P R O D U C T D A T A B U L L E T I N

400 STAINLESS STEEL

AK Steel

- Low Cost
- Corrosion and Oxidation Resistance Comparable to Type 410
- Good Fabricating Characteristics

Applications Potential

AK Steel 400 Stainless Steel is useful for a wide variety of applications requiring the corrosion resistance of a low-cost stainless steel.

Typical applications include heat exchangers, display racks, gas range burner rings, office furniture and other uses where corrosion resistance at minimum cost is important.

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PRODUCT DESCRIPTION

AK Steel 400 is one of the most economical chromium ferritic stainless steels. It combines low cost, corrosion and oxidation resistance comparable to Type 410 stainless steel with good fabricating characteristics. Because of its unique properties, AK Steel 400 Stainless Steel is an economical answer for many materials problems where improved corrosion or oxidation resistance is desired. For example, it is particularly useful where metallic-coated steels or other types of coatings provide only marginal corrosion protection.

AK Steel 400 Stainless Steel contains no titanium, so its surface is free of titanium streaks. This provides two important advantages over titanium-stabilized chromium stainless steels. First, the surface finish is improved to the extent that AK Steel 400 can be more readily used in applications where good appearance is a concern. Second, it alleviates excessive die wear that is characteristic of titanium-stabilized chromium stainless steels.

AK Steel 400 also provides improved deep drawing properties and higher impact properties at low temperatures than Type 409 stainless. It is nonhardenable by heat treatment because of its low carbon content which also minimizes hardening during welding.

Although it represents a significant improvement over titanium-stabilized stainless steel, the surface quality and uniformity of AK Steel 400 Stainless Steel is not intended to be competitive with standard AISI grade finishes such as 2D or 2B. Before selecting this material for applications where surface finish is of prime concern, AK Steel 400 Stainless Steel quality standards should be reviewed.

Composition

	%
Carbon	0.05 max.
Manganese	1.00 max.
Phosphorus	0.03 max.
Sulfur	0.03 max.
Silicon	1.00 max.
Chromium	12.00 - 13.00
Aluminum	0.25 max.
Iron	Balance

Available Forms

AK Steel 400 is available in thicknesses from 0.015" to 0.100" (0.38 to 2.54 mm) in widths up to 48" (1219 mm). For other sizes, inquire.

Metric Practice

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. 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. The term for force per unit of area (stress) is the newton per square meter (N/m^2). Since this can be a large number, the prefix mega is used to indicate 1,000,000 units and the term meganewton per square meter (MN/m^2) is used. The unit (N/m^2) has been designated a pascal (Pa). The relationship between the U.S. and the SI units for stress is: 1000 pounds/in^2 = 1 kip/in^2 (ksi) = 6.8948 meganewtons/m^2 (MN/m^2) = 6.8948 megapascals (MPa).

Mechanical Properties

Table 1
Typical Mechanical Properties

UTS ksi (MPa)	0.2% YS ksi (MPa)	Elongation % in 2" (50. 8 mm)	Hardness Rockwell
68 (469)	34 (234)	30	B72

Table 2
Typical Elevated Temperature Properties

Temperature °F (°C)	UTS ksi (MPa)	0.2% YS ksi (MPa)
Room	61.5 (424)	29.5 (203)
200 (93)	56.5 (390)	28.0 (193)
400 (204)	53.0 (365)	24.5 (169)
600 (316)	51.0 (352)	22.5 (155)
800 (427)	44.5 (307)	20.5 (141)
1000 (538)	30.0 (207)	16.0 (110)
1200 (649)	15.0 (103)	10.0 (70)
1400 (760)	7.5 (42)	5.0 (34)
1600 (871)	4.5 (31)	3.0 (21)

Physical Properties

Density, 0.27 lbs/in^3
7.47 g/cm^3

Electrical Resistivity, microhm-in (microhm-cm)
237 (60)

Specific Heat, BTU/lb/°F (kJ/k•K)
32 - 212°F (0 - 100°C) – 0.11 (0.46)

Thermal Conductivity, BTU/hr/ft^2/ft/°F (W/m•K)
212°F (100°C) – 14.4 (24.9)
932°F (500°C) – 16.5 (28.6)

Mean Coefficient of Thermal Expansion,
in/in/°F (µm/m•K)
75 - 212°F (24 - 100°C) – 6.00 x 10^{-6} (10.8)
75 - 600°F (24 - 316°C) – 6.24 x 10^{-6} (11.2)
75 - 900°F (24 - 482°C) – 6.53 x 10^{-6} (11.6)
75 - 1200°F (24 - 649°C) – 6.80 x 10^{-6} (12.2)
75 - 1500°F (24 - 816°C) – 7.06 x 10^{-6} (12.7)
75 - 1600°F (24 - 871°C) – 7.11 x 10^{-6} (12.8)

Modulus of Elasticity, ksi (MPa) 29 x 10^3 (200 x 10^3)

Corrosion Resistance

The corrosion resistance of AK Steel 400 is the same as Type 410 as demonstrated by laboratory and service tests. Corrosion resistance of welds and weld areas is comparable to that of the base metal.

Scaling Resistance

Destructive scaling in air begins at approximately 1300°F (704°C) for this alloy. This is considered the safe maximum service temperature for continuous exposure in air. However, maximum service temperature will vary appreciably, depending on atmosphere involved.

Heat Treatment

AK Steel 400 is not hardenable by heat treatment because of its low carbon content.

Process Anneal: Heat to 1620°F (882°C), air cool.

Fabrication

AK Steel 400 can be cut, blanked and formed without difficulty. Brakes and presses normally used for carbon steel can be used for this material.

Bend tests show that sheet 0.050" (1.27 mm) and thinner can be bent flat on itself without cracking; material 0.050" to 0.187" (1.27 to 4.75 mm) requires a minimum bend radius equal to the metal thickness, 1T; and thicknesses over. 0.187" (4.75 mm), a radius of 1-1/2 T. Forming tests have obtained typical Olsen cup values of 0.400" (10.16 mm).

Because AK Steel 400 Stainless Steel contains no titanium, it prevents die wear that may be caused by titanium streaks. This gives the material a distinct fabrication advantage over similar stainless steels that are stabilized with titanium.

Like other chromium stainless steels, AK Steel 400 will exhibit some roping during forming and deep drawing. The degree of roping can be minimized by a special mill routing. “Low Roping Quality” is available at an extra charge.

Finishing

AK Steel 400 Stainless Steel can be polished to improve the finish for many decorative applications. Polishing procedures are similar to those used for other chromium stainless steels such as Type 430, except that the lower standard of surface quality in AK Steel 400 Stainless Steel may result in additional required passes and somewhat reduced yield.

Weldability

This 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 slightly poorer weldability when compared to the most common alloy of the stainless class, Type 409. When a weld filler is required, AWS E/ER 309 and 309L or 310 are 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.

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