1802 Free-Cutting Wire Datasheet
Wire

Zapp is certified according to ISO 9001

1802 is a ferritic stainless free-cutting steel, alloyed with titanium and sulphur. It is characterized by very good machinability, superior corrosion resistance and good magnetic properties.

1802 is superior in all applications involving a sufficiently high cutting speed, preferably 200 - 300 m/min. The excellent machinability results in superior surface finish. Also in operations where low cutting forces and/or excellent chip flow, e.g. grooving, internal turning or drilling are an advantage, 1802 can offer improved production economy.

Service temperature -60 to 300 °C (-75 to 570 °F).
Scaling temperature in air 850 °C (1560 °F).

Standards
_ UNS: S18235
_ EN Number: 1.4523

Grade	EN no.	Structure	Cr	Mo	Ni	S	Ti
1802	1.4523	Ferritic	18	2.1	-	0.3	0.7
ASTM 316L	1.4404	Austenitic	17	2.1	11	-	-
ASTM 430F	1.4104	Ferritic	17	-	-	0.3	-
18/2	-	Ferritic	18	1.5	-	0.2	-

Chemical composition (nominal) %

C+N	Si	Mn	S	Cr	Mo	Ti
≤ 0.040	0.5	≤ 0.5	0.3	18	2.3	0.7

Program: Mechanical properties and tolerances

Finish	Size		Standard tolerance[2]		Mechanical properties at 20°C			
	Diameter	Length	Dim	Length			Elongation	Hardness
	mm	m		mm	R_m	$R_{p0.2}$	%	HB
					MPa	MPa		nominal
Wire and bar								
Drawn[1] wire on coils or spools	0.80 – 3.00		D1	-	750 - 950	620 - 820	7	
	3.01 – 8.10		D1	-	650 - 850	500 - 720	9	
Drawn[1] wire in length	0.60 – 3.00	2.00	D1	±10	750 - 950	620 - 820	7	
	3.01 – 10.50	3.00	D1	±10	650 - 850	500 - 720	9	
Ground	0.70 – 3.00	2.00	h8	±10	750 - 950	620 - 820	7	
	3.01 – 12.00	3.00	h8	±10	650 - 850	500 - 720	9	
Annealed								
Ground	12.00 - 15.00	3.00	h8	+0/-50	430 - 600	280	15	200
Peel turned	13.00 - 70.00	3.00	h11	+0/-50	430 - 600	280	15	200

1) Dull finish, but bright finish is also available in diameters 0.5 - 4.0 mm, tolerance D2. The drawn wire can also be supplied in annealed or soft drawn condition. Other properties on request.

2) Tolerance tables on request.

Mechanical properties at high temperatures

Nominal values, annealed

Temperature	R_m	$R_{p0.2}$	Elongation
°C	MPa	MPa	%
100	495	335	24
200	460	300	22
300	445	280	20

Impact strength

Transition temperature, °C	approx. 100
Impact energy Charpy V at 20°C, J	approx. 5

Accordingly, the steel should not be used for applications specifically requiring very good impact strength.

Physical properties

	Temperature, °C			
	20	**100**	**200**	**400**
Density, g/cm3	7.7	-	-	-
Modulus of Elasticity, MPa x10^3	225	220	210	195
Specific heat capacity, J/(kg °C)	460	500	540	580
Resistivity, µΩm	600	700	800	950
Thermal conductivity, W/(m °C)	22	22.5	23	24.5
Thermal expansion. x10^{-6}/°C	-	-	-	-
from 20 °C to 100 °C	10	-	-	-
from 20 °C to 200 °C	11	-	-	-
from 20 °C to 400 °C	11.5	-	-	-

Impact strength

Transition temperature, °C	approx. 100
Impact energy Charpy V at 20°C, J	approx. 5

Accordingly, the steel should not be used for applications specifically requiring very good impact strength.

Magnetic properties

1802 is a soft magnetic steel very suitable for cores in solenoid valves and other electromechanical equipment for service in highly corrosive environments. Like other titanium-alloyed steels, 1802 undergoes some discoloration even when annealed in protective atmosphere.
Recommendations for removing the oxide by pickling and for magnetic annealing can be supplied on request.

Magnetic properties (nominal values)	Wire and bar < 12 mm		Bar (annealed, ground, peel turned) > 12 mm	
	As delivered	Magnetic annealed [1]	As delivered	Magnetic annealed [1]
Permeability, μ_{max}	820	1,900	> 1,300	1,150
Remanence, B_r (T)	0.95	0.95	0.4 – 1.1	0.92
Coercive force, H_c (A/m)	580	200	< 280	350

[1] Heat treatment at 800 °C, holding time 2 hours, cooling 15 °C/hour to 600 °C.

Corrosion resistance

From general point of view corrosion resistance, 1802 is most closely comparable to steel of type ASTM 316.

Steel type	Structure	Cr, %	Mo, %	Ni, %
1802	Ferritic	18	2.3	-
AISI 316L	Austenitic	17	2.1	11
AISI 304L	Austenitic	18	9	-

Chloridic environments

High concentrations of chloride ions, elevated temperature or reduced pH, can result in local attacks in the form of pitting, crevice corrosion or stress corrosion cracking.
1802 and steel of type ASTM 316L have about the same Cr and Mo contents and both materials have improved resistance to pitting and crevice corrosion.
The most common way to improve machinability in steel is to alloy with sulphur, which combines with manganese to form manganese sulphides which have a positive influence on the cutting properties of the material. However, the manganese sulphides act as the same time as points of attack for corrosion. This problem has been solved in 1802 by binding the sulphur to titanium instead of manganese. The titanium sulphides have the same positive effect on machinability but do not act in the same way as points of attack for corrosion. This is confirmed by CPT-tests in neutral NaCl solutions. As for ASTM 316L, 1802 is not recommended for use in seawater if it cannot be equipped with cathode protection

Like ASTM 316L, 1802 is also suitable for use in dialysis machines which work with aline solutions containing 0,9 % NaCl, and in fresh water containing 10 - 200 ppm Cl-.

Acids

In most organic acids, e.g. lactic acid, formic acid and acetic acid, as well as in weaker inorganic acids such as phosphoric acid and in dilute sulphuric acid, 1802 possesses roughly the same corrosion resistance as ASTM 316L.
In sulphuric acid over 1 % at room temperature, 1802 is somewhat less resistant than AISI 316L.
The addition of titanium to 1802 is unfavorable in strongly oxidizing acids, e.g.g nitric acid. Like ASTM 316L, 1802 has
such low resistance to hydrochloric acid that it is not normally possible to make any practical use of the steel in such an environment.

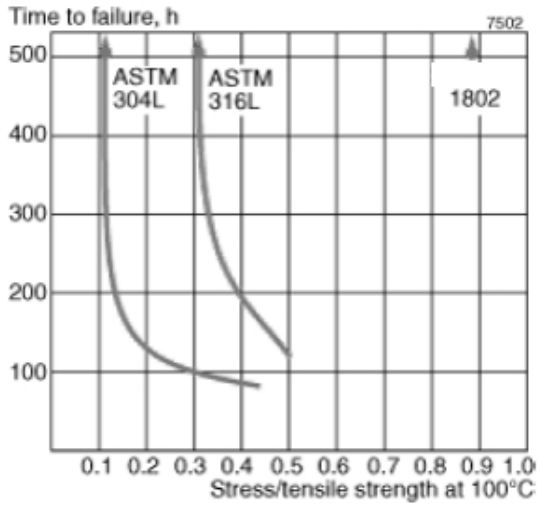
Air

The resistance of 1802 to atmospheric corrosion is at least as good as for ASTM 316L and much better than for ASTM 304L, according to results from three years exposure to the atmosphere in Stockholm (brackish water) and on the west coast of Sweden (salt water).

1802 compared to ASTM 316L	
Weak acids (e.g. organic acids, phosphoric acid)	Equivalent
Strong acids (e.g. nitric, hydrochloric acid)	Somewhat poorer
Chloride-containing water	Equivalent
Chloride-containing water where there is a risk of stress corrosion cracking	Superior

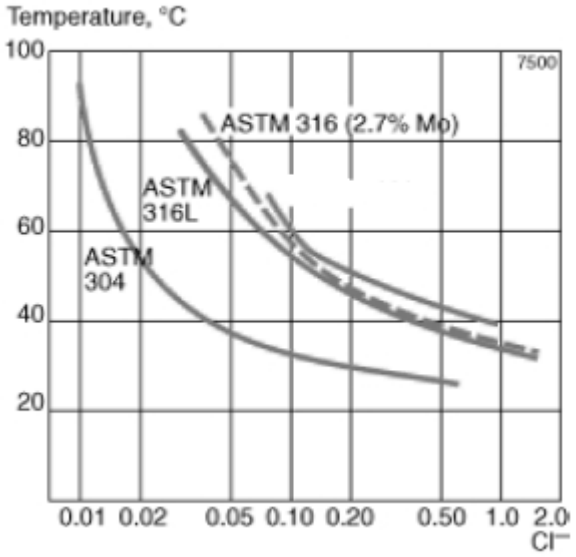
Stress corrosion cracking

1802 has superior resistance to chloride-induced stress corrosion cracking compared with austenitic steels with at moderate nickel content.



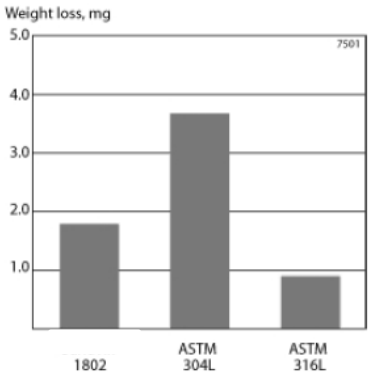
Pitting corrosion

The pitting characteristics of 1802 are extremely good. In critical pitting temperature testing (CPT testing), 1802 showed its ability to cope with higher temperatures than ASTM 304 and ASTM 316. This means that 1802 offers excellent resistance to pitting in most applications.



Crevice corrosion

1802 is clearly superior to ASTM 304 but slightly inferior to ASTM 316.



Heat treatment

Annealing at 850 C (1560 F), soaking in 5 - 30 minutes depending on size, thereafter quenching in water. Hardness level achieved after this annealing is approximately 165 HV5.

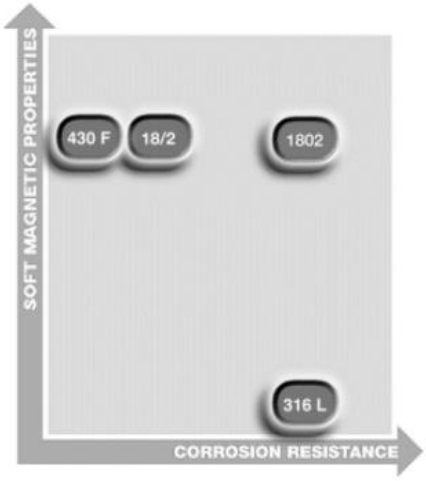
Intergranular corrosion

The risk of intergranular corrosion is very small in 1802, thanks to the addition of titanium in combination with a low carbon and nitrogen content. In the intergranular corrosion test specified in DIN 50914 and in ASTM A763-79 Practice Z (Strauss testing), 1802 has achieved an approved result. The latter test is applied in cases where the material fails to pass the bending prescribed by the former test.

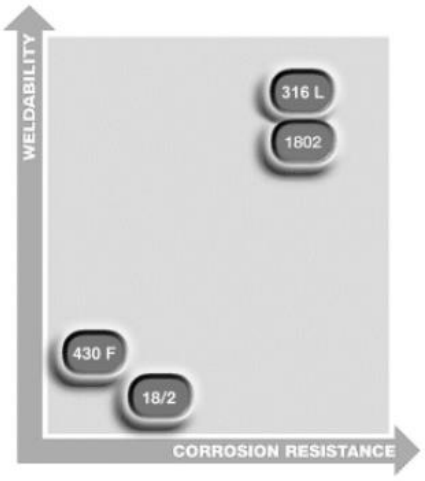
Numerous advantages using 1802

Also in other respects 1802 has proved to be a first class stainless free-cutting steel

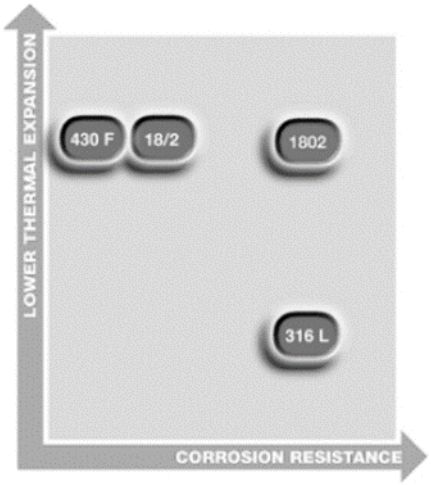
- favorable soft magnetic properties
- good weldability and well suited for brazing
- low thermal expansion
- good cold heading properties

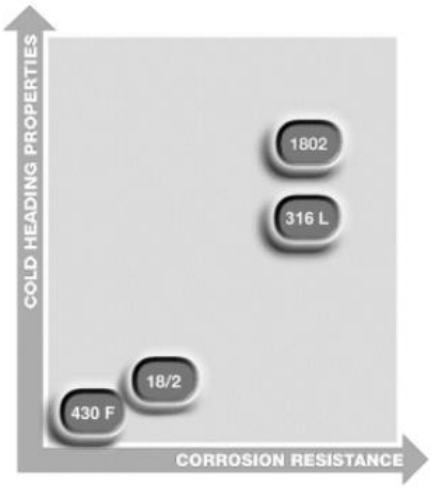


Type AISI 316 often considered as non magnetic.



AISI 430F and 18/2 are not recommended for welding and cold heading.





Zapp Precision Metals (Sweden) AB
PRECISION WIRE
Järnverksleden 18
81 134 Sandviken
Sweden
Phone +46 26 191800
precisionmetals-sweden@zapp.com
www.zapp.com

Last revision: January 2020