ValbrunaNordic

High alloy Austenitic Stainless Steel

EN 1.4539 – UNS N08904 – 904L

A stainless austenitic steel

Typical analysis %	C	Cr	Ni	Mo	Others
EN 1.4539	0,02	20	25	4,2	Cu
Delivery condition			Solution annealed		

(EN 1.4539 replaces SS 2562 –27)

Characteristic temperatures

	Temperature °C
Solidification range Scaling temperature in air	1390-1315 1000
Hot forming Solution annealing Stress relief annealing (max 5h)	1200-900 1050-1150 500
Use in pressure vessels	(-60)-400

Mechanical properties

Values for solution annealed condition acc. to EN 10272

Tensile strength Rm	N/mm^2	530-730
Proof strength $Rp_{0,2}$	N/mm^2	Min 230
Proof strength $Rp_{1,0}$	N/mm^2	Min 260
Elongation A_5	%	Min 35 (30)
Impact energy KV 20ºC	J/cm^2	Min 100 (60)
Hardness	HB	Max 230

( ) 160<d≤250

Physical properties

Temperature ºC	20	100	200	300	400
Density kg/dm^3	8,0	-	-	-	-
Modulus of elasticity E kN/mm^2	195	190	180	172	165
Mean coeff. of therm.expansion 20°C –Temp. 10^{-6} K^{-1} α	-	15	15,5	16	16
SpecificTherm. Capacity λ W/m °C	13	13,5	14	15	16
Electrical Resistivity µΩm	0,85	-	-	-	-
Specific heat J/kg °C	500	-	-	-	-

EN 1.4539 – 904L is a high alloy austenitic stainless steel with low carbon content. The grade is intended for use under severe corrosive conditions. The steel grade was originally developed to resist corrosion in dilute sulphuric acid. **EN 1.4539** is fully austenitic, and is less sensitive to precipitation of ferrite and sigma phase than conventional austenitic grades with high molybdenum content. Due to the combination of relatively high contents of chromium, nickel, molybdenum and copper,
EN 1.4539 has good resistance to general corrosion, particulary in dilute sulphuric acid.
It is non-magnetic in the annealed condition but may become slightly magnetic as a result of cold-working or welding.

Design features

⇒ Good resistance to uniform corrosion
⇒ Good resistance to pitting and crevice corrosion
⇒ Very good resistance to stress corrosion cracking
⇒ Good resistance to intercrystalline corrosion
⇒ Good formability and weldability

Corrosion resistance

Uniform corrosion

Uniform corrosion is characterized by a uniform corrosion of the steel surface in contact with the corrosive medium. Resistance is normally considered good if the corrosion rate is less than 0,1 mm/year. As a result of its high chromium, nickel and molybdenum contents and its alloying with copper, **EN 1.4539** is passivated even in reducing environments such as dilute sulphuric acid and formic acid. Its high nickel content contributes towards its relatively low corrosion rate in the active state.

Intercrystalline corrosion

EN 1.4539 has a very low carbon content. This means that there is very little risk of carbide precipitation in connection with ordinary heat treatment and welding. The risk of intercrystalline corrosion after ordinary heat treatment and welding is thereby eliminated.

Stress corrosion cracking

Conventional steels of the 1.4301 and 1.4401 type are sensitive to stress corrosion cracking (SCC) under certain conditions, i.e. a special environment in combination with tensile stress in the material, and often also an elevated temperature. Resistance to SCC increases with the increased content of nickel and molybdenum. Owing to its high nickel and molybdenum contents **EN 1.4539** is highly resistant to stress corrosion cracking in chloride solutions, concentrated hydroxide solutions and environments rich in hydrogen sulphide.

Pitting and crevice corrosion

Resistance to pitting corrosion and crevice corrosion is determined mainly by the content of chromium, molybdenum and nitrogen in the material. 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

Heat treatment

Solution annealing 1050-1150º C. Holding time at solution annealing temperature approx. 30 min, followed by rapid cooling in air or water.

Hardening

This grade cannot be hardened by heat treatment, but it can be hardened by cold working.

Fabrication

Hot and cold forming

Hot forming should be carried out in the temperature range 1200-950°C. It is important that the entire workpiece has been exposed to a sufficiently high temperature. In the case of partial heating, or cooling that is too slow, hot working should be followed by solution annealing. Bending, pressing and other forming operations can easily be done in cold condition. As with other austenitic steels, intermediate annealing must be carried out in connection with the more complicated forming operations such as complex deep drawing.

Machining

Like other austenitic steels **EN 1.4539** is tough and has a tendency towards work-hardening. This must be taken into account when the grade is machined. With the right choice of tool and machine data, fully satisfactory machining results can be obtained with this grade. For more detailed information on machining please refer to "Cutting data recommendations for EN 1.4539" which can be obtained on request.

Welding

EN 1.4539 is a fully austenitic steel and welding requires particular care. Under normal welding conditions, there is relatively little risk of cracking of the weld metal during solidification, although the risk may be marginally higher than for conventional austenitic steel grades. The steel can be welded by methods such as manual metal arc, GMAW (MIG), GTAW (TIG), submerged arc and plasma arc welding. Welding methods that involve a high heat input may increase the risk of hot cracking.

Filler metal of Avesta Welding 904L type of composition is recommended. These filler metals will give a weld with a pitting resistance comparable to the base metal.

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

Surface finish

EN 1.4539 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 material, cutting data, 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