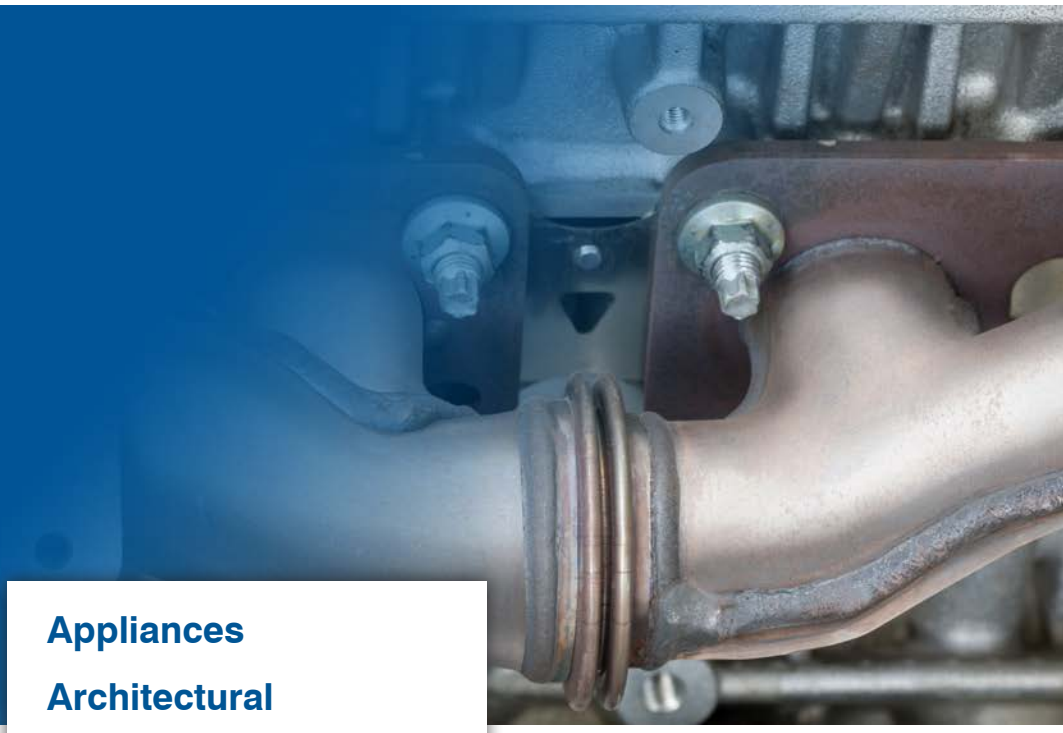
CLIFFS

441
STAINLESS STEEL



- **Appliances**
- **Architectural**
- **Heat Exchangers**
- **Kitchen Equipment**
- **Tubing**

441 STAINLESS STEEL is used in applications requiring improved high-temperature strength and creep resistance over Types 409 and 439. Cleveland-Cliffs 441 is suited for drawn components and bent tubing. Applications include appliances, food and kitchen equipment, heat exchangers and architectural structures.

Product Description

Cleveland-Cliffs 441 is a nominal 18% chromium (Cr) bearing ferritic stainless steel stabilized with niobium (Nb). Cleveland-Cliffs 441 provides good high-temperature strength that exceeds that of Types 409 and 439 stainless steels. Cleveland-Cliffs 441 offers good corrosion resistance in many exhaust gas environments, equivalent to that of Type 439 and Cleveland-Cliffs 18 Cr-Cb™ Stainless Steel.

Composition		(wt %)
Carbon	(C)	0.03 max.
Manganese	(Mn)	1.0 max.
Phosphorus	(P)	0.04 max.
Sulfur	(S)	0.03 max.
Silicon	(Si)	1.00 max.
Chromium	(Cr)	17.5 – 19.5
Nickel	(Ni)	1.00 max.
Niobium	(Nb)	0.30 + 9xC min. 0.90 max.
Nitrogen	(N)	0.03 max.
Titanium	(Ti)	0.10 – 0.50

AVAILABLE FORMS

Cleveland-Cliffs produces 441 stainless steel coils and cut lengths in thicknesses 0.018 – 0.100 in. (0.46 – 2.54 mm) and in widths up to and including 48 in. (1219 mm). For other sizes, contact your Cleveland-Cliffs sales representative.

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.

Mechanical Properties

TABLE 1 – ANNEALED CONDITION

	UTS, ksi. (MPa)	0.2% YS, ksi. (MPa)	Elongation % in 2 in. (50.8 mm)	Rockwell Hardness, B
Cleveland-Cliffs 18 Cr-Cb SS	72 (469) min.	47 (324) min.	30	80
Cleveland-Cliffs 441	71 (490)	45 (310)	32	78

FIGURE 1 – YIELD STRESS VS. TEMPERATURE

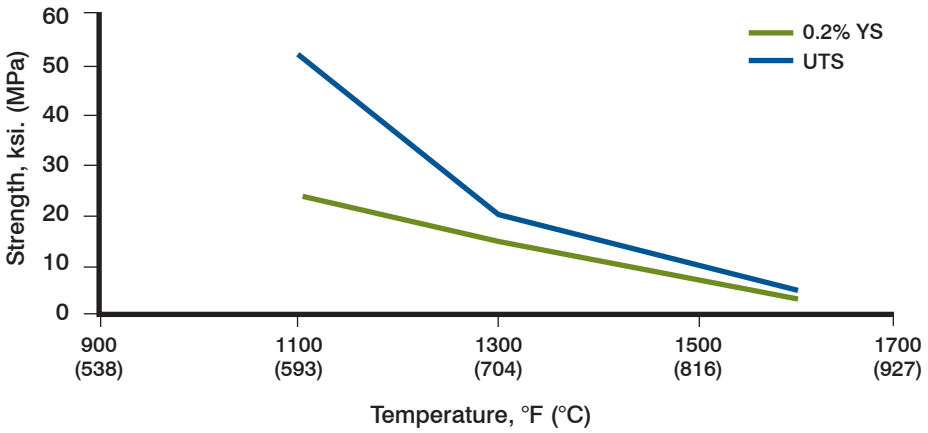


TABLE 2 – SHORT TIME ELEVATED TEMPERATURE MECHANICAL PROPERTIES

Alloy	Stress to rupture in 100 hrs. at 1300 °F (°C), ksi. (MPa)
Type 409	4.1 (28.3)
Type 439	4.0 (27.6)
Cleveland-Cliffs 441	5.0 (34.5)
Cleveland-Cliffs 18 Cr-Cb SS	5.8 (49.9)

Properties

CORROSION RESISTANCE

Cleveland-Cliffs 441 has proven to be equivalent to Cleveland-Cliffs 18 Cr-Cb Stainless Steel in corrosion resistance in continuous corrosion tests conducted. Being a 18% chromium alloy, Cleveland-Cliffs 441 shows improved corrosion and oxidation resistance when compared to standard Type 409 (11% chromium).

CYCLIC OXIDATION RESISTANCE

Cleveland-Cliffs 441 should possess similar (or slightly reduced) cyclic oxidation resistance compared to Cleveland-Cliffs 18 Cr-Cb Stainless Steel, but improved compared to Types 409, 439 and 439 low titanium stainless steels.

WELDABILITY

Cleveland-Cliffs 18 Cr-Cb Stainless Steel is generally considered to be weldable by common fusion and resistance welding processes, including laser and high frequency induction tube welding. This grade is generally considered to have diminished weldability compared to the most common alloy of this stainless class, Type 409. Application of weld heat can cause grain growth and reduced toughness in the Heat Affected Zone (HAZ). Use of a low heat input weld procedure, minimizing stress concentrations and warming of parts slightly prior to forming will reduce the tendency for brittle weld fracture in subsequent processing. The balanced dual stabilized (titanium and niobium) Cleveland-Cliffs 18 Cr-Cb Stainless Steel chemistry is not susceptible to the formation of continuous intergranular carbides that could lead to intergranular corrosion. When a matching weld filler is required, Cleveland-Cliffs 18 Cr-Cb Stainless Steel (No AWS Class) and EC439 Nb wires are often recommended for light gauge high temperature (>1000 °F) service where thermal cycling is expected. The addition of hydrogen to weld shielding gases for increased welding speed is discouraged, as the ferritic stainless steels are subject to hydrogen embrittlement. More information on the welding of ferritic stainless steels may be obtained from the following sources.

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).

CLIFFS

441 STAINLESS STEEL

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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May 2021