



## Nitronic® 40 Stainless Steel (UNS S21900, S21904, XM10, XM11)

Electralloy's Nitronic® 40 Stainless Steel is a nitrogen strengthened austenitic stainless steel with great versatility, combining high yield strength with good corrosion resistance. Room temperature yield strength is about twice that of Types 304, 321 and 347. Nitronic® 40 provides remarkably good elevated temperature properties and also retains its high strength and toughness at cryogenic temperatures. It has good high temperature oxidation resistance in air and resists stress corrosion cracking in severe marine environments at ambient temperature. Its austenite is so stable that it remains essentially non-magnetic at cryogenic temperatures or after up to 60% cold work.

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

|                                |                 |                             |                  |
|--------------------------------|-----------------|-----------------------------|------------------|
| <b>Carbon (max.)</b> .....     | <b>0.04</b>     | <b>Silicon (max.)</b> ..... | <b>1.00</b>      |
| <b>Manganese</b> .....         | <b>8.0/10.0</b> | <b>Chromium</b> .....       | <b>19/21.5</b>   |
| <b>Phosphorus (max.)</b> ..... | <b>0.04</b>     | <b>Nickel</b> .....         | <b>5.5/7.5</b>   |
| <b>Sulfur (max.)</b> .....     | <b>0.010</b>    | <b>Nitrogen</b> .....       | <b>0.20/0.40</b> |

### TYPICAL APPLICATIONS

**Electralloy's Nitronic® 40** is used in aircraft components; ducting, bellows systems, clamps, fasteners, flanges; pollution control and chemical processing; cryogenic service; and in the nuclear industry.

**Electralloy's Nitronic® 40** Stainless Steel is supplied in ingot, forging billet, bar and plate to meet the requirements of the following specifications, and more . . .

**AMS 5561, AMS 5562, AMS 5595, ASM 5656, ASTM 182, ASTM A269, ASTM A276, ASTM A312, ASTM A314, ASTM A473, ASTM A479, ASTM A580, ASTM A666, ASTM A813, ASTM A814, ASTM A943, ASTM A965, ASTM A988, ASME SA-412**

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## PHYSICAL PROPERTIES

|   |                |                                |                     |
|---|----------------|--------------------------------|---------------------|
| <b>Magnetic Permeability:</b> (Annealed Bar)                          |                |                                |                     |
| 75°F (24°C)   | —              | ~1.002                         |                     |
| -320°F (-196°C)   | —              | ~1.005                         |                     |
| <b>Typical Magnetic Permeability @ RT:</b>                            |                |                                |                     |
| Annealed  | —              | 1.004                          |                     |
| 15% cold work   | —              | 1.003                          |                     |
| 35% cold work   | —              | 1.005                          |                     |
| 60% cold work   | —              | 1.012                          |                     |
| <b>Density:</b> 0.283 lb./in. <sup>3</sup> (7.83 gm/cm <sup>3</sup> ) |                |                                |                     |
| <b>Poisson's Ratio:</b> (Annealed) 0.285                              |                |                                |                     |
| <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       | 9.3                            | 16.7                |
| 70 to 600   | 21 to 316      | 10.1                           | 18.2                |
| 70 to 1400  | 21 to 760      | 11.1                           | 20.0                |
| <b>Thermal Conductivity:</b>  |                |                                |                     |
| Temperature °F  | Temperature °C | BTU/ft <sup>2</sup> /in./°F/hr | W/m <sup>2</sup> *K |
| -290  | -179           | 54                             | 7.8                 |
| 200   | 93             | 96                             | 13.8                |
| 800   | 427            | 140                            | 20.2                |
| <b>Electrical Resistivity:</b>  |                |                                |                     |
| Temperature   |                | Resistivity                    |                     |
| °F  | °C             | microhm-cm                     |                     |
| 75  | 24             | 73                             |                     |

## HOT WORKABILITY

Nitronic® 40 may be hot worked by the same methods used with other austenitic stainless steels. However the alloy is stronger and requires more power for forging. Heating for hot working should be in temperature range of 2100°F to 2200°F.

## FABRICABILITY

Although it has higher yield strength than Type 304, Nitronic® 40 may be formed on the same fabricating equipment, with the same techniques, only more power. In-process annealing may be done between 1950°F to 2050°F.

## HEAT TREATMENT

Final annealing is done at 1900°F to 2000°F followed by rapid cooling. Nitronic® 40 cannot be hardened by heat treatment.

## MECHANICAL PROPERTIES

|   |             |      |        |     |    |
|---|-------------|------|--------|-----|----|
| <b>Minimum Acceptable Room Temperature Tensile:</b>   |             |      |        |     |    |
|   | UTS         |      | YS     |     | EI |
|   | ksi         | MPa  | ksi    | MPa | %  |
| Annealed Bar  | 90          | 621  | 50     | 345 | 45 |
| <b>Typical Short-Time Cryogenic and Elevated Temperature Tensile Properties:</b> (Annealed Bar) |             |      |        |     |    |
| -320°F (-196°C)   | 216         | 1489 | 119    | 820 | 36 |
| -100°F (-73°C)  | 136         | 938  | 79     | 545 | 51 |
| Room Temp.  | 104         | 717  | 54     | 372 | 55 |
| 400°F (204°C)   | 84          | 579  | 32     | 221 | 52 |
| 800°F (427°C)   | 76          | 524  | 27     | 186 | 50 |
| 1000°F (538°C)  | 69          | 476  | 24     | 52  |    |
| <b>Typical Charpy V-Notch Toughness:</b> (Annealed Bar)   |             |      |        |     |    |
| Room Temperature  | >240 ft*lbs |      | >324 J |     |    |
| -100°F (-73°C)  | 230 ft*lbs  |      | 310 J  |     |    |
| -320°F (-196°C)   | 115 ft*lbs  |      | 21 J   |     |    |

## CORROSION RESISTANCE

Electralloy's Nitronic® 40 exhibits good resistance to high temperature oxidation in air. Its general corrosion resistance in chemical media, industrial and marine environments is similar to that of Type 304 stainless steel. Nitronic® 40 has shown excellent stress-corrosion cracking resistance in tests for 15 years at ambient temperatures in severe seacoast atmospheres.

## MACHINABILITY

Nitronic® 40 is machined to same methods as other austenitic stainless steels, and like those alloys, also work hardens during machining. This requires rigid tooling, heavy feeds and slower speeds.

## WELDABILITY

Nitronic® 40 is readily weldable using TIG, MIG and shielded metal arc welding methods. Like other Nitronic® grades the high nitrogen content can interfere with electron beam welding by severe outgassing.

## MAGNETIC PERMEABILITY

Nitronic® 40 is useful in applications where low magnetic permeability is important because it remains essentially non-magnetic even in sub-zero temperatures or after severe cold working.

Nitronic® is a registered trademark of AK Steel.

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