Technical Datasheet

CARPENTER

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Printer Friendly Datasheet

CarTech® EnduraMet® 316LN Stainless

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Identification

UNS Number

- S31653

DIN Number

- 1.4429

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.03 %	**Manganese (Maximum)**	2.00 %
Phosphorus (Maximum)	0.045 %	**Sulfur (Maximum)**	0.030 %
Silicon (Maximum)	1.00 %	**Chromium**	16.00 to 18.00 %
Nickel	10.00 to 14.00 %	**Molybdenum**	2.00 to 3.00 %
Nitrogen	0.10 to 0.16 %	**Iron**	Balance

General Information

Description

CarTech EnduraMet 316LN stainless is a nitrogen-strengthened version of Type 316L stainless. By means of solid solution strengthening, the nitrogen provides significantly higher yield and tensile strength as annealed than Type 316L without adversely affecting ductility, corrosion resistance or non-magnetic properties. In the hot rolled unannealed condition, yield strengths of 75 ksi (518 MPa)or higher can be achieved for bar diameters up to 1.375in (34.925 mm).

Applications

Rebar has been a primary application for CarTech EnduraMet 316LN stainless. Specific rebar applications have included bridge decks, barrier and retaining walls, anchoring systems, chemical plant infrastructure, coastal piers and wharves, bridge parapets, sidewalks, and bridge pilings. Because of its low magnetic permeability, CarTech EnduraMet 316LN has been used in concrete rebar applications in close proximity to sensitive electronic devices and magnetic resonance medical equipment. The higher strength capability, 75 ksi (518 MPa) minimum yield strength, of CarTech EnduraMet 316LN is an added economical advantage.

Scaling

EnduraMet 316LN stainless has excellent scale resistance up to 1600°F (871°C).

Corrosion Resistance

EnduraMet 316LN stainless has good resistance to atmospheric corrosion and long-term resistance to general corrosion when embedded in concrete. In the 15 week corrosion macrocell test in simulated concrete pore solution, EnduraMet 316LN stainless had an average corrosion rate less than 0.25 micro-meter/yr.

In general, the corrosion resistance of EnduraMet 316LN stainless is similar to Type 316L. The higher nitrogen content enhances chloride pitting and crevice corrosion resistance.

EnduraMet 316LN withstands not only ordinary rusting but also most of the organic and inorganic chemicals. It resists corrosion by nitric acid and sulfurous acid compounds.

EnduraMet 316LN has good intergranular corrosion in the as-annealed and as-welded conditions due to its low carbon content. Some intergranular attack may occur in the hot rolled unannealed condition.

For optimum corrosion resistance, surfaces must be free of scale, lubricants, foreign particles, and coatings applied for drawing and heading. After fabrication of parts, cleaning and/or passivation should be considered.

Important Note: *The following 4-level rating scale is intended for comparative purposes only. Corrosion testing is recommended; factors which affect corrosion resistance include temperature, concentration, pH, impurities, aeration, velocity, crevices, deposits, metallurgical condition, stress, surface finish and dissimilar metal contact.*

Nitric Acid	Good	Sulfuric Acid	Moderate
Phosphoric Acid	Moderate	Acetic Acid	Good
Sodium Hydroxide	Moderate	Salt Spray (NaCl)	Good

Sea Water	Moderate	Sour Oil/Gas	Moderate
Humidity	Excellent		

Properties

Physical Properties

Specific Gravity	
Annealed	7.91
As Rolled	7.90
Density	
Annealed	0.2860 lb/in³
As Rolled	0.2850 lb/in³
Mean CTE	
77 to 122°F, Annealed	9.32 x 10^{-6} in/in/°F
77 to 212°F, Annealed	9.23 x 10^{-6} in/in/°F
77 to 302°F, Annealed	9.29 x 10^{-6} in/in/°F
77 to 392°F, Annealed	9.46 x 10^{-6} in/in/°F
77 to 482°F, Annealed	9.52 x 10^{-6} in/in/°F
77 to 572°F, Annealed	9.69 x 10^{-6} in/in/°F
77 to 662°F, Annealed	9.78 x 10^{-6} in/in/°F
77 to 752°F, Annealed	9.87 x 10^{-6} in/in/°F
77 to 842°F, Annealed	9.96 x 10^{-6} in/in/°F
77 to 932°F, Annealed	10.0 x 10^{-6} in/in/°F
77 to 1012°F, Annealed	10.1 x 10^{-6} in/in/°F
77 to 1112°F, Annealed	10.2 x 10^{-6} in/in/°F
77 to 1202°F, Annealed	10.3 x 10^{-6} in/in/°F
77 to 1292°F, Annealed	10.4 x 10^{-6} in/in/°F
77 to 122°F, Hot Rolled	7.90 x 10^{-6} in/in/°F
77 to 212°F, Hot Rolled	8.76 x 10^{-6} in/in/°F
77 to 302°F, Hot Rolled	9.11 x 10^{-6} in/in/°F
77 to 392°F, Hot Rolled	9.32 x 10^{-6} in/in/°F
77 to 482°F, Hot Rolled	9.48 x 10^{-6} in/in/°F
77 to 572°F, Hot Rolled	9.62 x 10^{-6} in/in/°F
77 to 662°F, Hot Rolled	9.72 x 10^{-6} in/in/°F
77 to 752°F, Hot Rolled	9.84 x 10^{-6} in/in/°F
77 to 842°F, Hot Rolled	9.96 x 10^{-6} in/in/°F
77 to 932°F, Hot Rolled	10.1 x 10^{-6} in/in/°F
77 to 1012°F, Hot Rolled	10.2 x 10^{-6} in/in/°F
77 to 1112°F, Hot Rolled	10.3 x 10^{-6} in/in/°F
77 to 1202°F, Hot Rolled	10.4 x 10^{-6} in/in/°F
77 to 1292°F, Hot Rolled	10.5 x 10^{-6} in/in/°F

- Mean Coefficient of Thermal Expansion

Typical Mechanical Properties

- CVN Impact Data
- Mechanical Properties - Various Test Temperatures
- RR Moore Rotating Beam Fatigue Tests
- Typical Room Temperature Hot Rolled Mechanical Properties

Heat Treatment

Annealing

Heat to 1850/2050°F (1010/1121°C) and rapidly quench in water or air. Typical hardness is Rockwell B 90/95.

Hardening

Cannot be hardened by heat treatment.

Workability

Hot rolling and controlling the finishing temperature can strengthen EnduraMet 316LN bar. After hot rolling, bars are not annealed.

Hot Working

EnduraMet 316LN stainless hot works similar to Type 316L, except more power is required to produce the same reduction.

Heat uniformly to 2100/2300°F (1149/1260°C). Reheat as often as necessary. Cool forgings in air. For optimum corrosion resistance, forgings must be annealed.

Cold Working

EnduraMet 316LN stainless can be heavily cold worked without intermediate annealing. Because of its higher initial strength, more power is required than Type 316L. Cold working can significantly increase strength and hardness.

Machinability

The machinability of EnduraMet 316LN is similar to other nitrogen-strengthened stainless steels, like EnduraMet 18Cr-3Ni-12Mn. Slow to moderate speeds, moderate feeds and rigid tools should be considered. Chips lend to be tough and stringy. Chip curlers or breakers are helpful. Use a sulfurized cutting fluid, preferably of the chlorinated type.

Following are typical feeds and speeds for EnduraMet 316LN stainless.

- Machinability Tables

Weldability

EnduraMet 316LN stainless can be satisfactorily welded by the shielded and resistance welding processes. Oxyacetylene welding is not recommended, since carbon pickup in the weld may occur. Since austenitic welds do not harden on air cooling, the welds should have good toughness.

When a filler metal is required, consider using a welding consumable with a matching analysis to Type 316LN or AWS E/ER 209. Both should provide welds with strength approaching that of the base metal. If high weld strength is not necessary, then consider AWS E/ER 316L.

Post-weld annealing is not required for most applications, but will provide optimum properties for severe service.

Other Information

Applicable Specifications

- ASTM A240
- ASTM A276
- ASTM A479
- ASTM A955
- BS 6744: 2001

Forms Manufactured

- Bar-Rounds
- Billet
- Rebar or (Bar-Reinforcing)
- Strip
- Wire
- Wire-Rod

Technical Articles

- Extending the Life of Concrete Structures with Solid Stainless Steel Reinforcing Bar
- Stainless Steel Rebar For Concrete Reinforcement: An Update And Selection Guide

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