

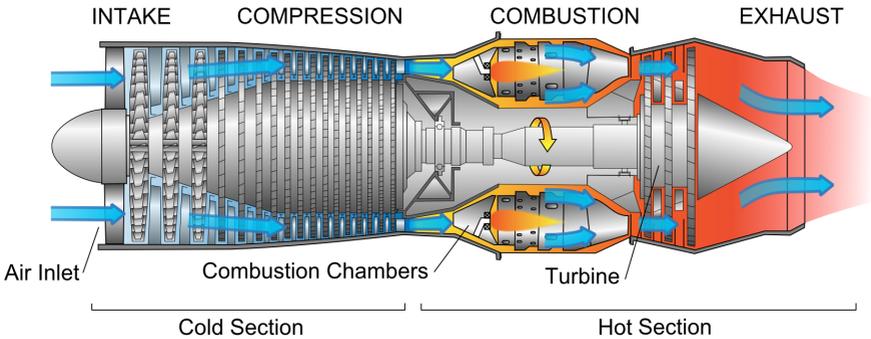
Tantalum for flight



TIC

Tantalum (Ta) is a rare grey metal with unique properties. When it is alloyed with certain other metals it produces **superalloys**, high performance alloys that allow engines to operate at hotter temperatures, making them more efficient and helping to reduce both the fuel costs and emissions.

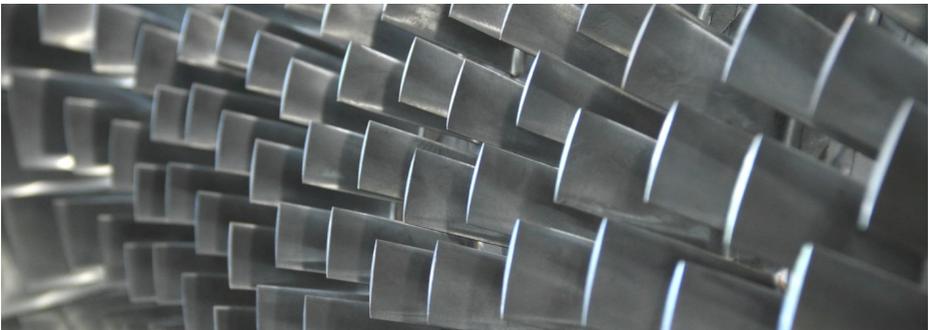
Superalloys possess unique properties that make them essential for the hot section of gas turbine engines on commercial and military aircraft: very high melting temperatures, high strength, and considerable resistance to wear in corrosive and oxidizing environments.



The sections of a gas turbine engine (wikicommons)

Tantalum has been used extensively in superalloys since the late 1960s. The very high melting point of tantalum (3017°C, 5463°F) helps strengthen the superalloy and also helps castability. Today about 20% of annual global tantalum demand is from superalloys.

Tantalum is added to the superalloy melt as high-purity virgin or scrap metal, or as revert. The latter either as foundry revert (pre-consumer scrap) or engine revert (processed end-of-life post-consumer scrap). Levels of oxygen (O) and nitrogen (N) must be exceptionally low in superalloy raw materials.



Inside a gas turbine engine (Shutterstock)

Selected nickel-based superalloys

Alloy / Element (%)	Ni	C	Cr	Co	Mo	W	Ta	Al	B	Hf	Re	other
CMSX-4	base	-	6.5	9.6	0.6	6.4	6.5	5.6	-	0.1	3	1.0 Ti
CMSX-10K	base	-	2.0	3.0	0.4	5.0	8.0	5.7	-	0.03	6	0.2 Ti
DD6	base	-	4.3	9	2	8	7.5	5.6	-	0.1	2	0.5 Nb
Mar M 247	base	0.16	8.2	10	0.6	10	3	5.5	0.02	1.5	-	0.05 Zr, 1.0 Ti
PWA 1426	base	0.1	6.5	12	2	6	4	6	0.02	1.5	3	0.03 Zr
PWA 1480	base	-	10	5	-	4	12	5	0	-	-	1.5 Ti
PWA 1484	base	-	5	10	1.9	5.9	8.7	5.7	-	0.1	3	
Rene' 142	base	0.12	6.8	12	2	5	6	6.2	0.02	1.5	3	0.02 Zr
Rene' N5	base	-	7	8	2	5	6	6.2	-	0.2	3	0.004 B
Rene' N6	base	-	4	12	1	6	7	5.8	-	0.2	5	
ZhS32-VI	base	-	4.9	9.3	1.1	8.7	4	6	-	-	2	1.6 Nb

Since the mid-1990s there has been an increase in the reprocessing of end-of-life gas turbine parts to form engine revert. The scrapped engine parts are cleaned of their zirconia- or alumina-based heat-resistant coating and then shot-blasted to remove any surface impurities, leaving only pure superalloy. This is re-melted to produce new superalloy parts. Industry sources claim that in 2017 engine revert supplied around 25% of all superalloy feedstock.

Outlook for superalloys

The high temperature capabilities of modern single-crystal superalloys make them essential to aircraft engines, as well as other types of gas turbines, such as industrial power generators.

The majority of superalloys are consumed in aircraft engines. Demand for new aircraft engines closely follows production of new aircraft and the outlook for this industry is strong in the foreseeable future. Boeing's most recent Market Outlook report estimates long-term growth at ~5% per year through to 2034, while the journal Airline Monitor is more optimistic still.

For more information on superalloys visit www.TaNb.org.



Rockets use superalloys too
(Shutterstock)



TANTALUM-NIOBIUM

INTERNATIONAL STUDY CENTER

www.TaNb.org

The T.I.C. is the international trade body that represents the tantalum and niobium industries. We have around 90 members from over 25 countries involved with all aspects of the tantalum and niobium industry supply chain (from mining and refining through to OEMs and recycling).

OBJECTIVES

- Increase awareness and promote the remarkable properties of tantalum and niobium.
- Host the Anders Gustaf Ekeberg Tantalum Prize, an annual award that recognises excellence in tantalum research.
- Organize a general assembly (conference) in October each year for business and technical presentations. Non-members may attend.
- Publish a quarterly Bulletin newsletter for members and stakeholders.
- Collect from the members (via an independent company to ensure confidentiality) statistics on the tantalum and niobium industries.
- Address key issues facing the industry, such as legislation, supply chain due diligence, and transport of radioactive materials (NORM).

Tantalum-Niobium International Study Center (T.I.C.)

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