SÜDWESTFALEN
Edelstahlwerke Südwestfalen GmbH

C: **max. 0,05**
Cr: **16,5 - 17,5**
Ni: **11,0 - 12,0**
Mo: **2,5 - 3,0**

1.4436
X3CrNiMo 17-13-3

1.4436

Stainless austenitic, chromium nickel molybdenum steel

Relevant current and obsolete standards:
- EN 10088-3 : 1.4436 X3CrNiMo 17-13-3
- AISI : -
- BS : 316 S13
- JIS : -
- AFNOR : Z7CND 18-12-03
- DIN : 1.4436
- SIS : 2343

Special grades for particular applications
- fine wire grade
- cold heading grade
- drawing grade

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

Special properties
- non-magnetic grade ($\mu_r \leq 1,3$)
- suited to cryogenic applications
- suitable for use up to 700°C

Physical Properties
- density (kg/dm^3) : 8
- electrical resistivity at 20°C (Ω mm^2/m) : 0,75
- magnetisable : no
- thermal conductivity at 20°C (W/m K) : 15
- specific heat capacity at 20°C (J/kg K) : 500
- thermal expansion ($10^{-6}K^{-1}$)
  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
- medical and pharmaceutical industries
- petrochemical industry

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

Finished product forms and conditions
- wire rod
- peeled bars ∅ 20 - 80
- bright bar h9, h11 ∅ 2 – 80
- bright coils h9, ∅ 0,8 - 20
- solution annealed and quenched
- direct quenched
- pickled
- drawn
- straightened
- peeled
- ground

Demand tendency ↘

1.4436 is essentially a more highly alloyed version of **1.4401** and is specified when the corrosion resistance of **1.4401** is no longer considered to be sufficient.

Corrosion resistance (PRE = 24.75 to 30.16)
1.4436 is slightly more resistant to corrosion than **1.4401**, especially in chloride containing environments, due to the slightly higher molybdenum addition. This improved corrosion resistance is reflected by the slightly higher PRE values for **1.4436**.

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Properties, applications and processing

1.4436 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, **1.4436** displays excellent corrosion properties. This grade of stainless steel is also resistant to corrosion in various acid environments.

Due to its relatively high carbon content, **1.4436** is not considered to be resistant to intergranular corrosion in the welded condition. Despite this, thin sections may be welded without the danger of intergranular corrosion. Please note that **1.4436** is not resistant to sea water.

Heat treatment / mechanical properties

Optimal mechanical and fabrication properties are realised after solution annealing in the temperature range 1020 - 1120°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^2)	$R_{p0,2}$: ≥ 200	370
- tensile strength (N/mm^2)	R_m : 500 – 700	670
- tensile elongation (%)	A_5 : ≥ 40	46
- hardness	HB : ≤ 215	200
- impact energy (J) @ 25°C	ISO-V : ≥ 100	220

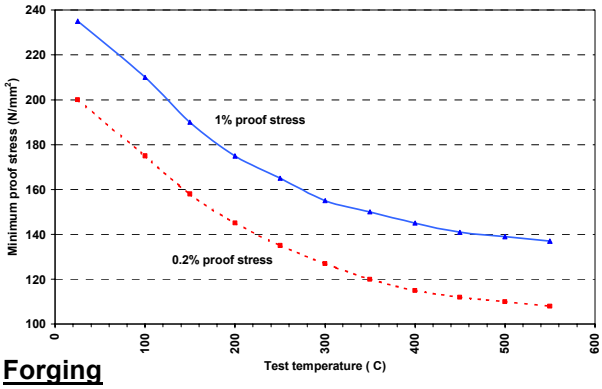
Weldability

1.4436 is readily weldable using all welding processes. Should a filler material be required, **Novonit® 4430**, can be used. Maximum interpass temperature during welding is 150°C. Heat treatment after welding is not necessary, but it must be borne in mind that the relatively high carbon content, allowed for in the specification, can result in the formation of chromium carbides which in turn can result in susceptibility to intercrystalline corrosion. When **1.4436** is ordered from KEP, however, no such problems should arise, since the carbon content has been reduced to such low levels that this problem has been eliminated.

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 **1.4436** are essentially the same as for **1.4401**. The following minimum tensile properties at various temperatures are specified in the EN 10088-3 : 1995 standard.



Forging

Work pieces are usually pre-heated to between 1150 - 1200°C with forging taking place between 1200 and 900°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

As a result of its higher alloy content, **1.4436** is more difficult to machine than **1.4401** or **1.4435** (Nirocut® version). For applications which require machining, the use of **NIRO-CUT® 4435** can be considered. When machining **1.4436**, the following cutting parameters can be used as a guideline when using coated hard metal cutting tools.

tensile strengths R_m in N/mm^2	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
solution annealed (560 - 640)	115 m/min	145 m/min	185 m/min

General comments

Although **1.4436** might be slightly cheaper than **1.4435**, it finds itself in a diminishing market as far as profiles is concerned. A possible reason for this could be that most profiles are subjected to further processing by machining and to date no **NIRO-CUT®** version exists. Most customers thus specify the improved machining, **1.4436**, which despite its higher sulphur content displays an almost equivalent corrosion resistance.

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