Specification Sheet: Alloy 303
(UNS S30300) W. Nr. 1.4305

A Free-Machining Austenitic Stainless Steel Developed for Applications Where Extensive Machining is Required

Alloy 303 (UNS S30300) is an austenitic stainless steel developed for applications requiring extensive machining operations. The alloy has a sulfur addition which assists in breaking up turnings while reducing drag on the cutting tool when compared to the machining characteristics of the conventional 18-8 stainless steels.

The alloy is nonmagnetic in the annealed condition, but may become slightly magnetic as a result of cold working. The addition of sulfur negatively impacts the corrosion resistance of 303 making it less resistant than 304 to mildly corrosive environments.

Applications

- Aerospace Parts
- Fittings
- Pump and Valve Components
- Screw Machine Products

Standards

ASTM ..... A 895

Corrosion Resistance

Alloy 303 is resistant to mildly corrosive environments. However, the alloy's corrosion resistance is inferior to 304 in most applications. Its corrosion resistance is superior to 416, another free-machining grade, but is somewhat inferior to other 400 series stainless steels which do not contain higher sulfur levels. In order to obtain optimal corrosion resistance, it is recommended that Alloy 303 be chemically treated to remove sulfides from the final surfaces.

Chemical Analysis

Weight % (all values are maximum unless a range is otherwise indicated)

Chromium	17.0 min.–19.0 max.	**Sulfer**	0.15–0.35
Nickel	8.0 min.–10.0 max.	**Silicon**	1.00
Carbon	0.10	**Copper**	1.00
Manganese	2.00	**Nickel**	0.110
Phosphorus	0.20	**Iron**	Balance

Physical Properties

Density
0.285 lbs/in^3
7.89 g/cm^3

Modulus of Elasticity
28.0 x 10^6 psi
193 GPa

Melting Range
2500–2590°F
1480–1530°C

Specific Heat
0.12 BTU/lb-°F (32–212°F)
502 J/kg-°K (0–100°C)

Thermal Conductivity 212°F (100°C)
112 BTU-in/hr-ft^2-°F
16.2 W/m-°K

Electrical Resistivity
28.3 Microhm-in at 68°C
72.0 Microhm-cm at 20°C

Mechanical Properties

Typical Values at 68°F (20°C)

Yield Strength 0.2% Offset		Ultimate Tensile Strength		Elongation in 2 in.	Hardness
psi (min.)	(MPa)	psi (min.)	(MPa)	% (min.)	(max.)
45,000	310	85,000	586	50	202 (HBN)

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Fabrication Data

Heat Treatment

Annealing — Heat to a minimum temperature of 1900°F (1038°C) and water quench or rapid cool by other means.

Hardening — Alloy 303 cannot be hardened by thermal treatment, it can only be hardened by cold working.

Cold Forming

The cold formability of Alloy 303 is adversely impacted by the high sulfur content. The alloy may be bent with a generous bend radius, however, when cold forming is required, 304 should be utilized.

Hot Forming

The high sulfur content of Alloy 303 also has a detrimental impact on hot workability. If hot forming is required, once again, 304 should be considered as an alternate selection.

Machining

Alloy 303 was developed specifically for ease of machining. The sulfur addition assists in breaking up turnings which reduces drag on the cutting tool. It produces small brittle chips and may be machined at high speeds with deep cuts and heavy feeds.

The table below suggests speeds and feeds for various machining operations for 303.

MACHINABILITY	High Speed Tooling		Carbide Tooling		Depth, Width or Diameter of Tool
	Speed (sfm)	Feed (in./rev.)	Speed (sfm)	Feed (in./rev)	(in.) (dia./in.)
Turning	115 135	0.0150 0.0050	375 600	0.025 0.007	0.005–0.200 0.002–0.004
Cut-off	90 100	0.0015 0.0025	275 325	0.002 0.004	1/16 1/4
Forming	100 100	0.0020 0.0015	375 350	0.003 0.002	1 2
Drilling	70 85 100	0.0060 0.0100 0.0200	— 700 800	— 0.005 0.007	1/4 1/2 1–2
Reaming	90 90	0.0050 0.0150	— —	— —	1/4 1–2
End Milling	130 130	0.0030 0.0060	300 350	0.004 0.009	1/2 1–2
Tapping and Threading	10 40	— —	— —	— —	7 threads/in. 25 threads/in.

Welding

Alloy 303 is not recommended for applications requiring welding. If it is necessary to weld the alloy, AWS E312 filler metal may be considered.

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