

# 409 STAINLESS STEEL

UNS S40920



AK Steel 409 Stainless Steels are especially useful for applications where oxidation or corrosion protection beyond the capacity of carbon steel and some coated steels is needed. Current applications include automotive and truck exhaust systems, including tubular manifolds; agricultural spreaders, gas turbine exhaust silencers, and heat exchangers. AK Steel 409 Stainless Steels are also useful for "difficult-to-form" hardware such as fuel filters.

### COMPOSITION

	ASTM A 240 UNS S40920 %	AK Steel 409 %
Carbon	0.03 max	0.02 max
Manganese	1.00 max	0.75 max
Phosphorus	0.040 max	0.040 max
Sulfur	0.02 max	0.020 max
Silicon	1.00 max	1.00 max
Chromium	10.50 - 11.70 max	10.50 - 11.70
Nickel	0.50 max	0.50 max
Nitrogen	0.03 max	0.02 max
Titanium	8x(C+N) min 0.15 - .50	8x(C+N) min 0.15 - .50

### AVAILABLE FORMS

AK Steel produces 409 stainless in coils and cut lengths in thicknesses 0.015" to 0.250" in widths up to and including 48". For welded applications over 0.120" thick, AK Steel Type 409 Ni Stainless Steel will provide improved toughness and weldability.

### MECHANICAL PROPERTIES

Typical Mechanical Properties  
(Annealed Condition)

	ASTM A 240 UNS S40920	AK Steel 409 0.040" - 0.070"
Ultimate Tensile Strength, ksi	55 min	60-68
0.2% Yield Strength, ksi	25 min	35-41
Elongation, % in 2"	20 min	31-39
Hardness, Rockwell B88 max		B66-B72

Properties Acceptable for Material Specification 0.041" to 0.075"

UTS, ksi	55 min
0.2% YS, ksi	30 min
Elongation, % in 2"	25 min
Hardness, Rockwell	B76 max

### PHYSICAL PROPERTIES

Density, lb/in <sup>3</sup>	0.280
Specific Electrical Resistance microhm-cm	60.0
Modulus of Elasticity in Tension psi	30.2 x 10 <sup>6</sup>

### CORROSION RESISTANCE

In general, the corrosion resistance of 409 stainless is about the same as Type 410 stainless steel. This is confirmed by standard and special corrosion tests, as well as extensive service experience. Tests also have been conducted to simulate exhaust system conditions. The results show 409 to be better than coated carbon steels, but worse than 18 Cr stainless steels in these engine condensate tests.

Corrosion resistance of welds and weld areas is nearly comparable to that of the base metal. In this respect, AK Steel

409 stainless is superior to Type 410 stainless steel because welding does not greatly impair the corrosion resistance of weld areas prone to chromium carbide sensitization.

AK Steel 409 Stainless Steels contain a certain number of surface inclusions which are the normal result of titanium stabilization additions to improve the steel. Occasionally, rusting may occur at these inclusion sites and lead to problems with cosmetic appearance. As a result, these steels are not suggested for applications where surface appearance is a factor. In cases where surface appearance is important, 400 stainless steels should be considered.

### OXIDATION RESISTANCE

The temperature at which 409 starts to exhibit destructive scaling in air is approximately 1450°F (789°C). This is considered the general maximum service temperature for continuous exposure in air. However, maximum service temperatures will vary appreciably, depending on the atmospheres involved.

### FABRICATION

409 stainless provides good fabricating characteristics and can be cut, blanked and formed without difficulty. Stainless steels provide fabricating characteristics that are much improved when compared to standard ASTM A 240 Type 409 stainless steel. Brakes and presses used normally on carbon steel can be used on 409 stainless.

Forming practices indicate that sheet 0.050" to 0.187" requires a minimum bend radius equal to the metal thickness, 1T; and material over 0.187", a radius of 1-1/2 T.

Standard forming tests show a typical Olsen Cup Height value of 0.400" and a Limiting Draw Ratio of 2.20 for AK Steel 409 Stainless Steels.

At times, the ability to form 409 stainless has been affected by temperature – in particular ductile-to-brittle transition temperatures (DBTT). AK Steel 409 Ni Stainless Steel offers improved resistance to brittle impact fractures at lower temperatures. The DBTT for hot-rolled 0.200" thick material is below -20°F, while after cold rolling to 0.075" thick material and annealing, the DBTT is below -75°F.

These steels offer benefits in tubing applications. Using an AK Steel 409 Stainless Steels analysis notably improved levels of formability in exhaust tubing in the as-high frequency welded condition.

The plastic strain ratio or  $r_m$  ( $\bar{r}$ ) value may be thought of as a material's resistance to thinning during drawing or tube bending operations. The higher the value, the greater the resistance to tearing or thinning. AK Steel 409 Stainless Steels have a typical  $r_m$  ( $\bar{r}$ ) value of 1.1 to 1.7.

## WELDING

AK Steel 409 Stainless Steels are readily welded by arc welding processes. When gauge thickness and weld joint

geometry permit the use of gas shielded metal-arc welding, joints having good properties are easily obtained. The electrode wire most often suggested is an AWS ER309 or ER308L austenitic stainless steel when the applications do not include exposure to high temperatures. AWS ER309 or ER308L stainless wire may also be employed for joining 409 stainless to mild steel. Thin wall components for elevated-temperature service should be weld fabricated with a matching weld filler such as 409 Cb. AWS ER430 and W18 Cr-Cb filler wires are suitable alternatives.

Guidelines for the Shielded Metal-Arc (SMA) process and selection of electrodes are about the same as those employed for GMA and GTA welding, except that matching fillers for thermal application are not available in covered electrode form. Suitable substitutes are E410NiMo and E360.

409 stainless is readily adaptable to resistance spot and seam welding.

## TEMPERATURE PROPERTIES

Elevated-Temperature Fatigue Strength (Tension/Tension R=0.1)

Temperature		Fatigue Strength to Surpass 10 <sup>7</sup> Cycles ksi (MPa)
°F	°C	
70	21	47 (324)
700	371	45 (310)
1100	593	17.0 (117)
1300	704	5.0 (34)
1500	816	1.5 (10)

Stress Rupture Properties  
0.045" – 0.060" (1.14 – 152 mm)

Temperature		Maximum Stress to Failure, ksi (MPa)	
°F	°C	100 HRS	1000 HRS
1300	704	4.1 (27.5)	3.2 (22.0)
1500	816	1.5 (10.3)	0.9 (6.2)

## SPECIFICATIONS

AK Steel 409 Stainless Steels are covered by specification ASTM A 240/A 240M. It is suggested that the issuing agency be contacted for the latest revision of the specification.

## METRIC CONVERSION

Data in this publication are presented in U. S. customary units. Approximate metric equivalents may be obtained by performing the following calculations:

Length (inches to millimeters) –  
Multiply by 25.4

Strength (ksi to megapascals or meganewtons per square meter) –  
Multiply by 6.8948

Temperature (Fahrenheit to Celsius) –  
(°Fahrenheit - 32) Multiply by 0.5556

Density (pounds per cubic inch to kilograms per cubic meter) –  
Multiply by 27,670

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