

# Type 304, Type 304L

## UNS S30400, UNS S30403

The basic austenitic stainless steel, a versatile corrosion resistant material for general purpose applications.

### Description

Type 304/304L is the modern evolution of the original “18-8” austenitic stainless steel. It is an economical and versatile corrosion resistant stainless steel suitable for a wide range of general purpose applications.

Type 304/304L is non-magnetic in the annealed condition but may become slightly magnetic as a result of cold working or welding.

### Dual Certification

It is common for 304L to be dual certified as 304 and 304L when the material meets both the lower carbon limit of Type 304L and the slightly higher strengths of Type 304. The producer of the steel must certify the material as Type 304 if it is to be used as Type 304 instead of Type 304L.

### Specifications

Type 304/304L can be supplied to meet AMS, ASTM, ASME, QQS, and MIL-S specifications.

### Product Forms Available

Plate  
Sheet  
Tubular Products  
Bar  
Angle  
Wire Rod  
Billet  
Fittings

### Corrosion Resistance

Type 304/304L is a versatile, general purpose stainless steel with good resistance to atmospheric corrosion, to many organic and inorganic chemicals, and to foods and beverages.

### Mechanical Properties

Table 1

	Typical*	ASTM	
		304	304L
Ultimate Tensile Strength, ksi	87	75 min	70 min
0.2% Offset Yield Strength, ksi	42	30 min	25 min
Elongation in 2 inches, %	58	40 min	40 min
Reduction in Area, %	70	—	—
Hardness, Rockwell B	82	92 max	92 max

\*0.375 inch plate

### Chemical Composition, wt. pct.

Table 2

	304	304L
Carbon	0.08 max	0.030 max
Manganese	2.00 max	2.00 max
Phosphorus	0.045 max	0.045 max
Sulfur	0.030 max	0.030 max
Silicon	0.75 max	0.75 max
Chromium	18.0-20.0	18.0-20.0
Nickel	8.0-10.5	8.0-12.0
Nitrogen*	0.10 max	0.10 max

\*flat-rolled products only

### Physical Properties

Table 3

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

### Heat Treatment Annealing

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

## Hardening

Type 304/304L cannot be hardened by heat treatment. However, Type 304/304L can be hardened by cold working.

## Workability Cold Working

Type 304/304L is readily formed and fabricated through a full range of cold working operations. It can be used in heading, drawing, bending, and upsetting. Any cold working operations will increase the strength and hardness of the material, and may leave it slightly magnetic.

## Hot Working

Type 304/304L 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

Type 304/304L is readily welded by a full range of conventional welding procedures (except oxyacetylene). AWS E308L/ER308L filler metals should be used with Type 304/304L steel, but the molybdenum-containing austenitic stainless steel filler metals may also be considered.

## Machinability

Type 304/304L is a tough austenitic stainless steel subject to work hardening during deformation and, unless modified for improved machining response, is resistant to chip breaking. The best machining

## 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	Outokumpu 2507	2205 Code Plus Two®	Outokumpu 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 <sup>-</sup> + N <sub>2</sub>	149	104	131	77	—	122	95	<55
10% Sulfuric Acid + 2000ppm Cl <sup>-</sup> + SO <sub>2</sub>	167	140	122	<<59p	—	104	<59	<<50
WPA1, High Cl <sup>-</sup> Content	203	176	122	≤50	<<50	203	113	86
WPA2, High F <sup>-</sup> Content	176	140	95	≤50	<<50	167	140	95

ps = pitting can occur

ps = pitting/crevice corrosion can occur

WPA	P <sub>2</sub> O <sub>5</sub>	Cl <sup>-</sup>	F <sup>-</sup>	H <sub>2</sub> SO <sub>4</sub>	Fe <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	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

results are achieved with slower speeds, heavier feeds, excellent lubrication, sharp tooling, and powerful, rigid equipment.

### **Corrosion Performance of Stainless Steels**

Table 4 compares 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 assists users and fabricators in the selection, qualification, installation, operation, and

maintenance of Type 304/304L stainless steel. Technical personnel, supported by the research laboratory of Outokumpu, draw on years of field experience with Type 304/304L to help you make the technically and economically correct materials decision.

Outokumpu is prepared to discuss individual applications and to provide data and experience as a basis for selection and application of Type 304/304L.

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

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*Outokumpu is a global leader in stainless steel. Our vision is to be the undisputed number one in stainless, with success based on operational excellence. Customers in a wide range of industries use our stainless steel and services worldwide. Being fully recyclable, maintenance-free, as well as very strong and durable material, stainless steel is one of the key building blocks for sustainable future.*

*What makes Outokumpu special is total customer focus – all the way, from R&D to delivery. You have the idea. We offer world-class stainless steel, technical know-how and support. We activate your ideas.*



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