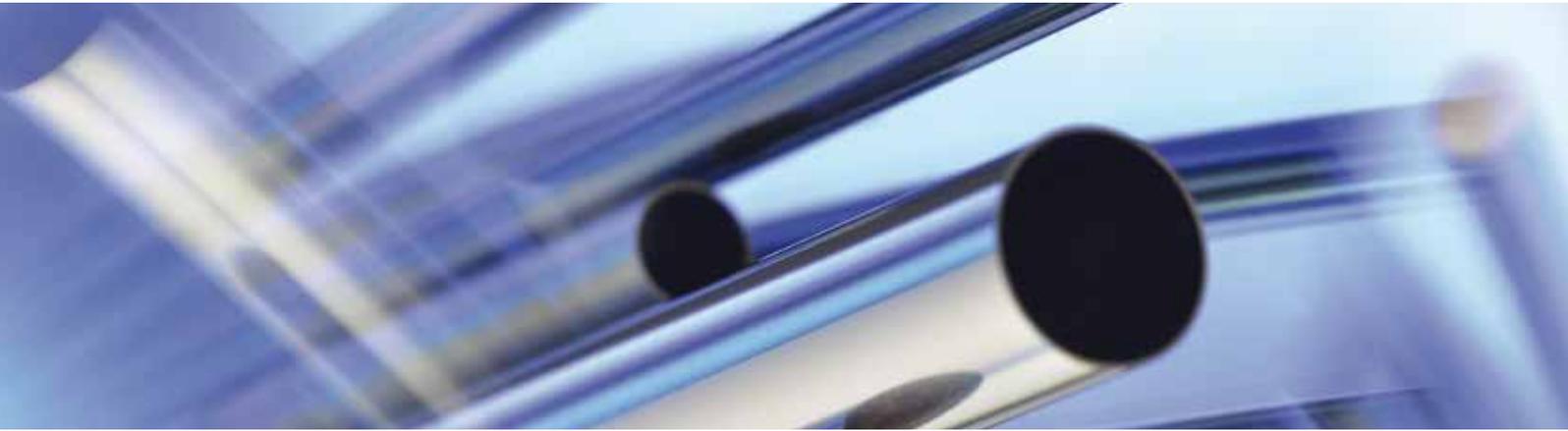


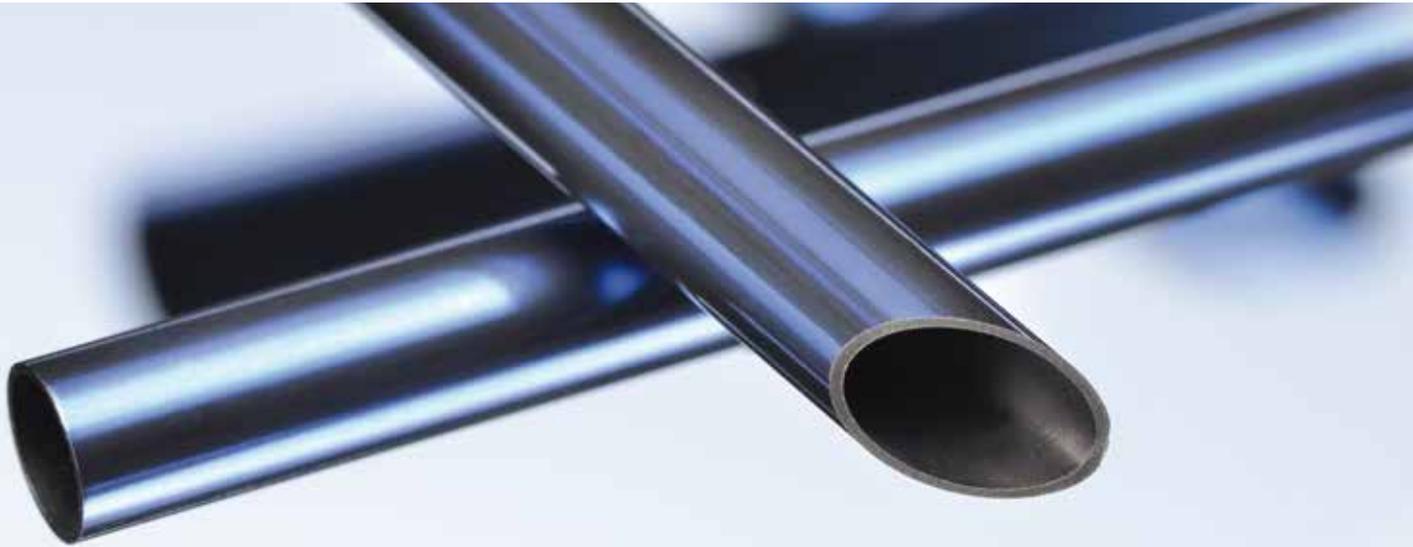


EUROFLEX[®]

WE CREATE SOLUTIONS



High quality semi-finished products and components for the medical industry



EUROFLEX is a globally leading manufacturer of high-quality semi-finished products and components for medical applications. The company was founded in 1993 and is a full subsidiary of G.RAU GmbH & Co. KG, which produces high-precision tubes, wires, sheet and components.

As a leading specialist for solutions made of Nitinol and many other innovative materials, EUROFLEX is the competent partner for many companies in the field of medical technology. Certified in accordance with DIN EN ISO 9001 and DIN EN ISO 13485, our management system ensures a consistently high level of product quality.





Developing innovative materials is only the beginning for EUROFLEX. A further decisive step is creating the product in a quality that convinces the customer. All of our tubes, wires, sheets and components are manufactured with the highest precision and comply with the high standards prevailing in the field of medical technology. Securing maximum quality in this sense is for us a matter of course.

And this is a principle that we also base our service on. We are a competent partner for our customers and gladly help them with their requirements. Many of our further developments of the alloys, which we currently employ, originate from the dialog we maintain with our customers. This is because we are only satisfied once we have found the optimal solution for you.

Innovative materials

Tubing, wire, sheet material and components



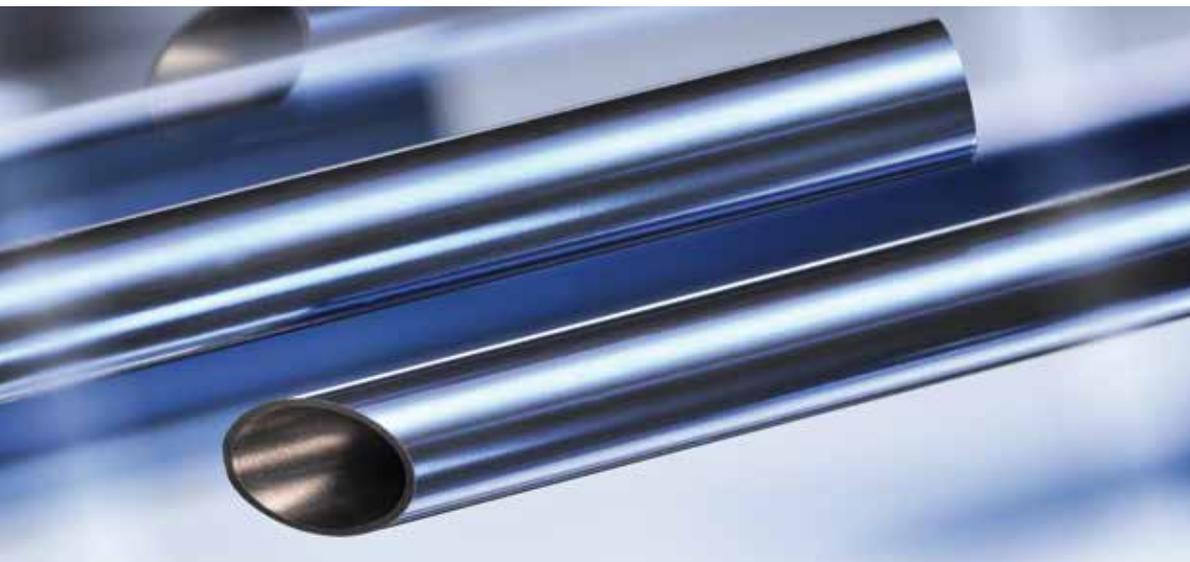
Precision products for the highest quality demands

Businesses in the field of medical technology have diverse requirements when it comes to products and materials. EUROFLEX offers a wide range of materials that truly convince through their innovation and quality.

From our product range:

NITINOL
COBALT-BASED ALLOYS
STAINLESS STEEL, NI-FREE ALLOYS
TITAN-BASED ALLOYS
TANTALUM
PRECIOUS METALS
ABSORBABLE ALLOYS ...

Used with preference in the field of medical technology, our semi-finished products and components serve as a basis for implants such as vascular support (stents) and a wide variety of other flexible medical instruments.





Based on our customers' needs, we serve as a strategic partner and advisor in developing innovative and custom-tailored solutions from the creation of the prototype to serial production.

Our many years of experience in alloys and their further development, as well as knowing the requirements of our customers, are the basis of the continued development of our product range.

Please ask us about our latest developments! We would be pleased to assist you in selecting and optimizing the suitable material and look forward to working with you.

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OUR BASIC DELIVERY-PROGRAM

Tubes

Nitinol superelastic	diameter 0,06 mm up to 20,00 mm wall thickness 0,02 mm up to 1,20 mm
Nitinol shape-memory	
Cobalt-based-alloys	in fabrication lengths / fixed lengths
Stainless steel	
Titan-based-alloys	
Tantalum	
Special materials	
Platinum-based-alloys	
Magnesium-based-alloys	
compound alloys	

Other materials and dimensions available on request.

Rapid Response

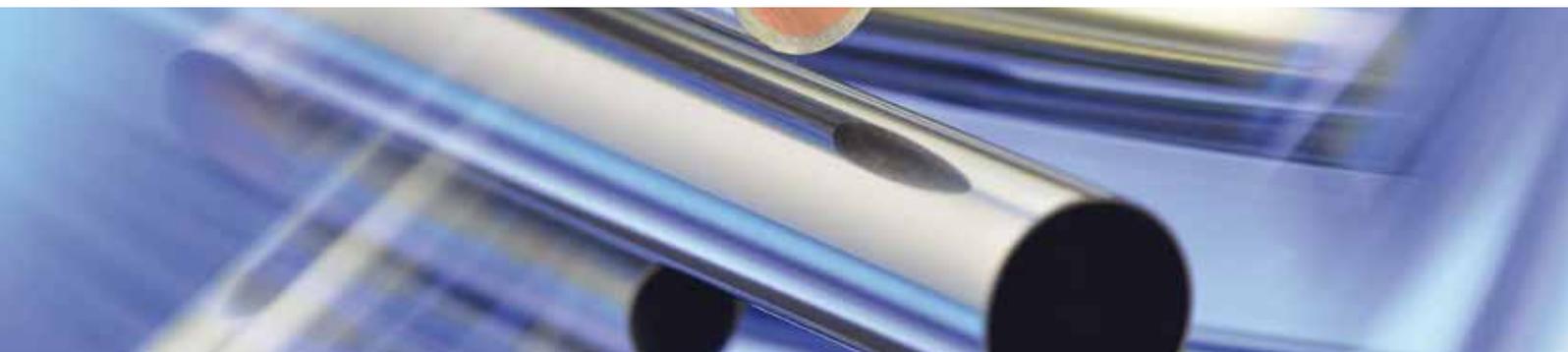
With our Rapid Response program which is integrated in our production, we are able to react very fast on short-time prototype requests. We can handle small lots of the common used alloys from our basic delivery program independently from the serial production. Customer specific tubes will be processed on serial identical production equipment, which gives us the opportunity to make an easy switch from sample to serial production.

In addition to our sample production we offer our customers a wide range of different tube sizes made of various alloys available off the shelf and online visible. This option completes our Rapid Response Program and give us the possibility to fulfil the requirements of the medical market in view of short reaction times.

Actual stock list available at:

www.euroflex.de

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OUR BASIC DELIVERY-PROGRAM

Round wires and bars

Nitinol superelastic	diameter 0,025 mm up to 20,00 mm
Nitinol shape-memory	
Platinum-based-alloys	
Magnesium-based-alloys	
compound alloys	

Other materials and dimensions available on request.

Flat and profiled wires

Nitinol superelastic	thickness 0,10 mm up to 2,00 mm
Nitinol shape-memory	width 0,50 mm up to 25,00 mm
Platinum-based-alloys	
Magnesium-based-alloys	
compound alloys	

Other materials and dimensions available on request.

Strip, flat-rolled

Nitinol superelastic	thickness 0,13 mm up to 3,20 mm
Nitinol shape-memory	width up to 25,00 mm

Other materials and dimensions available on request.

Components

Customer specified	upon request
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Nitinol round, flat and profiled wires are available with oxidized or oxid-free surface.

Nitinol tubes are available with oxidized or ground surface.

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NITINOL SUPERELASTIC TUBING

Nitinol Tubing, ASTM F 2633 Material Data

All values are typical at room temperature. Nitinol is a binary alloy suitable for superelastic applications at room and/or body temperature.

Alloy Composition according to ASTM F 2063

Nickel (nominal)	54,5 - 57 wt.-%
Titanium	balance
Oxygen + Nitrogen	max. 0,05 wt.-%
Carbon	max. 0,05 wt.-%

Physical Properties

Melting Point	1310° C
Density	6,5 g/cm ³
Electrical Resistivity	82 μ Ohm x cm
Coefficient of Thermal Expansion	11 x 10 ⁻⁶ /°C
Modulus of Elasticity	41-75 x 10 ³ MPa

Mechanical Properties according to ASTM F 2633 Table 1

Ultimate Tensile Strength (UTS)	min. 1000 MPa
Uniform Elongation	min. 10%

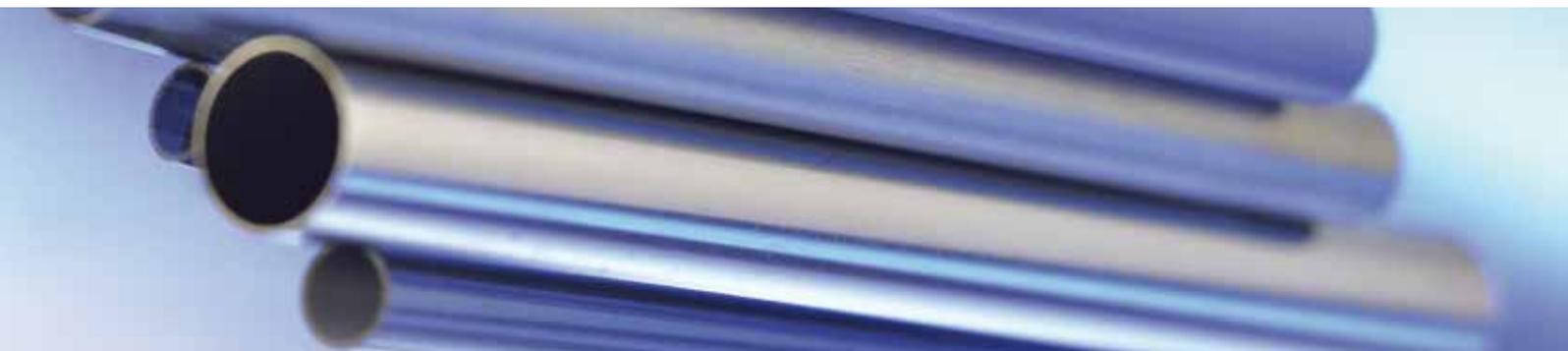
Superelastic Properties according to ASTM F 2633

Loading Plateau Stress (at 3% strain)	min. 380 MPa
Permanent Set (after 6% strain)	max. 0,3%
Transformation Temperature A _f	max. 15° C

Comments

These values should only be used as guidelines for developing material specifications. Properties of Nitinol are strongly dependent on processing history and ambient temperature. The mechanical and superelastic properties shown here are typical for standard superelastic straight tubes at room temperature tested in uniaxial tension. Bending properties differ, and depend on specific geometries and applications. Modulus is dependent on temperature and strain. Larger tubes (> 3,9 mm OD) may require custom specifications.

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NITINOL SUPERELASTIC AND SHAPE MEMORY WIRE

Nitinol Wire Material Data

All values are typical at room temperature. Nitinol is a binary alloy suitable for superelastic applications at room and/or body temperature. Nitinol shape memory is a binary alloy suitable for shape memory applications with transformation temperatures greater than 60° C.

Superelasticity

Shape Memory

Alloy Composition

Nickel (nominal)	54,5 - 57 wt.-%	54,5 wt.-%
Titanium	balance	balance
Oxygen	max. 0,05 wt.-%	max. 0,05 wt.-%
Carbon	max. 0,02 wt.-%	max. 0,02 wt.-%

Physical Properties

Melting Point	1310° C	1310° C
Density	6,5 g/cm ³	6,5 g/cm ³
Electrical Resistivity	82 μOhm x cm	76 μOhm x cm
Coefficient of Thermal Expansion	11 x 10 ⁻⁶ /°C	6,6 x 10 ⁻⁶ /°C
Modulus of Elasticity	41-75 x 10 ³ MPa	28-41 x 10 ³ MPa

Mechanical Properties

Ultimate Tensile Strength (UTS)	min. 1100 MPa	min. 1100 MPa
Total Elongation	min. 10%	min. 10%

Superelastic Properties

Loading Plateau Stress (at 3% strain)	min. 380 MPa	min. 100 MPa
Permanent Set (after 6% strain)	max. 0,2%	
Transformation Temperature A _f	max. 18° C	min. 60° C
Shape Memory Strain		max. 8%

Comments

These values should only be used as guidelines for developing material specifications. Properties of Nitinol are strongly dependent on processing history and ambient temperature. The mechanical and superelastic properties shown here are typical for standard superelastic straight wire at room temperature tested in uniaxial tension. Bending properties differ, and depend on specific geometries and applications. Modulus is dependent on temperature and strain. Certain shapes or product configurations may require custom specifications. Materials are also available in the cold-worked or annealed conditions.

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CO-ALLOY L-605 TUBING FOR SURGICAL IMPLANTS

L-605, ASTM F 90, Material Data

Chemical Composition

Carbon	0,05 - 0,15 wt.-%
Silicon	max. 0,4 wt.-%
Manganese	1,0 - 2,0 wt.-%
Phosphorus	max. 0,04 wt.-%
Sulfur	max. 0,03 wt.-%
Chromium	19,0 - 21,0 wt.-%
Nickel	9,0 - 11,0 wt.-%
Iron	max. 3,0 wt.-%
Tungsten	14,0 - 16,0 wt.-%
Cobalt	balance

Physical Properties

Melting Point	1410 - 1438° C
Density	9,23 g/cm ³
Modulus of Elasticity	243 x 10 ³ MPa

Mechanical Properties

	cold-worked	annealed
Ultimate Tensile Strength (UTS)	min. 1100 MPa	min. 900 MPa
Yield Strength	min. 900 MPa	min. 500 MPa
Elongation	min. 7%	min. 30%

Microstructure in fully annealed condition

Austenitic Grain Size	min. 7
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Comments

These values should only be used as guidelines for developing material specifications. Properties strongly depend on processing history. The values listed above are typical for uniaxial tension. Upon request, we can also deliver this material with other properties.

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CO-ALLOY MP35N TUBING FOR SURGICAL IMPLANTS

MP35N, ASTM F 562, Material Data

Chemical Composition

Carbon	max. 0,025 wt.-%
Silicon	max. 0,15 wt.-%
Manganese	max. 0,15 wt.-%
Phosphorus	max. 0,015 wt.-%
Sulfur	max. 0,010 wt.-%
Chromium	19,0 - 21,0 wt.-%
Nickel	33,0 - 37,0 wt.-%
Iron	max. 1,0 wt.-%
Molybdenum	9,0 - 10,5 wt.-%
Titanium	max. 1,0 wt.-%
Boron	max. 0,015 wt.-%
Cobalt	balance

Physical Properties

Melting Point	1315 - 1440° C
Density	8,43 g/cm ³
Modulus of Elasticity	233 x 10 ³ MPa

Mechanical Properties

	cold-worked	annealed
Ultimate Tensile Strength (UTS)	min. 1000 MPa	min. 800 MPa
Yield Strength	min. 650 MPa	min. 500 MPa
Total Elongation	min. 7%	min. 30%

Microstructure in fully annealed condition

Austenitic Grain Size	min. 7
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Comments

These values should only be used as guidelines for developing material specifications. Properties strongly depend on processing history. The values listed above are typical for uniaxial tension. Upon request, we can also deliver this material with other properties.

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STAINLESS STEEL TUBING FOR SURGICAL IMPLANTS AND DEVICES

316 L (ASTM F138), 316 Ti, 316 L, Material Data

316 L 1.4441 implantable Grade	316 Ti 1.4571	316 L 1.4404
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Chemical Composition

Carbon	max. 0,030 wt.-%	max. 0,08 wt.-%	max. 0,03 wt.-%
Silicon	max. 0,75 wt.-%	max. 0,75 wt.-%	max. 0,75 wt.-%
Manganese	max. 2,0 wt.-%	max. 2,0 wt.-%	max. 2,0 wt.-%
Phosphorus	max. 0,025 wt.-%	max. 0,045 wt.-%	max. 0,045 wt.-%
Sulfur	max. 0,010 wt.-%	max. 0,03 wt.-%	max. 0,03 wt.-%
Nitrogen	max. 0,10 wt.-%	max. 0,10 wt.-%	max. 0,10 wt.-%
Chromium	17,0 - 19,0 wt.-%	16,0 - 18,0 wt.-%	16,0 - 18,0 wt.-%
Molybdenum	2,25 - 3,0 wt.-%	2,0 - 3,0 wt.-%	-
Nickel	13,0 - 15,0 wt.-%	10,0 - 14,0 wt.-%	10,0 - 14,0 wt.-%
Titanium		5x %(C+N)-0,7	
Copper	max. 0,5 wt.-%	-	-
Iron	balance	balance	balance

Physical Properties

Melting Point	1750° C	1345° C	1371° C
Density	8,0 g/cm ³	8,0 g/cm ³	8,0 g/cm ³
Modulus of Elasticity	200 x 10 ³ MPa	193x10 ³ MPa	193x10 ³ MPa

Mechanical Properties

	cold-worked	annealed	annealed
Ultimate Tensile Strength	min. 860 MPa	min. 500 MPa	min. 500 MPa
Yield Strength	min. 690 MPa	min. 200 MPa	min. 200 MPa
Elongation	min. 7%	min. 40%	min. 40%

Microstructure in fully annealed condition

Austenitic Grain Size	min. 6	min. 8	min. 8
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Comments

Properties strongly depend on processing history and ambient temperature. Mechanical values listed above are typical for uniaxial tension. Upon request, we can also deliver this material with other properties.

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STAINLESS STEEL TUBING FOR SURGICAL DEVICES

304, 304 L, 321, 17-7 PH Material Data

304
1.4301

304 L
1.4306

321
1.4541

17-7 PH
1.4568

Chemical Composition

Carbon	max. 0,08 wt.-%	max. 0,03 wt.-%	max. 0,08 wt.-%	max. 0,09 wt.-%
Silicon	max. 0,75 wt.-%	max. 0,75 wt.-%	max. 0,75 wt.-%	max. 1,00 wt.-%
Manganese	max. 2,0 wt.-%	max. 2,0 wt.-%	max. 2,0 wt.-%	max. 1,00 wt.-%
Phosphorus	max. 0,045 wt.-%	max. 0,045 wt.-%	max. 0,045 wt.-%	max. 0,04 wt.-%
Sulfur	max. 0,03 wt.-%	max. 0,03 wt.-%	max. 0,03 wt.-%	max. 0,03 wt.-%
Nitrogen	max. 0,10 wt.-%	max. 0,10 wt.-%	max. 0,10 wt.-%	-
Chromium	18,0 - 20,0 wt.-%	18,0 - 20,0 wt.-%	17,0 - 19,0 wt.-%	16,0 - 18,0 wt.-%
Molybdenum	-	-	-	-
Nickel	8,0 - 12,0 wt.-%	8,0 - 12,0 wt.-%	9,0 - 12,0 wt.-%	6,5 - 7,75 wt.-%
Titanium	-	-	-	-
Aluminium	-	-	-	0,75 - 1,5 wt.-%
Iron	balance	balance	balance	balance

Physical Properties

Melting Point	1400° C	1400° C	1371° C	1400° C
Density	8,0 g/cm ³	8,0 g/cm ³	9,01 g/cm ³	7,65g/cm ³
Modulus of Elasticity	193 x 10 ³ MPa	193x10 ³ MPa	193x10 ³ MPa	200x10 ³ MPa

Mechanical Properties annealed

Ultimate Tensile Strength	min. 500 MPa	min. 500 MPa	min. 500 MPa	min. 800 MPa
Yield Strength	min. 200 MPa	min. 200 MPa	min. 200 MPa	min. 200 MPa
Elongation	min. 40%	min. 40%	min. 40%	min. 20%

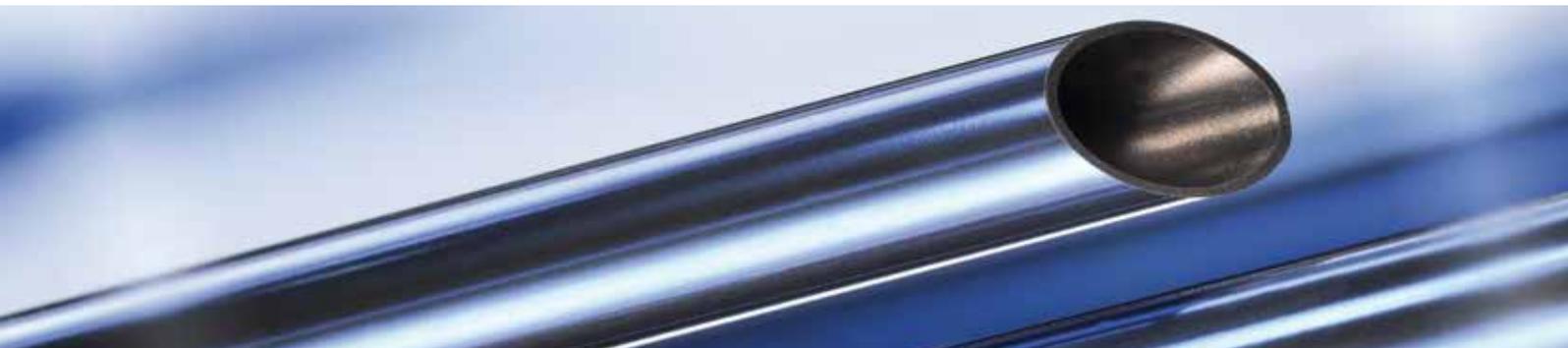
Microstructure in fully annealed condition

Austenitic Grain Size	min. 6	min. 6	min. 8	min. 8
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Comments

Properties strongly depend on processing history and ambient temperature. Mechanical values listed above are typical for uniaxial tension. Upon request, we can also deliver this material with other properties.

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NI-FREE STAINLESS STEEL MATERIAL FOR MEDICAL INDUSTRY

Higher strength, better corrosion resistance, and improved biocompatibility compared with other stainless steel alloys have been demonstrated by an essentially nickel-free stainless steel alloy designed for medical implants. Nitrogen is present at levels around 1,0 % compared with 0,1 to 0,5 % for the other stainless steel alloys and nickel levels are not higher than 0,3 %, compared with 9,0 to 15,0 %. The alloy also includes manganese. The content is higher than the levels in stainless steel alloys. The higher manganese content is required to maintain austenite stability in high nitrogen strengthened alloys such as Ni-free alloys. In tests meeting the standards, Ni-free stainless steel has exhibited significantly higher strength than any of the common nickel-containing stainless steel alloys for medical applications, in both the annealed and cold worked conditions. It has demonstrated corrosion resistance significantly greater than that of the widely applied 316L alloy.

EUROFLEX supplies two different grades.

ASTM 2229

1.4452

Chemical Composition

Carbon	max. 0,08 wt.-%	max. 0,15 wt.-%
Manganese	21,0 - 24,0 wt.-%	12,0 - 16,0 wt.-%
Phosphorus	max. 0,03 wt.-%	max. 0,05 wt.-%
Sulfur	max. 0,01 wt.-%	
Silicon	max. 0,75 wt.-%	max. 1,00 wt.-%
Chromium	19,0 - 23,0 wt.-%	max. 16,0 - 20,0 wt.-%
Nickel	max. 0,05 wt.-%	max. 0,30 wt.-%
Molybdenum	0,05 - 1,50 wt.-%	2,50 - 4,20 wt.-%
Nitrogen	0,85 - 1,10 wt.-%	0,75 - 1,00 wt.-%
Copper	max. 0,25 wt.-%	
Iron	balance	balance

Mechanical Properties (ISO 6892)

	cold-worked	annealed
Tensile Strength	min. 1100 MPa	min. 800 MPa
Yield Strength	min. 900 MPa	min. 550 MPa
Elongation	min. 5%	min. 30%

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TITANIUM-ALLOY GRADE 2 TUBING

Ti-Grade 2 Material Data acc. ASTM F 67 R50400

Chemical Composition

Nitrogen	max. 0,03 wt.-%
Carbon	max. 0,08 wt.-%
Hydrogen	max. 0,015 wt.-%
Iron	max. 0,03 wt.-%
Oxygen	max. 0,25 wt.-%
Titanium	balance

Physical Properties

Melting Point	1660° C
Density	4,51 g/cm ³
Modulus of Elasticity	103 x 10 ³ MPa
β-Transus-Temperatur	ca. 910° C

Mechanical Properties (annealed)

Ultimate Tensile Strength	min. 345 MPa
Yield Strength	min. 275 MPa
Total Elongation	min. 30%

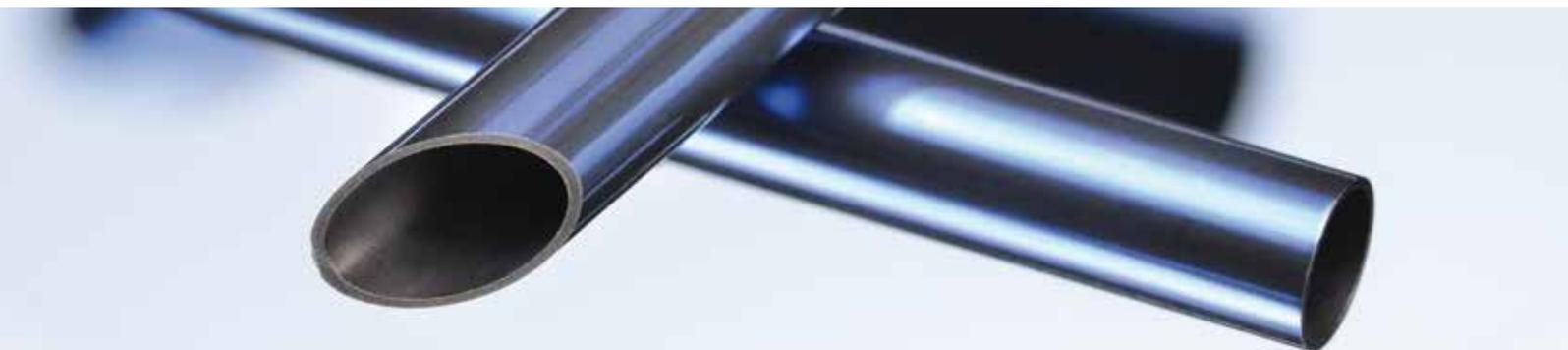
Microstructure in fully annealed condition

Grain Size	min. 4
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Comments

These values should only be used as guidelines for developing material specifications. Properties strongly depend on processing history. The values listed above are typical for uniaxial tension. Upon request, we can also deliver this material with other properties.

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TANTALUM-ALLOYS - TUBING FOR SURGICAL IMPLANTS

ASTM F 560 R05200

R05200
ASTM F 560

R05252

Chemical Composition

Carbon	max. 0,01 wt.-%	max. 0,01 wt.-%
Oxygen	max. 0,015 wt.-%	max. 0,015 wt.-%
Nitrogen	max. 0,01 wt.-%	max. 0,01 wt.-%
Hydrogen	max. 0,0015 wt.-%	max. 0,015 wt.-%
Niob	max. 0,1 wt.-%	max. 0,10 wt.-%
Tantalum	balance	balance
Tungsten		2,0 - 3,5 wt.-%

Physical Properties

Melting Point	2996° C	2996° C
Density at 20° C	16,6 g/cm ³	16,7 g/cm ³
Linear coefficient of thermal expansion at 20° C	6,4 x 10 ⁻⁶ m/(mK)	6,4 x 10 ⁻⁶ m/(mK)
Electrical conductivity at 20° C	8 x 10 ⁻⁶ [1/(Ωm)]	8 x 10 ⁻⁶ [1/(Ωm)]

Mechanical Properties (cold worked)

Ultimate Tensile Strength	min. 482 MPa	min. 900 MPa
Yield Strength	min. 345 MPa	min. 700 MPa
Elongation	min. 1,0 %	min. 1,0 %

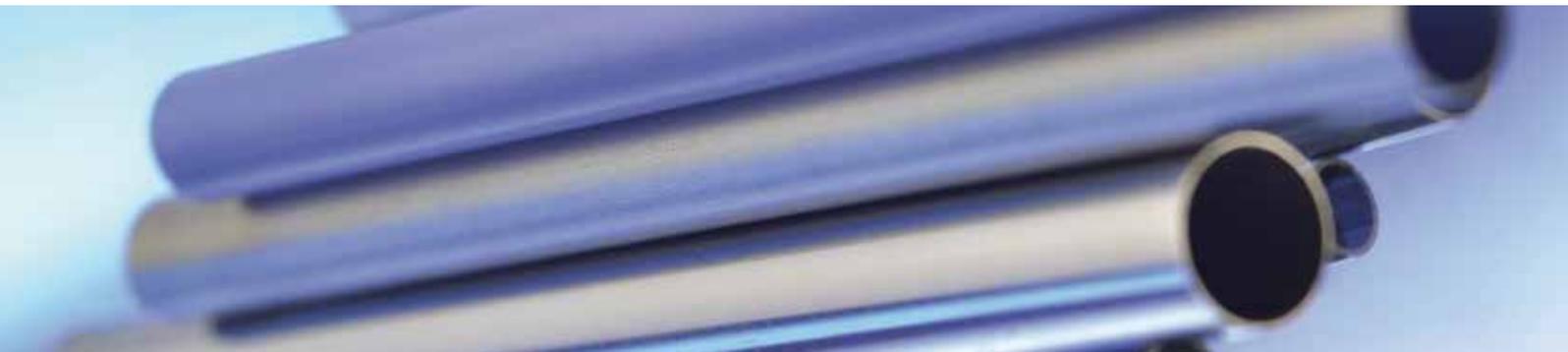
Microstructure in fully annealed condition

Grain Size	min. 4	min. 4
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Comments

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PLATINUM ALLOYS WIRE / TUBING

Material Data

Platinum alloys are available in the product form as tubes, round wire, shaped wires or coils.

	Pt ASTM B561	PtIr10	PtIr20	PtW8	PtW5
implantable	yes	yes	yes	yes	yes

Chemical Composition

Tungsten				7,0 - 9,0 wt.-%	4,5 - 5,5 wt.-%
Iridium	max. 0,015 wt.-%	9,5 - 10,5 wt.-%	19,0 - 21,0 wt.-%	max. 0,1 wt.-%	max. 0,1 wt.-%
Pd + Rh + Ru	max. 0,08 wt.-%	max. 0,1 wt.-%	max. 0,4 wt.-%	max. 0,4 wt.-%	max. 0,4 wt.-%
other elements	ASTM B561	max. 0,3 wt.-%	max. 0,1 wt.-%	max. 0,5 wt.-%	max. 0,5 wt.-%
Platinum	balance	balance	balance	balance	balance

Physical Properties

Melting Point	1773° C	1780° C	1830° C	1890° C	1830° C
Density	21,45 g/cm ³	21,60 g/cm ³	21,70 g/cm ³	21,30 g/cm ³	20,90 g/cm ³
Modulus of Elasticity	160 x 10 ³ MPa	220x10 ³ MPa	230x10 ³ MPa	230x10 ³ MPa	181x10 ³ MPa
Electrical Resistivity	0,106 μΩm	0,220 μΩm	0,310 μΩm	0,650 μΩm	0,434 μΩm

Mechanical Properties cold worked

Ultimate Tensile Strength	min. 480 MPa	min. 1062 MPa	min. 1439 MPa	min. 1507 MPa	min. 1233 MPa
Elongation	min. 1%	min. 2%	min. 2%	min. 2%	min. 2%

Microstructure in fully annealed condition

Austenitic Grain Size	min. 6	min. 7	min. 7	min. 7	min. 7
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NITINOL TUBES - PREMIUM PRECISION QUALITY

A new perspective for your needs

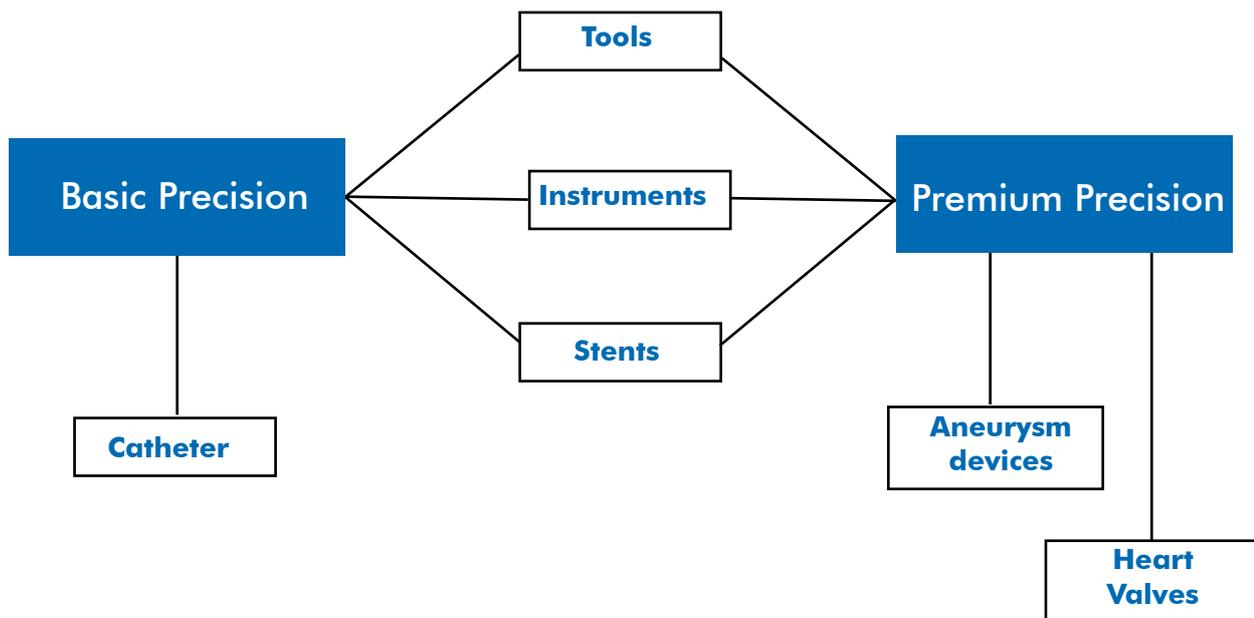
New technologies and new processes are requiring new solutions. In the medical industry new laser technologies and methods for treatments are optimizing product characteristics and open the door to new designs and new fields of applications.

EUROFLEX the leading supplier for Nitinol tubes offers the solution for the next generation of products made out of Nitinol tubes.

A new fabrication method makes it possible to process a semi-finished product with the thinnest oxide layer and smoothest ID surface quality available on the market – Premium Precision – extra smooth. It can be laser-cut and post processed with the known technologies. But on the same side those steps can be reduced in time and costs because of an adapted oxide layer structure.

Premium Precision quality is available for a wide range of OD/wall ratios. Special ratios can be offered according to available sources.

Explore the new possibilities and join the future – ask for sample quantities. Needless to say that tightest tolerances can be manufactured.



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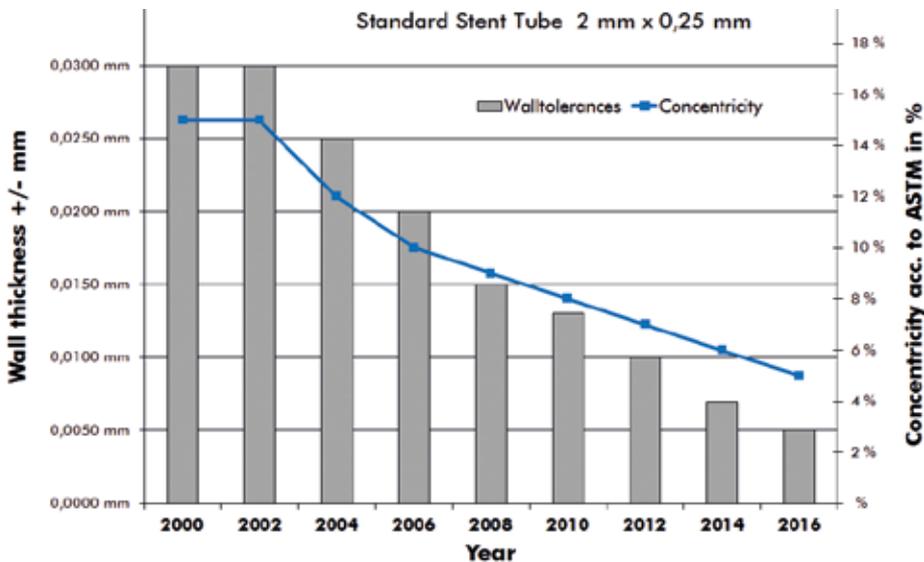
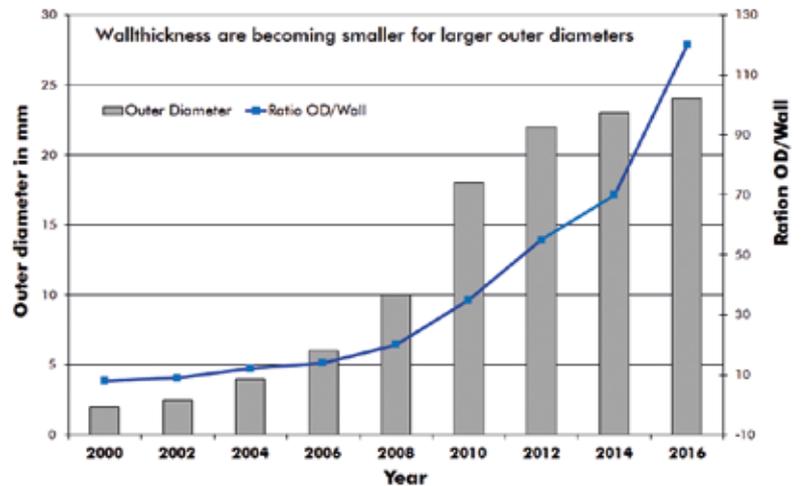
LARGE THIN WALLED NITINOL TUBES

The tolerance requirements for Nitinol tubes are continually increasing. As most Nitinol seamless precision tubes are manufactured by the drawing process, there are natural limits to the attainable dimensional accuracy. This becomes especially apparent when tubes with larger outer diameter relative to the wall thickness are manufactured. For about five years there has been an increased demand for large thin-walled Nitinol tubes with narrow tolerances.

EUROFLEX, the leading supplier of seamless Nitinol tubes worldwide, has therefore developed a new process which enables the production of large, thin-walled tubes with very narrow tolerances on wall and outer diameter.

Large thin wall tubing

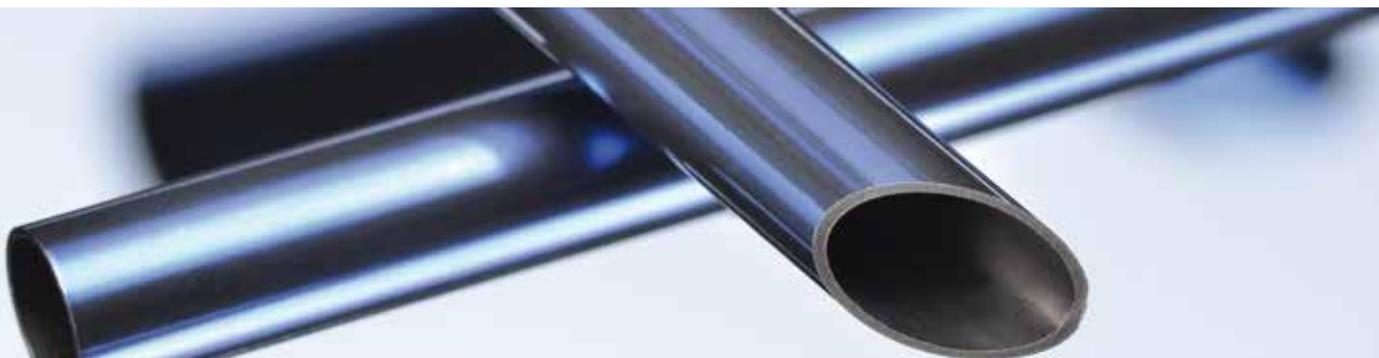
In the last 10 years requirements for OD/Wall ratio went up nearly threetimes and will go up even more for new devices like heart valve frames.



Premium Precision

In the last 12 years requirements for tolerances were continously increased. Our premium precision process has been optimized over the years to fulfil these requirements.

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NITINOL TUBES - INNER DIAMETER SURFACE HONE DRILLED PRECISION (HDP)

As the first supplier of Nitinol tubing with a centerless ground OD surface, we are delighted to now also offer Nitinol tubing with a high quality hone drilled ID surface.

We have created a completely new machining process, which produces Nitinol tubing with an extremely smooth ID surface, high precision ID quality and which has an improved wall thickness tolerance at the same time.

The ID surface can lower your expenses for ID surface finishes or can even be used as the final ID surface finish in certain cases.

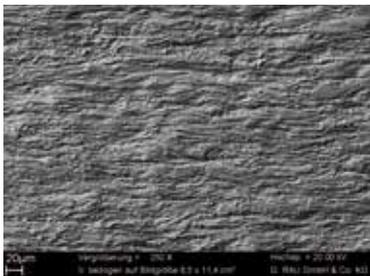
Our new process has many advantages for your product:

- ID surface quality like honed
- less wall thickness variation
- lowered expenses for surface finish
- smoother ID surface after electropolishing
- higher production yields due to optimized prematerial

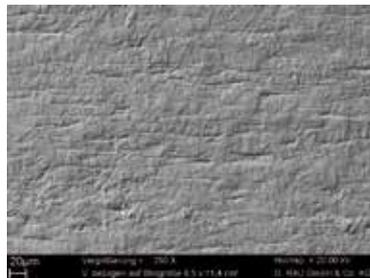
Application areas

Heart Valves, Stents

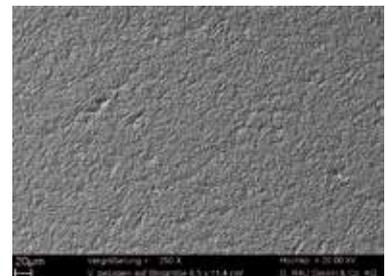
Basic Precision ID surface



Premium Precision ID surface



HDP-(Hone Drilled Precision) ID surface



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NITINOL TUBES - INNER DIAMETER SURFACE SLURRY CLEANING

To reduce mechanical and chemical finishing of your products, we offer not only ground inner surfaces – we now offer an ID Slurry Cleaning process for our tubes.

This process is available for tubes with an ID of 0,30 mm (0,012") up to 9,00 mm (0,350") It is one more option we provide you an removed oxide layer and optimized ID surfaces.

With this additional process it's possible to reduce your production steps and fabrication costs.

Please contact our project team if you have any questions.

We are ready to demonstrate this capability for with a small sample order for you to evaluate.



**Nitinol-Tubes
Inner diameter
surface
oxidized**

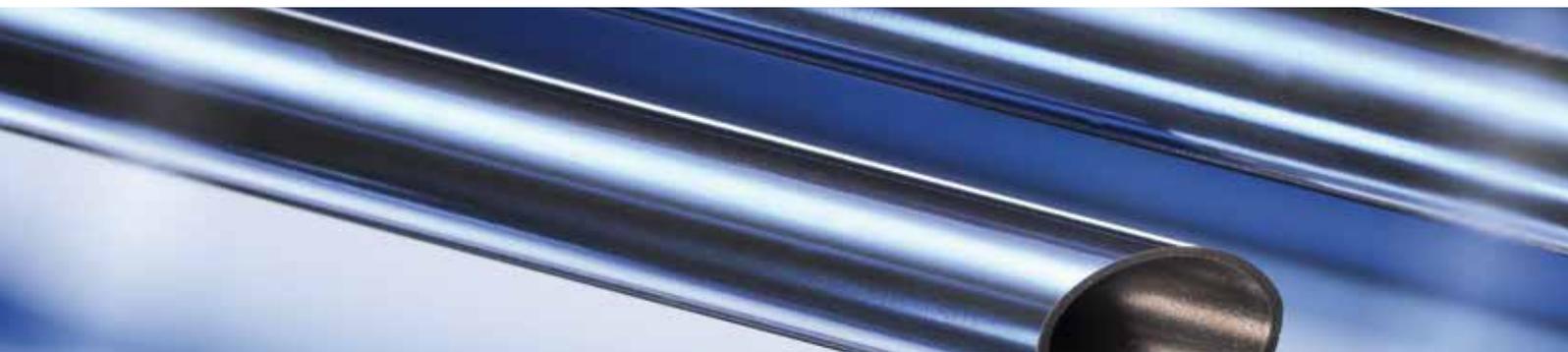


**Nitinol-Tubes
Inner diameter
surface
Slurry Cleaning**

Application areas

Catheters

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NITINOL TUBES SUPERELASTIC

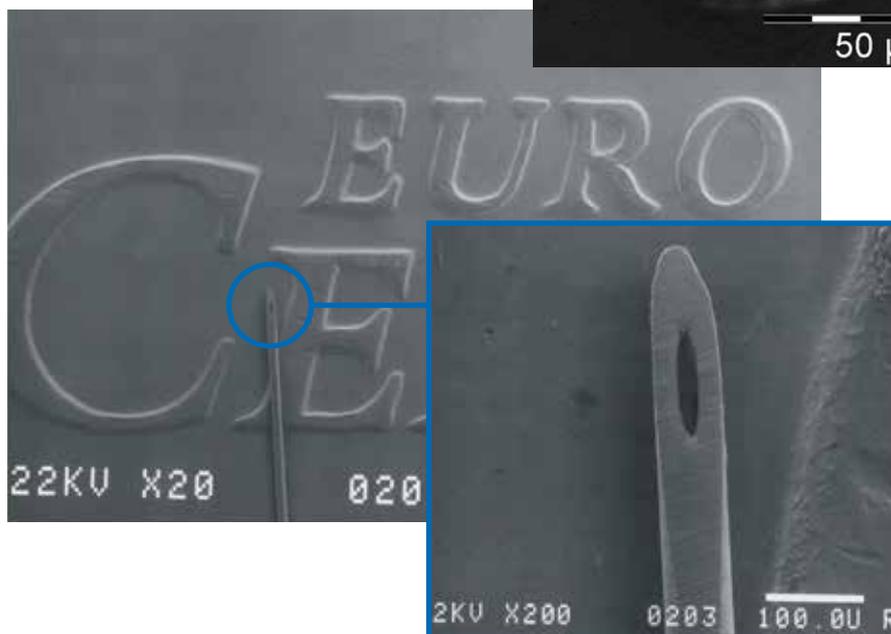
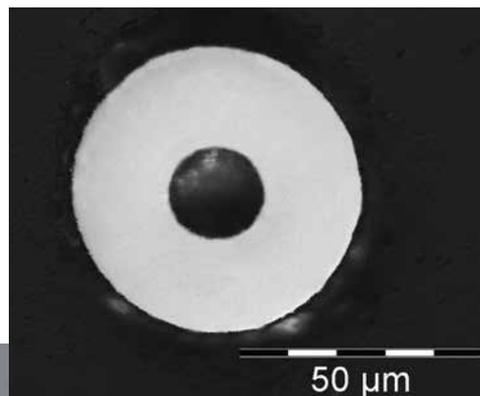
The smallest superelastic Nitinol tube ever drawn

Technical details

Dimensions	OD: 60 μm , ID: 20 μm
Mechanical properties	superelastic
A_f	< 15° C

Applications areas

Ophthalmology
Keyhole surgery
Neurosurgery
Aiming biopsy



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NITINOL AND MEDICAL COMPOUNDS

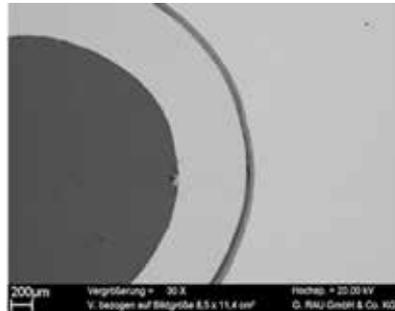
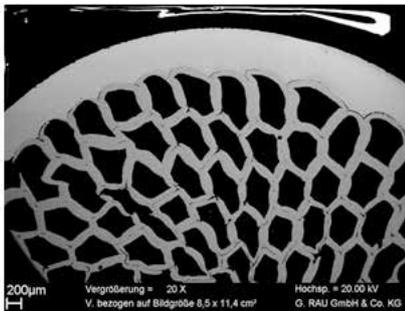
Application areas:

- woven and knitted stents with an optimized radiopacity and MRI compatibility
- heart pacemaker leads
- coiled wires for aneurysm devices

EUROFLEX offers a solution for a better radiopacity and MRI compatibility. A more than 100 years old approved technology in making metal compounds for different industries is now available for new medical devices of the next generation. We can fabricate a wide range of materials and their combinations in customized ratios and dimensions.

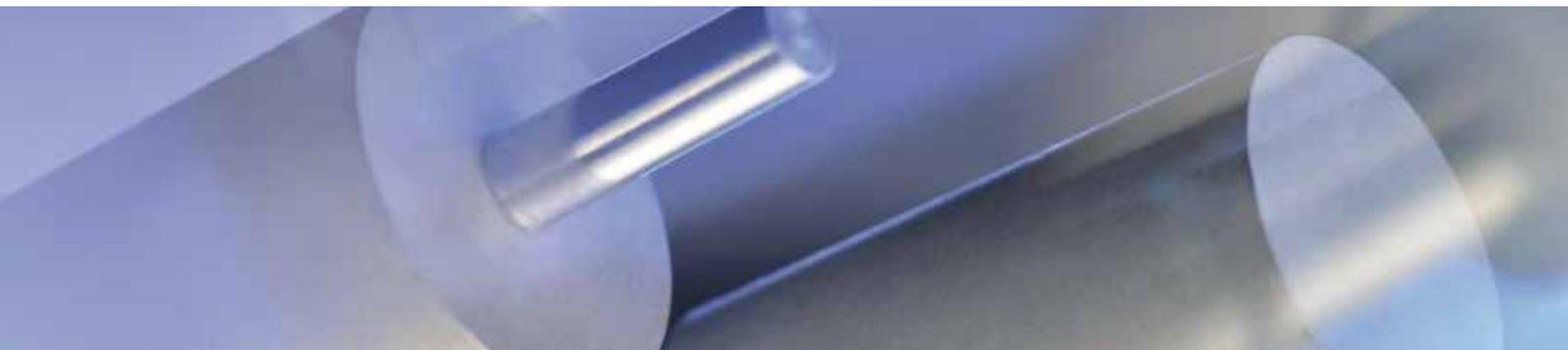
Typical compound materials can be combinations of stainless steel and precious metals, Nitinol and precious metals, CoCr and precious metals and many others.

Ask for your favourite combination.



NEW → Nitinol HCF compounds for medical applications with special requirements in view of fatigue life and surface quality. See more information on page 25 (HCF)

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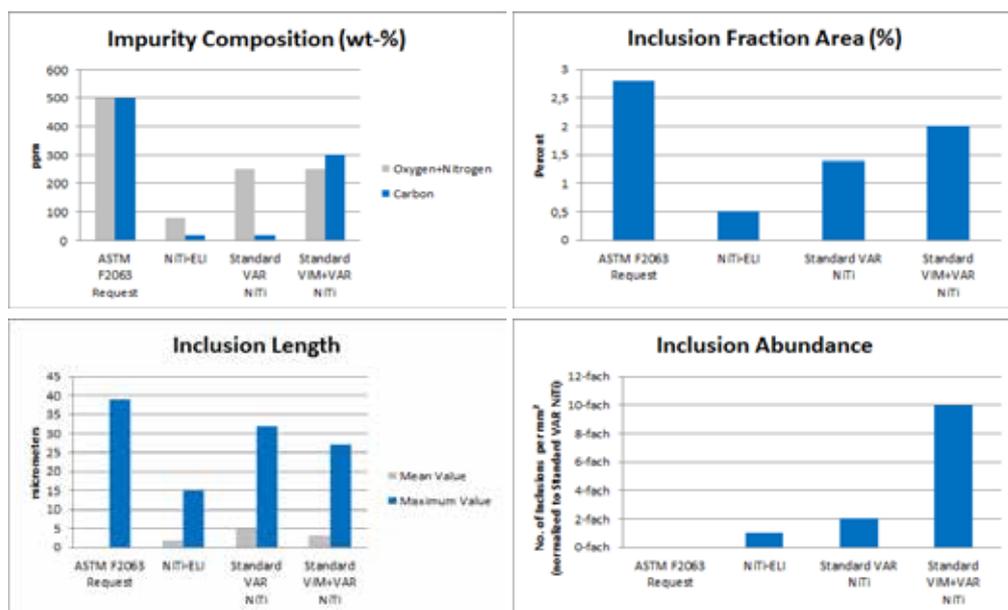


CLEANEST NITINOL WORLDWIDE: NITI-ELI

Introducing the world's purest Nitinol for the most critical medical applications

Based on the worldwide proven standards of excellence for strength, superelasticity, formability, corrosion resistance and biocompatibility as our standard Nitinol material for implants, NiTi-ELI is a consequent evolution. It allows to design next generation components, which will become smaller and more sophisticated in size and fields of application. Fewest inclusions of any Nitinol material means lowest likelihood of an inclusion residing in a critical region of the finished component.

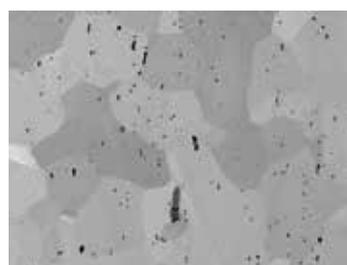
Lowest oxygen levels of any commercially available Nitinol results in fewest and smallest $Ti_4Ni_2O_x$ inclusions. Carbon-free material eliminates hard titanium-carbide (TiC) inclusions altogether.



NiTi-ELI

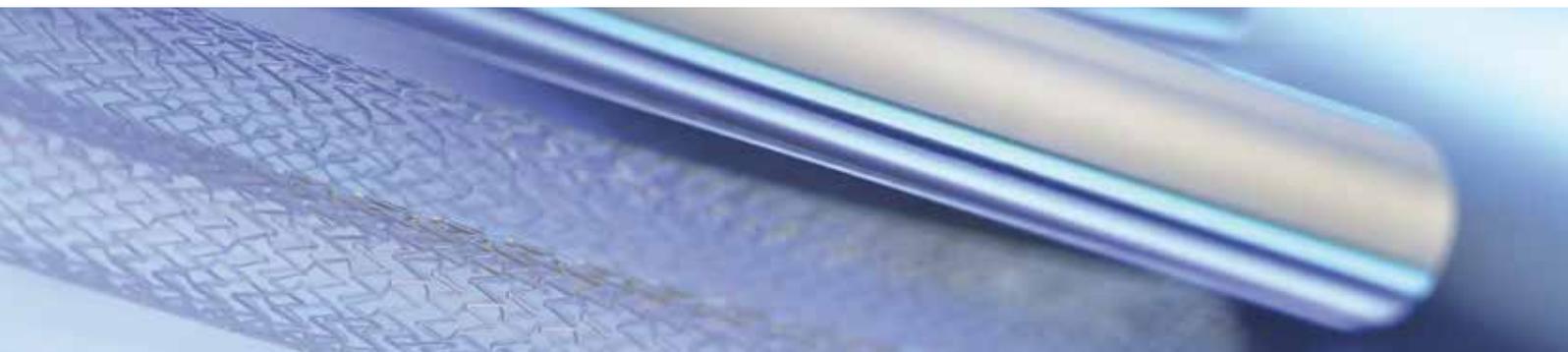


Standard VAR NiTi



Standard VIM+VAR NiTi

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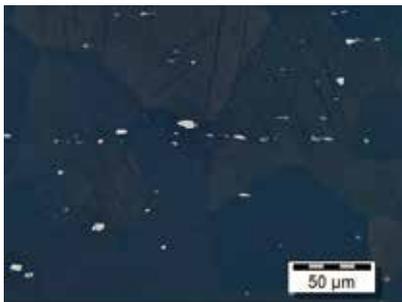


ADVANCED NITINOL ULTRA-FINE HCF-SE

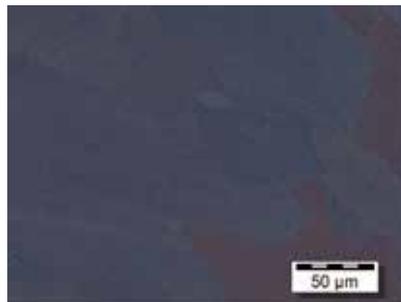
Based on the worldwide proven standards of excellence for strength, superelasticity, formability, corrosion resistance and biocompatibility as our standard Nitinol material for implants, Nitinol HCF-SE is a consequent evolution. It allows to design next generation improved generation components, which will become smaller and more sophisticated in size and fields of application.

The ultrafine dispersed secondary phases in the range of 4 μm and smaller have a significant impact on fatigue behavior.

A more than 10 times higher fatigue life has been reported. This makes the material the first choice for high-cycle fatigue devices like heart-valve frames and spine implants.



Standard VAR



HCF-SE

Material type	Area percentage of inclusion	Average inclusion size	St. Dev. inclusion size	Max. Inclusion size
VAR standard	0,73 %	2,80 μm	2,49 μm	16,5 μm
VAR extra low inclusions	0,14 %	1,11 μm	0,98 μm	8,1 μm
VIM/VAR extra low inclusions	0,49 %	1,32 μm	1,11 μm	10,9 μm
VAR/HCF-SE ultra fine inclusions	0,11 %	0,49 μm	0,21 μm	2,4 μm

- reported measurement -

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NITINOL FLAT-ROLLED STRIPS

EUROFLEX is now producing continuously rolled Nitinol strip material for the manufacturing of Nitinol components by stamping, laser cutting, and EDM.

Advantages of continuous rolled strip:

- Cost savings when processing strip on coils vs. short length pieces
- Consistent mechanical properties (Af, UTS...) and dimensions

Strip material is available in ASTM F2063 certified superelastic alloys, as well as in low inclusion material versions like Nitinol ELI. Strip material can be delivered on coils, in random lengths, or in customer-specific fixed lengths.

Size range

thickness 0,15 - 1,20 mm (0,006 - 0.0472") / width up to max. 25 mm (0.984")

(Note: Not all thickness/width combinations in these ranges are possible. Some larger sizes are possible.

Please contact us for confirmation if your size is feasible.)

Properties

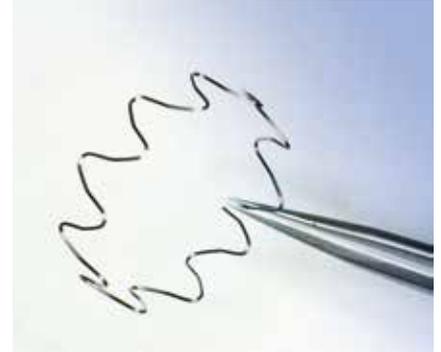
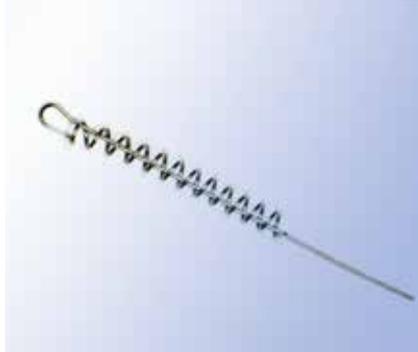
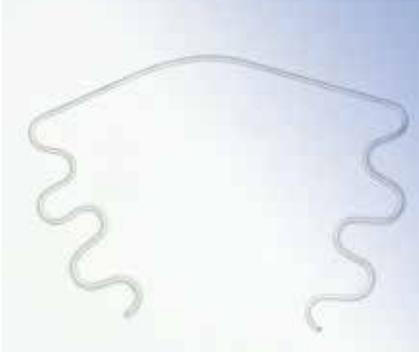
- ASTM F2063 certified Nitinol
- Superelastic
- Af < 10°C
- Oxide surface
- On coil or in lengths
- Natural or straight edges

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CUSTOMER SPECIFIED COMPONENTS

The EUROFLEX product portfolio includes customer-specific medical parts for areas such as spine, orthopedics, dental, urology, aneurysm devices, cardiology, and components for medical instruments.



We produce formed parts made of tubes, wires and sheets. We can offer spirals, such as tension and compression springs made of NITINOL, stamped parts, deep-drawn parts, and hot and cold-formed parts.

We have experience with many different medical materials; with a special focus on Nitinol. This material plays an important role in medical devices with its outstanding properties. Use our decades-long NITINOL experience in tube, wire and strip processing.

Our experience with formed parts is broad and diverse. Take advantage of our experience and technical understanding of metal forming technologies and manufacturing techniques for an economical solution for your serial production needs.

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You need more informations?

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Germany**

**Phone +49(0)7231.208.210
Fax +49(0)7231.208.7599
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TECHNICAL SPECIFICATIONS

Nitinol superelastic tubing ASTM F 2633	Nitinol superelastic wire ASTM F 2633	Nitinol shape memory tubing	Nitinol shape memory wire	Co-based alloy L-605 ASTM F 90	Co-based alloy MP35N ASTM F 562	Stainless steel 316 L 1.4441 ASTM F138	Stainless steel 316 Ti 1.4571	Stainless steel 316 L 1.4404	Stainless steel 304 1.4301	Stainless steel 304 L 1.4306	Stainless steel 321 1.4541	Stainless steel 17-7 PH 1.4568	Ni-free stainless steel ASTM 2229	Ni-free stainless steel ASTM 1.4452	Tantalum R05200 ASTM F 560	Tantalum R05252	Titanium-based alloy Grade 2 ASTM F 67	Platinum alloy Pt ASTM B561	Platinum alloy PtIr20	Platinum alloy PtW8	Platinum alloy PtW5
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Chemical Composition

Nickel (nominal)	wt.-%	54,5 - 57,0	54,5 - 57,0	54,5	54,5	Rest	Rest	Rest	Rest	Rest	Rest	Rest									
Titanium	wt.-%	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest
Oxygen	%	max. 0,05	max. 0,05	max. 0,05	max. 0,05	max. 0,05	max. 0,05	max. 0,05	max. 0,05	max. 0,05	max. 0,05	max. 0,05	max. 0,05	max. 0,05	max. 0,015	max. 0,015	max. 0,025				
Carbon	wt.-%	max. 0,05	max. 0,02	max. 0,02	max. 0,02	max. 0,02	max. 0,02	max. 0,02	max. 0,02	max. 0,02	max. 0,02	max. 0,02	max. 0,02	max. 0,02	max. 0,01	max. 0,01	max. 0,008				
Silicon	wt.-%																				
Manganese	wt.-%																				
Phosphorus	wt.-%																				
Sulfur	wt.-%																				
Chromium	wt.-%																				
Nickel	wt.-%																				
Iron	wt.-%																				
Tungsten	wt.-%																				
Cobalt	wt.-%																				
Molybdenum																					
Titanium																					
Boron																					
Nitrogen	wt.-%	max. 0,05																			
Hydrogen	wt.-%																				
Tantalum	wt.-%																				
Copper	wt.-%																				
Niobium																					
Aluminium	wt.-%																				
Iridium	wt.-%																				
Pd + Rh + Ru	wt.-%																				
other elements	wt.-%																				
Platinum																					

wt.-%

TECHNICAL SPECIFICATIONS

Nitinol superelastic tubing ASTM F 2633	Nitinol super-elastic tubing	Nitinol shape memory tubing	Nitinol shape memory wire	Co-based-alloy ASTM F 90 562	Co-based-alloy MP35N L-605 ASTM F 562	Stainless steel 316 L 1.4441 ASTM F138	Stainless steel 316 Ti 1.4571	Stainless steel 304 1.4301	Stainless steel 304 L 1.4306	Stainless steel 321 1.4541	Stainless steel 17-7 PH 1.4568	Ni-free stainless steel ASTM 2229 ASTM 1.4452	Ni-free stainless steel ASTM 2229 ASTM 1.4452	Tantalum R05200 ASTM F 560	Tantalum R05252	Titan-based-alloy Grade 2 ASTM F 67	Platinum-alloy Pt ASTM B561	Platinum-alloy PtIr10	Platinum-alloy PtIr20	Platinum-alloy PtW8	Platinum-alloy PtW5
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Physical Properties

Density	6,5 g/cm ³	6,5 g/cm ³	6,5 g/cm ³	9,23 g/cm ³	8,43 g/cm ³	8,0 g/cm ³	8,0 g/cm ³	8,0 g/cm ³	8,0 g/cm ³	9,01 g/cm ³	7,65 g/cm ³	7,77 g/cm ³	16,6 g/cm ³	16,7 g/cm ³	4,51 g/cm ³	21,6 g/cm ³	21,6 g/cm ³	21,7 g/cm ³	21,7 g/cm ³	20,9 g/cm ³	20,9 g/cm ³
Modulus of Elasticity MPa	41 · 10 ³	28 · 41 x 10 ³	28 · 41 x 10 ³	243 x 10 ³	233 x 10 ³	200 x 10 ³	193 x 10 ³	200 x 10 ³	200 x 10 ³	185 x 10 ³	186 x 10 ³	103 x 10 ³	220 x 10 ³	230 x 10 ³	181 x 10 ³						

Mechanical Properties (Nitinol)

Ultimate Tensile Strength	min. 1000 MPa	min. 1100 MPa	min. 1100 MPa																		
Total Elongation	min. 10%	min. 10%	min. 10%																		

Superelastic Properties according ASTM F 2633

Loading Plateau Stress	min. 380 MPa	min. 380 MPa																			
Permanent Set	max. 0,3%	max. 0,2%																			
Transformation Temp. A ₁	max. 15°C	max. 18°C																			

Shape Memory Properties

Loading Plateau Stress		min. 100 MPa	min. 100 MPa																		
Permanent Set		max. 8%	max. 8%																		
Transformation Temp. A ₁		min. 60°C	min. 60°C																		

Mechanical Properties cold-worked

Ultimate Tensile Strength				min. 1100 MPa	min. 1000 MPa	min. 860 MPa							min. 1100 MPa	min. 482 MPa	min. 900 MPa	min. 345 MPa	min. 480 MPa	min. 1062 MPa	min. 1439 MPa	min. 1507 MPa	min. 1233 MPa
Yield Strength				min. 900 MPa	min. 650 MPa	min. 690 MPa							min. 900 MPa	min. 345 MPa	min. 700 MPa	min. 275 MPa					
Total Elongation				min. 7%	min. 7%	min. 7%						min. 5%	min. 5%	min. 1,0%	min. 1,0%	min. 30%	min. 1%	min. 2%	min. 2%	min. 2%	min. 2%

Mechanical Properties annealed

Ultimate Tensile Strength				min. 900 MPa	min. 800 MPa	min. 490 MPa	min. 500 MPa	min. 500 MPa	min. 500 MPa	min. 500 MPa	min. 800 MPa	min. 800 MPa	min. 800 MPa								
Yield Strength				min. 500 MPa	min. 500 MPa	min. 190 MPa	min. 200 MPa	min. 550 MPa	min. 550 MPa												
Total Elongation				min. 30%	min. 30%	min. 35%	min. 40%	min. 40%	min. 40%	min. 40%	min. 20%	min. 30%	min. 30%								

Microstructure in fully annealed condition

Austenitic Grain Size				min. 7	min. 7	min. 6	min. 8	min. 6	min. 6	min. 8	min. 8	min. 7	min. 7	min. 4	min. 4	min. 4	min. 6	min. 7	min. 7	min. 7	min. 7
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Basic delivery program	page	6 - 7
Nitinol		
Tubes, superelastic	page	8
Wires, superelastic	page	9
Wires, shape-memory	page	9
Tubes - quality premium precision	page	18
Large thin-walled tubes	page	19
Hone Drilled Precision (HDP)-Inner diameter surface	page	20
Slurry Cleaning	page	21
Smallest tube in the world	page	22
Nitinol-compounds	page	23
Nitinol-ELI - The cleanest Nitinol worldwide	page	24
HCF-SE - High cycle fatigue	page	25
Nitinol strips (flat-rolled)	page	26
Cobalt-based alloys		
L-605	page	10
MP35N	page	11
Stainless steels		
316 L Medical Grade, 316 Ti, 316 L	page	12
304, 304 L, 321, 17-7 PH	page	13
Ni-free alloys	page	14
Titanium alloys	page	15
Tantalum alloys	page	16
Platinum alloys	page	17
Components	page	27
Technical specifications	page	29 - 30

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