ATOMIC AND CRYSTALLOGRAPHIC

Atomic Number	73
Atomic Weight	180.95
Atomic Volume	10.9 cm ^{3} / g-atom
Lattice Type	Body Center Cubic
Lattice Constant at 20˚C (68˚F) Å	3.296

MASS

	METRIC	ENGLISH
Density at 20˚C	16.6 g/cm ^{3}	0.600 lb/in ^{3}

THERMAL

Melting Point	2996˚C	5425˚F
Boiling Point	5425˚C	9800˚F
Specific Heat at 0˚C	.033 Cal/g/˚C	.036 BTU/lb/˚F
Average Linear Coefficient of Expansion at 25˚C (77˚F)	6.6cm/cm/˚C $\times 10^{-6}$	3.7in/in/˚F $\times 10^{-6}$
at 25˚C – 1000˚C (77˚F – 1832˚F)	7.3cm/cm/˚C $\times 10^{-6}$	4.1in/in/˚F $\times 10^{-6}$

THERMAL CONDUCTIVITY

20˚C	.13 Cal/cm-sec˚C	36 BTU/hr-ft˚F

MECHANICAL PROPERTIES OF TANTALUM

Tensile Strength (Annealed)	206.8 Mpa	30,000 PSI
Yield Strength (Annealed)	137.8 Mpa	20,000 PSI
Modulus of Elasticity (Tension)	185 Gpa	27,000,000 PSI
Nominal Hardness	35 Hrb	

MECHANICAL PROPERTIES OF TANTALUM + 2% TUNGSTEN

Tensile Strength (Annealed)	275.8 Mpa	40,000 PSI
Yield Strength (Annealed)	206.8 Mpa	30,000 PSI
Modulus of Elasticity (Tension)	185 Gpa	27,000,000 PSI
Nominal Hardness	70 Hrb	

Ta

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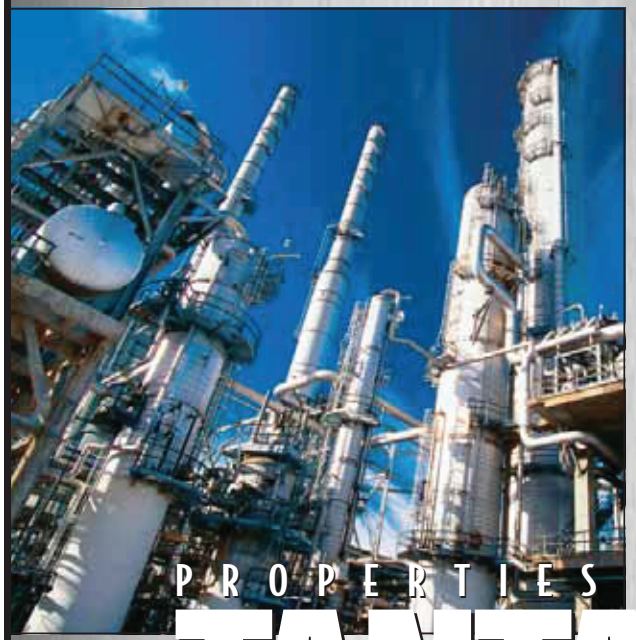

PROPERTIES OF TANTALUM

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TANTALUM—THE OBVIOUS CHOICE

Tantalum is a refractory metal with a melting point of 5425˚F (2996˚C). It is a tough, ductile metal which can be formed into almost any shape. It is used in corrosion resistant applications for environments no other metal can withstand. The major limitation of Tantalum is its reactivity with oxygen and nitrogen in the air at temperatures above 300˚C.

CORROSION RESISTANCE

Tantalum is the most corrosion resistant metal in common use today. The presence of a naturally occurring oxide film on the surface of Tantalum is the reason for its extreme corrosion resistant properties. It is inert to practically all organic and inorganic compounds. Its corrosion resistance is very similar to glass as both are unsuitable for use in hydrofluoric acid and strong hot alkali applications. For this reason Tantalum is often used with glass lined steel reactors as patches, dip tubes, piping and overhead condensers. Tantalum is inert to sulfuric and hydrochloric acid in all concentrations below 300˚F. Attack up to 400˚F is not significant and is in common use up to 500˚F. Tantalum is not attacked by nitric acid in concentrations up to 98% and temperatures up to at least 212˚F. Tantalum has proven itself to be totally inert in many applications. Some heat exchanger installations have been in continuous use for over 40 years in multi-product research environments without so much as a gasket change.

WIDE RANGE OF APPLICATIONS

The corrosion resistance, heat transfer properties and workability of Tantalum make it a perfect construction material for a wide range of equipment and applications. Tantalum is used in heat exchangers, condensers, columns, reactors, helical coils, pipe spools, valve linings and a variety of other components exposed to extremely corrosive fluids. It can be fabricated into most TEMA design shell and tube heat exchangers and bayonet heaters for chemical, petrochemical and pharmaceutical applications.

Tantalum can be clad to carbon steel to form a bimetallic material of construction. The Tantalum is used as a corrosion barrier while the substrate is used to contain pressure and stress. The corrosion resistance of Tantalum together with the low cost and high strength of carbon steel can often be the most economical choice for high pressure equipment.

Tantalum is the material to consider in any application where corrosion is a factor and the long-term benefits of reduced downtime, increased life expectancy and profitability is important. For many applications, Tantalum is the only reasonable choice.

CORROSION RESISTANCE OF TANTALUM (MILS PER YEAR)

MEDIA	CONCENTRATION	TEMPERATURE	NB	TA	TI	ZR
Acetic Acid	50%	Boiling	Nil	Nil	Nil	Nil
Bromine	Dry	200˚F	Nil	Nil	Nil	Nil
Chlorine	Wet	220˚F	Nil	Nil	Nil	10
Chromic Acid	50%	Boiling	1	Nil	>5	5
HCL	5%	200˚F	1	Nil	100	Nil
HCL	30%	200˚F	5	Nil	100	Nil
Nitric Acid	65%	Boiling	Nil	Nil	1	1
Nitric Acid	99%	Boiling	Nil	Nil	5	1
Sodium Hydroxide	10%	Room	Nil[1]	Nil[1]	Nil	Nil
Sulfuric Acid	40%	Boiling	Nil	Nil	5	3
Sulfuric Acid	98%	400˚F	5	Nil	50	200

[1] *Note: Material may become embrittled due to hydrogen attack.*

TANTALUM OUTPERFORMS OTHER MATERIALS

Today's global economy means increased competition. The control of cost including manufacturing efficiency, plant equipment costs and maintenance are paramount to survival. Chemical producers have recognized that increasing pressure and temperature increases efficiency in many applications. This also increases corrosion problems which Tantalum can handle.

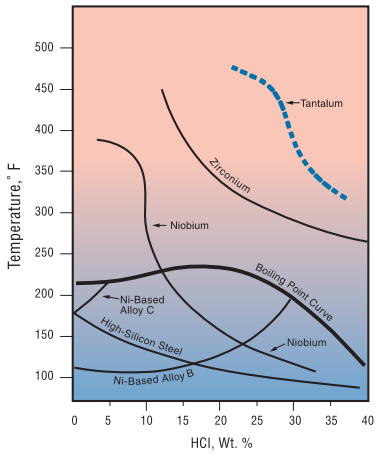
The largest cost of all is often maintenance and downtime. Industries from steel pickling to pharmaceutical have recognized that to stay competitive you first have to stay in production. It is no coincidence that the world's best, most progressive, and most profitable steel pickling and pharmaceutical companies standardize on Tantalum equipment to solve their corrosion problems.

The relatively high initial cost of Tantalum equipment is offset by its extremely low corrosion and long lifetime. Life cycle costs and manufacturing efficiencies need to be evaluated for a globally competitive manufacturing facility. Tantalum process equipment meets all these challenges.

TANTALUM PRICE AND AVAILABILITY

During the years 2000 and 2001, the price and availability of Tantalum mill products was very unstable and fluctuated to extreme highs and lows. The cause was a perceived shortage and panic buying in the electronics industry. The supply chain for Tantalum has responded with large amounts of capital spending and increased capacity to insure this will never happen again. Price and availability have returned to the normal and stable levels that Tantalum has experienced since the early 1970s.

Isocorrosion Diagram for 5 mpy for Tantalum and Other Materials in HCL



Isocorrosion Diagram for 5 mpy for Tantalum and Other Materials in Sulfuric Acid