

Guide to Common Industrial Titanium Grades

Standard Grades	Palladium Grades	Lean Palladium Grades	Ruthenium Grades	Min YS ksi (Mpa)	Min UTS ksi (Mpa)
Unalloyed Grades*					
1 Unalloyed (low interstitial)	11 Ti-0.15 Pd	17 Ti-0.05Pd	27 Ti-0.1 Ru	25 (170)	35 (240)
2 Unalloyed (norm. interstitial)	7 Ti-0.15 Pd	16 Ti-0.05Pd	26 Ti-0.1 Ru	40 (275)	50 (345)
3 Unalloyed (high interstitial)				55 (380)	65 (450)
Nickel-Molybdenum Alloy					
12 Ti-0.3 Mo-0.8 Ni				50 (345)	70 (483)
Aluminum Vanadium Alloys					
9 3Al-2.5V		18 3Al-2.5V-0.05 Pd	28 3Al-2.5V-0.1 Ru	70 (483)	90 (620)
23 6Al-4V ELI			29 6Al-4V ELI-0.1 Ru	110 (759)	120 (828)
5 6Al-4V		24 6Al-4V-0.05 Pd		120 (828)	130 (895)

Standard and Precious Metal Enhanced Titanium Alloys

ASTM Grades**	Nominal Composition	Tensile Strength		Yield Strength		Modulus of Elasticity		Endurance Limit***			Elong. in 2" min, %
		ksi	Mpa	ksi	Mpa	psi x10 ⁻⁶	Gpa	% of UTS	ksi	Mpa	
1 (11,17,27)	Unalloyed*	35	240	25	170	14.9	105-120	0.5	17.5	120	24
2 (7,16,26)	Unalloyed	50	345	40	275	14.9	105-120	0.5	25	173	20
3	Unalloyed	65	450	55	380	14.9	105-120	0.5	32.5	225	18
12	Ti 0.8Ni-0.3Mo	70	483	50	345	15	105-120	0.5	35	242	18
9 (18,28)	Ti 3Al 2.5V	90	620	70	483	16	105-120	0.5	45	310	15
23 (29)	Ti 6Al 4V ELI	120	828	110	759	16.5	105-120	0.55	66	455	10
5 (24)	Ti 6Al 4V	130	895	120	828	16.5	105-120	0.55	71.5	492	10

Titanium Mechanical Properties (ASTM plate specification, minimum)

* Unalloyed grades are also referred to as Commercially Pure or CP.

** Grades listed in parenthesis are mechanically identical but contain small amounts of palladium or ruthenium for enhanced corrosion resistance.

*** The fatigue values in the table are estimated based on 50% of the ultimate strength for tension to tension loading cycles and do not take in to account environmental effects which may reduce the acceptable values. Welds and cast material will exhibit lower values. Weld metal values are estimated as 80% of the base metal values. In addition, a reduction for notch effects and stress raisers may be needed, depending on design details utilized. The values do not include any safety factor or design margin of safety and should usually be de-rated by a factor of from 1.5 to 4, depending on design accuracy, service conditions, inspection, cost of maintenance, and severity of a failure.

Endurance or fatigue limit values at room temperature in air are estimated based on tensile strength and generally apply to 0 to limit stress load cycles. Values may be different for different loading cycles. Values are reduced for weld metal and castings, and may be reduced in some environments, and must always account for notch effects and stress raisers.

