Crucible 303 PLUS Data Sheet

Issue no. 8

CRUCIBLE 303 PLUS is a non-hardenable austenitic chromium-nickel steel to which elements have been added to improve machinability and non-galling characteristics. Better machinability than that of standard AISI Type 303 stainless is obtained by the use of modern manufacturing methods and stringent mill controls. This grade is non-magnetic in the annealed condition but slightly magnetic when cold worked. Typical applications are screw machine products and all machined parts requiring good corrosion resistance or non-magnetic properties.

Analysis

Carbon 0.15% max. Manganese 2.00% max. Silicon 1.00% max.

Phosphorus 0.20% max. Sulfur 0.15% min.

Chromium 17.00/19.00% Nickel 8.00/10.00% Molybdenum 0.60% max.

Typical applications

Screw machine products
Bar and fountain accessories
Machined shafts
Fishline guides
Homogenizers
Valves and accessories for chemical handling equipment

Forging

CRUCIBLE 303 PLUS should be forged at 2100 to 2350 F and finished above 1700F. Reheating should be used if necessary.

CRUCIBLE 303 PLUS is not recommended for severe upsetting operations.

Annealing

For maximum resistance to corrosion, CRUCIBLE 303 PLUS should be annealed at 1950F followed by a water quench. However, fully-annealed properties can be obtained by cooling rapidly from 1850/2050F to room temperature.

Hardening

CRUCIBLE 303 PLUS in small or thin sections can be hardened by cold working. The effect of cold working is shown on Page 6.

Note: Temperatures throughout data sheet are steel temperatures.

Forming

CRUCIBLE 303 PLUS will withstand only moderate cold working. It is not adaptable to severe cold-finishing operations.

Welding

CRUCIBLE 303 PLUS is not generally recommended for welding as grades containing sulfur (or selenium) often display porous welds.

Resistance to scaling

CRUCIBLE 303 PLUS scales at approximately 1650F. This temperature can vary with the type of atmosphere and application.

General corrosion resistance

The corrosion resistance of CRUCIBLE 303 PLUS was evaluated in a variety of corrosion tests normally used for stainless. Comparisons were made to AISI Type 304 stainless. The corrosion resistance of CRUCIBLE 303 PLUS is similar to that of AISI Type 304. No significant difference was observed in rust staining as evaluated by CASS, water-vapor column, and outdoor exposure testing. Weight loss in 10 percent sulfuric acid and in ferric chloride was greater than that of Type 304. Passivation greatly improves the pitting resistance of both grades in ferric chloride.

Corrosion Test	Exposure Time	Test Results	
		CRUCIBLE 303 PLUS	CRUCIBLE 304 PLUS
10% sulfuric acid at 78°F	4 hours	0.0112 g/in^2	0.0063 g/in^2
Crucible ferric chloride test at 78°F	4 hours	0.247 g/in^2 59 pits/in^2	0.016 g/in^2 9 pits/in^2
Crucible ferric chloride test at 78°F	4 hours	0.04 g/in^2 (Passivated) 12 pits/in^2	0.01 g/in^2 (Passivated) 2 pits/in^2
Glacial acetic acid - boiling	96 hours	0.078 g/in^2	0.021 g/in^2
65% nitric acid - boiling	96 hours	4.58 mils/month	1.06 mils/month
CASS test	16 hours	Slight rust stain	Trace of rust stain
Water-vapor column	13 cycles	Slight rust stain	No rust stain
Outdoor exposure	6 months	Slight rust stain	Trace of rust stain
Weatherometer exposure	1000 hours	No rust stain	No rust stain

Note: The laboratory corrosion data given above are for comparative purposes only. AISI Type 303 and Crucible 303 Plus are not recommended for use in severe corrosive environments.

Passivation

It is recommended that finished parts machined from stainless steel be passivated for optimum corrosion resistance.

Free-machining types are prone to dulling and discoloration in passivating treatments. It is important that correct procedures be followed when passivation is specified. The recommended treatment for CRUCIBLE 303 PLUS is shown below:

Acid concentration by volume of concentrated nitric acid	Sodium dichromate by weight	Bath temperature (°F)	Immersion time (min.)
20 - 40%	2.0%	110 - 140 (120 Typ.)	15 - 30

Machining

The improved machinability of CRUCIBLE 303 PLUS is achieved principally by controlling the composition and by using the most modern manufacturing equipment available to produce bars of exceptional uniformity. This method of manufacturing eliminates the "hard spot" problem which causes so many machining difficulties.

Machinability

Results of drill and tool life machinability tests are shown below. These laboratory tests have been found to correlate with results in machine shops.

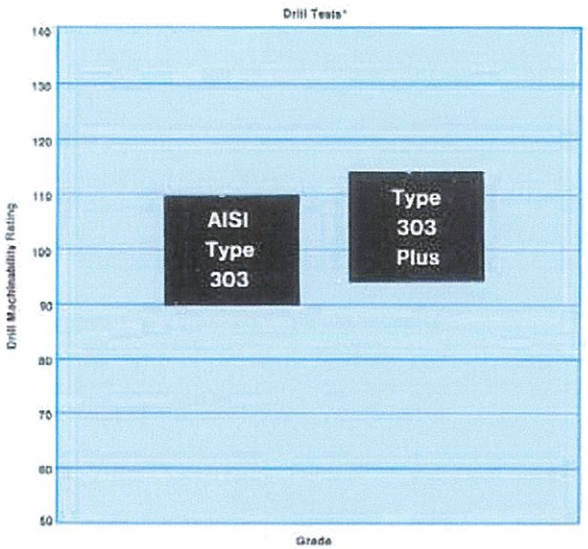

Figure 1

*Details on drill test techniques are described in the booklet, "Machining Crucible Stainless Steels."

Tool Life Test*

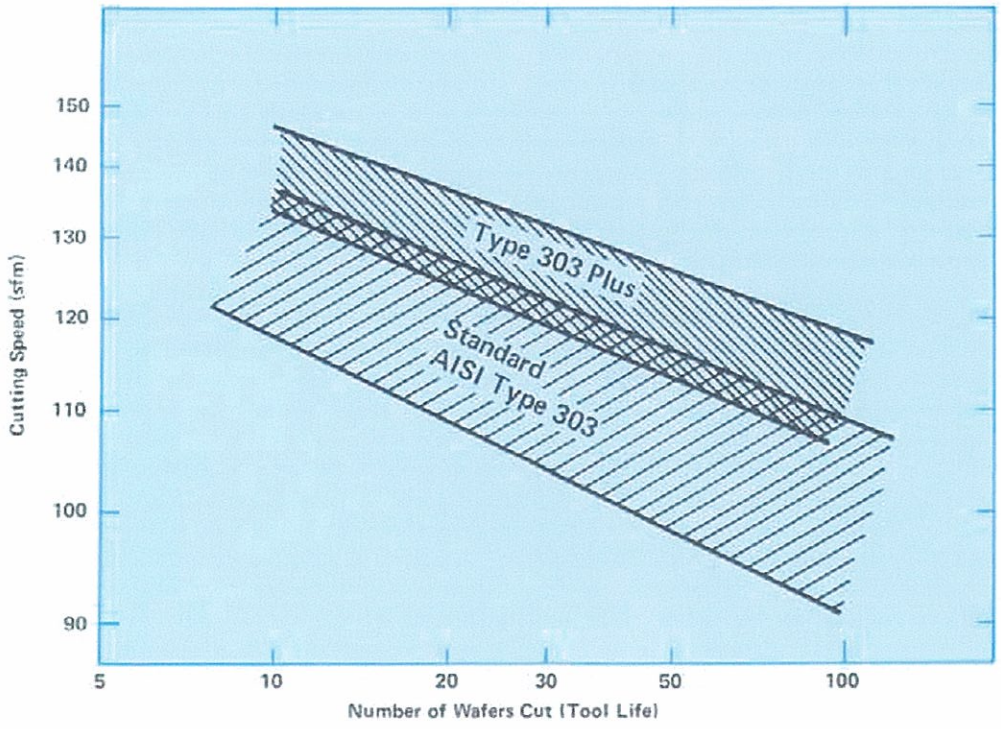

Figure 2

Machining data

Operation	Tool Width or (in) Depth of Cut	CRUCIBLE 303 PLUS High Speed Tooling *		Carbide Tooling	
		Speed (fpm)	Feed (in/rev)	Speed (fpm)	Feed (in/rev)
Turning single point	0.050	115	0.0060	220	0.010
	0.250	110	0.0055	220	0.020
	0.500	100	0.0045	200	0.025
Forming	1/2 wide	115	0.0020	210	0.003
	1 wide	110	0.0017	200	0.002
	1½ wide	110	0.0015	180	0.002
	2 wide	105	0.0013	180	0.002
Cutoff	1/16 wide	105	0.0017	210	0.002
	1/8 wide	110	0.0020	210	0.003
	3/16 wide	110	0.0020	220	0.003
	1/4 wide	115	0.0025	220	0.003
Drilling	1/16 dia.	65	0.0020		
	1/8 dia.	70	0.0030		
	1/4 dia.	70	0.0040		
	1/2 dia.	70	0.0045		
	3/4 dia.	75	0.0055		
	1 dia.	75	0.0065		
Threading†		10-25	–		
Tapping†		15-20	–		

†Use the higher speeds for the finer threads.

*Details on tool life test techniques and Crucible High Speed and Tool Bit recommendations are described in the booklet, "Machining Crucible Stainless Steels."

Specifications

CRUCIBLE 303 PLUS has found wide industry acceptance and meets the following specifications:

QQ-S-764a	MIL-W-52263-C	AMS 5640H	ASTM A581-69	ASTM A582-69

Physical properties

Modulus of elasticity in tension - psi	28,000,000
Electrical resistivity	
Room temperature (microhm — centimeters)	72.1
Specific heat (Btu/lb./°F) 32-212°F	0.12
Specific gravity	7.92
Weight (lb./cu.in.)	0.286
Thermal conductivity (Btu/hr./sq.ft./°F/ft.)	
200°F	9.4
1000°F	12.5
Mean coefficient of thermal expansion (in/in/°F x 10^{-6}) (See fig. 3)	
32- 212°F	9.6
32- 600°F	9.9
32-1000°F	10.2
32-1200°F	10.4
Melting point range (°F)	2550/2590

Mechanical properties

(All values are representative properties in the annealed condition)

Room Temperature

	Bar (1 in.rd.)
Tensile strength - psi	90,000
Yield strength (0.2% offset) - psi.	35,000
Elongation in 2 in., (%)	50
Reduction of area, (%)	55
Izod impact resistance, (ft.lbs.)	80
Hardness (BHN)	170
Cold bend, (deg.)	180

Thermal expansion

Annealed 2050°F,
Water quench

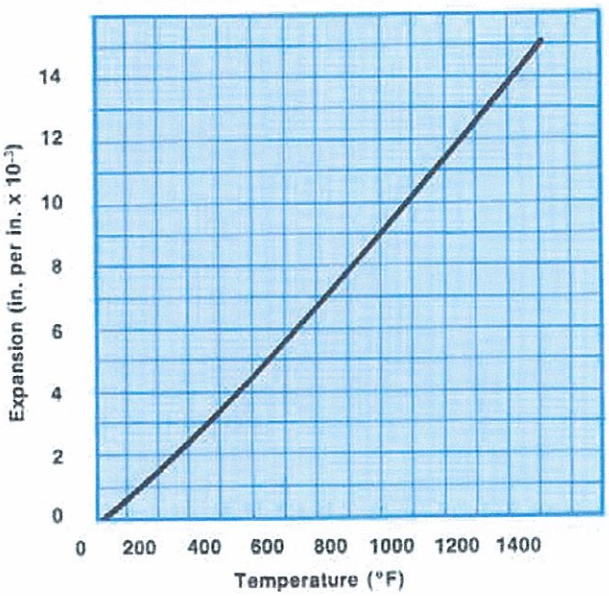

Figure 3

Mechanical properties as cold worked

Heat treatment: annealed, 1950°F, water quenched. Size: 3/8 in. rd., unstraightened and untempered.

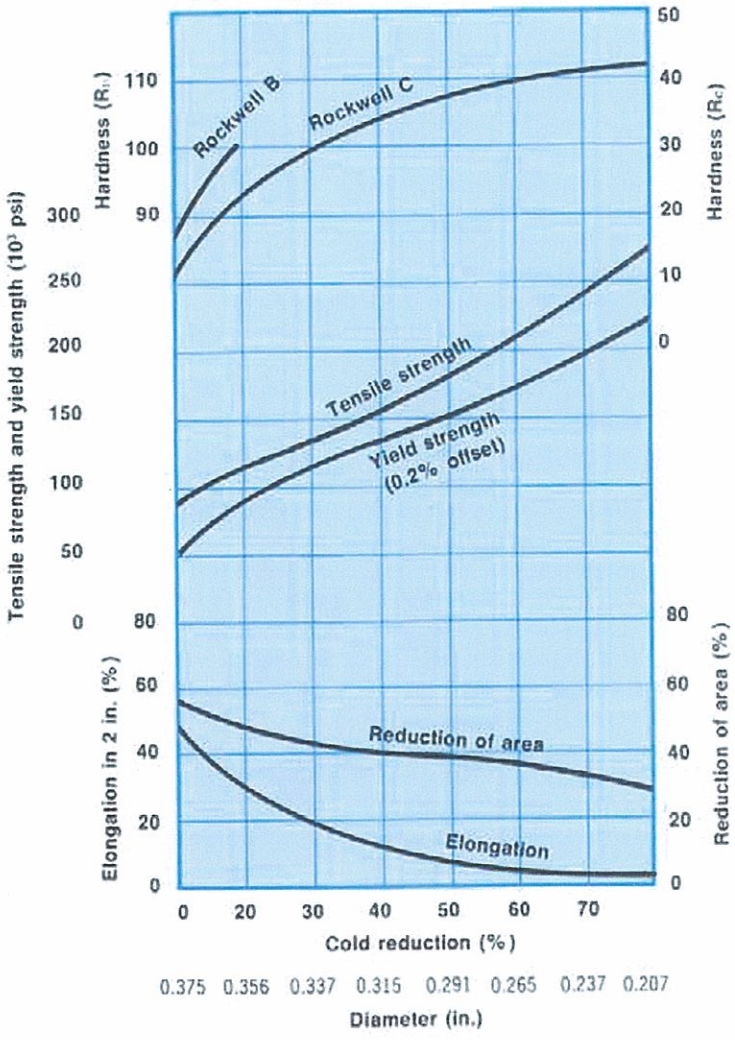

Figure 4

Crucible Industries LLC
575 State Fair Blvd., Solvay, NY 13209
www.crucible.com
800-365-1180 315-487-4111