AISI 304 VS 304L Stainless Steel (UNS S30403)

AISI 304 and 304L (SS304L) are austenitic stainless steels, and also known as 18/8 stainless steel. This article will introduce the differences between 304 and 304L stainless steel (304 vs 304L) from chemical composition, mechanical properties, corrosion resistance and weldability.

AISI 304L stainless steel is an ultra-low carbon version of SS 304 (Carbon content: ≤ 0.08 %). “L” is short for “Low carbon” and the maximum carbon content is 0.03%. The main purpose is to prevent carbide precipitation and improve weldability and corrosion resistance.

Difference Between 304 and 304L Chemical Composition

The table below gives 304L chemical composition, the maximum carbon content is 0.03%, while 304 is max 0.08%, other than that, the other composition are the same.

304L Chemical Composition, %										
ASTM Type	AISI (UNS)	C, ≤	Si, ≤	Mn, ≤	P, ≤	S, ≤	Cr	Ni	N, ≤	Notes
ASTM A240/A240M	304L (UNS S30403)	0.03	0.75	2.00	0.045	0.030	17.5-19.5	8.0-12.0	0.10	Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A276A/276M		0.03	1.00	2.00	0.045	0.030	18.0-20.0	8.0-12.0	–	Stainless Steel Bars and Shapes
ASTM A580/A580M		0.03	1.00	2.00	0.045	0.030	18.0-20.0	8.0-12.0	0.10	Stainless Steel Wire
ASTM A666		0.03	0.75	2.00	0.045	0.030	18.0-20.0	8.0-12.0	0.10	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A959		0.03	1.00	2.00	0.045	0.030	17.5-19.5	8.0-12.0	–	Wrought Stainless Steels
ASTM A473		0.03	1.00	2.00	0.045	0.030	18.0-20.0	8.0-12.0	–	Stainless Steel Forgings

ASTM A314		0.03	1.00	2.00	0.045	0.030	18.0-20.0	8.0-12.0	0.10	Billets and bars for forging

304 VS 304L Stainless Steel Properties

The following tables summarize 304 vs 304L stainless steel properties, including physical and mechanical properties.

Physical Properties

AISI 304L stainless steel physical properties are given in the following lists, including density, melting point and magnetic permeability.

SS304L Physical Properties	
Density, g/cm3 (lb/in.3)	8.03 (0.29)
Melting point, °C (°F)	1400-1450 (2550-2650)
Magnetic permeability	1.02 (Approximate)

Mechanical Properties

304 vs 304L stainless steel mechanical properties at room temperature are listed in the following tables.

304 vs 304L Mechanical Properties									
ASTM	AISI Type	Conditions	Tensile Strength, MPa (ksi), ≥	0.2% Yield Strength, MPa (ksi), ≥	Elongation in 50 mm (2 in.), %, ≥	Reduction of Area, %, ≥	Brinell Hardness (HBW), ≤	Rockwell Hardness (HRBW), ≤	Product forms
ASTM A276/A276M	304	Annealed, Hot finished	515 (75)	205 (30)	40	50	–	–	Bars and Shapes
	304L		485 (70)	170 (25)	40	50	–	–	
	304	Annealed, Cold finished, Dia ≤ 12.7 mm (0.5 in.)	620 (90)	310 (45)	30	40	–	–	
	304L								
	304	Annealed, Cold finished, Dia > 12.7 mm (0.5 in.)	515 (75)	205 (30)	30	40	–	–	
	304L		485 (70)	170 (25)	30	40	–	–	

ASTM A580/A580M	304	Annealed	520 (75)	210 (30)	35	50			Wire
	304L		485 (70)	170 (25)	35	50	–	–	
	304	Cold finished	620 (90)	310 (45)	30	40	–	–	
	304L								
ASTM A240/A240M	304		515 (75)	205 (30)	40	–	201	92	Plate, Sheet, and Strip
	304L		485 (70)	170 (25)	40	–	201	92	
ASTM A473/A473M	304	Annealed, Sections ≤ 5 in. (127 mm)	515 (75)	205 (30)	40	50	–	–	Forgings
		Annealed, Sections > 5 in. (127 mm)	70 (485)						
	304L		450 (65)	170 (25)	40	50	–	–	

Heat Treatment

Recommended annealing temperatures for AISI 304L stainless steel is 1010-1120 °C (1850-2050 °F).

Hardening: SS304L cannot be hardened by heat treatment, but can be hardened by cold working.

Welding

Both 304 and 304L stainless steel can be easily welded with or without filler metal. If necessary, the recommended filler metal for SS304 is E308, and SS304L is E308L. Weldments that are too large or too complex for full annealing require stress relieving, 304 weldments are easily sensitized, and intergranular corrosion or stress-assisted intergranular corrosion occurs. It is strongly recommended to use stable stainless steel (type 321, 347 or 348) or low carbon type (SS304L or SS316L), especially for those that require long-time stress relief.

Corrosion Resistance

Due to its ultra-low carbon content, SS304L has better corrosion resistance than SS 304.

The following table list 304 vs 304L stainless steel corrosion rates in boiling 50% NaOH solution.

Material	Base metal		Weld	
	mm/yr	mils/yr	mm/yr	mils/yr

SS304 (UNS S30400)	3.0	118	3.3	130
SS304L (UNS S30403)	1.8	71	2.2	87
SS316 (UNS S31600)	3.1	123.6	3.5	136.8
SS316L (UNS S31603)	1.97	77.6	2.17	85.4

Machinability (Machining)

The following tables show 304 and 304L stainless steel machinability (machining).

Nominal speeds and feeds for turning a variety of steels and cast irons with high-speed steel (HSS) single-point and box tools

Material	Hardness, HB	Condition	Depth of cut, mm (in)	High-speed steel tool				Tool material	
				Speed		Feed			
				m/min	sfm	mm/rev	in./rev	ISO	AISI
Wrought austenitic: 201, 202, 301, 302, 304, 304L, 305, 308, 321, 347, 348, 384, 385	135-185	Annealed	1 (0.04)	34	110	0.18	0.007	S4, S5	M2, M3
			4 (0.15)	27	90	0.4	0.015		
			8 (0.30)	21	70	0.5	0.02		
			16 (0.625)	17	55	0.75	0.03		

Nominal speeds and feeds for turning a variety of steels and cast irons with carbide-tipped single-point and box tools

Material	Hardness, HB	Condition	Carbide tool													
			Uncoated								Coated					
			Speed				Feed		Tool material grade		Speed		Feed		Tool material grade	
			Brazed		Indexable											
			m/min	sfm	m/min	sfm	mm/rev	in./rev	ISO	C	m/min	sfm	mm/rev	in./rev	ISO	C
Wrought austenitic: 201, 202, 301, 302, 304,	135-185	Annealed	105	350	120	400	0.18	0.007	K01, M10	C-3	160	525	0.18	0.007	CK01, CM10	CC-3
			100	325	105	350	0.4	0.015			135	450	0.4	0.015		
			76	250	84	275	0.5	0.02		C-2	105	350	0.5	0.02		CC-2
			60	200	64	210	0.75	0.03	K20,		–	–	–	–	–	–

304L, 305, 308, 321, 347, 348, 384, 385									M 20							

Nominal speeds and feeds for turning a variety of steels and cast irons with ceramic tools								
Material	Hardness, HB	Condition	Depth of cut, mm (in)	Speed		Feed		Type of ceramic
				m/min	sfm	mm/rev	in./rev	
Austenitic: 201, 202, 301, 302, 304, 304L, 305, 308, 321, 347, 348, 384, 385	135-185	Annealed	1 (0.040)	425	1400	0.13	0.005	Cold-pressed alumina
			4 (0.150)	275	900	0.25	0.010	
			8 (0.300)	185	600	0.40	0.015	

Nominal speeds and feeds for turning a variety of steels and cast irons with high-speed steel and carbide cutoff and form tools														
Material	Hardness, HB	Condition	Speed		Feed, mm/rev (in./rev)								Tool material grade	
					Cutoff tool width			Form tool width						
			m/min	sfm	1.5 mm (0.062 in.)	3 mm (0.125 in.)	6 mm (0.250 in.)	12 mm (0.500 in.)	18 mm (0.750 in.)	25 mm (1.00 in.)	35 mm (1.50 in.)	50 mm (2.00 in.)	ISO	AISI or C
Austenitic: 201, 202, 301, 302, 304, 304L, 305,	135-185	Annealed	26	85	0.033 (0.0013)	0.041 (0.0016)	0.050 (0.002)	0.050 (0.002)	0.041 (0.0016)	0.036 (0.0014)	0.030 (0.0012)	0.025 (0.001)	S4, S5, K40, M40	M2, M3, C-2
			84	275										

308, 321, 347, 348, 384, 385														

Speeds and feeds for the deep-hole trepanning of various steels with high-speed tool steels and carbide tools								
Material	Hardness, HB	Condition	Speed		Feed		Tool material grade	
			m/min	sfm	mm/rev	in./rev	ISO	AISI or C
Austenitic: 201, 202, 301, 302, 304, 304L, 305, 308, 321, 347, 348, 384, 385	135-185	Annealed	20	65	0.075	0.003	S4, S5	M2, M3
			84	275	0.15	0.006	K20	C-2
	225-275	Cold drawn	18	60	0.075	0.003	S4, S5	M2, M3
			69	225	0.10	0.004	K20	C-2

Nominal speeds for the thread grinding									
Material	Hardness, HB	Condition	Thread designation		Wheel identification ANSI	Wheel speed		Work speed	
			Pitch, mm	Threads per 25 mm (1 in.)		m/s	sfm	m/min	sfm
Wrought austenitic stainless steels: 201, 202, 301, 302, 302B, 304, 304L, 305, 308, 309, 309S, 310, 310S, 314, 316, 316L,	135-275	Annealed or cold drawn	6-2.5	4-12	A90RB	43	8,500	1.2	4.0
			2-1	13-27	A120SB	46	9000		
			0.8-0.45	28-63	A180TB	48	9500		
			0.4-0.35	64-80	A220UB	51	10000		

317, 321, 330, 347, 348, 384, 385										

Recommended speeds and feeds for the face milling of alloys with both high-speed steel and carbide cutters													
Material	Hardness, HB	Condition	Depth of cut, mm (in.)	High-speed steel tool			Carbide tool						
							Uncoated				Coated		
							Speed		Feed per tooth, mm (in.)	Tool material grade, ISO (C)	Speed, m/min (sfm)	Feed per tooth, mm (in.)	Tool material grade, ISO (C)
				Speed, m/min (sfm)	Feed per tooth, mm (in.)	Tool material, ISO (AISI)	Brazed, m/min (sfm)	Indexable, m/min (sfm)					
Wrought austenitic stainless steels: 201, 202, 301, 302, 304, 304L, 305, 308, 321, 347, 348, 384, 385	135-185 HB	Annealed	1 (0.040)	40 (130)	0.20 (0.008)	S4, S2 (M2, M7)	130 (430)	145 (475)	0.20 (0.008)	K10, M20 (C-2)	215 (700)	0.20 (0.008)	CK10, CM20 (CC-2)
			4 (0.150)	30 (100)	0.30 (0.012)	S4, S2 (M2, M7)	100 (325)	110 (360)	0.30 (0.012)	K20, M30 (C-2)	145 (475)	0.30 (0.012)	CK20, CM30 (CC-2)
			8 (0.300)	24 (80)	0.40 (0.016)	S4, S2 (M2, M7)	70 (230)	85 (280)	0.40 (0.016)	K30, M40 (C-2)	105 (350)	0.40 (0.016)	CK30, CM40 (CC-2)

Recommended speeds and feeds for the slab (or plain) milling of alloys with high-speed steel cutters						
Material	Hardness,	Condition	Depth of	Speed	Feed	High-speed

	HB		cut, mm (in.)			per tooth	steel tool material	
				m/min	sfm	mm (in.)	ISO	AISI
Wrought austenitic stainless steels: 201, 202, 301, 302, 304, 304L, 305, 308, 321, 347, 348, 384, 385	135-185 HB	Annealed	1 (0.040)	55	180	0.15 (0.006)	S4, S2	M2, M7
			4 (0.150)	43	140	0.20 (0.008)		
			8 (0.300)	34	110	0.25 (0.010)		

Recommended speeds and feeds for the end milling (peripheral) of alloys with both high-speed steel and carbide cutters														
Material	Hardness, HB	Condition	Radial depth of cut, mm (in.)	High-speed steel tool					Carbide tool					
				Speed, m/min (sfm)	Feed, mm/tooth (in./tooth), at cutter diameter of:				Tool material, ISO (AISI)	Speed, m/min (sfm)	Feed, mm/tooth (in./tooth), at cutter diameter of:				Tool material, ISO (C)
					10 mm (.375in)	12 mm (.5 in)	18 mm (.75 in)	25-50 mm (1-2 in.)			10 mm (.375in)	12 mm (.5 in)	18 mm (.75 in)	25-50 mm (1-2 in.)	
201, 202, 301, 302, 304, 304L, 305, 308, 321, 347, 348, 384, 385	135-185 HB)	Annealed	0.5 (0.020)	34 (110)	0.025 (0.001)	0.050 (0.002)	0.102 (0.004)	0.13 (0.005)	S4, S5, S2 (M2, M3, M7)	110 (360)	0.013 (0.005)	0.025 (0.001)	0.050 (0.002)	0.102 (0.004)	K20, M20 (C-2)
			1.5 (0.060)	24 (80)	0.050 (0.002)	0.075 (0.003)	0.13 (0.005)	0.15 (0.006)		82 (270)	0.025 (0.001)	0.050 (0.002)	0.075 (0.003)	0.13 (0.005)	
			dia m/4 dia m/4	21 (70)	0.025 (0.001)	0.050 (0.002)	0.102 (0.004)	0.13 (0.005)		72 (235)	0.025 (0.001)	0.038 (0.015)	0.063 (0.025)	0.102 (0.004)	
			dia m/2 dia m/2	18 (60)	0.025 (0.001)	0.038 (0.015)	0.075 (0.003)	0.102 (0.004)		67 (220)	0.013 (0.005)	0.025 (0.001)	0.050 (0.002)	0.075 (0.003)	

Applications

SS 304L stainless steel applications: Food processing equipment, in particular beer brewing, milk processing and brewing equipment, weaving, welding screens, for mining, quarrying and water filtration, pressure vessels, storage tanks, heat exchangers, piping systems, flanges, accessories, valves and pumps, elbow, pipe tee, and reducing tee, etc.

AISI 304L Stainless Steel Equivalent

AISI 304L stainless steel equivalent to European EN (German DIN EN, British BSI EN, France NF EN), ISO, Japanese JIS and Chinese GB standard (for reference).

US		European Union		ISO		Japan		China	
Standard	Type	Standard	Grade (Steel Number)	Standard	Grade (ISO Number)	Standard	Grade	Standard	Grade
AISI SAE; ASTM	304L (UNS S30403)	EN 10088-1; EN 10088-2; EN 10088-3	X2CrNi18-9 (1.4307); X2CrNi19-11 (1.4306)	ISO 15510	X2CrNi19-11 (4306-304-03-I)	JIS G4303; JIS G4304; JIS G4305;	SUS304L	GB/T 20878; GB/T 1220; GB/T 3280	00Cr19Ni10; 022Cr19Ni10 (New name)