Technical Data Sheet

ATI 303™

Austenitic Stainless Steel

(UNS S30300)

GENERAL PROPERTIES

ATI 303 alloy is a free-machining stainless steel specifically designed to exhibit improved machinability. It is a non-magnetic austenitic stainless steel which is not hardenable by heat treatment. It is the free-machining modification of the basic 18% chromium – 8% nickel stainless steel. Sulfur is added to produce the free-machining characteristics. The good mechanical and corrosion-resistant properties of the lower-sulfur grade are retained to the extent possible.

Forms and Conditions

This free-machining grade is available as hot rolled plates. These are furnished in the annealed condition for best machinability.

Specifications

ASTM A895
SAE J405

COMPOSITION

Element	Weight Percent
	ATI 303™
Carbon	0.15 max
Manganese	2.00 max
Silicon	1.00 max
Chromium	17.00-19.00
Nickel	8.00-10.00
Phosphorous	0.20 max
Sulfur	0.15 min
Iron	Balance

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RESISTANCE TO CORROSION

The addition of certain elements to stainless steels to impart better machining characteristics also slightly lowers corrosion resistance. For dry conditions, and in most mildly corrosive environments, the performance of free-machining grades are similar to their corresponding unmodified types. Where moist atmospheres are involved, some free machining grades may tend to form a rust film; and in certain severe environments, they may show somewhat increased corrosion as a result of the free machining additions. In a majority of cases, they will perform nearly the same as the basic parent composition. Where use under severe corrosive conditions is intended, the ATI Allegheny Ludlum Technical Center should be consulted for more specific information.

Because the free machining grades have a slightly reduced corrosion resistance compared with unmodified basic stainless steel, bright machined parts may be susceptible to surface dulling or etching by final treatment with nitric acid solutions. Caution in the use of such treatments is suggested. For mild action, mixtures containing as little as one or two percent by volume nitric acid, with additions of an inhibitor, may be allowable for short periods of time at 120 to 140°F (49-60°C). A solution of 12 percent nitric acid and 4 percent copper sulfate is also satisfactory where mild action is required. In some instances, the complete elimination of treatment with nitric acid solutions may be desirable.

RESISTANCE TO OXIDATION

ATI 303 alloy has good resistance to oxidation at temperatures up to 1700°F (927°C). In extreme oxidizing atmospheres, irregular scaling may be encountered, particularly above 1400°F (760°C).

The rate of oxidation of all stainless steels is greatly affected by the service atmosphere, by heating and cooling cycles, and by design considerations. Specific data does not apply to all service conditions. The personnel of ATI Allegheny Ludlum's Technical Center can supply data for specific applications on request.

PHYSICAL PROPERTIES

	ATI 303™
Melting Point	1400°C
	2552°F
Density	0.290 lb/in^3
	8.03 g/cm^3

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Coefficient of Thermal Expansion

Temperature Range		ATI 303™	
°C	°F	Per °C X 10^{-6}	Per °F X 10^{-6}
20-100	68-212	16.6	9.2
20-500	68-932	18.8	10.4
20-787	68-1450	19.6	10.9

Thermal Conductivity at 100°C (212°F)

	W/m•K	Btu•in/hr•ft^2•°F
Type 303	16.4	113.2

Electrical Resistivity

Temperature		ATI 303™	
°C	°F	Microhm-cm	Microhm-in
20	68	72.0	28.3
100	212	78.0	30.7
200	392	86.0	33.8
400	752	100.0	39.4
600	1112	111.0	43.7
800	1472	121.0	47.6

Magnetic Permeability

	ATI 303™
Annealed	1.02 max

MECHANICAL PROPERTIES

The typical mechanical properties of ATI 303 plate will be within the ranges shown below.

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Room Temperature Properties
Annealed Condition

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Yield Strength 0.2% offset	30 - 40 ksi 207 - 276 MPa
Tensile Strength	75 - 90 ksi 517 - 621 MPa
Elongation in 2 in., %	35 - 50
Reduction in Area, %	50 - 60

FABRICATING PROPERTIES

Welding

Although the free machining grades are not recommended for welding, they may be welded with some difficulty. ATI 303 alloy may be welded with Type 310 electrodes, and should be annealed after welding to redissolve precipitated carbides, thereby increasing the resistance of the material to intergranular corrosion.

Machining

The same machining methods commonly used for mild steel are applicable to ATI 303 stainless steel. High machining rates can be obtained for this material in the annealed condition, with hardness in the range of 200 to 240 Brinell. However, modifications in machining techniques are necessary to adjust to the special characteristics of ATI 303 stainless steel.

Since ATI 303 alloy will work harden, it should be machined at reduced surface feet per minute and heavier feeds to prevent glazing at the tool interface.

As a starting point, use the speeds and feeds shown in the following tables to machine ATI 303 alloy. These can then be modified for the equipment available and the general shop practice. The speeds and feeds shown were recorded for annealed material and approximately an eight hour tool life.

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Tool	Inches	mm	Annealed ATI 303™ Speed** Sfpm	Speed** Smpm	Feed in./Rev.	Feed cm./Rev.
Form Tool (Width)	1/4"	6.35	110	33.5	0.0026	0.0066
	1/2"	12.70	105	32.0	0.0022	0.0056
	3/4"	19.05	100	30.5	0.0019	0.0048
Box Tool (Depth)	1"	25.4	115	35.0	0.0065	0.0165
	1/8"	3.175	105	32.0	0.0060	0.0152
	1/4"	6.35	100	30.5	0.0055	0.0140
Twist Drill (Diameter)	1/4"	6.35	65	19.8	0.0045	0.0143
	1/2"	12.70	70	21.3	0.0050	0.0127
	3/4"	19.05	75	22.9	0.0055	0.0140
Sizing Reamer (Diameter)	1/2" & Under	12.7	90	27.4	0.0055	0.0140
	1/2" & Over	12.7	90	27.4	0.0085	0.0216
Finishing Reamer	All		35	10.7	0.0035	0.0089
Tapping			15/30	4.6/9.2	-	-
Cut Threads			20/45	6.1/13.7	-	-
Form Threads						

** Sfpm = surface feet per minute, Smpm = surface meters per minute

TOOLING:	A.I.S.I. TYPE
Single-Point & Box Tools	- T-5 & M-3
Form & Cut-off	- T-5 & T-15
Taps & Drills	- M-1 & M-10
Reamers	- T-5 & M-2

COOLANT:

Sulpho-Chlorinated Oil, Medium Viscosity.

Note: Positive Rake Tools Provide Best Finish and Reduce Work Hardening

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With Carbide Tooling

Operation	Feed per revolution		Depth of cut	
	inch / rev	cm / rev	inch	mm
Single point turning	0.015	0.038	0.250	6.35
Box tool turning	0.008	0.020	0.050	1.27
Cutoff	0.0045 - 0.009	0.011 - 0.023	0.063 - 0.250	1.6 - 6.35
Forming	0.006 - 0.003	0.015 - 0.008	0.50 - 2.00	12.7 - 50.8
Face milling	0.012 *	0.030	0.250	6.35
	0.014 *	0.034	0.050	1.27
End milling	0.006 *	0.015	0.050	1.27
	0.007 *	0.018	0.015**	0.38
Reaming	0.025	0.064	2.00	50.8
	0.003	0.008	0.125**	3.18

* Feed, inch per tooth. (cm/tooth)
**Reamer diameter, inch (mm)

Operation	Carmet Grade Designation		Surface Speed	
	First	Second	ATI 303™	
			feet / min	m / min
Single point turning	CA-4	CA-720	300	91
Box tool turning	CA-4	CA-720	350	107
Cutoff	CA-4	CA-720	225	68.6
Forming	CA-4	CA-720	225	68.6
Face milling	CA-4	CA-720	375	114
	CA-4	CA-720	440	134
End milling	CA-4	CA-720	325	99.1
	CA-4	CA-720	375	114
Reaming	CA-4	CA-720	200	61
	CA-4	CA-720	200	61

Generally stainless steels are tough, dissipate heat slowly and the austenitic grades work harden rapidly.

1. The relatively high strengths require equipment capable of withstanding the higher cutting pressures to prevent vibration and chatter.
2. The low heat conductivity necessitates the use of large quantities of coolant, and tools with sufficient mass to absorb and dissipate the heat.
3. Tools should be kept sharp to reduce work hardening and heat generation.
4. To prevent excessive work hardening of the austenitic grades do not permit tools to dwell or ride on the work.

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HEAT TREATMENT

Forging Temperatures

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Initial	2150 - 2300°F (1177 - 1260°C)
Final	1700 - 1750°F (927 - 954°C)

Annealing Temperatures

For maximum ductility, ATI 303 alloy should be annealed near the upper limit of the 1800 - 2000°F (982 - 1043°C) range. The material should be water quenched from the annealing temperature to prevent harmful carbide precipitation. For the same reason, heating within the 800 - 1500°F (427 - 816°C) temperature range should be avoided unless the material can be subsequently annealed.

Hardening Temperature

ATI 303 alloy is austenitic and cannot be hardened by heat treatment.

Oil quenching from 1700 - 1800°F (927 - 982°C) will fully harden ATI 416 stainless. Light sections may be fully hardened by air cooling from the hardening temperature. Appropriate tempering treatments may then be utilized to obtain desired strength and hardness levels.

Structure

ATI 303 stainless steel is austenitic at all temperatures. When heated within the range 800 - 1500°F (427 - 816°C), carbides will precipitate at the grain boundaries. Upon reannealing, the carbides will be redissolved.

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