

9.9007, ASTM F2581, UNS S29225

Implant Material - Data Sheet



Zapp is certified according to ISO 9001



Low Nickel High-Nitrogen Austenitic Stainless Steel 9.9007 for Surgical Implants

Standards

ASTM F 2581
UNS-S29225

Implant Steel – Material 9.9007

Ergste® 9.9007 CN is the latest development in a series of high-nitrogen stainless steels. Since decades the goal is to eliminate Nickel as an alloying element in biocompatible stainless steels.

Melting of Ergste® 9.9007 CN needs extreme care and the use of selected high-purity raw-materials. The result is a nickel-content below 0.05 mass-percent and a very low micro-slag inclusion level. Pressurized electro-slag remelting process (P-ESR) is used for re-melting.

Chemical compositions of nickel-free high-nitrogen stainless steels seen so far were based on very high nitrogen and manganese levels approaching 1% and 20% respectively. Since solubility of nitrogen is limited, higher nitrogen-contents tend to form chromium-nitride precipitations.

Manganese must be used keeping nitrogen in solid solution but will also impair corrosion resistance. Machinability is more difficult at increased nitrogen-content.

The solution of all of these detrimental effects was found replacing nitrogen by carbon. “Old school” metallurgy was adverse using higher carbon contents in conventional austenitic stainless steel. But when it is used in combination with nitrogen carbon it is able to solve the problems based on the use of excessive nitrogen.

The well-balanced compositional design was the result of careful analysis using Thermo-Calc computation.

Applications

- High-strength materials
- Orthodontic wires,
- Amagnetic and nickel-free
- Surgical implants

[Information about further medical applications at Zapp.](#)

Mechanical Characteristics

Condition*	Rm [MPa]	Rp0,2 [MPa]	A5 [%]	Z [%]
Annealed	827	482	40	50
Cold worked	1103	827	12	-

* Conditions according to ASTM F 2581

Other tensile ranges are available on request.
Small diameter wire can be supplied with a tensile ranging up to 2500 MPa.

Young's-Modulus: 194 GPa

Physical Properties

Density [g/cm³]	7.79
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Amagnetic Behavior

Relative magnetic permeability μ_r is used as a measure for the magnetic properties.

Annealed: μ_r : 1.001 – 1.002

Cold-worked: μ_r : 1.004 – 1.005

Even in highly cold-worked conditions it is possible to keep Ergste® 9.9007 CN in a fully austenitic condition.

Micro Cleanliness (ASTM E 45, method A using plate I-r)

	A	B	C	D
th	1.5	1.5	1.5	1.5
h	1.0	1.0	1.0	1.0

Advantages

- „Nickel-free“ (nickel max. 0.05 mass-%)
- High static and fatigue strength
- Excellent corrosion-resistance
- Fully amagnetic behavior

Chemical Composition (Mass-%)

	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	N	Fe
Min	0.15	0.20	9.5	-	-	16.5	-	2.7	-	0.45	Bal.
Max	0.25	0.60	12.5	0.020	0.010	16.5	0.05	2.7	0.25	0.55	Bal.

Heat Treatment

Solution-annealing temperature: min. 1,050 °C. Rapid quenching must be used in order not to prevent precipitations.

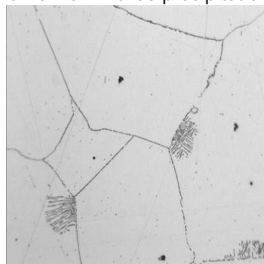
Heating the material in finished condition may cause embrittlement.

Microstructure after conventional annealing temperature 1,050 °C

Conventional high nitrogen

Cr-Mn-N-steel:

Chromium-nitride precipitations



Ergste® 9.9007 CN:

Free of precipitations



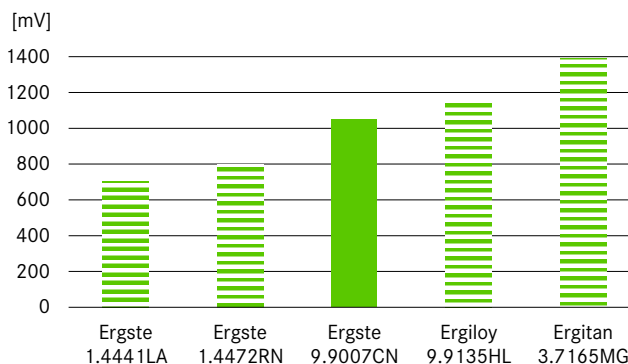
Machining

Due to strain-hardening effects in the chip-breaking zone machinability is more difficult compared to conventional stainless steels. Parameters must be evaluated together with the suppliers of tools and lubricants in order to find optimized conditions for the production process.

Corrosion

Ergste® 9.9007 CN has outstanding corrosion properties exceeding those of other austenitic stainless steels.

Comparison of the Pitting-Potential in Artificial Sweat at 40 °C (sce) for Different Materials



Corrosion resistance of Ergste® 9.9007 CN in comparison with other implantable materials.

[Please see our linecard of implant steel and further medical grades.](#)

[Information about implant steel and further medical grades at Zapp.](#)

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