



## Nitronic® 60 Stainless Steel (UNS S21800)

Electralloy's Nitronic® 60 Stainless Steel provides a significantly lower cost alternative to fight wear and galling compared to cobalt and high nickel alloys. Its uniform corrosion resistance exceeds Type 304 in most media. Chloride pitting resistance is superior to Type 316 and room temperature yield strength is twice that of 304 or 316. Nitronic® 60 offers excellent high temperature oxidation resistance and low temperature impact resistance.

### CHEMICAL COMPOSITION (Nominal Analysis, weight percent)

<b>Carbon</b> ( <i>max.</i> ).....	<b>0.10</b>	<b>Silicon</b> ( <i>max.</i> ).....	<b>3.5/4.5</b>
<b>Manganese</b> .....	<b>7.0/9.0</b>	<b>Chromium</b> .....	<b>16.0/18.0</b>
<b>Phosphorus</b> ( <i>max.</i> ).....	<b>0.04</b>	<b>Nickel</b> .....	<b>8.0/9.0</b>
<b>Sulfur</b> ( <i>max.</i> ).....	<b>0.010</b>	<b>Nitrogen</b> .....	<b>0.08/0.18</b>

### TYPICAL APPLICATIONS

Outstanding galling resistance at both room temperature and elevated temperatures makes Electralloy's **Nitronic® 60** Stainless Steel a valuable material for valve stems; seats and trim; fastening systems, including nuts and bolts; chain drive systems; pins, bushings and bearings; and pump components such as wear rings and lobes. **Nitronic® 60** is the most effective wear and galling resistant material for bridge pins and is used in hydroelectric dam wear applications. Cavitation erosion resistance of **Nitronic® 60** is superior to the austenitic stainless steels as well as duplex stainless steels making it highly successful for wear rings in vertical centrifugal pumps. The combination of **Nitronic® 60** and **Nitronic® 50** has replaced cobalt wear alloys in some cases. The use of **Nitronic® 60** weld overlay on most other stainless steels and certain carbon steels develops sound deposits with wear galling resistant properties about equal to an all weld deposit.

Electralloy's **Nitronic® 60** Stainless Steel is supplied in ingot, forging billet, bar, plate and welding wire to meet the requirements of the following specifications, and more...

**AMS 5848, ASTM A240, ASTM A276, ASTM A314, ASTM A193 (bolting), ASTM A194 (nuts), ASTM A479, ASTM A580 (wire), ASTM A351 (castings for high temp service), ASTM A743 (castings) AWS A5.9 (ER218 alloy weld wire), ASME Code Case 1817**

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## PHYSICAL PROPERTIES

Typical Magnetic Permeability @ RT:			
0% cold work	—	1.003	
25% cold work	—	1.004	
50% cold work	—	1.007	
75% cold work	—	1.010	
<b>Density:</b> 0.275 lb./in. <sup>3</sup> (7.622 gm/cm <sup>3</sup> )			
<b>Coefficient of Thermal Expansion:</b> (Annealed Material)			
Temperature °F	Temperature °C	10 <sup>-6</sup> in./in./°F	um/m/°C
70 to 200	21 to 93	8.8	15.8
70 to 600	21 to 316	9.6	17.3
70 to 1200	21 to 649	10.3	18.5

## WORKABILITY

Nitronic® 60 may be formed by the same methods used with other austenitic stainless steels. However the alloy is stronger and requires more power for forming and forging. Forging should be accomplished after heating to 2150°F. Additional reheats will be required relative to Type 316. In-process annealing for fabrication or forming may be done at 1900°F to 2000°F.

## HEAT TREATMENT

Annealing is done at 1900°F to 2000°F followed by water quenching. Nitronic® 60 cannot be hardened by heat treatment.

## CORROSION RESISTANCE

General corrosion resistance of Electralloy's Nitronic® 60 Stainless Steel falls between that of Types 304 and 316. Nitronic® 60 does offer better chloride pitting resistance and stress corrosion resistance than Type 316 in laboratory conditions. (Corrosion tests are not normally performed for Nitronic® 60 High Strength.)

## MACHINABILITY

Because of its desirable metallurgical properties of wear and galling resistance, machining of Nitronic® 60 is not easy. However with sufficient power and tool rigidity Nitronic® 60 can be very successfully machined. Use of coated carbide tooling is suggested.

## WELDABILITY

Nitronic® 60 is readily weldable using conventional joining processes. Weld metal tensile strengths are slightly above those of the unwelded base metal. Wear properties are near, but slightly below those of the unwelded base metal.

## MECHANICAL PROPERTIES

Room and Elevated Temperature Tensile:					
	UTS		YS		EI
	ksi	MPa	ksi	MPa	%
<i>Nominal 1" (25.4 mm) dia. bars</i>					
70°F (21°C)	104	717	57	393	62
400°F (204°C)	80	552	34	234	69
1200°F (649°C)	65	448	28	193	49
<b>Minimum Acceptable Tensile Properties:</b> (Annealed Bar)					
Room Temperature	95	655	50	345	50
<b>Effect of Cold Work on room Temperature Properties:</b>					
10%	120	827	91	627	51
30%	161	1110	132	910	26
70%	263	1813	217	1496	10
<b>Impact Data, Annealed Bar:</b>					
°F	°C	ft*lb		J	
70°	21°	>240		>325	
-320°	-196°	160		217	

## WEAR and GALLING RESISTANCE

Galling is defined as the tearing of metal surfaces which suddenly renders a component unusable. The galling resistance and wear resistance of Nitronic® 60 exceed all other austenitic stainless steel, ph and duplex stainless steel, and compares favorably with cobalt or high nickel wear alloys in many test conditions. Nitronic® 60 also performs successfully in elevated temperature service, 800°F - 1500°F (427°C - 816°C), for automotive valve trim, stems and bushings. Many galling resistance and wear compatibility test conditions and results are available in Electralloy's Nitronic® 60 Product Data Bulletin.

## MAGNETIC PERMEABILITY

Nitronic® 60 is characterized by low magnetic permeability even after severe cold working and at cryogenic temperatures.

## NITRONIC® 60 HIGH STRENGTH BAR

Electralloy's Nitronic® 60 bars are also available in a high-strength condition attained by proprietary processing. Bars cannot be subsequently hot forged or welded without loss of strength. Corrosion resistance may also be lessened to varying degrees depending upon environment. Refer to Electralloy's Nitronic® 60 Product Data Bulletin for additional information.

Nitronic® is a registered trademark of AK Steel.

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