

# P2000 – Where Strength and Toughness meet Corrosion Resistance

Mat.-No.: 1.4452 - X13CrMnMoN18-14-3



P2000 combines unique properties to enable the performance of high end products with simultaneous operational demands for extraordinary toughness, strength, stiffness, and outstanding corrosion resistance. Applications faced within the aerospace, automotive, mechanical engineering, oil & gas, medical, pharmaceutical and food industries, as well within high-value consumables on a daily basis.

Regarding the remelting process, nitrogen is added in order to stabilize the austenitic matrix. It becomes alloyed above its solubility level at ambient pressure by means of the Pressure Electroslag Remelting (PESR) process. This results in a homogenous microstructure consisting of a very pure metallic matrix leading to outstanding polishability, exceptional wear resistance, and high dimensional stability after heat treatment with a maximum service temperature of 500°C.

P2000 is a high-nitrogen non-magnetic stable austenitic stainless steel with exceptional corrosion resistance and ductility at ultimate strength levels of up to 2000 MPa.

The positive effect of the high nitrogen content is not limited to excellent corrosion resistance. Its progressive impact on the steel's mechanical properties results in a high ultimate strength and high fracture toughness to elastic modulus ratio, which is not matched by any other corrosion resistant steel available in the market.

## OUTSTANDING ADVANTAGES

- Extraordinary resistance against corrosion
- High yield and ultimate strength
- High ductility
- Astonishing strain hardening potential
- Low magnetic permeability
- Bio-compatibility

## MAIN FIELDS OF APPLICATION

- Aerospace and aeronautics, medical, automotive, racing and mechanical engineering, oil & gas, pharmaceutical and food industries
- Power plant engineering, offshore and maritime applications, motor engineering, fixing and fastening equipment (e.g. bolts, screws), vanes, spindles, extrusion and portioning units for the chemical and pharmaceutical industry, instruments for the medical industry, high end jewellery and watch parts

## PROPERTIES

■ Welding ability	2
■ Machinability	7
■ Wear resistance	8
■ Corrosion resistance	9
■ Toughness	9
■ Strength	9
■ Polishability	10

(1 = low - 10 = very good)

## CHEMICAL ANALYSIS

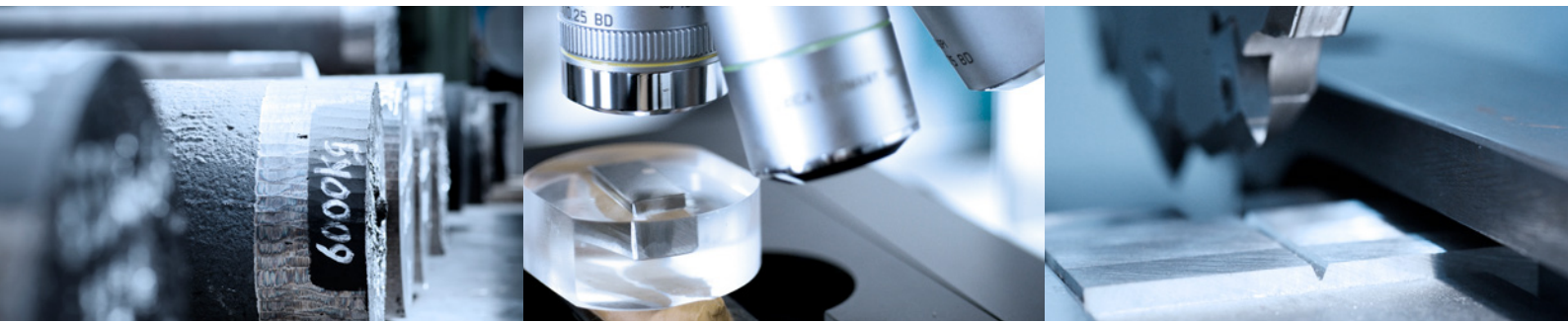
1.4452 X13CrMnMoN18-14-3	C	Si	Mn	Cr	Mo	Ni	N
Min.	-	-	12.00	16.00	2.50	-	0.75
Max.	0.15	1.00	16.00	20.00	4.20	0.30	1.00

Also available with Ni < 0,05 mass-%

## PRODUCT RANGE

1.4452 X13CrMnMoN18-14-3	Bars Ø	Bars Ø	Hot-rolled wire Ø
Min.	5 mm	40 mm	5 mm
Max.	20 mm	85 mm	20 mm
MOQ	600 kg	1000 - 1400 kg	600 kg

Other dimensions up on request – Plate possible as well



## HEAT TREATMENT

### Hot forming

Hot forming should be carried out between 1000°C to 1200°C. After hot forming to final dimension solution annealing is necessary.

### Solution annealing

P2000 needs to be heated up steadily to a temperature between 1120 to 1150°C. The holding time at solution annealing temperature after full heating through is 30 min. Subsequent cooling needs to be carried out with water to room temperature. The ultimate strength after this quenching is > 900 MPa.

### Stress-relieve annealing

If needed, a stress-relieve annealing can be done up to 400°C.

### Work hardening

The required final strength of austenitic steels is determined by work hardening. Depending on the stretch forming rate, ultimate strengths (R<sub>m</sub>) up to 2000 MPa can be achieved. Due to the enormous strain hardening potential the forming parameters have to be previously verified via technical feasibility.

### Tempering resistance

Due to the fact that the final strength of the austenitic steels is achieved by work hardening, the permanent influence of high temperatures has a negative impact on this strength. At temperatures < 100°C no strength losses are expected.

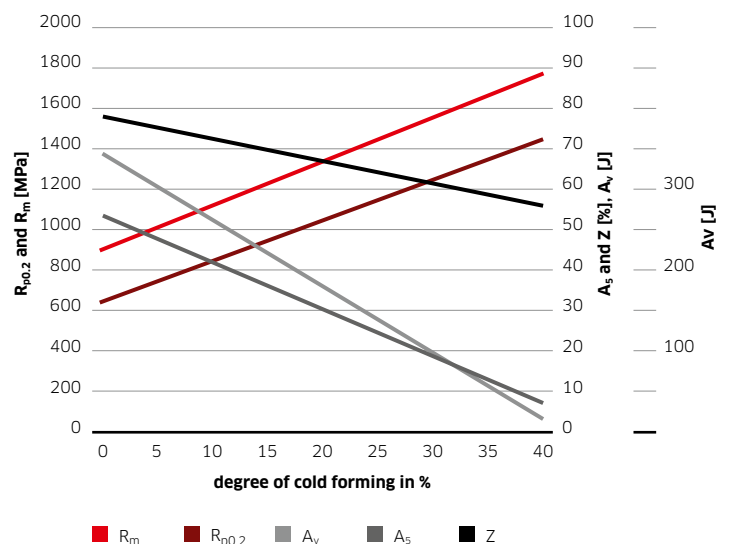
### Low temperature applicability

Based on the extraordinary alloy composition with the high nitrogen content these materials show superior toughness properties even at low temperatures. The transition temperature (DBTT) for this material group is approx. -100°C.

## Mechanical properties of P2000 (solution-annealed)

Yield strength	>600 MPa
Tensile strength	>900 MPa
Fracture elongation	>50 %
Notch impact toughness	>350 J

## Impact of Strain Hardening on Mechanical Properties



## Comparison of P2000 to other Grades

### Corrosion Resistance of Solution Annealed States

#### Critical Pitting Temperature acc. to ASTM G48 vs. PRE - Number

