

# High Performance Stainless takes the gall



# Nitronic 60

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**N**itronic 60 is truly an all purpose metal. This fully austenitic alloy performs well as a high temperature alloy for temperatures around 1800°F. The oxidation resistance of Nitronic 60 is similar to Type 309 S.S., and far superior to Type 304S.S.

The additions of silicon and manganese have given the alloy a matrix to inhibit wear, galling, and fretting even in the annealed condition. Higher strengths are attainable through cold working the material and is still fully austenitic after severe cold-working. This working does not enhance the

anti-galling properties as is normal for carbon steels and some stainless steels. The benefit to the cold or hot work put into the material is added strength and hardness.

The chromium and nickel additions give it comparable corrosion to 304 and 316 stainless steels, while having a twice the yield strengths of regular stainless steels. The high mechanical strength in annealed parts permits use of reduced cross sections for weight and cost reductions.

Several data sheets are available on the wear compatibility of this alloy with dissimilar couples, as well as self-mated coupled results.

If your galling problem occurs at less than 1500°F, then you should think about switching to a more economical alloy. Nitronic 60 has a better cost advantage than any other alloy available. Other materials require an additional amount of heat treating to raise their hardness, where NITRONIC 60 is excellent in the annealed condition.

## Properties & General Data

Nominal Chemistry					
Cr	Ni	Mn	Si	N	Fe
17	8	8.0	4	0.14	Bal.

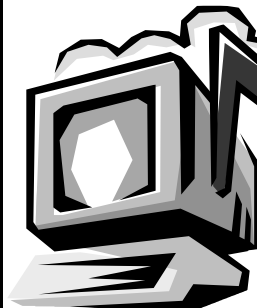
Mechanical Requirements					
Properties	UTS	0.2% YS	Elon.	R/A	Hardness
	(Ksi)	(Ksi)	(%)	(%)	(Rockwell)
Annealed	95-105	50-55	35	55	B 95

These are minimum values for annealed bars up to and over 0.5" Diameter through 12" Bar.

Specification levels for strain hardened bar					
HPA Strength Level	UTS (KSI) Min.	YS (KSI) Min.	Elon. (%) Min.	R/A (%) Min.	Dia Range (Inclusive)
Level 1	110	90	35	55	0.125" - 4"
Level 2	135	105	20	50	0.125" - 4"
Level 3	160	130	15	45	0.125 - 3.5"
Level 4	180	145	12	45	0.062" - 2"
Level 5	200	180	10	45	0.062" - 1.5"

Questions?? Call (800)HPA-LLOY

Density 0.274 lb/in  
 Specific Gravity 7.62  
 Thermal Expansion Coefficient (68 to 212°F)  
 8.8X10<sup>-6</sup> in/in/Deg F  
 Electrical Resistivity (68°F)  
 589 Ohms/ cir mil ft  
 Tensile Modulus of Elasticity 26x10<sup>6</sup> psi



**High Performance Alloys, Inc.**  
 444 Wilson St.  
 P.O. Box 40  
 Tipton, IN 46072  
 Tel (765)675-8871  
 Fax (765)675-7051

Any questions or comments can also be sent via E-Mail to:  
[Info@hpalloy.com](mailto:Info@hpalloy.com)  
[www.hpalloy.com](http://www.hpalloy.com)

## Specifications Listed

UNS S21800  
 Bar ASTM A276  
 ASTM A479  
 AMS 5848  
 LMA M7060  
 Plate/Sheet ASTM A240  
 Pipe & Tube SPECIALS  
 Billet ASTM A314  
 Fasteners A193 / A194  
 Welding Wire AWS A5.9 ER218

The typical properties listed on page one can be provided in rounds, wire, ribbon, strip & flat bar upon request. We have some high strength rounds & strip in stock, but will be glad to make a particular form, size or strength to meet our customers' exacting needs. See our GFM Edition Bulletin for further details on lead times & size capacities for high strength bar or long length requirements.

## Industry Applications

**Automotive valves** - can withstand gas temperatures of up to 1500°F for a minimum of 50,000 miles.

**Fastener galling** - capable of frequent assembly and disassembly, allowing more use of the fastener before the threads are torn up, also helps to eliminate corroded or frozen fasteners.

**Pins** - Used in roller prosthetics & chains to ensure a better fit of parts (closer tolerance, non-lubricated) and longer lasting.

**Marine shafts** - better corrosion than types 304 and 316, with double the yield strength.

**Pin and hanger expansion joints for bridges** - better corrosion, galling-resistance, low temperature toughness, & high charpy values at sub-zero temps compared to the A36 and A588 carbon steels commonly used.

## Corrosion Properties

The corrosion resistance of Armco NITRONIC 60 Stainless Steel falls between that of types 304 and 316. However, experience shows that in a wear system, a galling or seizure failure occurs first, followed by dimensional loss due to wear, and finally corrosion. Galling and wear must be the first concerns of the design engineer. Although the general corrosion resistance of NITRONIC 60 is not quite as good as Type 316, it does offer better chloride pitting resistance, stress corrosion cracking resistance and crevice corrosion resistance than Type 316 in laboratory conditions. Corrosion tests are not normally performed with NITRONIC 60 High Strength.

[www.hpalloy.com](http://www.hpalloy.com)

## MACHINING DATA

**Machinability Rating**  
 AISI B 1112 100%  
 Type 304 S.S. 45%  
 Nitronic 60 23%

Based on 1" Dia Annealed (Rp 95) 5 hour form tool life using high-speed tools.

Carbide tools are suggested, for rates better than 50% of Type 304.

Suggested starting rates are:

### Single Point turning :

**Roughing** - 0.15" depth, 0.015"/rev feed - 175 SFM  
**Finishing** - 0.025" depth, 0.007"/rev feed - 200 SFM

### Drilling :

**1/4" Dia hole** - 0.004"/rev feed - 60 SFM  
**1/2" Dia hole** - 0.007"/rev feed - 60 SFM  
**3/4" Dia hole** - 0.010"/rev feed - 60 SFM

### Reaming :

Feed - same as drilling - 100 SFM

### Side and Slot Milling :

**Roughing** - 0.25" depth - 0.007"/tooth feed - 125SFM  
**Finishing** - 0.050" depth - 0.009"/tooth feed - 140SFM

These rates are for carbide tools, Type C-2 for roughing, drilling and reaming. Type C-3 for finishing.

More information about casting repairs, or weld overlays can be obtained by request.

*High Performance stocks 25# spools 0.045" & 0.063" Dia And 1/8" Dia X 36" cut lengths to the AWS A.5 ER218*

*Material in this bulletin has been reprinted from Armco Bulletin No S-45, other Armco sources, and HPA data.*

## Corrosion (continued)

### Carburization Resistance

Armco NITRONIC 60 stainless retained the best combination of strength and ductility after exposure compared to Types 316L and 309, as shown below.

Alloy	Exposed	UTS	YS	Elon.	Bend
		ksi	ksi	% in (0.2%)	1.5T 4XD
Nitronic 60	No	116.0	49.5	74.0	180°
Nitronic 60	Yes	91.5	58.0	19.0	100°
Type 316L	No	76.0	30.0	74.4	180°
Type 316L	Yes	65.0	36.0	21.3	110°
Type 309	No	99.0	54.0	64.7	180°
Type 309	Yes	85.5	45.5	14.0	75°

## Welding Data

**N**ITRONIC 60 is readily welded using conventional joining processes. It can be handled like 304 and 316 S.S. No preheat or post weld heat treatments are necessary, other than the normal stress relief used in heavy fabrication. Most applications would use Nitronic 60 in the as-welded condition, unless corrosion resistance is a consideration.

Fillerless fusion welds (autogenous) have been made using GTA. These welds are free from cracking and have galling and cavitation resistance similar to the unwelded base metal. Heavy weld deposits using this process are sound and exhibit higher strength than the unwelded base metal. The metal to metal wear resistance of the GMA welds are slightly lower than the base metal wear resistance.

Welding of Nitronic 60 to itself needs to be looked at from the standpoint of the application. Factors such as strength, galling or corrosion need to be addressed to determine the type of filler and processing. For a good high strength weld use Nitronic 60, 309 or 310 as fillers in the as welded condition. For austenitic or wear resistance, use only the base for deposit or Nitronic 60 filler in the as welded condition. For best corrosion results compared to type 304 or 316, use Nitronic 60 filler and an anneal is necessary.