

# 409 Ni STAINLESS STEEL



- Superior Corrosion Resistance to Mild and Low-Alloy Steels
- Cost Effective Alternative to Austenitic Stainless
- Readily Welded
- Good Toughness, Particularly in Cold Weather
- High Strength

## AK Steel 409 Ni Stainless Steel Sheet, Strip and Plate

### Applications Potential

AK Steel 409 Ni Stainless Steel is an ideal material for applications requiring weldability and toughness superior to standard Type 409 in gauges greater than 0.120" (3.05 mm), at relatively low cost.

Potential coal-handling applications include chutes, hoppers, bunkers, flooring, perforated plate for sizing, flight conveyor wear liners, vibrating screen pans, blending bin feeders, paddle mixers, screw feeders, fuel bins and dryer components.

Potential transportation applications include hopper car discharge chutes, hopper car bodies, intermodal containers, trailers, bus frames, dump truck bed liners and automotive exhaust flanges.

Additional application potential includes noise suppression barriers, slurry pipelines, heat shields, cyclones, silos, belt scraper blades, screens and tanks.

## Table of Contents

	Page
Applications Potential .....	1
Product Description .....	3
Typical Composition .....	3
Available Forms .....	3
Metric Practice .....	3
Mechanical Properties .....	4
Corrosion Resistance .....	5
Corrosive Wear .....	5
Formability .....	6
Weldability .....	6
Grain Structure .....	7
Physical Properties .....	7

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Data referring to mechanical properties and chemical analyses are the result of tests performed on specimens obtained from specific locations of the products in accordance with prescribed sampling procedures; any warranty thereof is limited to the values obtained at such locations and by such procedures. There is no warranty with respect to values of the materials at other locations.

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# PRODUCT DESCRIPTION

AK Steel 409 Ni is a nominal 11% chromium stainless steel micro-alloyed with titanium, manganese and nickel that provides excellent weldability, toughness and fabricating characteristics in sections over 0.120" (3.05 mm). This is a cost effective alternative to mild and low-alloy steels providing superior corrosion and/or oxidation resistance.

Under wet sliding conditions, such as encountered in coal-handling equipment, AK Steel 409 Stainless Steel is a more cost-effective solution to carbon and AR (abrasion resistant) steels due to the corrosion component of the wear process.

The high-temperature strength and oxidation of this material are superior to carbon steel. The recommended maximum service temperature is 1350°F (730°C).

## Typical Composition

	%
Carbon	0.02
Manganese	0.70
Phosphorus	0.020
Sulfur	0.004
Silicon	0.35
Chromium	11.00
Nickel	0.85
Titanium	0.20
Nitrogen	0.015
Iron	Balance

## Available Forms

AK Steel produces 409 Ni Stainless Steel in hot-annealed and pickled coils in thicknesses from 0.220" to 0.400" (5.56 to 10.16 mm) max. and widths from 6" to 48" (152 to 1219 mm). For other thicknesses and widths, inquire. Capability for cold-rolled product is being developed.

## Metric Practice

Values shown in this bulletin were established in U.S. customary units. The metric equivalents of U.S. customary units shown may be approximate. Conversion to the metric system, known as the International System of Units (SI), has been accomplished in accordance with ASTM E380.

The newton (N) has been adopted by the SI as the metric standard unit of force as discussed in the AISI Metric Practice Guide. The term for force per unit of area (stress) is the newton per square metre (N/m<sup>2</sup>). Since this can be a large number, the prefix mega is used to indicate 1,000,000 units and the term meganewton per square metre (MN/m<sup>2</sup>) is used. The unit (N/m<sup>2</sup>) has been designated a pascal (Pa). The relationship between the U.S. and the SI units for stress is: 1000 pounds/in<sup>2</sup> = 1 kip/in<sup>2</sup> = 6.8948 meganewtons/m<sup>2</sup> (MN/m<sup>2</sup>) = 6.8948 megapascals (MPa).

## Mechanical Properties

**Table 1**

Typical Room Temperature Properties\*

Test Direction	UTS ksi, (MPa)	0.2% YS ksi, (MPa)	Elongation % in 2"	Hardness Rockwell B
Transverse	68.0 (469)	51.0 (352)	28.0	83

\*0.375" (9.5 mm) plate

**Table 2**

Minimum Properties Acceptable for Material Specification\*

	UTS ksi, (MPa)	0.2% YS ksi, (MPa)	Elongation % in 2" (50.8 mm)
AK Steel 409 Ni	60 (415)	40 (276)	20.0
Type 409 (per ASTM A240)	55 (380)	25 (205)	20.0

\*Annealed sheet, strip and plate

AK Steel 409 Ni Stainless Steel offers much higher design strength than standard Type 409 stainless steel as noted by the mechanical properties indicated in Table 2.

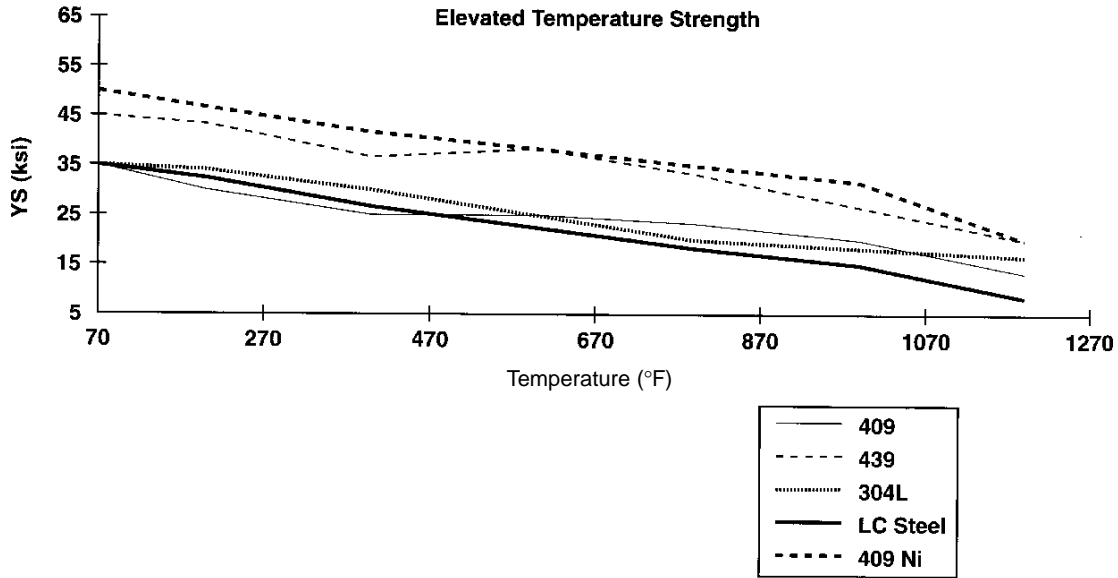
**Table 3**

Impact Strength\*

Specimen Orientation	Temperature °F (°C)	Energy ft-lbs (J)	W/A in-lbs/in <sup>2</sup> (mm•N/mm <sup>2</sup> )
Longitudinal	32 (0)	136 (152)	13,405 (2,346)
Transverse	32 (0)	109 (122)	10,722 (1,876)
Longitudinal	-25 (-32)	86 (96)	8,422 (1,474)
Transverse	-25 (-32)	65 (73)	6,422 (1,124)
Longitudinal	-50 (-46)	58 (65)	5,750 (1,006)
Transverse	-50 (-46)	53 (59)	5,200 (910)

\*0.375" (9.5 mm) plate

Regular Type 409 stainless steel has less than 10 ft-lbs (12 J) energy at the same thicknesses and temperatures shown in Table 3. It is more prone to brittle failure than AK Steel 409 Ni Stainless Steel during fabrication and service in sections greater than 0.120" (3.05 mm).



### Corrosion Resistance

The general corrosion resistance of AK Steel 409 Ni Stainless Steel is essentially equal to that of standard Type 409 stainless steel.

AK Steel 409 Ni Stainless Steel is over 200 times more corrosion resistant than mild steel in severe marine industrial environments.

### Corrosive Wear

Many components are subject to the combined detrimental effects of moisture and sliding wear. Materials handling equipment in such industries as coal, pulp and paper, and minerals are particularly prone to this problem. The data in Tables 4 and 5 show that AK Steel 409 Ni Stainless Steel is a cost-effective alternative to abrasion resistant and mild steels in these environments.

**Table 4**

Corrosive Wear of AK Steel 409 Ni Stainless Steel

Laboratory Test	409 Ni RB 82	Relative Wear*		
		NITRONIC® 30 RB 92	Astralloy V® RC 45	AR 500 RC 48
Ball Mill - pea gravel plus sea water	1.0	0.6	4.2	4.6
Ball Mill - pea gravel plus Ni-Cu mine water	1.0	0.5	—	3.0
Ball Mill - pea gravel plus Ni-Cu mine water	1.0	0.5	3.2	3.6
Ball Mill - pea gravel plus coal mine water	1.0	0.8	2.2	2.4

\*The lower the value, the more corrosion/wear resistant the alloy.

**Table 5**

## Material Comparator

	AR500	AK Steel 409 Ni	Type 304	NITRONIC® 30	Mild Steel
Formability	Very Poor	Good	Excellent	Excellent	Excellent
Weldability	Very Poor	Good	Excellent	Excellent	Excellent
Impact Resistance	Poor	Good	Excellent	Excellent	Good
Corrosive Wear (CW)	4.5	3.1	1.6	1.0 (Best)	10.0 (est.)
Alloy Cost Factor (ACF)	1.00	1.16	1.49	1.42	0.50
Life Cycle Cost Factor (CWxACF)	4.5	3.6	2.4	1.4	5.0

**Formability**

Since higher alloy content and finer grain size result in higher mechanical properties, fabrication of AK Steel 409 Ni Stainless Steel should be limited to moderate roll forming and blanking operations. Care should be taken to allow for the material's higher yield strength before forming.

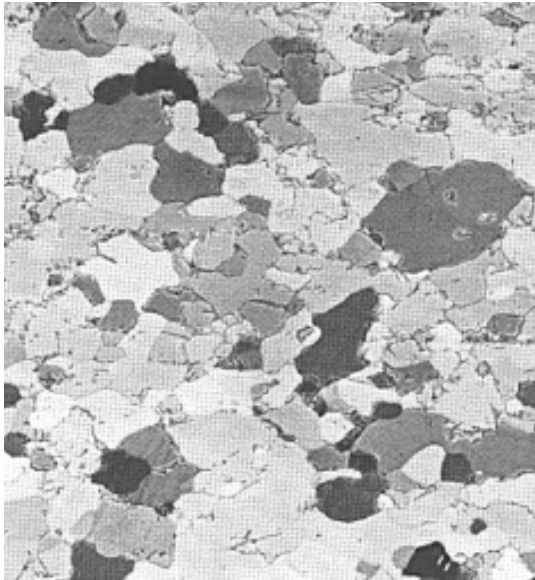
**Weldability**

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 better weldability in heavy sections than the most common alloy of the stainless class, Type 409. A major difference is the high nickel and manganese contents for this alloy which cause finer HAZ and weld metal structures that benefit toughness in heavy sections. When a weld filler is needed, AWS E/ER 309L is most often specified. Type 409 is well known in reference literature and more information can be obtained in the following ways:

1. ANSI/AWS A5.9, A5.22, and A5.4 (filler metals, minimum UTS and elongation).
2. "Welding of Stainless Steels and Other Joining Methods," SSINA, (800:982-0355).
3. "Welding Stainless Steels," FDB #SF-71.

## Grain Structure

Type 409



AK Steel 409 Ni



Typical 24X magnification grain structure for hot-rolled and annealed 0.31" (7.9 mm) thick plate of Type 409 versus AK Steel 409 Ni Stainless Steels. (Etchant: Vilellas Reagent). The fine grain structure of AK Steel 409 Ni Stainless Steel promotes toughness in welds and ease of fabricating in thicknesses greater than 0.120" (3.05 mm).

Like other martensitic and ferritic stainless steels, this alloy and the 410-type fillers require the use of low hydrogen welding practices to avoid embrittlement. For GMA and GTA welding, inert gas shielding is required to minimize oxidation of the deposit. The weld joints should be clean of all dirt and carbonaceous contaminants.

## Physical Properties

Density, 0.278 lbs/in<sup>3</sup> (7.70 g/cm<sup>3</sup>)

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