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Alloy Technical Data Sheet
Types 316 (S31600) & 316L (S31603)
Chromium-Nickel-Molybdenum Stainless Steels

GENERAL PROPERTIES
Types 316 (UNS S31600) and 316L (S31603) are molybdenum bearing austenitic stainless steels which are more resistant to general corrosion and pitting/crevice corrosion than the conventional chromium-nickel austenitic stainless steels such as Type 304. These alloys also offer higher creep, stress-to-rupture and tensile strength at elevated temperature..

In addition to excellent corrosion resistance and strength properties, the Types 316 and 316L Cr-Ni-Mo alloys also provide the excellent fabricability and formability which are typical of the austenitic stainless steels.

CHEMICAL COMPOSITION
Chemistries by ASTM A240 and ASME SA-240

Element	Percentage by Weight (maximum unless range is specified)	
	Type 316	Type 316L
Carbon	0.08	0.030
Manganese	2.00	2.00
Silicon	0.75	0.75
Chromium	16.00-18.00	16.00
Nickel	10.00-14.00	10.00-14.00
Molybdenum	2.00-3.00	2.00-3.00
Phosphorus	0.045	0.045
Sulfur	0.030	0.030
Nitrogen	0.10	0.10
Iron	Bal.	Bal.

RESISTANCE TO CORROSION
Types 316 and 316L are more resistant to atmospheric and other mild types of corrosion than the 18-8 stainless steels. In general, media that do not corrode 18-8 stainless steels will not attack these molybdenum-containing grades. One known exception is highly oxidizing acids such as nitric acid to which the molybdenum-bearing stainless steels are less resistant.

Types 316 and 316L are considerably more resistant than any of the other chromium-nickel types to solutions of sulfuric acid. Service tests are usually desirable as operating conditions and acid contaminants may significantly affect corrosion rate. Where condensation of sulfur bearing gases occurs, these alloys are much more resistant than other types of stainless steels. In such applications, however, the acid concentration has a marked influence on the rate of attack and should be carefully determined.

The molybdenum-bearing Types 316 and316L stainless steels also provide resistance to a wide variety of other environments. As shown by the laboratory corrosion data below, these alloys offer excellent resistance to boiling 20% phosphoric acid. They are also widely used in handling hot organic and fatty acids. This is a factor in the manufacture and handling of certain food and pharmaceutical products where the molybdenum-containing stainless steels are often required in order to minimize metallic contamination.

Generally, the Type 316 and 316L grades can be considered to perform equally well for a given environment. A notable exception is in environments sufficiently corrosive to cause intergranular corrosion of welds and heat-affected zones on susceptible alloys. In such media, the Type 316L grade is preferred over Type 316 for the welded condition since low carbon levels enhance resistance to intergranular corrosion.

LINEAR COEFFICIENT OF THERMAL EXPANSION

Temperature Range				Coefficients	
°F		°C		in/in/°F	cm/cm/°C
68 -	212	20 -	100	$9.2x10^{-6}$	$16.5x10^{-6}$
68 -	932	20 -	500	$10.1x10^{-6}$	$18.2x10^{-6}$
68 -	1832	20 -	1000	$10.8x10^{-6}$	$19.5x10^{-6}$

THERMAL CONDUCTIVITY

Temperature Range		Btu/hr·ft·°F	W/m·K
°F	°C		
68-212	20-100	100.8	14.6

The overall heat transfer coefficient of metals is determined by factors in addition to the thermal conductivity of the metal. The ability of the 18-8 stainless grades to maintain clean surfaces often allows better heat transfer than other metals having higher thermal conductivity.

SPECIFIC HEAT

°F	°C	Btu/lb/°F	J/kg °K
68	20	0.108	450
200	93	0.116	485

MAGNETIC PERMEABILITY
Austenitic stainless steels are nonmagnetic in the annealed, fully austenitic condition. The magnetic permeability of the Type 316 in the annealed condition is generally less than **1.02 at 200 H (oersteds)**.

ELECTRICAL RESISTIVITY

Value at 68° F (20° C)	
Microhm-in	Microhm-cm
29.1	74.0

MECHANICAL PROPERTIES
Room Temperature Mechanical Properties
Minimum mechanical properties for annealed Types 316 and 316L austenitic stainless steel plate, sheet and strip as required by ASTM specifications A240 and ASME specification SA-240, are shown below.

Property	Minimum Mechanical Properties	
	Type 316	Type 316L
Yield Strength 0.2% Offset psi (MPa)	30,000 (205)	25,000 (170)
Ultimate Tensile Strength psi (MPa)	75,000 (515)	70,000 (485)
Percent Elongation in 2 in. or 51 mm	40.0	40.0
Hardness, Max. Brinell (RB)	217 (95)	217 (95)

PHYSICAL PROPERTIES

Melting Range	2540-2630ºF (1390-1440ºC)
Density	0.29 lb/in^3 (8.027g/cm^3)
Specific Gravity	8.03
Modulus of Elasticity in Tension	29 x 10^6 (200 GPa)*

* In the cold worked condition, the modulus is lowered.