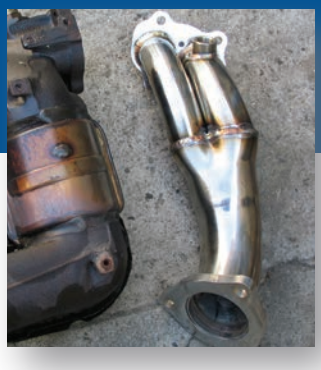
CLIFFS

444
STAINLESS STEEL



Automotive Components

Brewery Equipment

Food Processing

Water Tanks

TYPE 444 is equivalent to Type 304 in many corrosion environments and has lower coefficient of expansion and better thermal conductivity. It has superior chloride stress corrosion cracking resistance to Types 304 and 316. It is oxidation and creep resistant at elevated temperatures, making it a preferred material for the most demanding applications in automotive exhaust. Applications requiring high-quality corrosion resistance and resistance to chloride stress corrosion cracking are ideal for this alloy. Current uses include food processing, brewery and wine-making equipment, hot-water tanks, heat exchanger tubing and automotive components.

Product Description

Type 444 is a low-carbon (C), low nitrogen (N), dual-stabilized ferritic stainless steel that provides pitting and crevice corrosion resistance superior to most ferritic stainless steels and some austenitic stainless steels. Type 444 is dual stabilized with titanium and niobium. Type 444 is equivalent to Type 304 in many corrosion environments and has lower coefficient of expansion and better thermal conductivity. It has superior chloride stress corrosion cracking resistance to Types 304 and 316.

SPECIFICATIONS

Type 444 stainless steel sheet and strip is covered by the following specifications:

- ASTM A268
- ASTM A240

AVAILABLE FORMS

Cleveland-Cliffs produces Type 444 stainless steel in coils and cut lengths in thicknesses 0.010 – 0.090 in. (0.25 – 2.29 mm) and widths up to and including 40 in. (1016 mm).

The values shown in this bulletin were established in U.S. customary units. The metric equivalents of U.S. customary units shown may be approximate.

PHYSICAL PROPERTIES

Density, lbs./in.^{3} (g/cm^3)	0.28 (7.75)
Electrical Resistivity, $\mu\Omega$•in. ($\mu\Omega$•cm) 70 °F (21 °C)	22.50 (57)
Specific Heat, BTU/lbs./°F (kJ/kg•K) 32 – 212 °F (0 – 100 °C)	0.102 (0.427)
Thermal Conductivity, BTU/hr./ft./°F (W/m•K) 212 °F (100 °C)	15.5 (26.8)
Coefficient of Thermal Expansion, in./in./°F (μm/m•K) 32 – 212 °F (0 – 100 °C)	6.1 x 10^{-6} (11.0)

Composition		(wt %)
Carbon	(C)	0.025 max.
Manganese	(Mn)	1.00 max.
Phosphorus	(P)	0.04 max.
Sulfur	(S)	0.03 max.
Silicon	(Si)	1.00 max.
Nitrogen	(N)	0.035 max.
Chromium	(Cr)	17.5 – 19.5
Nickel	(Ni)	1.00 max.
Molybdenum	(Mo)	1.75 – 2.5
Titanium + Niobium	(Ti + Nb)	0.20 + 4(C+N) min., 0.80 max.

Properties

TABLE 1 – TYPICAL MECHANICAL PROPERTIES

UTS, ksi. (MPa)	0.2% YS, ksi. (MPa)	Elongation % in 2 in. (50.8 mm)	Rockwell Hardness
75 (515)	52 (360)	30	B85

TABLE 2 – PROPERTIES ACCEPTABLE FOR MATERIAL SPECIFICATION

UTS, ksi. (MPa)	0.2% YS, ksi. (MPa)	Elongation % in 2 in. (50.8 mm)	Rockwell Hardness
60 (414) min.	40 (276) min.	27 min.	B90 max.

CORROSION RESISTANCE

Type 444 provides excellent corrosion resistance in moderately severe environments of many types, including chlorides and organic acids found in foods and beverages. It also provides satisfactory resistance to dilute sulfuric acid solutions and to highly-concentrated sodium hydroxide.

FORMABILITY

Type 444 provides excellent formability and can be readily deep drawn and spin formed. Stretch forming, however, is limited in application for this material.

WELDABILITY

The ferritic class of stainless steels is generally considered to be weldable by the common fusion and resistance techniques. Special consideration is required to avoid brittle weld fractures during fabrication by minimizing discontinuities, maintaining low weld heat input and occasionally warming the part somewhat before forming. This particular alloy is generally considered to have poorer weldability than the most common alloy of the stainless class, Type 409. A major difference is the higher chromium plus molybdenum and niobium additions for this alloy, which requires even greater care to avoid brittle weld fractures during forming in cold weather. When a weld filler is needed, AWS E/ER 316L is most often specified. Type 444, or Cleveland-Cliffs 18 Cr-2 Mo, is well known in reference literature, and more information can be obtained in this way.

1. ANSI/AWS A5.9, A5.22, and A5.4 (stainless welding electrode specifications).
2. “Welding of Stainless Steels and Other Joining Methods,” SSINA, (www.ssina.com).

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About Cleveland-Cliffs Inc.

Cleveland-Cliffs is the largest flat-rolled steel producer in North America. Founded in 1847 as a mine operator, Cliffs also is the largest manufacturer of iron ore pellets in North America. The Company is vertically integrated from mined raw materials and direct reduced iron to primary steelmaking and downstream finishing, stamping, tooling, and tubing. The Company serves a diverse range of markets due to its comprehensive offering of flat-rolled steel products and is the largest steel supplier to the automotive industry in North America. Headquartered in Cleveland, Ohio, Cleveland-Cliffs employs approximately 25,000 people across its mining, steel and downstream manufacturing operations in the United States and Canada.

CLIFFS

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