

Stainless Steel 904l (UNS N08904)



Stainless Steel 904l has medium corrosion resistance properties such as oxidation resistance. It is a suitable austenitic stainless steel to be used in the prevention of hot seawater corrosion and chloride based attack. It resists chloride based stress corrosion cracking and acidic corrosion. SS 904 is used in acid processing equipments, gas washing, condenser tubes, heat exchangers, oils and gas treatment and paper industry.

Steel 904l is non-magnetic in many environments and has supreme welding and forging features. The austenitic configuration offers superior hardness even lower than cryogenic temperature.

Chemical Composition

Carbon (C)	0.08 %
Chromium (Cr)	17 to 20 %
Copper (Cu)	1 %
Iron (Fe)	Rem %
Lead (Pb)	0.005 %
Manganese (Mn)	2 %
Nickel (Ni)	34 to 37 %
Phosphorous (P)	0.03 %
Silicon (Si)	0.75 to 1.5 %
Sulfur (S)	0.03 %
Tin (Sn)	0.025 %

Physical Properties

Density	0.289 lb/cubic-inch or 7.90 gram/cubic cm
Specific Gravity	7.99

Specific Heat	0.11 Btu/lb/Deg F - [32-212 Deg F])
Magnetic Permeability	1.02
Modulus of elasticity Tension	28.5
Thermal conductivity	11.5 W/m-K at 20oC or 79.8 BTU-in/hr-ft ² -°F at 68 oF
	12.9 W/m-K at 100oC or 89.5 BTU-in/hr-ft ² -°F at 212oF
Electric resistivity	480 micro-ohm at 68oF

Mechanical Properties

Tensile Strength	490 Mpa
Yield strength	220 Mpa
Elongation	35 %
Modulus of elasticity	200 GPa or 29000 ksi
Poisson ratio	0.333
Shear Modulus	73 Gpa or 10600 ksi
Electrical Resistivity	0.0000952 ohm-cm
Magnetic permeability	1.02

Linear Coefficient of thermal expansion

Temperature		Micro-meter/meter-oC	Micro-inch/inch-oF
oC	oF		
20 oC to 100 oC	68 oF to 212 oF	15.3	8.50
20 oC to 400oC	68 oF to 752 oF	16.5	9.17
20 oC to 800 oC	68 oF to 1470 oF	18.2	10.1

Thermal Conductivity

Temperature		W/(m °C)	Btu/(ft h °F)
oC	oF		
20 oC	68 of	12 W/(m oC)	7 Btu/(ft h °F)
100 oC	200 of	14 W/(m °C)	8 Btu/(ft h °F)
200 oC	400 of	16 W/(m °C)	9 Btu/(ft h °F)
300 oC	600 of	18 W/(m °C)	10.5 Btu/(ft h °F)
400 oC	800 of	20 W/(m °C)	11.5 Btu/(ft h °F)
500 oC	1000 of	22 W/(m °C)	13 Btu/(ft h °F)
600 oC	1200 of	23 W/(m °C)	14 Btu/(ft h °F)
700 oC	1300 of	23 W/(m °C)	14.5 Btu/(ft h °F)

Specific Heat Capacity

Temperature		J/(kg °C)	Btu/(lb °F)
oC	oF		
20 oC	68 of	460 J/(kg °C)	0.11 Btu/(lb °F)
100 oC	200 of	485 J/(kg °C)	0.12 Btu/(lb °F)
200 oC	400 of	515 J/(kg °C)	0.12 Btu/(lb °F)
300 oC	600 of	545 J/(kg °C)	0.13 Btu/(lb °F)
400 oC	800 of	570 J/(kg °C)	0.14 Btu/(lb °F)
500 oC	1000 of	590 J/(kg °C)	0.14 Btu/(lb °F)
600 oC	1200 of	605 J/(kg °C)	0.15 Btu/(lb °F)

700 oC	1300 of	615 J/(kg °C)	0.15 Btu/(lb °F)
--------	---------	---------------	------------------

Thermal Expansion

Temperature		Per oC	Per oF
oC	oF		
30 oC to 100 oC	86 oF to 200 oF	15.5 Per oC	8.5 Per oF
30 oC to 200 oC	86 oF to 400 oF	16 Per oC	9 Per oF
30 oC to 300 oC	86 oF to 600 oF	16.5 Per oC	9 Per oF
30 oC to 400 oC	86 oF to 800 oF	17 Per oC	9.5 Per oF
30 oC to 500 oC	86 oF to 1000 oF	17 Per oC	9.5 Per oF
30 oC to 600 oC	86 oF to 1200 oF	17.5 Per oC	9.5 Per oF
30 oC to 700 oC	86 oF to 1300 oF	17.5 Per oC	10 Per oF

Electric Resistivity

Temperature		Micro-ohm meter	Micro-ohm inch
oC	oF		
20 oC	68 of	0.94 Micro-ohm meter	37 Micro-ohm inch
100 oC	200 of	0.99 Micro-ohm meter	38.8 Micro-ohm inch
200 oC	400 of	1.07 Micro-ohm meter	42.2 Micro-ohm inch
300 oC	600 of	1.13 Micro-ohm meter	44.6 Micro-ohm inch
400 oC	800 of	1.15 Micro-ohm meter	45.5 Micro-ohm inch
500 oC	1000 of	1.17 Micro-ohm meter	45.8 Micro-ohm inch
600 oC	1200 of	1.15 Micro-ohm meter	45.9 Micro-ohm inch
700 oC	1300 of	1.18 Micro-ohm meter	46.5 Micro-ohm inch

Modulus of Elasticity

Temperature		MPa	ksi
oC	Of		
20 oC	68 of	195 MPa	28.5 ksi
100 oC	200 of	190 MPa	27.5 ksi
200 oC	400 of	182 MPa	26.5 ksi
300 oC	600 of	174 MPa	25 ksi
400 oC	800 of	166 MPa	24 ksi
500 oC	1000 of	158 MPa	22.5 ksi

Corrosion Resistance

Stainless steel type 904L is primarily fabricated to offer resistance to the sulfuric acid and it also possesses superior resistance to the various conditions. It has outstanding resistance to the hot sea water and chloride conditions. The significant content of nickel offers outstanding resistance to stress corrosion cracking as compare to the other stainless steel alloys. The copper content enhances the resistance to sulfuric acid and other reducing acids especially in the rigorous conditions.

In the various atmospheres, **stainless steel 904L grade** offers moderate corrosion resistance between the standard austenitic 316L alloy and highly alloyed 6% molybdenum and equivalent to super austenitic alloy types. In the presence of rigorous nitric acid, the lower

resistance as compare to molybdenum-free alloys like 304L and 310L are used. To get the highest stress corrosion cracking resistance in the crucial conditions, the steel is recommended to solution treating subsequent to cold processing.

Fabrication

Heat Processing

The 904L alloy possesses high resistance to oxidation though just like other alloys it goes through the structure deformation at high temperatures. The steel should not be utilized over 400oC. The solution processing like heating up to 1090oC to 1175oC and quick quenching is done. It is impossible to work harden type steel 904L through heat processing.

Forging

Austenitic stainless steel 904L is a highly pure grade containing low content of sulfur. Its machining is not as such easy but it can be machined by following the standard methods. If the alloy has to be used in the rigorous corrosion cracking media, it should be annealed after cold processing.

Welding

Stainless steel 904L alloy can be best welded by implementing the standard procedures. The careful processing is needed when the alloy solidifies completely and becomes prone to hot breaking particularly in the limited weldments.

Available Forms

Wire, Mesh, Flanges, Pipe, Tubing, Foil, Strip, Sheet, Rod, Bar