ValbrunaNordic

Duplex Stainless Steel

EN 1.4462 – UNS S31803, S32205 - 2205

An austenitic-ferritic stainless steel

Typical analysis %	C	Cr	Ni	Mo	Others
EN 1.4462	0,02	22	5,7	3,1	N
Delivery condition			Solution annealed		

(EN 1.4462 replaces SS 2377 –02)

Characteristic temperatures

	Temperature °C
Solidification range Scaling temperature in air	1445-1385 1000
Hot forming Solution annealing Stress relief annealing (max 5h)	1200-950 1020-1100 1020-1100
Use in pressure vessels	(-10)-300

Mechanical properties

Values for solution annealed condition acc. to EN 10272

Tensile strength Rm	N/mm^2	650-880
Proof strength $Rp_{0,2}$	N/mm^2	Min 450
Proof strength $Rp_{1,0}$	N/mm^2	Min 340
Elongation A_5	%	Min 20
Impact energy KV 20°C -40°C	J/cm^2 J/cm^2	Min 100 Min 40
Hardness	HB	Max 270

Physical properties acc. to EN 10088

Temperature °C	20	100	200	300
Density kg/dm^3	7,8	-	-	-
Modulus of elasticity E GPa	200	194	186	180
Mean coeff. of therm.expansion 20° C –Temp. $x10^{-6} \cdot K^{-1}$	-	13	13,5	14,0
SpecificTherm. Capacity W/m · K	15	16	17	18
Electrical Resistivity Ω · mm^2/ m	0,80	0,85	0,90	1,00
Specific heat J/kg · K	500	530	560	590

The steel is susceptible to embrittlement when applied in the temperature range of 350-950°C .(Sigma phase 600-950°C, 475°C embrittlement 350-525°C) In normal welding and heat-treatment operations the risk of embrittlement is low.

General characteristics

Duplex stainless steel also referred to as an austenitic-ferritic steel, combine many of the beneficial properties of ferritic and austenitic steels. Due to its high content of chromium and nitrogen, and often also molybdenum, this steel offer good resistance to pitting and uniform corrosion. The duplex micro-structure contributes to their high strength and high resistance to stress corrosion cracking. Duplex steels also have good weldability.

Design features

⇒ High strength
⇒ High resistance to pitting corrosion, crevice corrosion, uniform corrosion, stress corrosion cracking and corrosion fatigue.
⇒ Good erosion and fatigue resistance
⇒ High energy absorption
⇒ Low thermal expansion
⇒ Good weldability

Corrosion resistance

Uniform corrosion

Uniform corrosion is characterised by a uniform attack on the steel surface that has come into contact with a corrosive medium. The corrosion resistance is generally considered good if the corrosion attack is less than 0,1 mm/year. Due to the high content of chromium **EN 1.4462** offers excellent corrosion resistance in many media.

Intercrystalline corrosion

The duplex microstructure and the low carbon content gives **EN 1.4462** very good resistance to intercrystalline corrosion. The composition of the steel ensures that austenite is reformed in the heat-affected zone after welding. The risk of undesirable precipitation of carbides and nitrides in the grain boundaries is thus minimized.

Stress corrosion cracking

Conventional steels of the 1.4301 and 1.4401 type can be attacked by stress corrosion cracking (SCC) in chloride environments at high temperatures in combination with tensile stress. Due to their continuous ferritic phase, stainless steels of the duplex type are much less sensitive to this type of corrosion.

EN 1.4462 is also an approved material according to NACE MR0175 "Standard Material Requirements-Metals for Sulfide Stress Cracking and Stress Corrosion Cracking Resistance in Sour Oilfield Environments".

Pitting and crevice corrosion

Resistance to pitting corrosion and crevice corrosion increases with the content of chromium, molybdenum and nitrogen in the steel. This is often illustrated by using the pitting resistance equivalent (PRE) for the material, which can be calculated using the formula:

PRE = %Cr + 3.3 x %Mo + 16 x %N or by measuring the critical crevice corrosion temperature (CCT) at which corrosion occurs in a well-defined solution

Heat treatment

Solution annealing 1020-1100ºC. Holding time at solution annealing temperature approx. 30 min, followed by rapid cooling in water. Stress relief treatments can in special cases be performed at 550ºC-600ºC.

Fabrication

Hot and cold forming

Hot forming should be carried out in the temperature range 1200-950°C. It should however, be observed that the strength of the duplex material is low at high temperatures. Hot working should normally be followed by solution annealing.

Due to the high proof strength of duplex material, greater working forces than those required for austenitic steel are usually needed for cold forming of duplex steel. The spring back is relatively high because of the high yield point. Solution annealing is normally recommended after more than 10 % cold deformation.

Machining

Duplex stainless steels, such as **EN 1.4462**, are generally more difficult to machine than conventional austenitic steels and have different machining properties than those of high-alloy austenitic steels. The main difference is that duplex steels are relatively easier to machine with high-speed tools than with cemented carbide tools compared to austenitic stainless steels with similar alloy content.

Welding

EN 1.4462 has generally a good weldability and can be welded using most of the welding methods used for stainless steels:

- Shielded metal arc welding (SMAW)
- Gas tungsten arc welding, GTAW (TIG)
- Gas metal arc welding, GMAW (MIG)
- Flux-cored arc welding (FCW)
- Plasma arc welding (PAW)
- Submerged-arc welding (SAW)

Due to the balanced composition, the heat affected zone obtains a sufficiently high content of austenite to avoid the risk of localised corrosion.
Welding shall be performed without preheating, and cooling between passes to below 150ºC.
Filler material Avesta Welding 2205 or similar shall be used to ensure weld properties comparable to those of the parent metal.

More detailed information concerning the procedures for welding these steels can be obtained from Avesta Welding AB.

Surface finish

EN 1.4462 is available with pickled or machined and peeled surface.

Stock standard

Please refer to our stock standard leaflet.

Technical support

VALBRUNA NORDIC AB will be helpful in giving further advice and recommendations concerning choice of materials, welding, heat treatment etc.

MATERIAL STANDARDS

SS-EN 10272	Stainless steel bars for pressure purposes
SS-EN 10088-3	Stainless steels-Part 3 Technical delivery conditions for semi-finished products, bars, rods and sections for general use
ASTM A 276/ ASME SA-276	Stainless steel bars for general purposes
ASTM A 479/ ASME SA-479	Stainless steel bars for pressure boilers/pressure vessels