POGGIPOLINI

SPECIAL FITTINGS CATALOGUE

TECHNICAL CATALOGUE

01/20 edition

EXPERTISE, INNOVATION, EXCELLENCE.

Calisto, my father, founded the Poggipolini company in 1950, in Bologna, Italy.
His talent led him to work for special medical and jewelry industries.

In 1970 we manufactured the first titanium fasteners for racing applications. In our region, also called Motor-Valley, many of the major high performance motorsports companies (such as Ferrari, Lamborghini, Ducati, etc..) are established and for this reason we developed our technologies and business towards this sector.

After 40 years, Poggipolini is recognised as a leading manufacturing company in the Motorsports and Automotive industries, but from 2008 we started to focus on the Aerospace industry. So we started to transfer our know-how and technologies to this sector and today Aerospace represents our main market.

I always remind to our people that we are just at the beginning of a new, important chapter of our history.
We are here to prove our values: expertise, innovation & excellence.

Stefano Poggipolini

President | CEO

1.0 FITTING CONFIGURATION

FITTING TYPE	
	Hose Fittings 518
	Hose Fittings 513 (Three Way Forged)
	Banjo Crimp
	Lockring
	Forged Hose Fittings 519
	Double Swiel Forged Hose Fittings 506
	Socket
	Olive
	Take Off Banjo Bolt w/Washer
	Banjo

FITTING CODING SYSTEM

INCLUDING HEAT TREATMENTS - COLORING BY ANODIC OXIDATION AND WEAR-RESI-

5 00 0 00 000

TYPE
5 Hose Fitting

SHAPE
13 Three exits

MATERIAL
1 Titanium

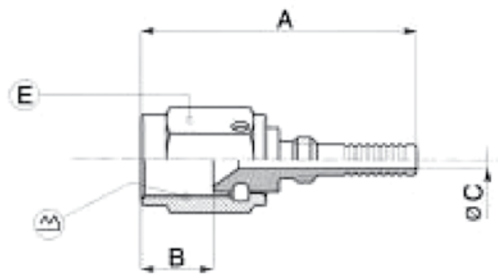
TREATMENT
00 Nothing
01 Oxidation
02 Nitriding

TYPE	T1-T2-T3	DIMEN.
X	1 5/16-32 23/8-32	D
Y	1 5/16-32	F
Z	4 Crimp sz 3 5 Crimp sz 4 6 Crimp sz 5 7 Crimp sz 6 8 Crimp sz 2	G

AEROSPACE QUALITY

2.0 DATA SHEETS

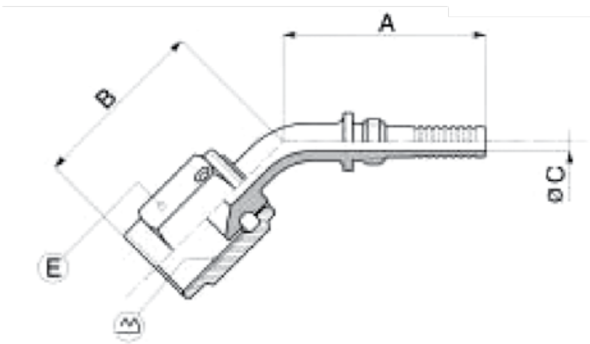
HOSE FITTINGS 518



AEROSPACE QUALITY

Code	Size	Thread	A max	B	C max	E	gr.
518140300	03	3/8- 24UNF	32.4	7.4	2.00	11	4.5
518140400	04	7/16- 20UNF	34.6	9.2	3.50	14	8.5
518140500	05	1/2- 20UNF	37.2	9.2	4.75	16	12.0
518140600	06	9/16- 18UNF	39.7	9.3	6.80	18	18.5

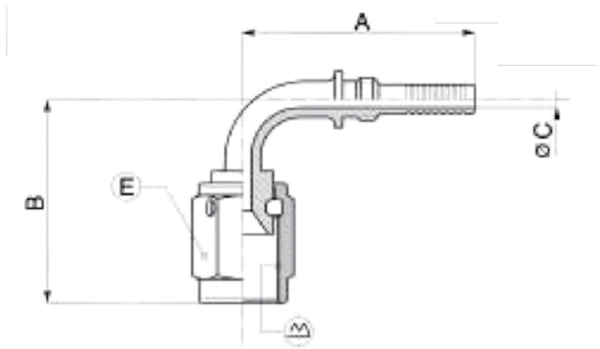
HOSE FITTINGS 518 45°



AEROSPACE QUALITY

Code	Size	Thread	A max	B	C max	E	gr.
518140345	03	3/8- 24UNF	27.2	23.9	2.00	11	6.0
518140445	04	7/16- 20UNF	30.8	30.0	3.50	14	10.5
518140545	05	1/2- 20UNF	35.0	33.0	4.75	16	15.5
518140645	06	9/16- 18UNF	41.0	36.0	6.80	18	22.0

HOSE FITTINGS 518

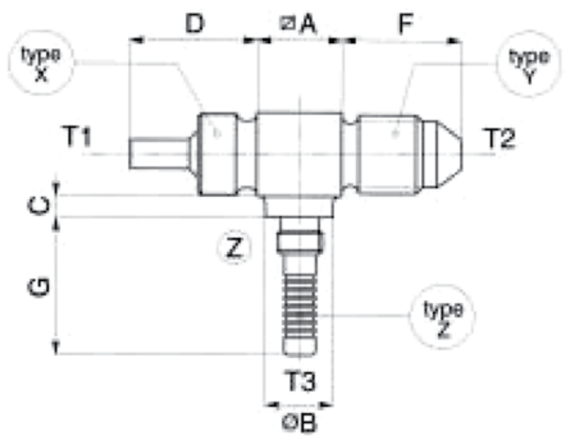


AEROSPACE QUALITY

Code	Size	Thread	A max	B	C max	E	gr.
518140390	03	3/8- 24UNF	27.2	23.9	2.00	11	6.5
518140490	04	7/16- 20UNF	30.8	30.0	3.50	14	11.0
518140590	05	1/2- 20UNF	35.0	33.0	4.75	16	16.5
518140690	06	9/16- 18UNF	41.0	36.0	6.80	18	23.0

HOSE FITTINGS 513

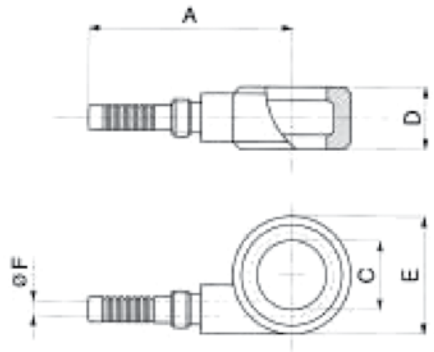
THREE WAY FORGED



AEROSPACE QUALITY

Size	A	B	C	D	F	G
02	8.0	4.1	1.95	13.40	-	16.00
03	10	9.6	2.0	14.15	14	16.30
04	10	9.6	2.0	-	-	17.70
05	13	12.0	3.0	-	-	19.30
06	13	12.0	3.0	-	-	21.00

BANJO CRIMP

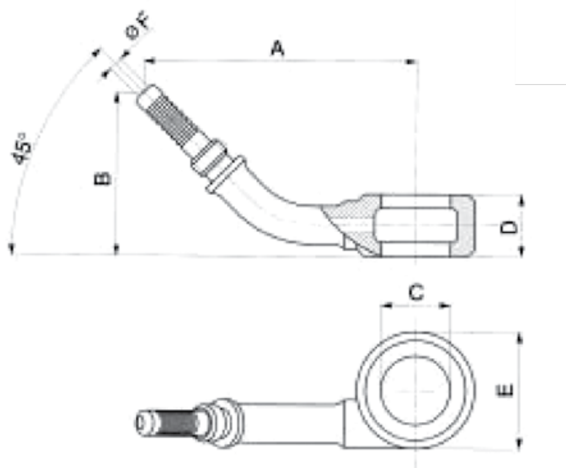


AEROSPACE QUALITY

Code	Size	A	C	D	E	F	gr.
599132300	03	29.5	10.0	9.0	17	2.0	6.0

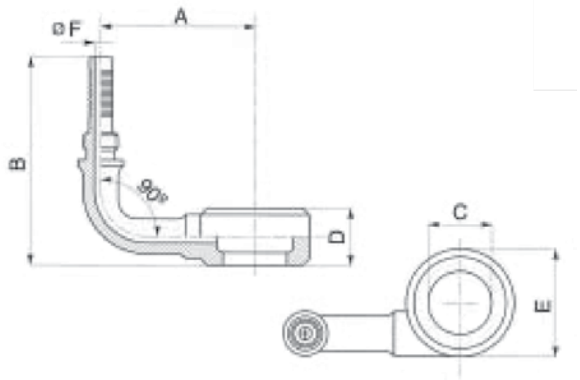
BANJO CRIMP 45°

POGGIPOLINI



Code	Size	Thread	A	B	C	D	E	F	gr.
599132345	03	12-32 UNEF	39.5	28.8	10.0	9.0	17	20	6.8

BANJO CRIMP 90°

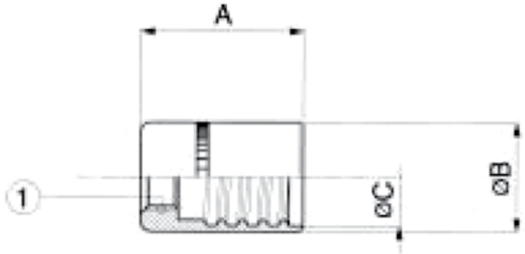


Code	Size	Thread	A	B	D	F	gr.
599132390	03	12-32 UNEF	21.5	31.5	9.0	2.0	7.0

STAINLESS STEEL 304

LOCKRING

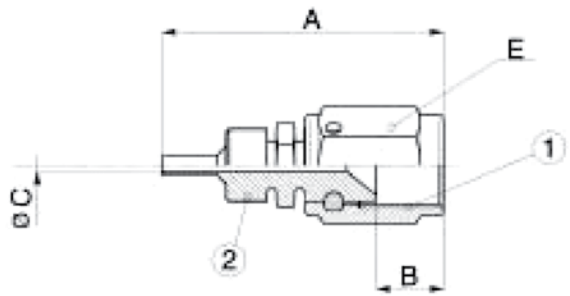
POGGIPOLINI



AEROSPACE QUALITY

Code	Size		A	B	C	gr.
518340003	03	12-32 UNEF	15.0	9.75	6.90	4.5
518340004	04	9/32-32 UNEF	17.4	11.8	9.30	7.0
518340005	05	23/64-28 UNEF	17.4	12.9	10.40	7.5
518340006	06	27/64-28 UNEF	20.7	15.2	12.35	10.5

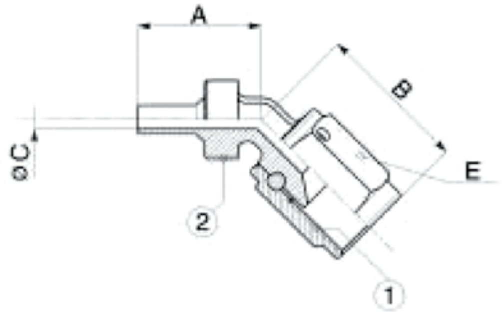
FORGED HOSE FITTINGS 519



AEROSPACE QUALITY

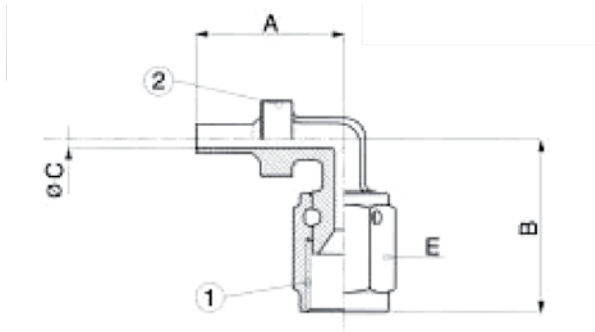
Code	Size	1	2	Amax	B	Cmax	E	gr.
519140200	02	5/16-24UNF	5/16-32UNF	28.7	6.3	1.3	9.5	6.0
519140300	03	3/8-24UNF	3/8-32UNF	31.1	7.3	2.3	11.0	6.5
519140301	3/2	3/8-24UNF	5/16-32UNF	30.5	7.3	1.3	11.0	6.3

FORGED HOSE FITTINGS 519 45°



Code	Size	1	2	Amax	B	Cmax	E	gr.
519140245	02	5/16-24UNF	5/16-32UNF	13.4	17.2	1.3	9.5	6.5
519140345	03	3/8-24UNF	3/8-32UNF	14.8	18.5	2.3	11.0	7.0
519140346	3/2	3/8-24UNF	5/16-32UNF	14.2	18.5	1.3	11.0	7.3

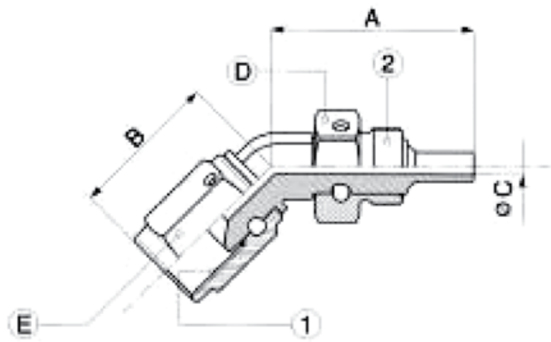
FORGED HOSE FITTINGS 519 90°



AEROSPACE QUALITY

Code	Size	1	2	Amax	B	Cmax	E	gr.
519140290	02	5/16-24UNF	5/16-32UNF	19.0	20.0	1.3	9.5	7.0
519140390	03	3/8-24UNF	3/8-32UNF	18.5	21.7	2.3	11.0	7.5
519140391	3/2	3/8-24UNF	5/16-32UNF	17.2	21.7	1.3	11.0	7.8

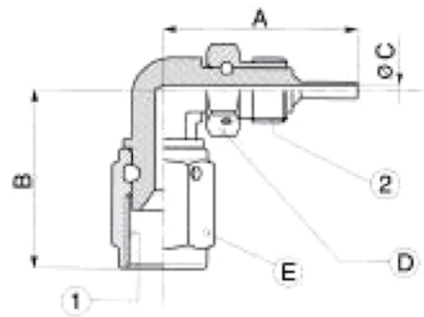
DOUBLE SWIVEL FORGED HOSE FITTINGS 506 45°



AEROSPACE QUALITY

Code	Size	1	2	Amax	B	Cmax	D	E	gr.
516140245	3/2	3/8-24UNF	5/16-32UNF	24.0	18.3	1.3	10	11	10.5
516140345	03	3/8-24UNF	3/8-32UNF	24.6	18.3	2.3	12	11	12.0

DOUBLE SWIVEL FORGED HOSE FITTINGS 506 90°



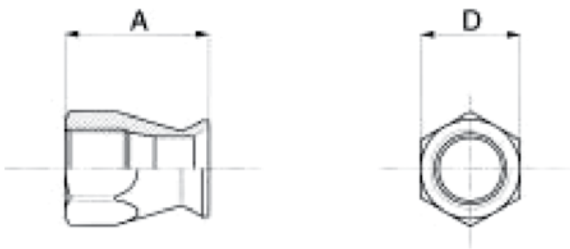
AEROSPACE QUALITY

Code	Size	1	2	Amax	B	Cmax	D	E	gr.
506140290	3/2	3/8-24UNF	5/16-32UNF	24.0	22.3	1.3	10	11	11.0
506140390	03	3/8-24UNF	3/8-32UNF	24.6	22.3	2.3	12	11	12.5

TITANIUM

SOCKET

POGGIPOLINI

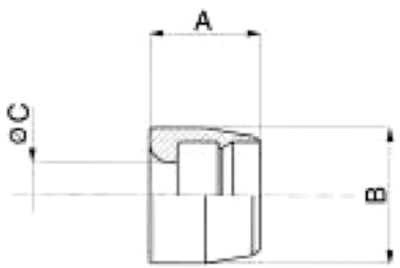


AEROSPACE QUALITY

Code	Size		Amax	D	gr.
503140200	02	5/16-32UNF	13.70	9.5	2.00
503140300	03	3/8-32UNF	15.80	11.0	2.50
503140400	04	1/2-28UNF	19.80	14.0	3.50

OLIVE

POGGIPOLINI

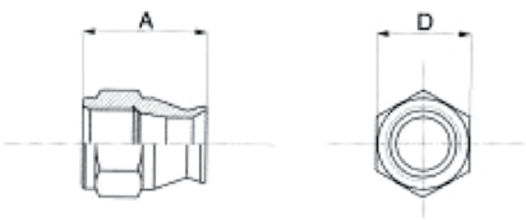


AEROSPACE QUALITY

Code	Size	Amax	B	C	gr.
504400200	02	5.9	6.10	2.60	0.50
504400300	03	6.1	7.40	3.70	0.80
504400400	04	7.4	9.50	5.40	1.00

SOCKET

POGGIPOLINI

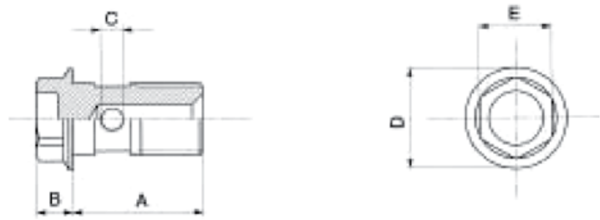


AEROSPACE QUALITY

Code	Size	Thread	Amax	D (hex)	gr.
50320300X	03	1/8-28 GAS	15.90	12	2.30

SINGLE TAKE OFF BANJO BOLT w/WASHER

POGGIPOLINI

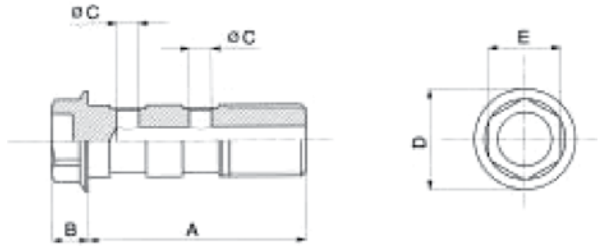


AEROSPACE QUALITY

Code	Thread	A	B	C	D	E	gr
501241000	M10 x 1.00	18.0	5.0	3.0	14	10	5.0
501241025	M10 x 1.25	18.0	5.0	3.0	14	10	5.0

SINGLE TAKE OFF BANJO BOLT w/WASHER

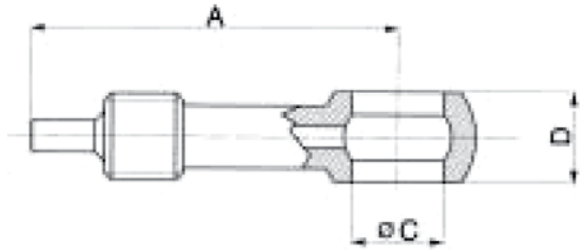
POGGIPOLINI



AEROSPACE QUALITY

Code	Thread	A	B	C	D	E	gr
501241000	M10 x 1.00	30.0	5.0	3.0	14	10	5.0
501241025	M10 x 1.25	30.0	5.0	3.0	14	10	5.0

BANJO

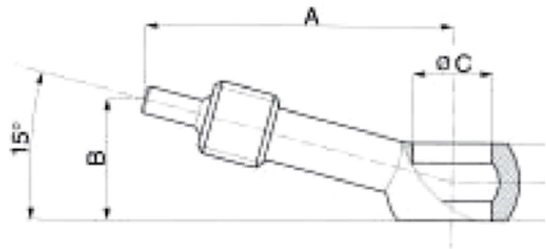


AEROSPACE QUALITY

Code	Size	Thread	A	C	D	gr
50720000x	03	1/8-28 GAS	40.0	10	10	6.0

BANJO 15°

POGGIPOLINI

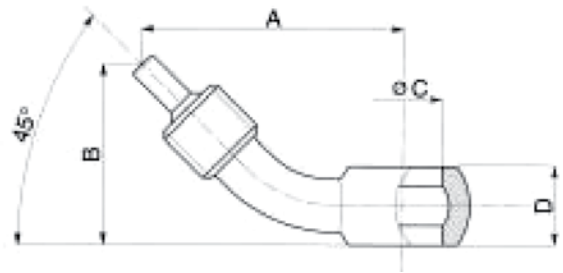


AEROSPACE QUALITY

Code	Size		A	B	C	D	gr
50720015x	03	1/8-28 GAS	38.6	15.4	10	10	6.0

BANJO 45°

POGGIPOLINI

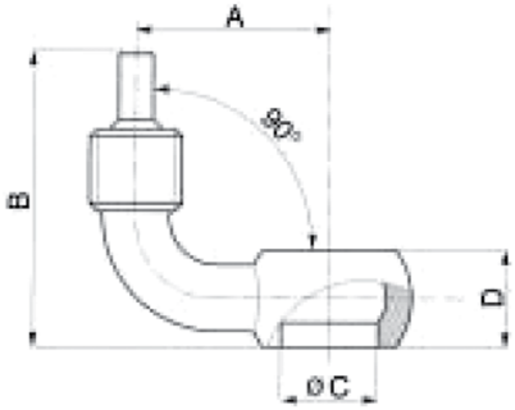


AEROSPACE QUALITY

Code	Size		A	B	C	D	gr
50720045x	03	1/8-28 GAS	33.0	23.0	10	10	6.0

BANJO 90°

POGGIPOLINI



AEROSPACE QUALITY

Code	Size		A	B	C	D	gr
50720090x	03	1/8-28 GAS	20.0	30.5	10	10	6.0

APPENDIX

01/20 edition

3.0 APPENDIX

3.1 MATERIALS

Since 1950 Poggipolini has acquired considerable expertise on various types of materials.

Poggipolini is capable to work and find the best applications for the following materials:

Ti6Al4V	AISI 4340	MP35N
13-8 PH	MLX 17	Maraging 300
15-5 PH	Inconel 718	AL7075 T6/
17-4 PH	Aermet 100	AL7068 T6511

3.2 TITANIUM Ti6Al4V

Titanium is available on the market as commercially pure or as alloys.

Commercially pure titanium has a hexagonal Alfa type crystalline structure and increases its mechanical resistance (ultimate strength psi) with each grade classification (from grade 1 to grade 4). With the addition of alloying elements such as aluminium, vanadium, and molybdenum, titanium alloys are created which have cubic Alfa + Beta crystalline structures. These Alfa + Beta alloys are the most used commercially, due to their ductile-weight-mechanical resistance relationships.
Of these, the most used titanium alloys are 6Al4V (grade 5) and 3Al 2,5V (grade 9) which are used to make bolts, mechanical components and chassis.

Titanium and its alloys are used in all those fields in which one or more of the following factors are important: high strength-to-weight ratio, mechanical resistance, corrosive resistance, electrical resistivity.

Titanium and titanium alloys owe their excellent corrosion resistance to a stable, protective surface layer of titanium oxide; titanium alloys are highly resistant to pitting corrosion, and it is rarely encountered.

Nominal Ø or Least Thickness or Nominal Wall Thickness (mm)	Tensile Strenght (MPa)	Yield Strenght at 0.2% Offset (MPa)	Elongation in 4D% (Long.)	Elongation in 4D% (L.T.)	Elongation in 4D% (S.T.)	Reduction of Area % (Long.)	Reduction of Area % (L.T.)	Reduction of Area % (S.T.)
Up to 50.8	931	862	10	10	-	25	20	-
Over 50.8 to 101.60	896	827	10	10	10	25	20	15
Over 101.60 to 152.40	896	827	10	10	8	20	20	15

3.3 CORROSION RESISTANT

Titanium and titanium alloys owe their excellent corrosion resistance to a stable, protective surface layer of titanium oxide. Titanium metal is highly reactive with oxygen, and the surface oxide forms spontaneously and instantaneously in contact with air and most media. Damage to the oxide film usually heals rapidly if the environment contains oxygen or moisture at the parts per million level. Hence titanium alloys are highly resistant to corrosion, usually corrode at negligible rates and require no corrosion allowance. However, anhydrous or highly reducing conditions may prevent the formation or healing of the oxide film, and corrosion may then become rapid.
This form of corrosion resistance is similar to that of aluminium and magnesium alloys, and of stainless steels, which also rely on a protective oxide film on the surface of a reactive metal.

When titanium is fully passive, corrosion rates are typically lower than 0.04 mm/year, due to the highly stable surface protective film. In many environments the film may thicken, which gives interference colours and a slight weight gain. General corrosion may be encountered in reducing acid conditions, particularly at elevated temperatures. In strong and hot reducing acids the titanium oxide film can dissolve, and the unprotected titanium metal be taken rapidly into solution.

Pitting Corrosion

Titanium alloys are highly resistant to pitting corrosion, and it is rarely encountered.

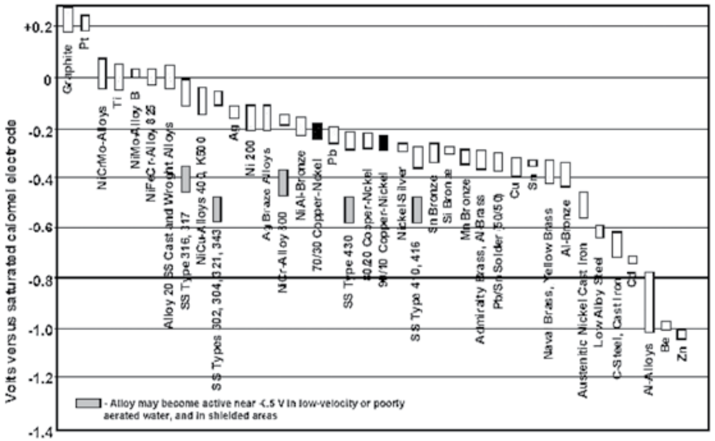
Stress Corrosion Cracking

The commercially pure titanium alloys (grades 1, 2, 7, 11, 12) are immune to SCC except in a few environments, such as anhydrous methanol solutions containing halides, nitrogen tetroxide and red fuming nitric acid.
The higher strength alloys have been found susceptible to SCC in aqueous chloride solutions at high stress levels in laboratory tests, but the problem is rarely encountered in practice.

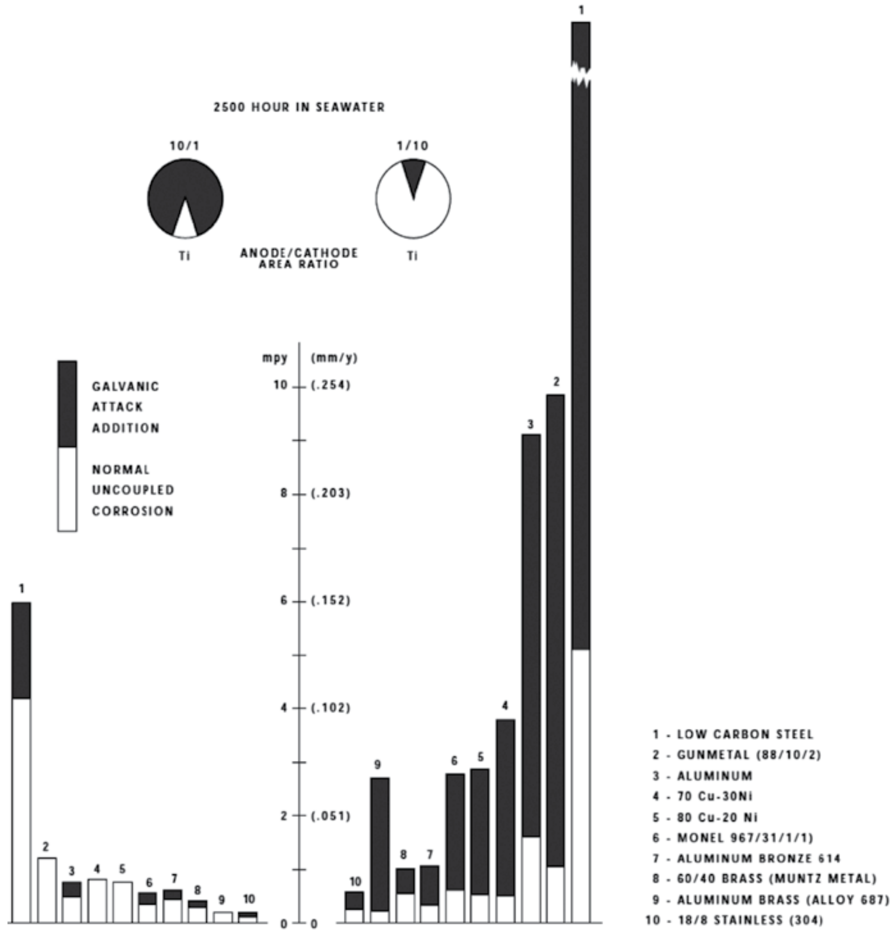
Galvanic Couples

Titanium rarely suffers accelerated corrosion on coupling with other metals, but it may accelerate the corrosion of a more active metal coupled to it. The rate of attack depends on many factors, including solution chemistry and temperature, and the cathode to anode surface area ratio.
The coupling of titanium with dissimilar metals usually does not accelerate the corrosion of the titanium. The exception is in reducing environments where titanium does not passivate. Under these conditions, it has a potential similar to aluminum and will undergo accelerated corrosion when coupled to other more noble metals. Because titanium is usually the cathodic member of any galvanic couple, hydrogen will be evolved on its surface proportional to the galvanic current flow. This may result in the formation of surface hydride films that are generally stable and cause no problems. If the temperature is above 170°F (77°C), however, hydriding can cause embrittlement.

In order to avoid problems with galvanic corrosion, it is best to construct equipment of a single metal. If this is not practical, use two metals that are close together in the galvanic series, insulate the joint or cathodically protect the less noble metal. If dissimilar metals are necessary, construct the critical parts out of titanium, since it is usually not attacked, and use large areas of the less noble metal and heavy sections to allow for increased corrosion.



The table above gives the galvanic series in seawater. In this environment, titanium is passive and exhibits a potential of about 0.0V versus a saturated calomel reference cell which places it high on the passive or noble end of the series. For most environments, titanium will be the cathodic member of any galvanic couple. It may accelerate the corrosion of the other member of the couple, but in most cases, the titanium will be unaffected.

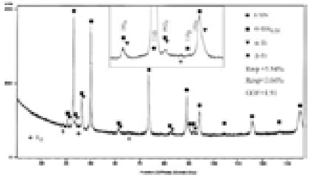


The table above shows the accelerating effect that titanium has on the corrosion rate of various metals when they are galvanically connected in seawater.

If the area of the titanium exposed is small in relation to the area of the other metal, the effect on the corrosion rate is negligible. However, if the area of the titanium (cathode) greatly exceeds the area of the other metal (anode) severe corrosion may result.

Erosion Corrosion

The hardness of the surface oxide film gives excellent resistance to erosion corrosion, which is outstanding compared to most other candidates for heat exchanger service. High flow rates (30m/sec) can be used without problems due to inlet turbulence or pump cavitation effects.



Fatigue Corrosion

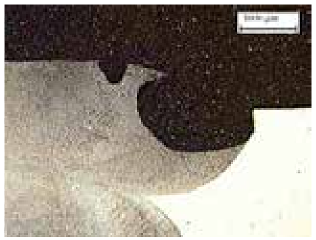
The highly protective surface oxide film results in insignificant reductions in fatigue strength in water, sea water and most chloride solutions where corrosion is not active.

Water & Sea Water

Titanium alloys corrode negligibly in sea water at temperatures up to 260°C. Even under biofouling and deposits, pitting and crevice corrosion are not encountered. Marine atmospheres, splash and tidal zones, and soils also have no effect. Corrosion at tight design crevices may be seen in waters with higher than about 1000 ppm of chlorides at temperatures above about 75°C.

Oxidising Media

Titanium alloys are highly resistant to oxidising acids, with corrosion rates typically less than 0.03 mm/year.



Hydrogen Damage

Titanium alloys are widely used in environments containing hydrogen, and where impressed currents or galvanic couples generate hydrogen. Hydrogen embrittlement of the titanium may result due to the formation of titanium hydride precipitates, usually without significant reduction of the performance of the alloy. Embrittlement is loss of ductility and toughness of the alloy.

The surface oxide film is a highly effective barrier to the passage of hydrogen, and only traces of moisture or oxygen are effective in maintaining the oxide film. Hence hydrogen embrittlement can usually be avoided. It is unlikely to be encountered at temperatures below about 80°C, or at solution pH between 3 and 12.
The usual cause of hydrogen damage is excessive hydrogen charging from an impressed current corrosion protection system, or a galvanic couple (see below) with a more active metal, such as aluminium, zinc or magnesium. Metals which remain passive, such as other titanium alloys, stainless steels, copper alloys and nickel alloys, are unlikely to cause this problem.

Reducing Acids

Corrosion of titanium alloys may be encountered when the temperature & concentration of reducing acid solutions exceed critical values, which breaks down the surface oxide layer. Reducing acids include sulphuric, sulphamic, oxalic, trichloroacetic, phosphoric and halogen acids such as hydrochloric and hydrofluoric.

Crevice Corrosion

Titanium alloys may suffer crevice corrosion attack by a similar mechanism to that encountered in stainless steels: oxygen depleted reducing acid conditions develop within tight crevices isolated from the bulk corrosion media. Crevice corrosion may be encountered in hot (>70°C) solutions containing chlorides, bromides, fluorides, iodides or sulphates. It can stem from metal to metal joints such as tube to tubesheet joints or badly designed welds, at gaskets, or at surface deposits.

Alloy Composition Effects

All the commercial purity grades corrode at very low rates while the metal remains in the passive condition. Small contents (< 2 – 3%) of the elements normally present have little effect on the oxide film, and hence on corrosion resistance. However, where the corrosion resistance is marginal (i.e. corrosion rates above about 0.13 mm/year), small amounts of elements such as sulphur and iron accelerate the corrosion rate of the alloy. Minor additions of other elements, such as palladium and nickel, can greatly reduce corrosion under these conditions, and made to highly corrosion resistant alloys such as grade 7.

Titanium 6Al 4V

As in other titanium alloys, Titanium 6Al-4V has excellent resistance to corrosion specially in seawater, making it a good choice for use in offshore and subsea oil & gas operations where seawater corrosion and weight are concerns.

Titanium 6Al-4V is resistant to general corrosion, but may be quickly attacked by environments that cause breakdown of the protective oxide layer including hydrofluoric (HF), hydrochloric (HCl), sulphuric and phosphoric acids. Titanium 6Al-4V resists attack by pure hydrocarbons and most chlorinated and fluorinated hydrocarbons, provided that water has not caused formation of small amounts of hydrochloric and hydrofluoric acids.

4.0 OTHER MATERIALS

13-8 PH

13-8 PH VAR is in a family of martensitic precipitation hardening stainless steel. It is produced as a consumable electrode, vacuum arc remelted product offering excellent transverse toughness and ductility even in large section. High strength is developed by a simple low-temperature heat treatment. Due to the chemical composition and controlled melting practise, 13-8 VAR has an essentially ferrite-free microstructure. This material has a typical density of 7.8kg/dm3.

Ideal for applications where very high strength and toughness are required. This alloy is also used when good general / stress corrosion cracking resistance and minimal property directionality are needed. Applications include aircraft structural parts, landing gear components, shafts, valves, fittings and fasteners.

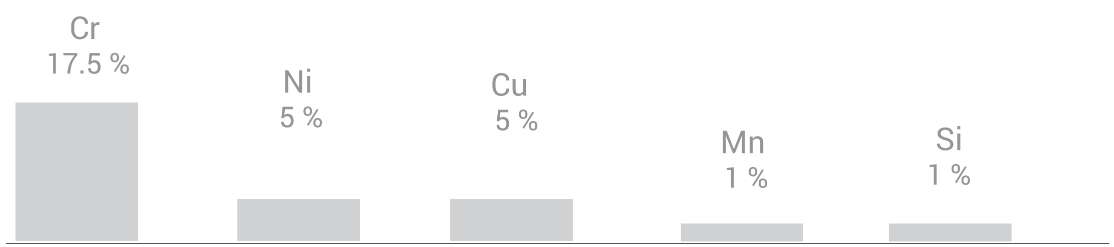
Condition	Specimen Orientation	Tensile Strenght (MPa)	Yield Strenght at 0.2% Offset (MPa)	Elongation in 4D%	Reduction of Area %
H950	Longitudinal Transverse	1517 1517	1413 1413	10 10	45 35
H1000	Longitudinal Transverse	1413 1413	1310 1310	10 10	50 40
H1025	Longitudinal Transverse	1276 1276	1207 1207	11 11	50 45
H1050	Longitudinal Transverse	1207 1207	1138 1138	12 12	50 45
H1100	Longitudinal Transverse	1034 1034	931 931	14 14	50 50
H1150	Longitudinal Transverse	931 931	621 621	14 14	50 50

17-4 PH

17-4 PH is in a family of martensitic precipitation hardening stainless steel; it contains 4% copper and may be hardened by a single low-temperature precipitation hardening heat treatment, producing excellent mechanical properties at a high strength level.

It has a tipical density of 7.75 kg/dm3 and can be magnetised.
Used where high strength and good corrosion resistance are required as well as for application requiring high fatigue strength, good resistance to galling and stress corrosion resistance.

Condition	Tensile Strenght (MPa)	Yield Strenght at 0.2% Offset (MPa)	Elongation in 4D%	Reduction of Area %
H900	1310	1172	10	40
H925	1172	1069	10	44
H1025	1069	1000	12	45
H1075	1000	862	13	45
H1100	965	793	14	45
H1150	931	724	16	50



15-5 PH

15-5 PH VAR is a martensitic, precipitation hardening stainless steel containing 4% copper. It possesses all the advantages of 17-4 PH, including single low-temperature thermal treatment. It also offers excellent transverse notch toughness and ductility and very good uniformity of properties.

The mechanical properties in larger sections and forgeability are superior to that of 17-4 PH. This alloy has a typical density of 7.8 kg/dm3 and magnetic permeability of 95.

15-5 PH is very suitable for intricate parts requiring machining and welding and\or where distortion in conventional heat treatment is a problem. It's employed where high strength and good corrosion resistance are required.

Condition	Specimen Orientation	Tensile Strenght (MPa)	Yield Strenght at 0.2% Offset (MPa)	Elongation in 4D%	Reduction of Area %
H900	Longitudinal Transverse	1310 1310	1172 1172	10 6	35 20
H925	Longitudinal Transverse	1172 1172	1069 1069	10 7	38 25
H1025	Longitudinal Transverse	1069 1069	1000 1000	12 8	45 32
H1075	Longitudinal Transverse	1000 1000	862 862	13 9	45 33
H1100	Longitudinal Transverse	965 965	793 793	14 10	45 34
H1150	Longitudinal Transverse	931 931	724 724	16 11	50 35

AISI 4340

This chromium-nickel-molybdenum alloy is a widely used deep-hardening constructional steel. It is used at a variety of strength levels and at each level possesses remarkable ductility and toughness. High fatigue strength makes AISI 4340 ideal for highly stressed parts. It maintains its strength and hardness at elevated temperatures.
The density of this material is typically 7.85 kg/dm3.

Nominal Cross-Sectional Area Square Centimeters	Tensile Strenght (MPa)	Yield Strenght at 0.2% Offset (MPa)	Elongation in 4D%	Reduction of Area %
Up to 645, inc.	1793	1496	6	30
Over 645 to 929, inc.	1793	1496	5	25
Over 929	1793	1496	4	20

MLX17

This steel stainless has excellent mechanical properties in the longitudinal and transverse directions, excellent balance between strength and toughness properties and excellent fatigue resistance, good resistance to corrosion and stress corrosion and very good weldability.
Its applications are on forgings and mechanical parts in stainless steel requiring very good mechanical properties, structural parts and fasteners.

Condition	Specimen Orientation	Tensile Strenght (MPa)	Yield Strenght at 0.2% Offset (MPa)	Elongation in 4D%	Reduction of Area %
H950	Longitudinal Transverse	1655 1655	1517 1517	10 8	45 35
H1000	Longitudinal Transverse	1517 1517	1379 1379	10 10	50 40

INCONEL 718

Alloy 718 is a precipitation hardenable nickel-based alloy designed to display exceptionally high yield, tensile and creep-rupture properties at temperatures up to 1300°F. This alloy has excellent weldability when compared to the nickel-base superalloys hardened by aluminum and titanium. This alloy has been used for jet engine and high-speed airframe parts such as wheels, buckets, spacers, and high temperature bolts and fasteners.

Specimen Orientation	Tensile Strenght (MPa)	Yield Strenght at 0.2% Offset (MPa)	Elongation in 4D%	Reduction of Area %
Longitudinal	1276	1034	12	15
Long-Transverse	1241	1034	10	12
Transverse	1241	1034	6	8

AERMET 100

AerMet 100 (UNS K92580) is an alloy that has been designed to have properties of excellent hardness and strength combined with exceptional ductility and toughness. AM 100 is used in applications that require high fracture toughness and excellent resistance to stress corrosion cracking and fatigue. AerMet® 100 is considered as a candidate for use in applications such as Armour, Fasteners, Landing Gear, Jet Engine Shafts, Structural Members, Drive Shafts, Structural Tubing.

Property	Value Aged at 900 °F	Value Aged at 875°F
Tensile Strenght	1931 MPa	1999 MPa
Yield Strenght at 0.2% Offset	1620 MPa	1689 MPa
Elongation in 4D	8%	8%
Reduction of Area	45%	35%

MP35N

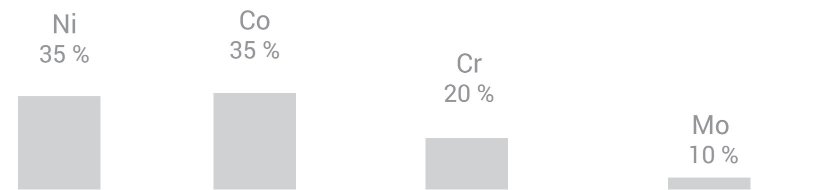
MP35N alloy is a nonmagnetic, nickel-cobalt-chromium-molybdenum alloy possessing a unique combination of ultrahigh tensile strength (up to 300 ksi [2068 MPa]), good ductility and toughness, and excellent corrosion resistance. In addition, this alloy displays exceptional resistance to sulfidation, high temperature oxidation, and hydrogen embrittlement.

MP35N alloy possesses excellent resistance to sulfidation, high temperature oxidation, hydrogen embrittlement, saline solutions and most mineral acids.

This alloy features exceptional resistance to stress corrosion cracking at very high strength levels under severe environmental conditions that can crack most conventional alloys. It is also highly resistant to other forms of localized attack, such as pitting and crevice corrosion.

In seawater environments, this alloy is virtually immune to general, crevice and stress corrosion, regardless of strength level or process condition.

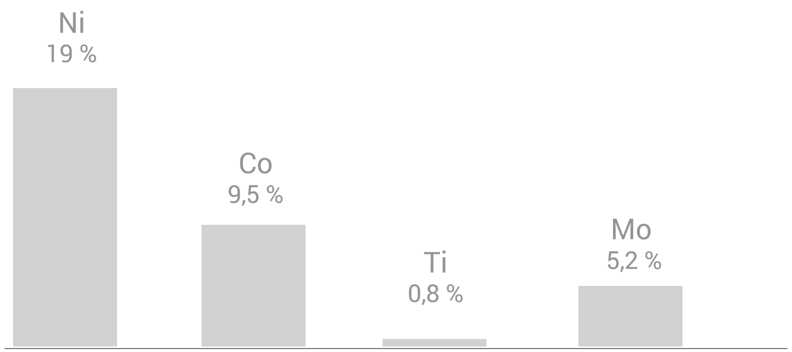
Property	Value
Tensile Strenght	1793 MPa
Yield Strenght at 0.2% Offset	1586 MPa
Elongation in 4D	8%
Reduction of Area	35%



MARAGING 300

Maraging is an iron-based steel alloyed with 18% nickel and 7 to 12% cobalt as a strengthening agent. Essentially carbon-free, other alloying elements include moly, aluminum and titanium. This combination creates a superior steel that maintains high strength and toughness, has uniform, predictable shrinkage during heat treatment, resists corrosion and crack propagation, has a high level of cleanliness and excellent polishability and remains readily weldable.

Property	Value
Tensile Strenght (MPa)	2035
Yield Strenght at 0.2% Offset (MPa)	2000
Elongation in 4D (%)	12
Charpy notch impact (J)	17

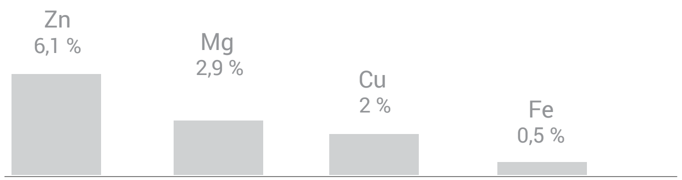


AL7075 T6/T651

Alloy 7075 has been the standard workhorse 7XXX series alloy within the aerospace industry ever since. It was the first successful Al-Zn-Mg-Cu high strength alloy using the beneficial effects of the alloying addition of chromium to develop good stress-corrosion cracking resistance in sheet products. Although other 7XXX alloys have since been developed with improved specific properties, alloy 7075 remains the baseline with a good balance of properties required for aerospace applications.

Alloy 7075 has been thoroughly evaluated for corrosion resistance of atmospheric weathering, stress-corrosion cracking and exfoliation in all currently available tempers. These values have been used as a standard for comparison in the development of more recent high strength aerospace alloys.

Property	Value
Hardness (HB)	150
Hardness (HRC A)	53,5
Hardness (HRC B)	87
Hardness (HV)	175
Tensile Strenght (MPa)	572
Yield Strenght 0.2% Offset (MPa)	503
Elongation (%)	11



AL7068 T6511

7068 alloy provides the highest mechanical strength of all aluminium alloys and matching that of certain steels. This outstanding alloy combines a yield strength of up to 700 MPa (up to over 30% greater than that of 7075 alloy) and good ductility with corrosion resistance similar to 7075 and other features beneficial to high performance component/equipment designers.

The highly attractive overall combination of mechanical properties (retained at elevated temperatures better than 7075) and other important characteristics of 7068 have resulted in the widespread specification of the alloy to markedly reduce the weight/cross section or significantly increase the strength of critical components in diverse market sectors.

Nominal Ø or Least Thickness or Nominal Wall Thickness (mm)	Tensile Strenght (MPa)	Yield Strenght at 0.2% Offset (MPa)	Elongation 4D%
6.35 to 76.20	683	655	5

MATERIAL R&D

Poggipolini works side by side with the most important materials manufacturers with the aim of developing new materials and to find from these new materials the best solutions and applications for its customers.

5.0 MANUFACTURING

Poggipolini controls in house the entire manufacturing process, from Designing to the final NDT special processes.
In the following pages we present in detail each process.

PROCESSES

HOT HEAD FORGING

Poggipolini is expert and specialist on hot head forging. Forging is a metal forming process that involves applying compressive forces to a work piece to deform it, and create a desired geometric change to the material. The forging process is very important in industrial metal manufacture, particularly in the extensive iron and steel manufacturing industry. A steel forge is often a source of great output and productivity.

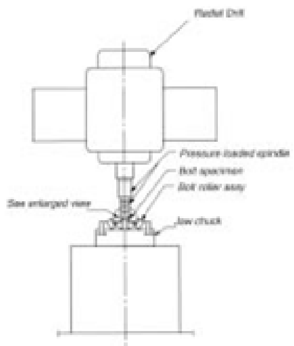
Work stock is put in to the forge. It may be rolled, it may also come directly from cast ingots or continuous castings. The forge will then manufacture steel forgings of desired geometry and specific material properties. These material properties are often greatly improved.

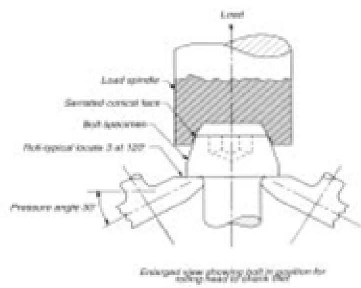
Metal forging is known to produce some of the strongest manufactured parts compared to other metal manufacturing processes and obviously, is not just limited to iron and steel forging, but to other metals as well. Different types of metals will have a different factors involved when forging them. Some will be easier to forge than others. Various tests are described later to determine forging process factors for different materials. Aluminum, magnesium, copper, titanium, and nickel alloys are also commonly forged metals.

Ordinarily, head parts are cold processed by using header or press, but in case of bad plastic processability, material such as Titanium-alloy and heat resisting steel head parts are processed by hot forging. In order to control part processing, fibre flow at head parts is checked usually.

HEAD TO SHANK FILLET

Almost all the bolts rolled after head treatment will break down at the head part due to tension or tension fatigue test. In order to make the strength of head parts and thread parts balance, the strength of head parts is increased. To realize above purpose, by cold processing under head fillet surface roughness is improved by vanishing effect. As a result of this processing residual compression stress is given and fatigue strength of the head part is increased.

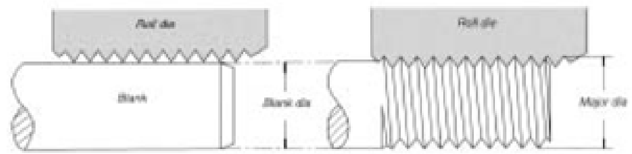




THREAD ROLLING

Thread rolling is a metal rolling process used extensively in manufacturing industry to produce screws, bolts and other fasteners. A common thread rolling process, used in industry to manufacture threaded parts, involves forming the threads into the metal of a blank by a pressing and rolling action between two die. The die surfaces hold the shape and the force of the action forms the threads into the material. A similar metal forming process has been developed for the production of gears.

Thread rolling, in modern manufacturing, has an extremely high productivity rate, significantly higher than producing threaded parts by machining. Machining is the alternative method to industrial manufacturing of threaded parts. Producing threads by this method has several other benefits over machining. Forming will harden the metal through cold working, does not waste material by cutting, and produces a favorable grain structure to strengthen the part with respect to its function.



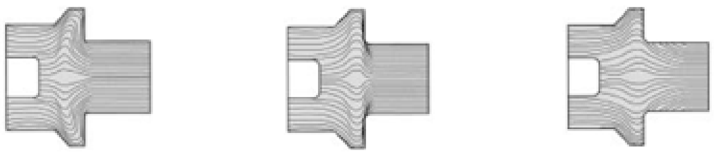
HEAT TREATING

Poggipolini can perform Vacuum Heat Treatment, that permit these different treatments:

- Annealing
- Stress Relieving
- Precipitation Hardening
- Subzero Treatment
- High Pressure Quenching

ANNEALING
Is a heat treatment wherein a material is altered, causing changes in its properties such as strength and hardness. It is a process that produces conditions by heating to above the re-crystallization temperature and maintaining a suitable temperature, and then cooling. Annealing is used to induce ductility, soften material, relieve internal stresses, refine the structure by making it homogeneous, and improve cold working properties.

STRESS RELIEVING
Machining induces stresses in parts. The bigger and more complex the part, the more the stresses. These stresses can cause distortions in the part over the long term. If the parts are clamped in service, then cracking could occur. Also hole locations can change causing them to go out of tolerance. For these reasons, stress relieving is often necessary.



PRECIPITATION HARDENING
Hardening is a process in which steel parts are heated(at a controlled rate) till the austenitic crystal phase is attained and is then quickly cooled(quenched) by introducing a suitable gas.

SUBZERO TREATMENT

Cryogenic hardening is a cryogenic treatment process where the material is cooled to approximately −185 °C (−301 °F), usually using liquid nitrogen. It can have a profound effect on the mechanical properties of certain steels, provided their composition and prior heat treatment are such that they retain some austenite at room temperature.

It is designed to increase the amount of martensite in the steel's crystal structure, increasing its strength and hardness, sometimes at the cost of toughness.

HIGH PRESSURE QUENCHING

For many years now, gas quenching has been the preferred process in the heat treatment of high-speed steels and hot and cold working tool steels.

With the development of separate gas quenching chambers, it is often possible to replace oil quenching with high-pressure gas quenching using nitrogen or helium for heat treating case hardening steels or other low alloyed materials.

The success of this dry quenching technology is based on its environmental and commercial efficiency. Quenching gases such as nitrogen or helium are absolutely inert and without any ecological risk. They leave no residues on the workpieces or in the hardening furnaces. Therefore, investments in equipment such as washing machines or fire monitoring systems are redundant. This, in turn, reduces operating costs for hardening. When helium is used as a quenching gas, appropriate recycling systems for unlimited repeated use of the helium are available.

THE ADVANTAGES OF PROCESS ARE:

- Reduction of hardening distortion and/or variation of distortion
- Quenching intensity adjustable by control of gas pressure and gas velocity
- Process flexibility
- Clean, non-toxic working conditions
- Integration into manufacturing lines
- Reproducible quenching result
- Clean and dry parts, no washing
- Simple process control

5.1 COATINGS

PASSIVATION

The passivation process returns the stainless steel or other metals back to its original specifications by removing unwanted debris and oils from the surface and then submerging the part into a passivating bath. When a part is machined, various particles can permeate the surface of the base metal, weakening it's resistance to corrosion and making the part more susceptible to environmental factors. Debris, dirt and other particles and residue such as free iron, grease and machining oils all affect the strength of the natural surface and can become embedded in the surface during the machining process. These often go unseen to the human eye and are often the cause of the deterioration.

As stated above, "passive" is defined as being less affected by environmental factors. The process improves and purifies the surface of the part. The restored surface acts like a protective coating to environmental factors such as air, water and other extreme environments. It is important to note that passivation does not change the outward appearance of the base metal.

The passivation of stainless steel is a process performed to make a surface passive, i.e., a surface film is created that causes the surface to lose its chemical reactivity. Stainless steel is already known as being corrosion-resistant, however the passivation process further strengthens its' natural coating by improving the exterior surface of the overall part. Stainless steel passivation unipotentializes the stainless steel with the oxygen absorbed by the metal surface, creating a monomolecular oxide film. Passivation can result in the very much-desired low corrosion rate of the metal. Passivation is also accomplished by stainless steel electropolishing.

ADVANTAGES OF PASSIVATION ARE:

- Improved Corrosion Resistance
- Uniform, Smooth Appearance and Finish
- Deburring (Polished Surface)
- Cleanliness
- Improved and Extended Life of Product

ANODISING

Anodising is an electrochemical process that converts the metal surface into a decorative, durable, corrosion-resistant, anodic oxide finish. Aluminum is ideally suited to anodising, although other nonferrous metals, such as magnesium and titanium, also can be anodised.
The anodic oxide structure originates from the material substrate and is composed entirely of material oxide. This material oxide is not applied to the surface like paint or plating, but is fully integrated with the underlying material substrate, so it cannot chip or peel. It has a highly ordered, porous structure that allows for secondary processes such as coloring and sealing.

Anodising is accomplished by immersing the material into an acid electrolyte bath and passing an electric current through the medium. A cathode is mounted on the inside of the anodising tank; the material acts as an anode, so that oxygen ions are released from the electrolyte to combine with the material atoms at the surface of the part being anodised. Anodising is, therefore, a matter of highly controlled oxidation—the enhancement of a naturally occurring phenomenon. The unique anodized finish is the only one in the metals industry that satisfies each of the factors that must be considered when selecting a high performance material finish:

DURABILITY
Most anodized products have an extremely long life span and offer significant economic advantages through maintenance and operating savings. Anodizing is a reacted finish that is integrated with the underlying aluminum for total bonding and unmatched adhesion.

COLOR STABILITY
Exterior anodic coatings provide good stability to ultraviolet rays, do not chip or peel, and are easily repeatable.

EASE OF MAINTENANCE
Scars and wear from fabrication, handling, installation, frequent surface dirt cleaning and usage are virtually non-existent. Rinsing or mild soap and water cleaning will usually restore an anodised surface to its original appearance. Mild abrasive cleaners can be used for more difficult deposits.

AESTHETICS
Anodising offers a large and increasing number of gloss and color alternatives and minimizes or eliminates color variations. Unlike other finishes, anodising allows the material to maintain its metallic appearance.

COST
A lower initial finishing cost combines with lower maintenance costs for greater long-term value.

HEALTH AND SAFETY
Anodising is a safe process that is not harmful to human health. An anodised finish is chemically stable, will not decompose, is non-toxic, and is heat-resistant to the melting point of material.
Since the anodising process is a reinforcement of a naturally occurring oxide process, it is non-hazardous and produces no harmful or dangerous by-products.

DLC

DLC is an acronym for diamond-like carbon. DLC has some of the valuable properties of diamond, including: high hardness, low friction, resistance to wear, chemical inertness, biological compatability, electrical insulation, optical transparency, and smoothness. In common terms, DLC is harder than natural diamond and slicker than "Teflon."

DLC coatings are used to impart some of the useful characteristics of diamonds onto other materials. DLC coatings can be deposited on nearly all metals, metal alloys, and also on nonmetals such as silicon, glass, ceramics, plastics, etc. DLC can be deposited at low (<200°C) substrate temperature.
DLC coating has many commercial applications, including machine tools, aerospace parts, engine parts, medical implants, and high-end watches. Depending on the application, different formulations of DLC coatings are used.
DLC coatings produce dramatic improvements in the performance and life of tools, components, and machines. The hardness of DLC coatings is the foundation of their benefits. DLC in all forms is extremely hard.
DLC's hardness also makes it durable. DLC coatings protects moving parts from abrasion, maintaining smooth movement for much longer than uncoated parts. Engines with DLC coated parts create more horsepower and have longer lifetimes from mechanical parts that rotate, slide, and face other types of wear.

DLC coatings creater lower coefficients of friction. As friction is the enemy of almost all moving parts, lowering it creates nearly universal improvement, regardless of the industry. Thus, DLC is found in engines, tools, the machining of cast and wrought aluminum, plastic injection molds, pumps, machine parts, bearings, cams, and even razor blades. Reduced friction also reduces the need for lubrication, which improves efficiency within the supply chain from raw material through to the end user.

TIN

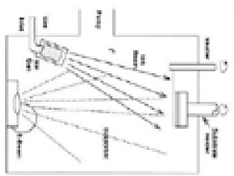
Titanium Nitride, TiN, is a binary compound of titanium and nitrogen. It is an extremely hard ceramic material, often used to coat titanium alloys, steel, carbide and aluminum components, to improve the surface properties of the object.

Applied in a thin layer, TiN is used to harden and protect cutting surfaces and sliding, for decorative purposes, and as a surface finish is non-toxic.
The TiN coatings have a color similar to gold. Depending on the substrate and the surface finish, the TiN has a coefficient of friction between 0.4 and 0.6 with respect to itself (without lubricants). The hardness of the coatings of TiN is difficult to measure, given that the coatings are very hard and when they are very thin the hardness test ultimately penetrate the substrate. It is estimated that the hardness of TiN is ~85 in C scale Rockwell (~2500 in Vickers scale or 24.5 GPa). For such high values the scale of Rockwell is considered approximate.To measure the hardness of TiN particular techniques have been developed.

IVD

Ion Vapor Deposition (IVD) of aluminum is a vacuum plating process which deposits pure aluminum on nearly any metal. The important advantages of this coating over cadmium, are that it is non-toxic, non-hazardous and safe to apply. This assures that the user has an environmentally safe coating. There are as many reasons for using IVD aluminum as there are combinations of substrates and operating environments. The following are the most common:

IVD ALUMINUM ON STEEl
This process provides excellent “sacrificial” corrosion resistance with no hydrogen embrittlement. A .001-.002-inch coating averages 7500 hours in 5% neutral salt. Other benefits include a useful operating temperature up to 925 F and galvanic compatibility with aluminum structures.



IVD ALUMINUM ON HEAT AND CORROSION RESISTANT ALLOYS
Provides the same benefits as with steel, plus oxidation resistance at high temperature-925 F, as deposited and significantly higher after high-temperature diffusion. The coating may be deposited directly on the substrate without special preparation such as nickel strike.

IVD ALUMINUM ON TITANIUM

Provides the same benefits as with steel, plus the coating can be anodised or hard anodised to improve the wear-resistance, low absorptance-high emissivity, dielectric, color and all other properties of anodic coatings on aluminum. The coating retards titanium combustion. And it permits painting and adhesive bonding using the same techniques as with aluminum.

IVD ALUMINUM ON ALUMINUM

Adds corrosion resistance to high strength aluminum alloys without sacrificing fatigue resistance, as will occur with anodising. Allows use of casting (A-380, etc.) and microcrystalline alloys in applications normally restricted to wrought materials. Also provides corrosion resistance in applications where electrical continuity or bond is required. This eliminates “jumper” connections.

TOP COAT\DRY LUBRIFICANT

Dry lubricants or solid lubricants are materials which despite being in the solid phase, are able to reduce friction between two surfaces sliding against each other without the need for a liquid oil medium.

The two main dry lubricants are graphite and molybdenum disulfide. They offer lubrication at temperatures higher than liquid and oil-based lubricants operate. Dry lubricants are often used in applications such as locks or dry lubricated bearings. Such materials can operate up to 350 °C (662 °F) in oxidizing environments and even higher in reducing/non-oxidizing environments (molybdenum disulfide up to 1100 °C, 2012 °F).
The low-friction characteristics of most dry lubricants are attributed to a layered structure at the molecular level, with weak bonding between layers.
Such layers are able to slide relative to each other with minimal applied force, thus giving them their low friction properties.

However, a layered crystal structure alone is not necessarily sufficient for lubrication. In fact, there are also some solids with non-lamellar structures that function well as dry lubricants in some applications. These include certain soft metals (indium, lead, silver, tin),polytetrafluroethylene, some solid oxides, rare-earth fluorides, and even diamond.

Limited interest has been shown in low friction properties of compacted oxide glaze layers formed at several hundred degrees Celsius in metallic sliding systems. However, practical use is still many years away due to their physically unstable nature.

THE FOUR MOST COMMONLY USED SOLID LUBRICANTS ARE:

GRAPHITE: used in air compressors, food industry, railway track joints, open gear, ball bearings, machine-shop works, etc. It is also very common for lubricating locks, since a liquid lubricant allows particles to get stuck in the lock, worsening the problem.

MOLYBDENUM DISULFIDE (MOS2): used in CV joints and space vehicles. Will lubricate in a vacuum.

HEXAGONAL BORON NITRIDE: used in space vehicles. Also called “white graphite.”

TUNGSTEN DISULFIDE: similar usage as molybdenum disulfide, but due to the high cost, only found in some dry lubricated bearings.

Graphite and molybdenum disulfide are the predominant materials used as dry lubricants.

ZINC ALUMINIUM FLAKES COATINGS

Zinc Aluminium flakes coatings are non-electrolytically applied coatings, which provide good protection against corrosion. These coatings consist of a mixture of zinc and aluminium flakes, which are bonded together by an inorganic matrix.

THERE ARE THREE GROUPS OF ZINC FLAKE COATINGS:

1. Zinc flake coatings containing Cr(VI) (hexavalent chromium): surfaces containing Cr(VI) provide greater anti-corrosion protection with a thinner coating, but Cr(VI) is carcinogenic and poses a potential risk to the environment. New European decrees prohibit the use of surfaces containing Cr(VI).

2. Solvent based Cr(VI)-free zinc flake coatings.

3. Water based Cr(VI)-free zinc flake coatings. Cr(VI)-free coatings are more environmentally friendly than surfaces with a Cr(VI) content. No zinc flake coatings used in the automotive industry nowadays contain this substance. Various manufactures, such as car companies and their suppliers, have produced their own specifications and supply rules in order to define the requirements for these coating systems.

VISION

OUR VISION IS TO BECOME YOUR ADDED VALUE, YOUR SOLUTIONS PROVIDER.

We are driven by a continuous pursuit of excellence on every single aspect from innovative manufacturing systems to the latest materials, coatings and treatments.

Our certifications shows our level of competence and quality.

Our passion shows our commitment to the best and beyond.

AER-Ed. 01/20

Poggipolini S.r.l.
Via Emilia Levante, 262 - 40068 S. Lazzaro di Savena (BO) - ITALY

T. +39 051 6256090 **F**. +39 051 6257084 **E**. contact@poggipolini.it

WWW.**POGGIPOLINI.IT**