

**C:** max. 0,03  
**Cr:** 17,0 - 18,0  
**Ni:** 12,5 - 13,5  
**Mo:** 2,5 - 3,0

**1.4435**  
X2CrNiMo 18-14-3

**Stainless austenitic, chromium nickel molybdenum steel with low carbon content**

Relevant current and obsolete standards:

- EN 10088-3 : 1.4435 X2CrNiMo 18-14-3
- AISI : 316 L
- BS : 316 S11  
316 S13  
316 S31
- JIS : 316
- AFNOR : Z3CND 17-12-03  
Z3CND 18-14-03
- DIN 17440 : 1.4435
- SIS : 2353
- Baseler Norm 2

**Special grades for particular applications**

- improved machining grade: **NIRO-CUT® 4435**

**General properties**

- corrosion resistance : very good
- mechanical properties : average
- forgeability : average
- weldability : excellent
- machinability : average

**Special properties**

- non-magnetic grade ( $\mu_r \leq 1,1$ )
- suited to cryogenic applications
- Suitable for use up to 500°C

**Physical Properties**

- density (kg/dm<sup>3</sup>) : 7,98
- electrical resistivity at 20°C ( $\Omega \text{ mm}^2/\text{m}$ ) : 0,75
- magnetisability : slight
- thermal conductivity at 20°C (W/m K) : 15
- specific heat capacity at 20°C (J/kg K) : 500
- thermal expansion ( $10^{-6}\text{K}^{-1}$ )
- between 20 and 100°C : 16,0
- 20 and 200°C : 16,5
- 20 and 300°C : 17,0
- 20 and 400°C : 17,5
- 20 and 500°C : 18,0

**Typical applications**

- chemical industry
- electronic equipment
- crude oil and petrochemical industries
- Medical and pharmaceutical industry

Hint - additional information on the machinability of this grade of stainless steel can be found in the brochure entitled **NIRO-CUT®**.

**Processing properties**

- automated machining : average
- hammer and die forging : yes
- cold forming : yes
- cold heading : seldom
- machinable : average
- suited to polishing : yes

**Product forms and conditions**

- wire rod
- peeled bars  $\varnothing$  20 - 80
- bright rod/bars h9,  $\varnothing$  2 - 80
- bright wire coils h9,  $\varnothing$  0,8 - 20
- pickled
- drawn
- straightened
- peeled
- ground

**Demand tendency** ↗

## Properties, applications and processing

**1.4435** is a more highly alloyed variant of **1.4404** and is commonly regarded as a medical grade of stainless steel due to its excellent resistance to all forms of corrosion and also due to the excellent surface finish that can be obtained.

### Corrosion resistance (PRE = 25.25 to 30.66)

**1.4435** displays excellent resistance to corrosion in most natural waters (urban, rural and industrial), even at moderate chloride and salt contents. In the food, beverage and agricultural sectors, **1.4435** displays excellent corrosion properties. This grade of stainless steel is also resistant to corrosion in various acid environments.

Due to its low carbon content, **1.4435** is still resistant to intergranular corrosion after welding, i.e. in the sensitised condition. Corrosion testing in accordance with the following corrosion testing specifications, is thus sufficient to establish resistance to corrosion:

AFNOR NF 05-159  
ASTM A262-75. Practice E  
DIN EN ISO 3651-2

The higher molybdenum addition compared to **1.4404**, makes **1.4435** more resistant to corrosion in reducing acids and chloride containing media.

### Heat treatment / mechanical properties

Optimal mechanical and fabrication properties are realised after solution annealing in the temperature range 1000 - 1100°C followed by rapid cooling in air or water.

In the solution annealed condition, the following mechanical properties may be attained when testing in the longitudinal direction:

Property	Specification	Typical
- yield strength (N/mm <sup>2</sup> )	R <sub>p0.2</sub> : ≥ 200	320
- tensile strength (N/mm <sup>2</sup> )	R <sub>m</sub> : 500 – 700	660
- tensile elongation (%)	A <sub>5</sub> : ≥ 40	55
- hardness	HB : ≤ 215	200
- impact energy (J) @ 25°C	ISO-V : ≥ 100	210

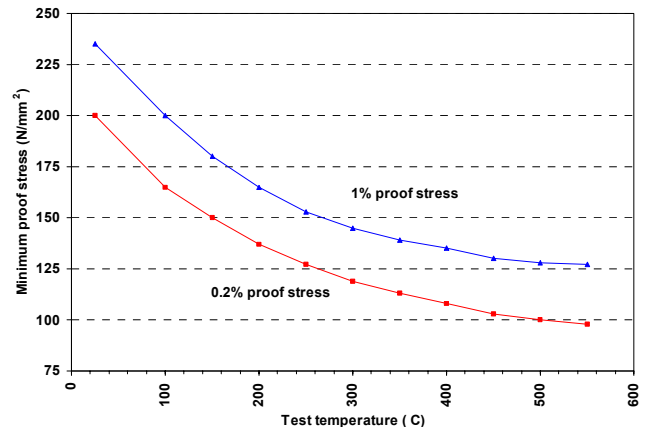
### Weldability

**1.4435** is readily weldable using all welding processes. Should a filler material be required, **No-vonit® 4430**, can be used. Maximum inter-pass temperature during welding is 150°C. Heat treatment after welding is not necessary, and even large sections are resistant to intercrystalline corrosion after welding, due to the low carbon content. Any scale or heat tint that results from welding or high temperature processing must either be mechanically or chemically removed

followed by a suitable passivating treatment to restore the corrosion resistance.

### Elevated temperature properties

The elevated temperature properties of **1.4435** are essentially the same as for **1.4404**. The following minimum tensile properties at various temperatures are thus what can be expected for **1.4435**:



### Forging

Work pieces are usually pre-heated to between 1150 - 1180°C with forging taking place between 1180 und 950°C. After forging the forged component must be rapidly cooled in either air or water to avoid the formation of any undesirable phases which might adversely affect the corrosion and/or mechanical properties.

### Machining

For applications which require machining, the **NIRO-CUT® 4435** grade is recommended since the composition and production route followed to produce this grade compensates for the work hardening tendency of the material. Due to the low carbon content and stable microstructure, **NIRO-CUT® 4435** can be readily machined.

When machining **NIRO-CUT® 4435**, the following cutting parameters can be used as a guideline when using coated hard metal cutting tools.

tensile strengths	depth of cut (mm) feed (mm/rev)		
	6 mm 0,5 mm/r	3 mm 0,4 mm/r	1 mm 0,2 mm/r
R <sub>m</sub> in N/mm <sup>2</sup>			
solution annealed (560 - 640)	130 m/min	160 m/min	205 m/min