PRODUCT DATA BULLETIN

301 STAINLESS STEEL

UNS S30100

AK Steel

- High Strength and Good Ductility When Cold Worked
- Excellent Corrosion Resistance
- Readily Welded
- Readily Formed and Drawn

Applications Potential

High strength and excellent corrosion resistance make Type 301 Stainless Steel useful for a wide variety of applications. Typical uses include aircraft structural parts, trailer bodies, diaphragms, utensils, architectural and automotive trim, automobile wheel covers, roof drainage products, tablewear, storm door frames and conveyor belts.

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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

Type 301 is an austenitic chromium-nickel stainless steel that provides high strength and good ductility when cold worked. It is a modification of Type 302 in which the chromium and nickel contents are lowered to increase the cold work-hardening range. This permits higher tensile strengths to be achieved by rolling with a lower loss of ductility than with Type 302.

The grade is essentially non-magnetic when annealed. However, when the grade is cold worked, it becomes more magnetic than other standard austenitic stainless steels.

Composition

	%
Carbon	0.15 max.
Manganese	2.00 max.
Phosphorus	0.045 max.
Sulfur	0.030 max.
Silicon	0.75 max.
Chromium	16.00 - 18.00
Nickel	6.00 - 8.00
Nitrogen	0.10 max.
Iron	Balance

Available Forms

AK Steel produces Type 301 Stainless Steel in thicknesses from 0.01" to 0.25" (0.25 to 6.35 mm) max. and widths up to 48" (1219 mm). For other thicknesses and widths, inquire.

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^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 metre (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 = 6.8948 meganewtons/m^2 (MN/m^2) = 6.8948 megapascals (MPa).

Mechanical Properties

Table 1

Room Temperature Properties*

	UTS ksi (MPa)	0.2% YS ksi (MPa)	Elongation % in 2" (50.8 mm)	Hardness Rockwell
Annealed (typical)	110 (758)	40 (276)	60	B85
1/4 Hard	125 (862)*	75 (517)*	25*	C25
1/2 Hard	150 (1034)*	110 (758)*	18*	C32
3/4 Hard	175 (1207)*	135 (931)*	12*	C37
Full Hard	185 (1276)*	140 (965)*	9*	C41

* Minimum - standard practice is to produce to either minimum tensile strength, minimum yield streng th or minimum hardness, but not to combinations of these properties.

Table 2

Elevated Temperature Properties*

Temperature °F (°C)	UTS ksi (MPa)	0.2% YS ksi (MPa)	Elongation % in 2" (50.8 mm)
Room	185 (1276)	151 (1041)	9.0
200 (93)	174 (1200)	145 (1000)	7.0
400 (204)	168 (1158)	140 (965)	4.5
600 (316)	156 (1076)	130 (896)	6.0
800 (427)	145 (1000)	119 (820)	6.0

*Full-Hard Sheet

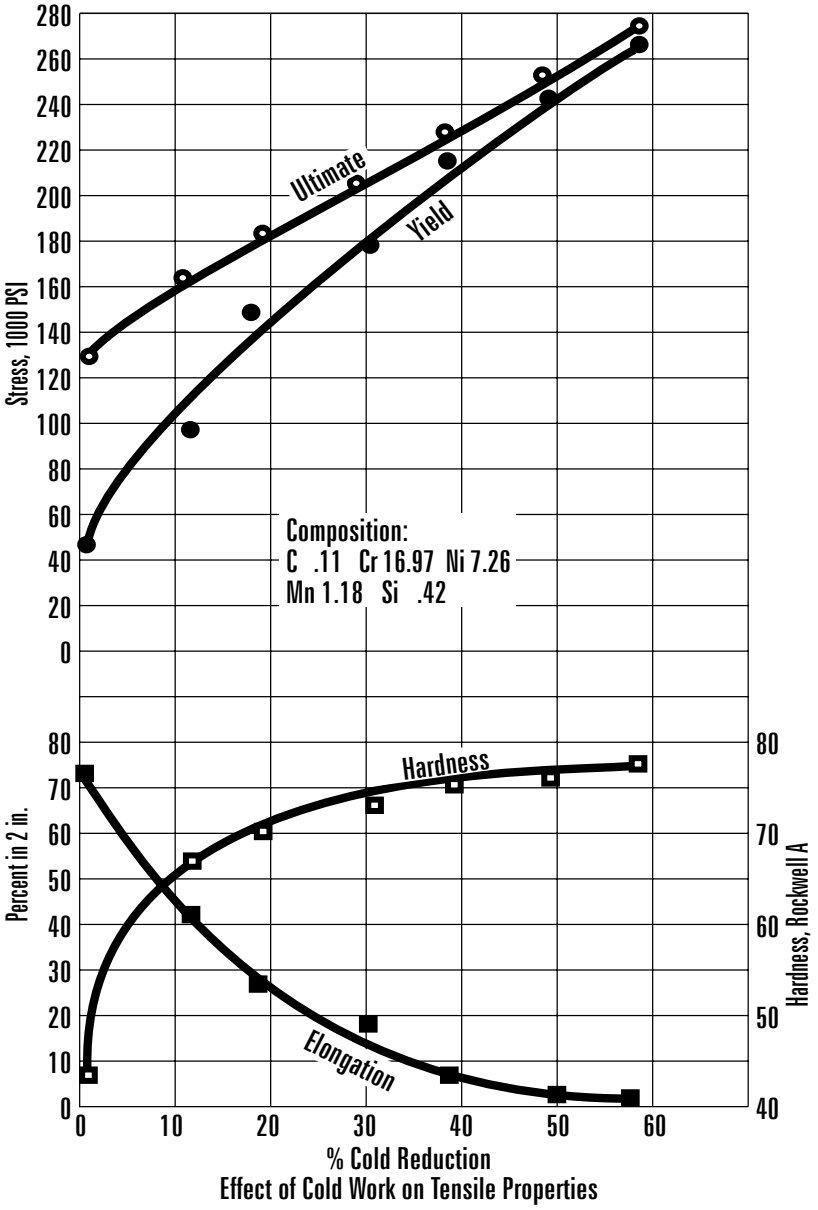
Table 3

Sub-Zero Properties

Test Temperature °F (°C)	UTS ksi (MPa)	0.2% YS ksi (MPa)	Elongation % in 2" (50.8 mm)
Annealed Condition			
-320 (-196)	275 (1896)	75 (517)	30
-80 (-62)	195 (1344)	50 (345)	40
-40 (-40)	180 (1241)	48 (331)	42
32 (0)	155 (1069)	43 (296)	53
70 (21)	110 (758)	40 (276)	60
Half-Hard Condition			
-320 (-196)	290 (1999)	115 (793)	25
-80 (-62)	205 (1413)	105 (724)	37
-40 (-40)	188 (1296)	101 (696)	38
32 (0)	170 (1172)	98 (676)	46
70 (21)	150 (1034)	110 (758)	48

Table 4
Impact Strength

Test Temperature °F (°C)	Izod V-Notch, ft-lbs (J) Annealed	1/4-Hard
-320 (-196)	114 (161)	100 (136)
-80 (-62)	112 (126)	100 (136)
-40 (-40)	110 (123)	100 (136)
32 (0)	108 (121)	100 (136)
70 (21)	102 (114)	100 (136)



Effect of Cold Work on Tensile Properties

Physical Properties

Density, 0.285 lbs/in^3
7.88 g/cm^3

Electrical Resistivity, microhm-in (microhm-cm)
68°F (20°C) – 27.4 (69.5)

Specific Heat, BTU/lb/°F (kJ/kg•K)
32-212°F (0-100°C) – 0.12 (0.50)

Thermal Conductivity, BTU/hr/ft^2/ft/°F (W/m•K)
at 212°F (100°C) – 9.4 (16.2)
at 932°F (500°C) – 12.4 (21.4)

Mean Coefficient of Thermal Expansion,
in/in/°F (µm/m•K)
32– 212°F (0 - 100°C) – 9.4 x 10^{-6} (16.9)
32– 600°F (0 - 315°C) – 9.9 x 10^{-6} (17.8)
32–1000°F (0 - 538°C) –10.2 x 10^{-6} (18.4)
32–1200°F (0 - 649°C) –10.4 x 10^{-6} (18.7)

Modulus of Elasticity, ksi (MPa)
28.0 x 10^3 (193 x 10^3) in tension
11.2 x 10^3 (78 x 10^3) in torsion

Magnetic Permeability, H = 200 Oersteds
Annealed – 1.02 max.

Melting Range, °F (°C) – 2250 - 2590 (1399 - 1421)

Corrosion Resistance

Type 301 Stainless Steel exhibits corrosion resistance comparable to Types 302 and 304 in the milder service conditions. Resistance to atmospheric corrosion, food, juices and road de-icing salt is excellent. The best corrosion resistance is obtained in the cold worked then annealed condition. When Type 301 is heated or cooled through a temperature range of 800 - 1600°F (427 - 871°C) without subsequent annealing, it may undergo carbide precipitation that may result in intergranular corrosion.

Oxidation Resistance

The maximum temperature to which Type 301 can be exposed continuously without appreciable scaling is about 1600°F (871°C). For intermittent exposure, the maximum exposure temperature is about 1450°F (788°C).

Heat Treatments

Type 301 is non-hardenable by heat treatment.

Annealing: Heat to 1900 - 2050°F (1038 - 1121°C), then water quench.

Stress Relief Annealing: Heat to 500 - 900°F (260 - 482°C), then air cool.

Cold Working

High hardness and strength for structural applications are achieved through cold working. In addition to the annealed condition (110 ksi {758 MPa} tensile strength), Type 301 strip normally is produced in various cold-rolled tempers up to full hard (185 ksi {1276 MPa} minimum tensile strength).

Heavily cold-rolled material has a lowered modulus of elasticity and exhibits directional properties in that the compressive yield strength in the longitudinal direction is lower than the longitudinal tensile yield strength. These directional properties can be minimized and the modulus raised by stress relieving for up to eight hours at about 800°F (427°C). Stress relieving is also recommended to improve the performance of heavily cold-worked parts such as springs.

Although Type 301 work hardens rapidly, it is one of the most readily formed stainless steels. It is possible to stretch form this grade more severely than other 300 series grades. This is due to the high work-hardening rate which increases the strength to compensate for the reduction in cross-sectional area. One of the few forming operations in which high work hardening may be detrimental is deep drawing. Type 301 is not normally recommended for the most severe deep drawing operations where successive draws will be used.

Formability

Type 301 can be readily formed and drawn. Due to its high work-hardening rate, intermediate annealing may be necessary for severe drawing and forming operations.

Weldability

The austenitic class of stainless steels is generally considered to be weldable by the common fusion and resistance techniques. Special consideration is required to avoid weld "hot cracking" by assuring formation of ferrite in the weld deposit. This particular alloy is generally considered to have similar weldability than the most common alloy of this stainless class, Type 304L Stainless Steel. A major difference is the high C content for this alloy, which causes the weld heat-affected-zones to be susceptible to accelerated corrosion (I.G.C.) in certain environments. When a weld filler is needed, AWS E/ER 308 is most often specified. Type 301 Stainless Steel 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-1.
4. ANSI/AWS B2.1.009-90 (GTAW 300's @ 0.50" - 0.14").
5. ANSI/AWS B2.1-8-024-94 (GTAW 300's @ 1/8" - 1-1/2").
6. ANSI/AWS B2.1.013-91 (SMAW 300's @ 0.050" - 0.14").
7. ANSI/AWS B2.1-8-023-94 (SMAW 300's @ 1/8" - 1-1/2").
8. ANSI/AWS B2.1.005-90 (GMAW 300's @ 0.050" - 0.14").

Specifications

Type 301 Stainless Steel is covered by the following specifications:

ASTM A 240
ASTM A 666

AK Steel

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Stainless Steel
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PD-134 7180-0087 PDF 7/07