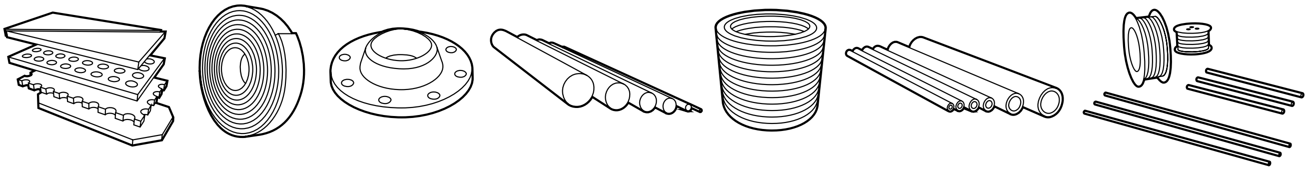
Titanium Grade 1-4 Datasheet
High Performance Alloys

Zapp is certified to ISO 9001



Titanium Grade 1-4

Commercially pure titanium belongs to the group of reactive metals. It provides a very favorable strength-to-density ratio. Depending on the concentration of interstitial elements, Titanium shows good ductility and manufacturing properties. This, combined with good corrosion resistance and creep strength, covers a wide range of applications.
The very dense surface oxide layer is the reason why Titanium provides good corrosion resistance in oxidizing media. In case of damage the new growth of the oxide layer occurs immediately, if oxygen is present. is suitable for use in cooling water, seawater, brackish water, wet chlorine, chlorine dioxide, hypochlorites, hypochlorates, sulfides, nitric acid as well as low melting metals.
The material shows a very good biological compatibility with human tissues and bones. This is the reason for increasing demand in medical applications and the jewelry industry.

Applications

- Condensers in coolers in power stations
- Coolers for sodium hypochlorite solutions
- Heat exchangers and pipe systems for sea- and brackish water as well as for processing of hydrocarbons
- Facilities for production of acetaldehyde
- Stripper for urea plants
- Zinc coating baths and galvanotechnics, titanium anodes for the chlor alkali electrolysis
- Integrally finned tube for cooling device and air conditioning equipment as well as sea water cooled condensers
- Components in flue gas desulphurization plants
- Surgical implants
- Aerospace-components*

* CP Titanium to aerospace material specifications

Specifications

	Grade 1	Grade 2	Grade 3	Grade 4
DIN-Designation	Ti 1	Ti 2	Ti 3	Ti 4
DIN Base Material-Number	3.7025	3.7035	3.7055	3.7065
DIN Filler Metal-No.	3.7026	3.7036	3.7056	3.7066
Aerospace- Datasheet-Number	3.7024	3.7034	-	3.7064
UNS	R50250	R50400	R50550	R50700
VdTÜV-Datasheet	230			
DIN	17850, 17860, 17861, 17862, 17863, 17864, 17866, 1737			
ASTM	B 265, B 338, B 348, B 363, B 367, B 381, B 861, F 67, F 467, F 468			
ASME	SB 265, SB 338, SB 363, SB 381, SB 384			
MIL	MIL-T-9046, MIL-T-9047, MIL-R-81556, MIL-R-81588, MIL-F-83142			
SAE	AMS 4900, AMS 4901, AMS 4941, AMS 4942, AMS 4951			
ISO	5832-2			

* not all Ti-grades are available in all specifications

Forms of delivery

Sheet	hot or cold rolled, annealed
Strip	cold rolled, annealed, bright
Tube/ Pipe	welded or seamless, annealed
Bar	rolled or forged, annealed, machined
Wire	rolled or drawn, annealed
Forging	annealed, rough-machined or finished size
Welding Filler Metal	rod, wire

Please feel free to contact our technical engineers if you need more specified or other product forms, details or if there are any questions left.

Fabrication

CP Titanium Grades are hot and cold formable. The capability of forming increases with decreasing content of interstitials – especially oxygen.
Material which is cold worked more than 5 %, needs to be soft annealed to obtain the specified mechanical properties and optimum corrosion resistance after being strengthened by cold working.
Machining can be done by use of conventional methods.

Heat treatment

Preferably electrical heated furnace in inert gas atmosphere or vacuum.

Cooling medium: inert gas or air. Annealing at approximately 700 °C/3 minutes per mm thickness but minimum 15 minutes of holding time. Stress relieve annealing at 450 °C to 600 °C, holding time approximately 30 minutes.

Welding

CP Titanium Grades are welded with matching filler metal of the same grade or lower grade (= grade providing higher degree of purity). Suitable welding technics are gas tungsten arc (GTAW) and gas metal arc (GMAW):

For example Argon of 99.99 % purity should be used. Other possible procedures are plasma, laser and electron beam welding. Base and filler metals have to be dry and free of impurities and oxides. Full inert gas protection including the backside of the weld is required. Titanium shows a high affinity to atmospheric gases at temperature higher or equal 250 °C.

This leads to oxidation and surface embrittlement. Qxidized ends of filler metal rod/wire need to be removed before further welding.

The use of weld chambers is suitable for smaller components. A post weld heat treatment as stress relieve annealing is only required, if due to heavy sizes or the structural design residual welding stresses may occur.

Chemical composition*

	Fe	C	N	O	H	Ti
Ti 1 max.	0.20	0.08	0.03	0.18	0.015	Bal.
Ti 2 max.	0.30	0.08	0.03	0.25	0.015	Bal.
Ti 3 max.	0.30	0.08	0.05	0.35	0.015	Bal.
Ti 4 max.	0.50	0.08	0.05	0.40	0.015	Bal.

* weight percent

Physical properties

	Ti 1	Ti 2	Ti 3	Ti 4
Coefficient of thermal expansion 0-200°C	8.7 x 10^{-6} [K^{-1}]	8.7 x 10^{-6} [K^{-1}]	9.1 x 10^{-6} [K^{-1}]	9.4 x 10^{-6} [K^{-1}]
Specific electrical resistivity*	0.47	0.48	0.52	0.55
	[$\Omega \cdot mm^2 \cdot m^{-1}$]			
Melting point	ca. 1660 [°C]			
Density*	4510 [$kg \cdot m^{-3}$]			
Modulus of elasticity* (approx.)	105 [GPa]			
Specific heat*	526 [$J \cdot kg^{-1} \cdot K^{-1}$]			
Thermal conductivity*	22 [$W \cdot m^{-1} \cdot K^{-1}$]			

* bei Raumtemperatur

Mechanical properties at room temperature *

	YS** at 1.0 % Offset [MPa]	UTS*** [MPa]	Elongation A min. [%]
Ti 1	≥ 200	290 - 410	30
Ti 2	≥ 270	390 - 540	22
Ti 3	≥ 350	460 - 590	18
Ti 4	≥ 410	540 - 740	16

* deviations are possible depending on product form, size and specification.
** yield strength (YS)
*** ultimate tensile

Mechanical propeties at elevated temperatures*

		315 °C	425 °C	540 °C
Ti 1	YS at 0.2 % Offset [MPa]	103	90	-
	UTS [MPa]	179	138	-
Ti 2	YS at 0.2 % Offset [MPa]	124	103	76
	UTS [MPa]	207	179	131
Ti 3	YS at 0.2 % Offset [MPa]	138	117	90
	UTS [MPa]	221	200	152

* approximate values

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Further information regarding our products and locations are available in our image brochure and under www.zapp.com

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