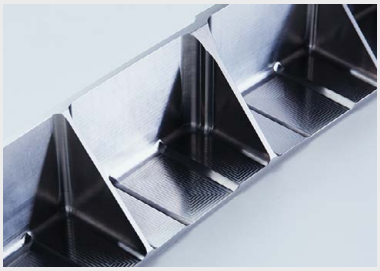
NORSK TITANIUM

TITANIUM FACT SHEET

TITANIUM: **ELEMENT 22**

Titanium was discovered in 1791 by English amateur geologist William Gregor, and has enabled dramatic performance improvements in the aerospace, defense, energy, autosport, and oceanic industries ever since. Titanium's strength-to-weight ratio, the highest of any metal, gives designers a material as strong as steel for nearly half the weight. With corrosion resistance on a par with platinum, titanium can even endure dilute hydrochloric and sulfuric acid attacks.[1]

Although titanium gets its prestige from high-profile aircraft like the Lockheed Martin SR-71 Blackbird, about 95% of titanium ore extracted from the earth is actually refined into titanium dioxide—a white pigment used in paints, paper, toothpaste, and plastics.[2] The remaining ore is refined into metal, two-thirds of which satisfies the $9B aircraft engine and airframe titanium market, where it is often paired with carbon fiber components due to compatible thermal expansion and corrosion characteristics. Titanium also enjoys use in armor plating, naval ships, spacecraft, and missiles due to its 3,000°F melting point and light weight. Because of these benefits, the global market for titanium is strong at $18B and growing at 4%–5% annually.[3]



Ti-6Al-4V Titanium Alloy

Yield Strength	**830 MPa**
Ultimate Tensile Strength	**900 MPa**
Density	**4.43 g/cc**
Modulus of Elasticity	**120 GPa**

LEGACY TITANIUM PRODUCTION

Ore is reduced into porous sponges › Sponges are melted into ingots › Ingots are converted into billet shapes › Billets are machined into products

Downsides to legacy titanium production processes are high complexity, long lead times, and waste during part production, resulting in a value proposition imbalance between performance and cost. Buy-to-fly ratios in excess of 15:1 are common (aerospace manufacturers buy 15 pounds of titanium for every pound of finished product).

Titanium's Role in Modern Commercial Aircraft

The drive to greater efficiency requires modern commercial aircraft to use carbon fiber for their airframes. More carbon fiber in the airframe requires the use of more titanium structural parts in the design. Titanium has minimal fatigue concerns, is highly resistant to corrosion, and helps create the load-bearing frame structure of the aircraft.

Boeing 787 Dreamliner
RPD™ titanium components

NORSK TITANIUM
RAPID PLASMA DEPOSITION™ (RPD™)

The world's first FAA-approved, OEM-qualified, 3D-printed structural titanium part

With Norsk Titanium's **Rapid Plasma Deposition**™ (RPD™) process, parts can be reduced to a buy-to-fly ratio of 4:1 to 3:1, illustrating the inefficiency of legacy process techniques.[4] Norsk Titanium RPD™ preserves the strength and weight benefits of titanium, while reducing processing time and cost up to 30%–50%.

Sources: 1. Encyclopedia Britannica 2006, 2. United States Geological Survey, 3. Roskill, 4. Reuters