

PRODEC® Type 304 UNS S30400

OUTOKUMPU

A special quality of standard Type 304 with composition and processing for enhanced machinability.

Description

PRODEC® 304 is an improved version of standard Type 304. With advanced ladle metallurgy techniques, the steel is processed for improved machinability and outstanding uniformity. PRODEC 304 offers faster machining speeds, longer tool life, improved part quality, and lower total cost of machined parts.

PRODEC 304 is nonmagnetic in the annealed condition but may become slightly magnetic as a result of cold working or welding.

Specifications

PRODEC 304 meets the same AMS, ASTM, ASME, QQS, and MIL-S specifications as standard Type 304.

Product Forms Available

Plate
Bar

Corrosion Resistance

PRODEC 304 is a versatile, general purpose stainless steel with good resistance to atmospheric corrosion, to many organic and inorganic chemicals, and to foods and beverages. It has also been used in vacuum processing equipment and specialized instruments where high integrity is essential.

Although improvements in machinability in the past have been associated with reduced corrosion resistance, PRODEC 304 has been shown to have corrosion resistance within the range typically expected of Type 304 stainless steel.

Machinability

PRODEC 304 is melted to a closely controlled chemistry and ladle-treated to achieve control of the composition, amount, size, shape, and distribution

of the nonmetallic inclusions (sulfides and oxides) normally occurring within a standard stainless steel. These inclusions provide for chip breaking and for reduced wear of carbide tooling at high machining speeds. PRODEC 304 permits higher machining speeds, longer tool life, and superior part quality with reduced total cost for finished parts.

Tables 1-7 give some speeds and feeds obtained

Turning

Table 1

Feed (in/rev)	Cutting depth (in)	Cutting speed, sfm			High speed steel
		Cemented C7	carbides C6	C5	
< 0.012	0.08	820	650	—	130
0.012-0.020	0.08-0.20	—	590	490	115
0.020-0.040	0.20-0.40	—	330	295	65

Threading

Table 2

Tool	Speed (sfm)
Cemented Carbide (C6-C5)	295-425
High Speed Steel	50-65

Reaming

Table 3

Ream diameter (in)	Cutting Speed (sfm)		Feed (in/rev)
	Cemented carbide	High speed steel	
< 0.40	165	33-50	0.004-0.008
0.40-0.80	165	33-50	0.012
> 0.80	165	33-50	0.012-0.016

Coolant/lubricant: emulsion or cutting oil

Cut Off

Table 4

Tool	Speed (sfm)	Feed (in/rev)
Cemented Carbide (C5)	330-490	0.004-0.008
High Speed Steel	80	0.002

Milling

Table 5

Operation	Cemented carbide			High speed steel	
	Speed (sfm)	Feed (in/tooth)	Type of carbide	Speed (sfm)	Feed (in/tooth)
Face Milling	490-820	0.006-0.012	C7-C6	80-100	0.005-0.008
Side Milling	590-790	0.010-0.012	C7-C6	80-100	0.005-0.008
End Milling	490-720	0.004-0.008	C7-C6	80-100	0.001-0.006
End Milling (Solid cemented carbide)	165-330	0.002-0.008	C5	—	—

Drilling — High Speed Steel Twist Drills

Table 6

Drill diameter (in)	Speed		Feed (in/rev)
	rpm	sfm	
0.04	3200-3800	33-38	0.002
0.12	1600-1800	50-57	0.004
0.20	1080-1270	57-66	0.008
0.40	540-640	57-66	0.012
0.60	360-430	57-66	0.014
0.80	270-320	57-66	0.016
1.20	180-220	57-66	0.018

Notes:

1. Cutting Fluid: Ample flow of 10% emulsion coolant.
2. With short NC drills, feed can be increased about 40%.
3. When hole depth exceeds 4x diameter, clear chips from hole.
4. With TiN-Coated HSS drills, speed can be increased 10%.
5. Table 5 applies to rotating workpieces, as in drilling a bar in a lathe. For rotating drill and fixed workpiece, as in drilling a hole in a plate, the maximum speed should not exceed 50 sfm, but higher feeds may be considered depending on drill alignment, rigidity, and machine power.

Drilling — Indexable Insert Drills Cemented Carbides

Table 7

Drill diameter (in)	Speed (sfm)	Feed (in/rev)	Type of carbide	
			Center	Periphery
0.80	655-820	0.004	C6	C7
1.20	655-820	0.005	C6	C7
1.60	655-820	0.006	C6	C7
2.00	655-820	0.008	C6	C7

Notes:

Cutting Fluid—Pressure: >44 psi; Amount: > 6.5 gal/min
Cutting data for indexable insert drills are highly dependent on the make of drill; the manufacturer's recommendations should be considered.

Mechanical Properties

Table 8

	Typical	ASTM
Tensile Strength, ksi	85	75 min
0.2% Yield Strength, ksi	35	30 min
Elongation in 2 inches, pct.	60	40 min
Reduction of Area, pct.	70	—
Hardness HB, Rockwell B	160	201 max

in tests for PRODEC 304, providing guidelines for possible adaptation to particular machining programs. The data provided are based on achieving tool lives of 15 minutes for cemented carbides and 60 minutes for high speed steel tools.

Heat Treatment
Annealing

PRODEC 304 should be heated to 1900°F minimum and water quenched or rapidly cooled by other means.

Chemical Composition

Table 9

	PRODEC 304
Carbon	0.08 max
Manganese	2.00 max
Phosphorus	0.045 max
Sulfur	0.030 max
Silicon	0.75 max
Chromium	18.0-20.0
Nickel	8.0-10.5
Nitrogen	0.10 max (flat-rolled products only)

Physical Properties

Table 10

Density, lb/in ³	0.285
Modulus of Elasticity, psi	29 x 10 ⁶
Linear Expansion, 68-212°F/°F	9.4 x 10 ⁻⁶
Thermal Conductivity, Btu/h ft°F	8.7
Heat Capacity, Btu/lb°F	0.12
Electrical Resistivity, Ω-inch	27.6 x 10 ⁻⁶

Hardening

PRODEC 304 cannot be hardened by heat treatment. However, PRODEC 304 can be strengthened by cold working.

Workability Cold Working

PRODEC 304 is readily formed and fabricated through a full range of cold working operations. It

can be used in heading, drawing, bending, and upseting. Any cold working operations will increase the strength and hardness of the material, and may leave it slightly magnetic.

Hot Working

PRODEC 304 can be forged in the 1700-2200°F range. For maximum corrosion resistance, forgings should be annealed at 1900°F minimum and water quenched or rapidly cooled by other means after hot working operations.

Welding

PRODEC 304 is readily welded by a full range of conventional welding procedures (except oxyacetylene). AWS E308/ER308 or E308L/ER308L filler metals should be used with PRODEC 304

Lowest Temperature (°F) at Which the Corrosion Rate Exceeds 5 mpy

Table 4

Corrosion Environment	654 SMO®	254 SMO®	904L	Type 316L (2.7 Mo)	Type 304	2507	2205 Code Plus Two®	2304
0.2% Hydrochloric Acid	>Boiling	>Boiling	>Boiling	>Boiling	>Boiling	>Boiling	>Boiling	>Boiling
1% Hydrochloric Acid	203	158	122	86	86p	>Boiling	185	131
10% Sulfuric Acid	158	140	140	122	—	167	140	149
60% Sulfuric Acid	104	104	185	<54	—	<57	<59	<<55
96% Sulfuric Acid	86	68	95	113	—	86	77	59
85% Phosphoric Acid	194	230	248	203	176	203	194	203
10% Nitric Acid	>Boiling	>Boiling	>Boiling	>Boiling	>Boiling	>Boiling	>Boiling	>Boiling
65% Nitric Acid	221	212	212	212	212	230	221	203
80% Acetic Acid	>Boiling	>Boiling	>Boiling	>Boiling	212p	>Boiling	>Boiling	>Boiling
50% Formic Acid	158	212	212p	104	≤50	194	194	59
50% Sodium Hydroxide	275	239	Boiling	194	185	230	194	203
83% Phosphoric Acid + 2% Hydrofluoric Acid	185	194	248	149	113	140	122	95
60% Nitric Acid + 2% Hydrochloric Acid	>140	140	>140	>140	>140	>140	>140	>140
50% Acetic Acid + 50% Acetic Anhydride	>Boiling	>Boiling	>Boiling	248	>Boiling	230	212	194
1% Hydrochloric Acid + 0.3% Ferric Chloride	>Boiling, p	203ps	140ps	77p	68p	203ps	113ps	68p
10% Sulfuric Acid + 2000ppm Cl ⁻ + N ₂	149	104	131	77	—	122	95	<55
10% Sulfuric Acid + 2000ppm Cl ⁻ + SO ₂	167	140	122	<<59p	—	104	<59	<<50
WPA1, High Cl ⁻ Content	203	176	122	≤50	<<50	203	113	86
WPA2, High F ⁻ Content	176	140	95	≤50	<<50	167	140	95

ps = pitting can occur
ps = pitting/crevice corrosion can occur

WPA	P ₂ O ₅	Cl ⁻	F ⁻	H ₂ SO ₄	Fe ₂ O ₃	Al ₂ O ₃	SiO ₂	CaO	MgO
1	54	0.20	0.50	4.0	0.30	0.20	0.10	0.20	0.70
2	54	0.02	2.0	4.0	0.30	0.20	0.10	0.20	0.70

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steel, but the molybdenum-containing austenitic stainless steel filler metals may also be considered. After welding PRODEC 304 it may be necessary to fully anneal to restore the corrosion resistance lost by sensitization to intergranular corrosion when chromium carbides were precipitated in the grain boundaries in the weld heat-affected zone.

Corrosion Performance of Stainless Steel

Table 11 compares the performance of Type 304 with other stainless steels in a variety of common corrosive environments. The table shows the lowest temperature at which the corrosion rate exceeds 5 mpy. All testing was done in accordance with the requirements of the Materials Technology Institute of the Chemical Process Industries (MTI)

Technical Support

Outokumpu Stainless, Inc. assists users and fabricators in the selection, qualification, installation, operation, and maintenance of PRODEC 304 stainless steel. Technical personnel, supported by the research laboratory of Outokumpu Stainless, can draw on years of field experience with PRODEC 304 to help you make the technically and economically correct materials decision.

Outokumpu Stainless is prepared to discuss individual applications and to provide data and experience as a basis for your selection and application of PRODEC 304.

Outokumpu Stainless works closely with its distributors to ensure timely availability of PRODEC 304 in the forms, sizes, and quantities required by the user. For assistance with technical questions and to obtain top quality PRODEC 304, call Outokumpu Stainless, Inc. at 1-800-833-8703.

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