JACQUES ALLEMANN
NOTZ group advanced metal solutions

Phynox

Rods • Wire • Axles

Description	CoCr20Ni15Mo	En-Norm	AFNOR	DIN
		1.1231 / C67S	C67S	Ck67

Chemical composition

Fe	Co	Cr	Ni	Mo	Mn	Si	C	P	S	Be	O*
Rest	39.0–41.0	19.0-21.0	15.0–18.0	6.5–7.5	1.50–2.50	≤ 0.12	≤ 0.15	≤ 0.015	≤ 0.015	≤ 0.001	≤ 1.0

Chemical analysis according to the European standard EN in mass percentages. / *Other

Dimensions

Diameter
Ø 0.02 – 4.00 mm
The product can be supplied as a round material (in round shape) or in customer-specific geometries or shapes.

Delivery mode
- as a ring
- on assorted spools
- straightened
- Axles

Main technical properties and features

Application and use
Phynox is categorized as a cobalt alloy and possesses extraordinary characteristics in tensile strength, tenacity, ductility and resistance to corrosion. Additionally, it is biocompatible and therefore well established as an implant material. The alloy is made up of: 40% cobalt, 20% chrome, 16% nickel, and 7% molybdenum. This material is used whenever high resistance to corrosion is required and material fatigue not an option. Primary implementation includes but is not limited to: the medicinal and dental sectors, chemical industry, aeronautics, and even the watch industry, where Phynox is a favoured material for spring and axle manufacturing.
Tensile strengths up to 2800N/mm^2 (depending on the diameter) can be reached with appropriate thermal treatment. A long flex life, the ability to withstand very high temperatures and non-magnetic behaviour are also key characteristics that define Phynox.

Resistance to corrosion
Both organic and mineral acids are completely or almost completely unable to attack Phynox, allowing it to leave even the best stainless steels behind in terms of resistance to corrosion. Together with its inactivity when contacting bodily fluids or tissue, this resistivity makes Phynox an excellent choice for implants.

Thermal treatment
Phynox can be hardened at a temperature of 520°C for three hours in a vacuumed or an argon flooded oven. Exposure to air will cause a green colouring to manifest, which has no impact on the materials' mechanical properties. The level of hardness at delivery should be chosen in an appropriate fashion, as the delivery condition influences the maximum effect of the heat treatment.

Weldability
Phynox can be easily welded as well as soldered; however, only cold-worked material can be hardened. Therefore, areas which are welded should not be exposed to excessive mechanical stress.

Surface Finish

Execution	Cleaning	Diameter
drawn	chemically purged	Ø 0.020 – 3.499 mm
surface ground	chemically purged	Ø 3.500 – 4.000 mm

Diameter tolerances

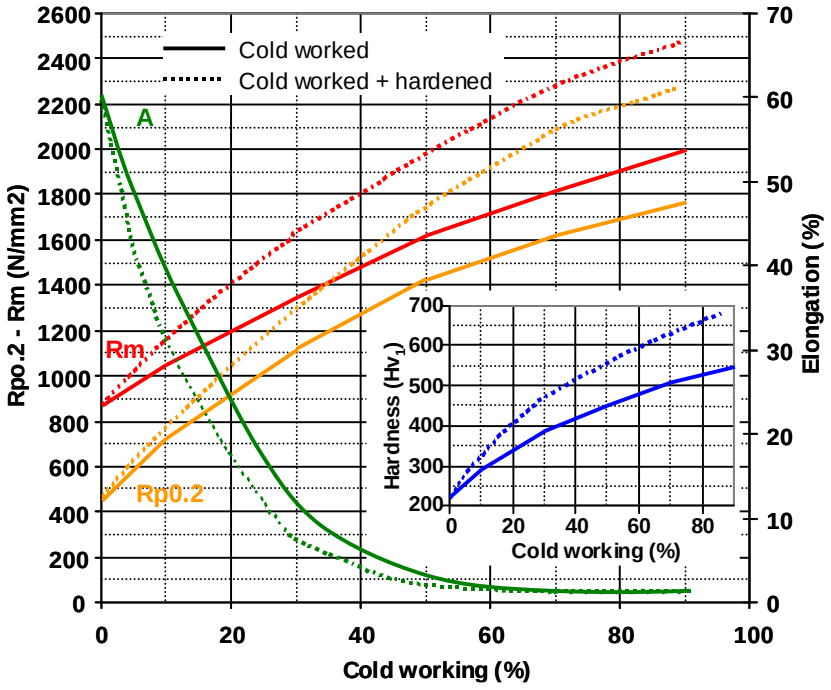
Diameter mm	Tolerance %	Tolerance µ
0.020 – 0.249	-	± 1.0
0.250 – 0.399	-	± 1.5
0.400 – 1.500	-	± 2.0
1.500 – 4.000	-	± 2.5

Mechanical Properties

Condition at delivery mm	Tensile strength in cold-twisted condition at delivery N/mm²
0.005 – 0.019	950 – 2250*
0.020 – 0.199	950 – 2250*
0.200 – 0.499	950 – 2250*
0.500 – 0.999	950 – 2250*
1.000 – 1.999	950 – 2250*
2.000 – 4.000	950 – 2250*

* higher tensil strength on request

Typical cold working curve of Phynox.
Values of Rm, Rp0.2, A, et HV_1 before and after hardening at (520 °C 3h).



Cleanliness
According to ISO 5832/7, AFNOR NF S90-4

non metallic inclusions			
Typ A	Typ B	Typ C	Typ D
sulfides	aluminates	silicates	globular oxides
1	3	1	1

Aging
Phynox cannot be hardened in the annealed state. A previous cold deformation is required to activate the hardening reaction of the material. Basically, the higher the degree of cold deformation, the higher the increase in strength.

Heat treatments

Treatment	Temperature	Duration	Cooling
Annealing	1050 °C	0.5 h	Cooling in the air*, gas or water
Aging	480 – 540 °C	2 – 5 h	Preferably in a 10^{-5} T vacuum or under argon protective atmosphere.
Stress relieving	< 250-300°C	1 – 2 h	-

* A treatment in air oxidizes the surface by forming a yellowish oxide layer.

Protective atmospheres
As a precautionary measure, all thermal treatments should always be carried out in an H_2-free atmosphere.

Remark
- A stress relieving treatment of the cold deformed products is recommended.
- A stress relieving treatment of the cold deformed products to uniformize their internal stresses before machining is recommended.

Physical properties

Young's Modulus	20 ºC	215.00 GPA
Poisson ratio	20 ºC – 200 ºC	0.3
Density	-	8.3 g/cm^3
Coefficient of thermal expansion	20 ºC	12.50 W/m °K
Specific electric resistance	20 ºC	0.10 μΩcm
Specific heat	20 ºC	450.00 J/kgK
Melting point	-	1450 – 1460 °C
Magnetic properties	-	Nonmagnetic For all practical purposes, Phynox in nonmagnetic through all temperature range.

Processing

Machining

The optimal cutting conditions for the material depend on the machine tools, the cutting tools used, the chip dimensions, lubricant-cooling fluid, the desired tolerances, as well as the surface roughness.

Machinability	difficult
Cutting speed	low, Vc ≈ 20-40 m/min
Feed	moderate to high
Lubricant-cooling	individual choice

Polishing

- In the cold worked condition, the polishing is easier.
- Phynox is suitable for the "Haut de gamme" polishing of the watch industry.

Note

All information provided in this data sheet is based on the best knowledge and the latest state of the art, but without guarantee. The use of materials should always be discussed with our sales specialists or our materials laboratory on a product- and application-specific basis.

Bernstrasse 24
CH 2555 Brügg
Phone +41 32 485 15 66

www.jacques-allemann.com
info@jacques-allemann.ch