# Material Information

# Titanium Grade 5

## Introduction

Titanium Grade 5, also known as Ti-6Al-4V, UNS R56400, or W.Nr. 3.7165, is the most widely used alpha-beta titanium alloy, renowned for its exceptional strength-to-weight ratio, high mechanical strength, and excellent corrosion resistance. Containing 6% aluminum and 4% vanadium, it offers nearly triple the yield strength of commercially pure titanium (such as Titanium Grade 2) while maintaining a density approximately 45% lower than steel. In sheet metal fabrication, Titanium Grade 5 is the premier material choice for high-stress structural components operating in demanding environments from cryogenic conditions up to 750°F (400°C).

## Advantages

Titanium Grade 5 delivers superior tensile and yield strength combined with high fatigue resistance and fracture toughness. It exhibits exceptional corrosion resistance in seawater, marine atmospheres, chlorides, and many organic and mineral acids. Furthermore, its mechanical properties can be enhanced through heat treatment (solution treating and aging), and it maintains its structural integrity and oxidation resistance at elevated temperatures where aluminum and standard steels degrade.

## Disadvantages

Titanium Grade 5 has limited ductility and high yield strength at room temperature, making cold sheet metal forming, tight bending, and deep drawing significantly more challenging. It exhibits severe springback during bending and requires higher forming force or warm/hot forming for complex geometries. Material costs are substantially higher than stainless steel, aluminum, and unalloyed titanium grades. Additionally, Titanium Grade 5 is highly prone to galling and adhesive wear when subjected to unlubricated sliding contact against other metals.

## Tolerance

We offer tolerances as tight as +/- 0.005". Tighter tolerances are available upon manual review.

## Recommendation

The combination of an unbeatable strength-to-weight ratio, high fatigue strength, excellent corrosion resistance, and elevated-temperature performance makes Titanium Grade 5 an outstanding choice for high-performance structural sheet metal parts. It is strongly recommended for weight-critical aerospace airframe components, motorsport chassis fittings, high-stress clips and brackets, medical device housings, and high-performance defense hardware.

| Material Specifications (For reference only.) | |
|---|---|
| Tensile strength | ≥ 895MPa |
| Yield strength | 880 to 1100MPa |
| Elongation at Break | 10% |
| Modulus of elasticity | 114GPa |
| Density | 4.43 g/cm$^3$ |

## Attention

When designing sheet metal parts with Titanium Grade 5, product designers and engineers must account for its limited room-temperature formability and high springback by incorporating generous bend radii (typically 4t to 6t or larger for cold forming) and avoiding tight geometric corners that could cause localized cracking. If ultimate structural strength is not strictly required, Titanium Grade 2 should be considered instead to reduce material cost and simplify sheet metal forming. To prevent adhesive wear and galling in moving or touching assemblies, surface treatments such as anodizing, dry-film lubricants, or protective bushings should be specified. Additionally, for continuous service temperatures above 750°F (400°C), thermal oxidation and creep resistance should be evaluated, as higher-temperature specialty titanium alloys may be required.

## Applications

3DSPRO finds people using Titanium Grade 5 to make functional parts and prototypes in the following industries and applications.

*Aerospace and defense:*
Airframe structural brackets, clip angles, engine nacelle hardware, ducting, firewall panels, fastener hardware, missile skins, and satellite structural fittings requiring high strength-to-weight efficiency.

*Motorsport and high-performance automotive:*
Exhaust system components, high-stress chassis brackets, suspension mounting hardware, heat shields, and custom lightweight structural brackets subjected to high vibration.

*Medical and defense hardware:*
Specialized surgical instrument enclosures, custom orthopedic fixture components, tactical equipment hardware, and high-strength wearable housing components.

*Marine and high-stress industrial engineering:*
High-strength offshore fasteners, pressure vessel components, specialized subsea hardware, and high-integrity chemical processing components operating under heavy cyclic loads.