	200°F	260
20% HCl	Hydrochloric Acid	95°F	165
50% MgCl ₂	Magnesium Chloride	392°F	0.2
40% HNO ₃	Nitric Acid	212°F	2.30
70% HNO ₃	Nitric Acid	158°F	1.56
10% H ₂ C ₂ O ₄	Oxalic Acid	95°F	0.58
5% H ₃ PO ₃	Phosphoric Acid	151°F	0.2
30% H ₃ PO ₃	Phosphoric Acid	140°F	39
85% H ₃ PO ₃	Phosphoric Acid	70°F	7
5% H ₂ SO ₄	Sulfuric Acid	70°F	9
25% H ₂ SO ₄	Sulfuric Acid	77°F	28.3
75% H ₂ SO ₄	Sulfuric Acid	95°F	41
98% H ₂ SO ₄	Sulfuric Acid	392°F	1.5
Sea Water @ High Pressure		690°F	nil

Applicable Specifications

Grade 1, 2, 3, 4 - Form	ASTM	ASME	Military Standard	Aerospace Standard	European Standard
Bar	B348	SB348	MIL-T-9047	-	EN 10204-3.1
Sheet & Plate	B265	SB265	MIL-T-9046 CP-3	4902G, T-9046 CP-3	EN 10204-3.1
Seamless Pipe	B861	SB861	-	-	EN 10204-3.1
Welded Pipe	B862 ²	SB862 ²	-	-	EN 10204-3.1
Welded & Seamless Tube	B338	SB338	-	-	EN 10204-3.1

1. Annealed. 2. No addition of filler metal.

Please contact Corrosion Materials for a complete list of available items from inventory.

In-house machine and weld facilities help insure that the most common items will be in stock. Items not in stock can be fabricated in a short period of time either in-house or through our extensive, approved subcontractor and supplier network.

We also supply a complete range of items in the following alloys; Alloy C276, B2, B-3[®], F-255, Alloy 22, 625, 200/201, Alloy 400, 405 and 600. Bar products are also available in K500, Alloy 800H/HT[®], and Alloy 6B as well as various Ti grades.

(800HT[®] is a registered trademark of Special Metals Corporation. B-3[®] is a registered trademark of Haynes International Inc.)

The data and information contained in this pamphlet have been taken from open literature and is believed to be reliable. The information contained is intended to be used as a guide. Corrosion Materials does not make any warranty or assume any legal liability for its accuracy, completeness or usefulness.

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