

# High Performance Stainless takes the stress



## NITRONIC 50 Stainless Steel Product Description

NITRONIC 50 Stainless Steel provides a combination of corrosion resistance and strength not found in any

other commercial material available in its price range. This austenitic stainless has corrosion resistance greater than that provided by Types 316 and 316L, plus approximately twice the yield strength at room temperature. In addition, Armco NITRONIC 50 Stainless has very good mechanical properties at both elevated and sub-zero temperatures. And, unlike many austenitic stainless steels, NITRONIC 50 does not become magnetic when cold worked.

## High Strength (HS) Bar Properties

NITRONIC 50 stainless bars also are available in a high-strength condition attained by special processing techniques. The superior strength of NITRONIC 50 HS produced by hot-rolling is size dependent, approaching that of annealed bars with sizes over 3" diameter. Because its high strength is produced by mill processing, welding operations cannot be performed on this material without loss of strength. High-strength bars produced by rotary forging-special practice may have somewhat reduced resistance to corrosion and sulfide stress cracking.

*Also ask us about our full line of Nitronic 60 : Bar, weld wire, sheet, plate and special pipe and tube!*

High Performance Alloys can make hot rolled, cold worked, & strain hardened High Performance Stainless steel bars in house now. Ask for our GFM Bulletin for more information about our bar processing capabilities. We have expanded to enhance product availability. HPA also does a full line of high strength Nickel based Alloys.

Nominal Chemistry						
Cr	Ni	Mn	Mo	Si	N	Fe
22	12.5	5	2.25	1.0 Max	0.3	Bal.

Typical Mechanicals					
Properties	UTS	0.2% YS	Elong.	R/A	Hardness
Condition	(Ksi)	(Ksi)	(%)	(%)	(Rockwell)
Annealed	116	57	47	70	B 91

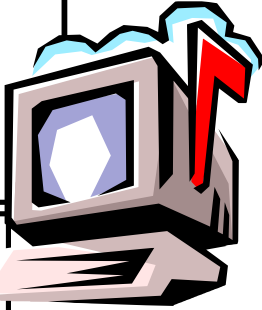
These are typical results, and should only be used as reference points. A normal high strength order parameter would be one of the following : % CW, a min. Hardness, Tensile or Tensile & Yield.

Specification levels for strain hardened bar					
HPA Strength Level	UTS (KSI) Min.	YS (KSI) Min.	Elong. (%) 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 - 2.375"
Level 4	180	145	12	45	0.062" - 2"
Level 5	200	180	10	45	0.062" - 1.5"

# Questions?? Call (800)HPALLOY

Density 75°C 0.285 lb/in  
 Specific Gravity 7.88  
 Thermal Expansion Coefficient (70 to 200°F)  
 9.0X10<sup>-6</sup> in/in/Deg F  
 Electrical Resistivity (68°F) 492 Ohms/ cir mil ft  
 Tensile Modulus of Elasticity 28x10<sup>6</sup> psi  
 Torsional Modulus of Elasticity 10x10<sup>6</sup> psi

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Any questions or comments can also be sent via E-Mail to:  
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Although Armco NITRONIC 50 stainless is considerably stronger than the conventional 300 series stainless steels, the same fabricating equipment and techniques can be used. In-process annealing should be done at 2050 F. Cooling practices are the same as those required for the 300 series. forging temperatures of 2150 F to 2250 F are recommended. Slower speeds and higher feeds may have to be employed during machining operations than those used for Type 316.

## Welding

In addition to the improved corrosion resistance, NITRONIC 50 can be welded successfully using conventional welding processes that are normally employed with the austenitic stainless steels. As with most stainless steels, good weld joint properties can be obtained without the necessity of preheat or postweld annealing. The matching weld filler (NITRONIC 50 AWS E/ER209) for Armco NITRONIC 50 Stainless Steel is similar to many of the regular austenitic stainless steel filler metals in that a small percentage of magnetic ferrite phase has been introduced to as sure sound weld deposits. If the strength levels or superior corrosion resistance in the weld deposits are not required, other filler metals can be used to advantage because of reduced costs and/or ready availability. The small quantity of the second phase usually produces a magnetic permeability value of approximately 1.2 in shielded metal-arc weld deposits. This corresponds to a ferrite number (FN) of approximately 6. Highly overalloyed Ni base fillers are suggested for applications requiring high resistance to pitting media or very low as-deposited magnetic permeability.

### GTA Weld Joints

Gas tungsten arc weld joints have been fused successfully in several fiat-rolled gauges of Armco NITRONIC 50

# Fabrication & Welding Data

Resistance (cont.)

produce sound, high-strength joints in

both annealed and cold-reduced sheet.

Average shear strength data for spot welded joints in Armco

NITRONIC 40 Stainless Steel appear in the Product Data Bulletin, "Armco NITRONIC 40 Stainless Steel Sheet and Strip. Armco NITRONIC 50 Stainless Steel is expected to perform in a similar manner.

### Conventional Weld Filler Metal

Armco NITRONIC 50 stainless can be readily welded with the more conventional austenitic weld - provided that the design of a particular application can accommodate the differences in strength and corrosion characteristics.

### GTA Weld Joints (Cont.)

Stainless Steel.

Mechanical property values similar to those of the base metal have been obtained in the as-welded condition. The corrosion resistance of GTA welded joints has been evaluated using the standard Huey test (ASTM A 262, Practice C) for detecting intergranular attack in stainless steels. Laboratory test experience shows that welds made using the NITRONIC 50W Stainless Steel filler metal exhibit the same resistance to intergranular attack as the base metal.

### Heavy Section Weld Joint Properties

The mechanical properties of welds in 1-1/4" (32.1 mm) thick plate have been determined using two weld processes that are normally employed in heavy section welding, namely, (a) shielded metal arc (SMA) or stick electrode welding and (b) gas metal arc (GMA) or MIG welding with the spray mode. Heat input is important in obtaining the most satisfactory weld joint. Narrow stringer beads rather than a wide "weave" technique should be used for highest weld ductility. Good shielding of the molten puddle is important to eliminate additional nitrogen from the atmosphere that could cause porosity. Both stringer beads and adequate shielding are normal factors in good stainless steel welding practice.

### Resistance Welding

Although no direct resistance welding experience has been obtained with Armco NITRONIC 50 Stainless Steel, the similarity of the alloy to Armco NITRONIC 40 Stainless Steel suggests a good response to resistance spot welding and cross-wire welding techniques. The welding schedules outlined in the fabricating bulletin, "Welding Armco Stainless Steels," can be used as a guide to

## MACHINING DATA

### Machinability Rating

AISI B 1112 100%

Type 304 S.S. 45%

Nitronic 50 21%

Based on 1" Dia Annealed (R<sub>B</sub> 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* - 90-140 SFM

*Finishing* - 120-190 SFM

### Drilling : 30 to 50 SFM

### Reaming : 90 SFM

### Side and Slot Milling :

*Roughing* - .25" depth - 0.007"/tooth 125SFM

*Finishing* - .050" depth - 0.009"/tooth 140SFM

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

Alloy produces good surface finish.

## Typical Mechanical Properties Armco NITRONIC 50 Stainless Plate Weld Joints

Weld Process	Weld Filler	UTS ksi (MPa)	0.2% YS ksi (MPa)	Elong. % in 2"	Red. in Area. %	Failure Location
Shielded Metal Arc (SMA)	NITRONIC 50W	113 (779)	78 (524)	20	36	Weld Metal
Gas Metal Arc (GMA) Spray	NITRONIC 50W	112 (772)	77 (531)	21	30	Weld Metal

## Specifications Listed

UNS S20910  
 Bar ASTM A276  
 ASTM A479  
 AMS 5764  
 Plate/Sheet ASTM A240  
 ASTM A412  
 AMS 5861  
 Pipe & Tube SPECIALS  
 ASTM A312  
 ASTM A403  
 Forgings ASTM A314  
 Fasteners A193 / A194  
 Welding Wire AWS ER209  
 NACE MR-01-75

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

- **Superior corrosion resistance**
- **Almost double the yield strength**
- **Exceptionally low magnetic permeability**
- **Outstanding cryogenic properties**

### Applications Potential

Outstanding corrosion resistance gives NITRONIC 50 Stainless Steel the leading edge for applications where Types 316, 316L, 317 and 317L are only marginal. It's an effective alloy for the petroleum, petrochemical, chemical, fertilizer, nuclear fuel recycling, pulp and paper, textile, food processing and marine industries.

Components using the combination of excellent corrosion resistance and high strength currently include pumps, valves and fittings, fasteners, cables, chains, screens and wire cloth, marine hardware, boat and pump shafting, heat exchanger parts, springs and photographic equipment.

**Fastener** - High strength, and higher strength fasteners can improve the durability of your equipment

**Marine hardware** - Mastings, tie downs

**Marine and Pump shafts** - Better corrosion than types 304 and

**Valves and fittings** - 316, with double the yield strength.

**Downhole rigging** -

**Reduced cross sections** -

## Corrosion Properties

### Corrosion Resistance

Armco NITRONIC 50 Stainless Steel provides outstanding corrosion resistance - superior to Types 316, 316L, 317 and 317L in many media. For many applications the 1950 F (1066 C) annealed condition provides adequate corrosion resistance and a higher strength level. In very corrosive media or where material is to be used in the as-welded condition, the 2050 F (1121 C) annealed condition should be specified. High-Strength (HS) NITRONIC 50 bars are useful for applications such as shafting and bolting, but do not quite exhibit the corrosion resistance of the annealed conditions in all environments.

### Intergranular Attack

The resistance to intergranular attack is excellent even when sensitized at 1250 F (675 C) for one hour to simulate the heat-affected zone of heavy weldments. Material annealed at 1950 F (1066 C) has very good resistance to intergranular attack for most applications. However, when thick sections are used in the as-welded condition in certain strongly corrosive media, the 2050 F (1121 C) condition gives optimum corrosion resistance.

### Stress-Corrosion Cracking Resistance

In common with most stainless steels, under certain conditions, Armco NITRONIC 50 Stainless Steel may stress-corrosion crack in hot chloride environments. When tested in boiling 420/0 MgCl<sub>2</sub> solution, a very accelerated test, NITRONIC 50 Stainless Steel is between types 304 and 316 stainless steels in resistance to cracking. There is little difference in susceptibility to cracking whether in the annealed, high-strength (HS), or cold-drawn conditions.

### Sulfide Stress Cracking

Both laboratory tests and field service experience have shown that Armco NITRONIC 50 stainless has excellent resistance to sulfide stress cracking in air conditions. NITRONIC 50 in both the annealed and high-strength (hot rolled) conditions has been included in the 1996 revision of NACE Standard MR-01 -75' "Sulfide Stress Cracking Resistant Metallic Material for Oil Field Equipment," at hardness levels up to RC 35 maximum. The resistance to cracking in laboratory tests in synthetic sour-well solution.

(5% NaCl + ½% acetic acid, saturated with H<sub>2</sub>S)

### Annealing Temperature

For best corrosion resistance, Armco NITRONIC 50 Stainless Steel can be supplied annealed at 1950 F to 2050 F (1066 C to 1121 C). For most applications, the 1950 F (1066 C) condition should be selected, as it provides a higher level of mechanical properties along with excellent corrosion resistance. When as-welded material is to be used in strongly corrosive media, the 2050 F (1121 C) condition should be specified in order to minimize the possibility of intergranular attack.

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