



Resource Guide

CHROMIUM NICKEL TYPES

WEIGHTS & TYPES



Type 301 - UNS S30100

High Tensile Stainless Sheets

This is a “17-7” grade of chromium nickel stainless steel, manufactured by the electric-furnace process. Sufficient discard is taken from each ingot to ensure sound steel required to meet the exacting requirements of the aircraft industry. Type 301 is not hardenable by heat treatment, and the high tensile properties of the sheets are the result of cold working.

Analysis

C Max.	Mn Max.	P Max.	S max.	Si Max.	Cr	Ni	Cu Max.	Mo Max.
.15	2.00	0.45	0.30	1.00	16.00/18.00	6.00/8.00	.50	.50

Specifications

The following specifications are generally applicable: MIL-S-5059, ASTM A 177

Applications

Structural parts where a corrosion-resisting steel is required but where gas or arc welding and elevated temperatures are not involved. This material is used in applications requiring higher strength characteristics than are found in annealed sheets.

Corrosion Resistance

The corrosion-resisting properties of Type 301 are comparable to those of Type 302, data for which will be found on page 12.

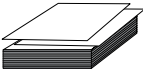
Mechanical Properties

	Tensile Strenght (psi)	Yield Strength (psi)	Min. Elongation in 2"	
			.015" Thick and Under	.016" Thick and Over
Condition 1/4 Hard	125,000 Min.	75,000 Min.	25%	25%
Condition 1/2 Hard	150,000 Min.	110,000 Min.	15%	18%
Condition Hard	185,000 Min.	140,000 Min.	8%	9%

Weldability

Easily welded by all the commercial processes except forge or hammer welding. The resulting weld has good toughness and ductility. Annealing is recommended after welding to maintain maximum corrosion resistance.

Type 301 High Tensile Sheets - 1/4, 1/2, & Full Hard



No. 2B Finish - Bright Cold Rolled

Thickness in Inches	Estimated Weight, Lbs.		Thickness in Inches	Estimated Weight, Lbs.	
	Per Sq. Ft.	Per Sheet		Per Sq. Ft.	Per Sheet
Condition 1/4 Hard			Condition 1/2 Hard		
.012	.504	15.1	.012	.504	15.1
.016	.672	20.2	.016	.672	20.2
.0161	.676	20.3	.0161	.676	20.3
.020	.840	25.2	.020	.840	25.2
.025	1.050	31.5	.025	1.050	31.5
.032	1.344	40.3	.032	1.344	40.3
.036	1.512	45.4	.036	1.512	45.4
.040	1.680	50.4	.040	1.680	50.4
.050	2.100	63.0	.050	2.100	63.0
.063	2.646	79.4	.063	2.646	79.4
.080	3.360	100.8	.080	3.360	100.8
.090	3.780	113.4	.090	3.780	1113.4
.125	5.250	157.5	.125	5.250	157.5

Note: Stock Size 36" x 120"

Types 302, 304 & 304L

UNS S30200, S30400, S30403

Sheets, Plates, Bars, Angles, Billets

Color Markings

Type 304 Bars, Angles, Billets—Pink and White.

Types 304L Bars, Billets—Pink with Brown Stripe.

Type 302 is the basic “18-8” chromium-nickel stainless steel. It combines excellent mechanical properties with remarkable resistance to many corrosive agents encountered in domestic and industrial use. It is non-magnetic in the annealed condition and not hardenable by heat treatments. Both hardness and tensile strength can be increased by cold working. This is an electric-furnace product manufactured to meet the exacting standards of the aircraft industry.

The analysis of Type 304 is similar to that of Type 302, except that Type 304 is modified by lowered carbon content. This provides good resistance to corrosion in welded construction where subsequent heat treatment is not practicable. Billets and plates are available not only in the regular Type 302 and 304 analyses, but also in an extra low carbon analysis, known as Type 304L. The advantage of this analysis is that it precludes any harmful precipitation in the 800°-1500° F range, such as might otherwise occur in welding heavier sections.

Analysis

	C Max.	Mn Max.	P Max.	S Max.	Si Max.	Cr	Ni	Cu Max.	Mo Max.
302	.12	2.00	.040	.030	1.00	17.00/19.00	8.00/10.00	.50	.50
304	.08	2.00	.040	.030	1.00	18.00/20.00	8.00/11.00	.50	.50
304L	.03	2.00	.040	.030	1.00	18.00/20.00	8.00/12.00	—	—

Specifications

The following specifications are generally applicable:

Sheets & Plates: MIL-S-5059, AMS-5513, ASTM A 167, ASTM A 240

Bars: MIL-S-7720, QQ-S-763, AMS-5639, ASTM A 276, ASTM A 479

Billets: QQ-S-763, ASTM A 314

Applications

Used where corrosion resistance and good mechanical properties are primary requirements. These grades are widely accepted in industries where the highest degree of sanitation and cleanliness is of prime importance. Parts for handling acetic, nitric and citric acids, organic and inorganic chemicals, dyestuffs crude and refined oils, etc., are fabricated from this material. Because of its lack of magnetism, it is highly desirable for instruments. It is also widely used for architectural trim. Type 302 sheets are used in applications where corrosion resistance is required, but where gas or arc welding and elevated temperatures are not involved. Type 304, as noted above, finds particular use in applications requiring welding.

Corrosion Resistance

Types 302 and 304 show good resistance to corrosion. They are highly resistant to strong oxidizing acids, such as nitric acid, and resist attack by a wide variety of organic and inorganic chemicals. Maximum corrosion resistance is obtained in the annealed condition. Intergranular corrosion may occur when material is heated within or cooled through the range of 800°-1500° F.

Resistance to Scaling

Excellent scale resistance at temperature up to 1600°F in continuous service. Chromium-nickel grades have a high coefficient of expansion, which should be considered in designing.

Mechanical Properties

Applicable specifications require the following properties of sheets in the annealed condition:

	Tensile Strength (psi)	Minimum Elongation in 2"		
		.015" Thick and Under	.016" Thick to .030"	.031" Thick and Over
Type 302	75,000/11,000	40%	45%	50%
Type 304	100,000 Max.	40%	40%	40%

In practice, annealed sheets and plates will *average* as follows:

Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2"	Rockwell "B" Hardness 85
90,000	40,000	50%	85

Machinability

Types 302 and 304 have a machinability rating of approximately 45%, with 1212 rated as 100%. Surface cutting speed on automatic screw machines is approximately 75 feet per minute.

Weldability

Easily welded by all the commercial processes except forge or hammer welding. The resulting weld has good toughness and ductility. Annealing is recommended after welding to maintain maximum corrosion resistance.

Forming

These grades have very good drawing and stamping properties.

Forging

Forge between 2100° and 2350°F. Do not forge below 1700°F.

Annealing

Annealing range is between 1850° and 2050°F. Cool rapidly. Water should be used for heavier sections; air for lighter section. The stress relieving range is between 400° and 750°F.

Type 302 & 304 Stainless Sheets

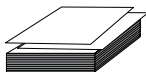
Annealed (Physical Condition A)

No. 2B Finish - Bright Cold Rolled

No. 2D Finish - Dull Cold Rolled

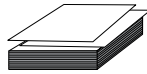
No. 3 Finish - Polished One Side

No. 4 Finish - Polished One Side



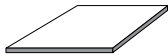
Thickness	Width & Length Inches	Est. Wt. Lbs. per Sheet	Thickness	Width & Length Inches	Est. Wt. Lbs. per Sheet	Thickness	Width & Length Inches	Est. Wt. Lbs. per Sheet
.012" (30 Ga.)				120	40.3		120	80.6
.504 Lb. Sq. Ft.			.030" (22 Ga.)				144	96.8
36 x 120 15.1			1.260 Lb. Sq. Ft.			60 x 120 100.8		
0.16" (28 Ga.)			36 x 96 30.2			144 121.0		
.672 Lb. Sq. Ft.			120 37.8			.060" (16 Ga.)		
36 x 120 20.2			48 x 96 40.3			2.520 Lb. Sq. Ft.		
.0161" (27 Ga.)			120 50.4			36 x 96 60.5		
.676 Lb. Sq. Ft.			.0351" (20 Ga.)			120 75.6		
36 x 120 20.3			1.474 Lb. Sq. Ft.			48 X 96 80.6		
.018" (26 Ga.)			36 x 96 35.4			120 100.8		
.756 Lb. Sq. Ft.			120 44.2			144 121.2		
36 x 96 18.1			48 x 96 47.2			60 x 120 126.0		
120 22.7			120 59.0			144 151.2		
48 x 96 24.2			144 70.8			.075" (14 Ga.)		
120 30.2			.040" (20 Ga.)			3.150 Lb. Sq. Ft.		
.020" (25 Ga.)			1.680 Lb. Sq. Ft.			30 x 96 63.0		
.840 Lb. Sq. Ft.			36 x 120 50.4			120 78.8		
36 x 120 25.2			.048" (18 Ga.)			144 94.5		
.024" (24 Ga.)			2.016 Lb. Sq. ft.			36 x 96 75.6		
1.088 Lb. Sq. ft.			36 x 96 48.4			120 94.5		
36 x 96 24.2			120 60.5			42 x 120 110.3		
120 30.2			42 x 120 70.6			48 x 96 100.8		
48 x 96 32.3			48 x 96 64.5			120 126.0		

Types 302 & 304 Stainless Sheets (Continued)



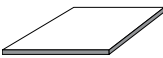
Thickness	Width & Length Inches	Est. Wt. Lbs. per Sheet	Thickness	Width & Length Inches	Est. Wt. Lbs. per Sheet	Thickness	Width & Length Inches	Est. Wt. Lbs. per Sheet
	144	151.2		120	132.3			
60 x	120	157.5	48 x	96	141.1		144	241.9
	144	189.0		120	176.4	60 x	120	252.0
.090" (13 Ga.)				144	211.7	.135" (10 Ga.)		
3.780 Lb. Sq. Ft.			60 x	120	220.5	5.670 Lb. Sq. ft.		
36 x	96	90.7		144	264.6	36 x	96	136.1
	120	113.4	.120" (11 Ga.)				120	170.1
48 x	96	121.0	5.040 Lb. Sq. ft.			48 x	96	181.4
	120	151.2	36 x	96	121.0		120	226.8
.105" (12 Ga.)				120	151.2		144	272.2
4.410 lb. sq. ft.			48 x	96	161.2	60 x	120	283.5
36 x	96	105.8		120	201.6		144	340.2

Types 302, 304, & 304L Plates ~ Hot Rolled, Annealed, & Pickled



Thickness & Width				Billing Wt. Per Lineal Ft.	Thickness & Width				Billing Wt. Per Lineal Ft.	Thickness & Width				Billing Wt. Per Lineal Ft.
3/16	x	36		25.74		96			89.30		84			115.47
		48		34.32	5/16	x	36		41.24		96			131.97
		60		42.90		48			54.98	1/2	x	36		64.99
		72		51.47		60			68.73		48			86.65
		84		60.05		72			82.48		60			108.32
		96		68.63		84			96.22		72			129.98
1/4	x	36		33.49		96			109.97		84			151.64
		48		44.65	3/8	x	36		49.49		96			173.30
		60		55.81		48			65.98	5/8	x	36		80.49
		72		66.97		60			82.48		48			107.32
		84		78.13		72			98.98		72			160.99

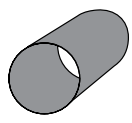
Types 302, 304, & 304L Plates (Continued)



Thickness & Width				Billing Wt. Per Lineal Ft.		Thickness & Width				Billing Wt. Per Lineal Ft.		Thickness & Width				Billing Wt. Per Lineal Ft.	
84				187.82		84				298.66		84				515.70	
96				214.65		96				341.32		96				589.38	
3/4	x	36	96.37	1 1/4	x	36	159.00	2	x	36	252.02						
48				128.49		48				212.00		48				336.03	
72				192.74		72				318.01		72				504.05	
84				224.86		84				371.01		84				588.06	
36				256.98		96				424.01		96				672.06	
7/8	x	36	111.87	1 1/2	x	36	190.01	2 1/2	x	36	315.34						
48				149.16		48				253.35		48				420.45	
72				223.16		72				380.02		72				630.68	
84				261.04		84				443.36		3	x	36	378.90		
96				298.33		96				506.70		48				505.20	
1	x	36	128.00	1 3/4	x	36	221.02					72	757.81				
48				170.66		48				294.69							
72				256.00		72				442.03							

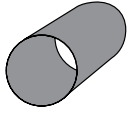
Note: Stock lengths up to 20'

Types 302, 304, & 304L Rounds ~ Cond. A - Annealed



Size in Inches	Est. Wt., Lbs		Size in Inches	Est. Wt., Lbs		Size in Inches	Est. Wt., Lbs	
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar
Ann. & C. D.			7/16	.5116	6.139	7/8	2.046	24.56
1/8	.0418	.5012	1/2	.6682	8.019	15/16	2.349	28.19
3/16	.0940	1.128	Ann. & Ground			1	2.673	32.07
7/32	.1279	1.535	9/16	.8457	10.15	1/16	3.017	36.21
1/4	.1671	2.005	5/8	1.044	12.53	1/8	3.383	40.59
5/16	.2610	3.132	11/16	1.263	15.16	3/16	3.769	45.23
11/32	.3158	3.790	3/4	1.504	18.04	1/4	4.176	50.12
3/8	.3759	4.510	13/16	1.765	21.17	5/16	4.604	55.25

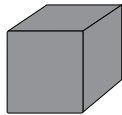
Types 302, 304, & 304L Rounds (Continued)



Size in Inches	Est. Wt., Lbs		Size in Inches	Est. Wt., Lbs		Size in Inches	Est. Wt., Lbs	
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar
Ann. & Ground (cont.)			3/8	30.45	365.3	6	96.22	1155
3/8	5.053	60.64	1/2	32.74	392.9	1/4	104.4	1253
7/16	5.523	66.28	5/8	35.12	421.5	1/2	112.9	1355
1/2	6.014	72.17	3/4	37.59	451.0	3/4	121.8	1461
5/8	7.058	84.70	4	42.77	513.2	7	131.0	1572
3/4	8.186	98.23	Hot Rolled, Ann. Rough Turned			1/2	150.4	1804
7/8	9.397	112.8	3	24.06	288.7	3/4	160.5	1926
2	10.69	128.3	1/4	28.23	338.8	8	171.1	2053
1/8	12.07	144.8	1/2	32.74	392.9	1/4	181.9	2183
1/4	13.53	162.4	3/4	37.59	451.0	1/2	193.1	2317
3/8	15.08	180.9	4	42.77	513.2	9	216.5	2598
1/2	16.71	200.5	1/4	48.28	579.3	1/2	241.2	2895
5/8	18.42	221.0	1/2	54.13	649.5	10	267.3	3207
3/4	20.21	242.6	3/4	60.31	723.7	11	323.4	3881
7/8	22.09	265.1	5	66.82	801.9	12	384.9	4619
3	24.06	288.7	1/4	73.67	884.0	13	451.7	5421
1/8	26.10	313.2	1/2	80.86	970.2	14	523.9	6287
1/4	28.23	338.8	3/4	88.37	1060			

Note: Stock Lengths 10' to 20' and 20' to 22'

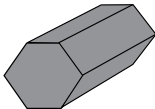
Types 302 & 304 Squares ~ Cond. A - Annealed



Est. Wt., Lbs.			Est. Wt., Lbs.		
Size in Inches	Per Sq. Foot	12-Foot Bar	Size in Inches	Per Sq. Foot	12-Foot Bar
Ann. & C.D.			H.R., Ann. & Pick.		
3/16	.120	1.44	1	5/8	8.987
1/4	.213	2.55		3/4	10.42
5/16	.332	3.99	2		13.61
3/8	.479	5.74		1/4	17.23
1/2	.751	10.21		1/2	21.27
5/8	1.329	15.95		3/4	25.74
3/4	1.914	22.97	3		30.63
7/8	2.606	31.27		1/2	41.69
1	3.403	40.84	4		54.45
1/4	5.318	63.81			653.4
1/2	7.657	91.89			
2	13.61	163.4			
1/2	21.27	255.2			

Note: Stock Lengths 10' to 12'

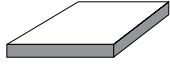
Types 302 & 304 Cold Drawn Hexagons ~ Cond. A - Annealed



Est. Wt., Lbs.			Est. Wt., Lbs.		
Size in Inches	Per Sq. Foot	12-Foot Bar	Size in Inches	Per Sq. Foot	12-Foot Bar
1/4	.184	2.21	1		2.947
5/16	.288	3.45		1/8	3.730
7/16	.564	6.77		1/4	4.605
1/2	.737	8.84		3/8	5.572
9/16	.933	11.19		1/2	6.631
5/8	1.151	13.82		5/8	7.783
11/16	1.393	16.72		3/4	9.026
3/4	1.658	19.89	2		11.79
					141.5

Note: Stock Lengths 10' to 12'

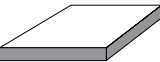
Types 302 & 304 Flats ~ Hot Rolled, Annealed, & Pickled



Est. Wt., Lbs.				Est. Wt., Lbs.				Est. Wt., Lbs.			
Size in Inches		Per Sq. Foot	12-Ft. Bar	Size in Inches		Per Sq. Foot	12-Ft. Bar	Size in Inches		Per Sq. Foot	12-Ft. Bar
1/8 x	1/2	.213	2.55	2 1/2	2.127	25.52		2 1/2	4.254	51.05	
	5/8	.266	3.19	3	2.552	30.63		3	5.105	61.26	
	3/4	.319	3.83	4	3.403	40.84		3 1/2	5.956	71.47	
	1	.425	5.11	5	4.254	51.05		4	6.806	81.68	
	1 1/4	.532	6.38	6	5.105	61.26		5	8.508	102.1	
	1 1/2	.638	7.66	5/16 x	1	1.064	12.76	6	10.21	122.5	
	2	.851	10.21	1 1/4	1.329	15.95		5/8 x	3/4	1.595	19.14
	2 1/2	1.064	12.76	2	2.127	25.52		1	2.127	25.52	
	3	1.276	15.31	3/8 x	1/2	.638	7.66	1 1/4	2.659	31.91	
3/16 x	1/2	.319	3.83	3/4	.957	11.49		1 1/2	3.191	38.29	
	3/4	.479	5.74	1	1.276	15.31		1 3/4	3.722	44.67	
	1	.638	7.66	1 1/4	1.595	19.14		2	4.254	51.05	
	1 1/4	.798	9.57	1 1/2	1.914	22.97		1/2	5.318	63.81	
	1 1/2	.957	11.49	1 3/4	2.233	26.80		3	6.381	76.57	
	1 3/4	1.117	13.40	2	2.552	30.63		4	8.508	102.1	
	2	1.276	15.31	2 1/4	2.871	34.46		3/4 x	1	2.552	30.63
	2 1/4	1.436	17.23	2 1/2	3.191	38.29		1 1/4	3.191	38.29	
	2 1/2	1.595	19.14	3	3.829	45.94		1 1/2	3.829	45.94	
	3	1.914	22.97	3 1/2	4.467	53.60		1 3/4	4.467	53.60	
	4	2.552	30.63	4	5.105	61.26		2	5.105	61.26	
1/4 x	3/8	.319	3.83	4 1/2	5.743	68.91		2 1/2	6.381	76.57	
	1/2	.425	5.11	5	6.381	76.57		3	7.657	91.89	
	5/8	.532	6.38	6	7.657	91.89		3 1/2	8.933	107.2	
	3/4	.638	7.66	1/2 x	3/4	1.276	15.31	4	10.21	122.5	
	1	.851	10.21	1	1.702	20.42		6	15.31	183.8	
	1 1/4	1.064	12.76	1 1/4	2.127	25.52		1 x	1 1/4	4.254	51.05
	1 1/2	1.276	15.31	1 1/2	2.552	30.63		1 1/2	5.105	61.26	
	1 3/4	1.489	17.87	1 3/4	2.978	35.73		1 3/4	5.956	71.47	
	2	1.702	20.42	2	3.403	40.84		2	6.806	81.68	

Note: Stock Lengths 10' to 12'

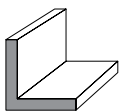
Types 302 & 304 Flats (Continued)



Est. Wt., Lbs.			Est. Wt., Lbs.			Est. Wt., Lbs.		
Size in Inches	Per Sq. Foot	12-Ft. Bar	Size in Inches	Per Sq. Foot	12-Ft. Bar	Size in Inches	Per Sq. Foot	12-Ft. Bar
2 1/2	8.508	102.1	3	12.76	153.1	1 3/4 x 2	11.91	142.9
3	10.21	122.5	4	17.02	204.2	2 1/2	14.89	178.7
3 1/2	11.91	142.9	1 1/2 x 1 3/4	8.933	107.2	3	17.87	214.4
4	13.61	163.4	2	10.21	122.5	2 x 2 1/2	17.02	204.2
6	20.42	245.0	2 1/2	12.76	153.1	3	20.42	245.0
1 1/4 x 2	8.508	102.1	3	15.31	183.8	4	27.23	326.7
2 1/2	10.64	127.6	4	20.42	245.0	3 x 4	40.84	490.1

Note: Stock Lengths 10' to 12'

Types 302 & 304 Angles ~ Hot Rolled, Annealed, & Pickled



Est. Wt., Lbs.			Est. Wt., Lbs.		
Size in Inches	Per Sq. Foot	20-Ft. Length	Size in Inches	Per Sq. Foot	20-Ft. Length
3/4 x 3/4 x 1/8	.59	11.8	3/16	2.44	48.8
1 x 1 x 1/8	.80	16.0	1/4	3.19	63.8
3/16	1.16	23.2	3/8	4.70	94.0
1/4	1.49	29.8	2 1/2 x 2 1/2 x 3/16	3.07	61.4
1 1/4 x 1 1/4 x 1/8	1.01	20.2	1/4	4.10	82.0
3/16	1.48	29.6	3/8	5.90	118.0
1/4	1.92	38.4	3 x 3 x 1/4	4.90	98.0
1 1/2 x 1 1/2 x 1/8	1.23	24.6	3/8	7.20	144.0
3/16	1.80	36.0	4 x 4 x 1/4	6.60	132.0
1/4	2.34	46.8	3/8	9.80	196.0
2 x 2 x 1/8	1.65	33.0	1/2	12.80	256.0

Note: Stock Lengths 10' to 12'

Type 302, 304, & 604L Billets

Refer to Page 99

Types 303S & 303Se

Free Machining UNS S30300, S30323

Stainless Bars and Billets

Color Markings

Type 303S—Annealed Bars, Pump Shafting and Unannealed Billets: Ends Painted Red.

High Tensile Bars (Condition B): Ends painted Gray & Orange.

Type 303Se—Annealed Bars and Unannealed Billets: Ends painted Purple

High Tensile Bars (Condition B): Ends painted Brown

Type 303 is “18-8” chromium-nickel stainless steel modified by the addition of selenium or sulphur, as well as phosphorus, to improve machinability and non-seizing properties. It is the most readily machinable of all the chromium-nickel grades and has good corrosion resistance. It is non-magnetic in the annealed condition and not hardenable by heat treatment. Tensile strength and hardness can be increased by cold working. It is manufactured by the electric-furnace process and meets the exacting requirements of the aircraft industry.

Analysis

	C Max.	Mn Max.	P Max.	S	Se	Si Max.	Cr	Ni	Mo M ax.	Cu Max.
303S	.15	2.00	.15	.15/.40	—	1.00	17.00/19.00	8.00/10.00	.75	.75
303Se	.15	2.00	.15	.04 Max.	.15/.35	1.00	17.00/19.00	8.00/10.00	.75	.75

Specifications

The following specifications are generally applicable:
AMS-5640, ASTM A 314, ASTM A 581, ASTM A 582.

Applications

Used almost exclusively for parts requiring machining, grinding or polishing where good corrosion resistance is also required. Its non-seizing and non-galling properties make it ideal for moving parts. Being an austenitic steel, it is useful where low magnetic permeability is desired.

Corrosion Resistance

Because of the elements that are added to improve machinability, Type 303 has slightly less general corrosion resistance than regular chromium-nickel grades such as Type 302. Maximum corrosion resistance is obtained in the annealed condition.

Resistance to Scaling

This grade has excellent scale resistance at temperatures up to 1600°F in continuous service. Like other chromium-nickel grades, it has a high coefficient of expansion which should be considered in designing.

Mechanical Properties

	Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2"	Reduction of Area
Condition A (Annealed)				
Under 1/4"	125,000 Max.	—	35% Min.	50% Min.
1/4" and over	115,000 Max.	—	35% Min.	50% Min.
Condition B (High tensile)				
Up to 3/4"	125,000 Min.	100,000 Min.	12% Min.	35% Min.
Over 3/4" to 1"	115,000 Min.	80,000 Min.	15% Min.	35% Min.
Over 1" to 1 1/4"	105,000 Min.	65,000 Min.	20% Min.	35% Min.
Over 1 1/4" to 1 1/2"	100,000 Min.	50,000 Min.	28% Min.	45% Min.
Over 1 1/2" to 3"	95,000 Min.	45,000 Min.	28% Min.	45% Min.

Mechanical Properties (Continued)

In practice, annealed sheets and plates will average as follows:

	Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2"	Reduction of Area	Izod Impact Ft./Lbs.	Brinell Hardness
H.R. Ann	90,000	35,000	50%	55%	80	160
Ann. & C.F.	100,000	60,000	40%	53%	—	228

Machinability

Type 303 has considerably better machining characteristics than the other chromium-nickel grades. It has a machinability rating of approximately 60%, with 1212 rated 100%. Surface cutting speed on automatic screw machines is approximately 100 feet per minute.

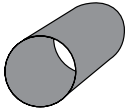
Forming

This grade has fairly good forming properties.

Annealing

Annealing range is between 1850° and 2050°F. Cool rapidly. Water should be used for heavier sections; air for lighter sections. The stress relieving range is between 400° and 750°F.

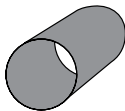
Types 303S & 303Se Rounds ~ Cond. A - Annealed



Est. Wt. Lbs.			Est. Wt. Lbs.			Est. Wt. Lbs.		
Size in Inches	Per Sq. Foot	12 -Ft. Bar	Size in Inches	Per Sq. Foot	12 -Ft. Bar	Size in Inches	Per Sq. Foot	12 -Ft. Bar
Annealed & Cold Drawn Max. Brinell 235			19/32	.942	11.31	1/8	12.07	144.8
			5/8	1.044	12.53	3/16	12.79	153.5
1/16	.010	.13	21/32	1.151	13.81	1/4	13.53	162.4
3/32	.024	.28	11/16	1.263	15.16	5/16	14.29	171.5
1/8	.042	.50	23/32	1.381	16.57	3/8	15.08	180.9
5/32	.065	.78	3/4	1.504	18.04	7/16	15.88	190.6
3/16	.094	1.13	25/32	1.631	19.58	1/2	16.71	200.5
13/64	.110	1.32	13/16	1.765	21.17	5/8	18.42	221.0
7/32	.128	1.54	27/32	1.903	22.83	11/16	19.31	231.7
1/4	.167	2.01	7/8	2.046	24.56	3/4	20.21	242.6
9/32	.211	2.54	29/32	2.195	26.34	7/8	22.09	265.1
5/16	.261	3.13	15/16	2.349	28.19	15/16	23.06	276.8
21/64	.288	3.45	31/32	2.508	30.10	3	24.06	288.7
3/8	.376	4.51	1	2.673	32.07	1/8	26.10	313.2
13/32	.441	5.29	1/16	3.017	36.21	1/4	28.23	338.8
7/16	.512	6.14	1/8	3.383	40.59	1/2	32.74	392.9
15/32	.587	7.05	3/16	3.769	45.23	3/4	37.59	451.0
1/2	.668	8.02	1/4	4.176	50.12	4	42.77	513.2
Annealed & Ground Max Brinell 223			5/16	4.604	55.25	1/2	54.13	649.5
			3/8	5.053	60.64	5/8	57.18	686.1
1/8	.042	.50	7/16	5.523	66.28	3/4	60.31	723.7
3/16	.094	1.13	1/2	6.014	72.17	5	66.82	801.9
1/4	.167	2.01	9/16	6.526	78.31	Hot Rolled Ann. & Pickled Max. Brinell 207		
5/16	.261	3.13	5/8	7.058	84.70			
3/8	.376	4.51	11/16	7.612	91.34	3	24.06	288.7
13/32	.441	5.29	3/4	8.186	98.23	1/4	28.23	338.8
7/16	.512	6.14	13/16	8.781	105.4	1/2	32.74	392.9
1/2	.668	8.02	7/8	9.397	112.8	3/4	37.59	451.0
17/32	.754	9.05	15/16	10.03	120.4	4	42.77	513.2
9/16	.846	10.15	2	10.69	128.3	1/4	48.28	579.3

Note: Stock Lengths 10' to 12' and 20' to 22'

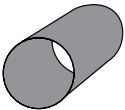
Types 303S & 303Se Rounds (Continued)



Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.	
	Per Sq. Foot	12 -Ft. Bar		Per Sq. Foot	12 -Ft. Bar		Per Sq. Foot	12 -Ft. Bar
Hot Rolled Ann. & Pickled Max. Brinell 207			1/4	73.67	884.0	1/2	112.9	1355
			1/2	80.86	970.2	7	131.0	1572
4 1/2	54.13	649.5	3/4	88.37	1060	1/2	150.4	1804
3/4	60.31	723.7	6	96.22	1155	8	171.1	2053
5	66.82	801.9	1/4	104.4	1253	9	216.5	2598

Note: Stock Lengths 10' to 12' and 20' to 22'

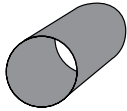
Types 303S & 303Se Cold Drawn Rounds ~ Cond. B - High Tensile



Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.	
	Per Sq. Foot	12 - Ft. Bar		Per Sq. Foot	12 - Ft. Bar
3/32	.024	.28	1	2.673	32.07
1/8	.042	.50	1/16	3.017	36.21
3/16	.094	1.13	1/8	3.083	40.59
1/4	.167	2.01	1/4	4.176	50.12
5/16	.261	3.13	3/8	5.053	60.64
3/8	.376	4.51	1/2	6.014	72.17
7/16	.512	6.14	5/8	7.058	84.70
1/2	.668	8.02	3/4	8.186	98.23
9/16	.846	10.15	7/8	9.397	112.8
5/8	1.044	12.53	2	10.69	128.3
11/16	1.263	15.16	1/4	13.53	162.4
3/4	1.504	18.04	1/2	16.71	200.5
13/16	1.765	21.17	3/4	20.21	242.6
7/8	2.046	24.56	3	24.06	288.7
15/16	2.349	28.19			

Note: Stock Lengths 10' to 12'

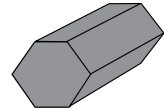
Type 303S Precision Pump Shafting ~ Max. Brinell 223



Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.	
	Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar
5/8	1.044	20.88	1/4	4.176	83.53
3/4	1.504	30.07	7/16	5.523	110.5
7/8	2.046	40.93	1/2	6.014	120.3
1	2.673	53.46	11/16	7.612	152.2
1/8	3.383	67.66	15/16	10.03	200.7
3/16	3.769	75.38	2 3/16	12.79	255.8

Note: Stock Lengths 20'-1" to 22'-1"

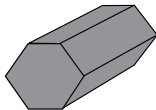
Types 303S & 303Se C.D. Hexagons ~ Cond. B - High Tensile



Size in Inches	Est. Wt., Lbs		Size in Inches	Est. Wt., Lbs	
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar
1/4	.184	2.21	7/8	2.257	27.08
3/8	.415	4.97	1	2.947	35.37
7/16	.564	6.77	1/8	3.730	44.76
1/2	.737	8.84	1/4	4.605	55.26
9/16	.933	11.19	3/8	5.572	66.87
5/8	1.151	13.82	1/2	6.631	79.56
11/16	1.393	16.72	5/8	7.783	93.39
3/4	1.658	19.89	3/4	9.026	108.3

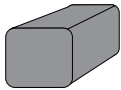
Note: Stock Lengths 10' to 12'

Type 303S & 303Se C.D. Hexagons ~ Cond. A - Annealed Max. Brinell 235



Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.	
	Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar
3/16	.104	1.24	1	2.947	35.37	15/16	11.06	132.8
1/4	.184	2.21	1/16	3.327	39.93	2	11.79	141.5
5/16	.288	3.45	1/8	3.730	44.76	1/8	13.31	159.7
3/8	.415	4.97	3/16	4.156	49.87	3/16	14.10	169.2
7/16	.564	6.77	1/4	4.605	55.26	1/4	14.92	179.0
1/2	.737	8.84	5/16	5.077	60.93	5/16	15.76	189.1
9/16	.933	11.19	3/8	5.572	66.87	3/8	16.62	199.5
5/8	1.151	13.82	7/16	6.090	73.08	1/2	18.42	221.0
11/16	1.393	16.72	1/2	6.631	79.56	5/8	20.31	243.7
3/4	1.658	19.89	5/8	7.783	93.39	3/4	22.29	267.5
13/16	1.946	23.35	11/16	8.393	100.7	13/16	23.31	279.8
7/8	2.257	27.08	3/4	9.026	108.3	7/8	24.36	292.3
15/16	2.590	31.08	7/8	10.36	124.3			

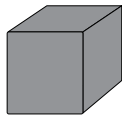
Note: Stock Lengths 10' to 12'



Types 303S & 303Se Billets Refer to Page 99

Type 303S & 303Se Squares ~ Cond. A - Annealed

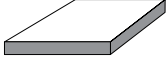
Max. Brinell 235



Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.	
	Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar
Cold Drawn			Hot Trolled Annealed & Pickled			Condition B High Tensile /Cold Drawn		
1/8	.053	.64	2	13.61	163.4	1/4	.213	2.55
3/16	.120	1.44	1/4	17.23	206.7	3/8	.479	5.74
1/4	.213	2.55	1/2	21.27	255.2	1/2	.851	10.21
5/16	.332	3.99	3/4	25.74	308.8	5/8	1.329	15.95
3/8	.479	5.74	3	30.63	367.5	3/4	1.914	22.97
7/16	.651	7.82	1/2	41.69	500.3	7/8	2.606	31.27
1/2	.851	10.21	4	54.45	653.4	1	3.403	40.84
5/8	1.329	15.95				1/8	4.307	51.69
3/4	1.914	22.97				1/4	5.318	63.81
7/8	2.606	31.27				1/2	7.657	91.89
1	3.403	40.84						
1/8	4.307	51.69						
1/4	5.318	63.81						
3/8	6.434	77.21						
1/2	7.657	91.89						
5/8	8.987	107.8						
3/4	10.42	125.1						
7/8	11.96	143.6						
2	13.61	163.4						

Note: Stock Lengths 10' to 12'

Type 303S & 303Se Cold Drawn Flats ~ Cond. A - Annealed



Size in Inches				Est. Wt. Lbs.			Size in Inches				Est. Wt. Lbs.		
		Per Sq. Foot	12 -Ft. Bar						Per Foot	12 -Ft. Bar			
1/8 x	1/2	.213	2.55	3/8 x	3/4	.957	11.49	3/4 x	1	2.552	30.63		
	3/4	.319	3.83		1	1.276	15.31		1 1/4	3.191	38.29		
	1	.425	5.11		1 1/4	1.595	19.14		1 1/2	3.829	45.94		
	1 1/2	.638	7.66		1 1/2	1.914	22.97		1 3/4	4.467	53.60		
	2	.851	10.21		1 3/4	2.233	26.80		2	5.105	31.26		
3/16 x	1/2	.319	3.83		2	2.552	30.63		3	7.657	91.89		
	3/4	.479	5.74		3	3.829	45.94		4	10.21	122.5		
	1	.638	7.66		4	5.105	61.26	1 x	1 1/4	4.254	51.05		
	1 1/2	.957	11.49	1/2 x	3/4	1.276	15.31		1 1/2	5.105	61.26		
	2	1.276	15.31		1	1.702	20.42		1 3/4	5.956	71.47		
	3	1.914	22.97		1 1/4	2.127	25.52		2	6.806	81.68		
1/4 x	1/2	.425	5.11		1 1/2	2.552	30.63		2 1/2	8.508	102.1		
	3/4	.638	7.66		1 3/4	2.987	35.73		3	10.21	122.5		
	1	.851	10.21		2	3.403	40.84		4	13.61	163.4		
	1 1/4	1.064	12.76		2 1/2	4.254	51.05	1 1/4 x	1 1/2	6.381	76.57		
	1 1/2	1.276	15.31		3	5.105	61.26		2	8.508	102.1		
	1 3/4	1.489	17.87		4	6.806	81.68		2 1/2	10.64	127.6		
	2	1.702	20.42		1	2.127	25.52		3	12.76	153.1		
	3	2.127	25.52		1 1/2	3.191	38.29		4	17.02	204.2		
	4	2.552	30.63		2	4.254	51.05	1 1/2 x	2	10.21	122.5		
		3.403	40.84		3	6.381	76.57		3	15.31	183.8		
					4	8.508	102.1						

Note: Stock Lengths 10' to 12'

Types 316 & 316L UNS S31600, S31603

Sheets, Plates, Bars, Billets

Color Markings

Type 316 Bars, Billets—Ends Pink with Black Stripe.

Types 316L Billets—Ends Pink with Blue Stripe.

Type 316 is “18-8” chromium-nickel stainless steel modified by the addition of molybdenum, which greatly increases its corrosion resistance as well as its mechanical properties at elevated temperatures. It is non-magnetic in the annealed condition and not hardenable by heat treatment. Since it has good cold forming and drawing properties, it is an outstanding stainless steel suitable for a large number of applications. Manufactured by the electric-furnace process, it meets exacting standards required by some industries. Billets and plates are available not only in the regular Type 316 analysis, but also in an extra low carbon analysis known as Type 316L. The advantage of the reduced carbon content is that it precludes any harmful precipitation in the 800°-1500°F range, such as might otherwise occur in welding heavier sections.

Analysis

	C Max.	Mn Max.	P Max.	S Max.	Si Max.	Cr	Ni	Mu	Cu Max.
Bars, Billets Type 316	.08	2.00	.040	.030	1.00	16.00/18.00	10.00/14.00	2.00/3.00	.50
Sheets, Plates Type 316	.08	2.00	.040	.030	1.00	16.00/18.00	10.00/14.00	2.00/3.00	.50
Billets Type 316L	.03	2.00	.040	.030	1.00	16.00/18.00	10.00/14.00	2.00/3.00	—

Specifications

The following specifications are generally applicable:

Sheets & Plates: MIL-S-5059, ASTM A 167, ASTM A 240

Bars: MIL-S-7720, AMS-5648, QQ-S-763, ASTM A 276, ASTM A 479

Billets: AMS-5648, ASTM A 314

Applications

Widely used in the paper, textile and chemical industries, where parts are subjected to the corrosive effects of salts and reducing acids. Also used in the manufacture of pharmaceuticals in order to avoid excessive metallic contamination. Because Type 316 possesses the highest creep and tensile strength at elevated temperatures of any of the more commonly used stainless steels, it finds extensive use where the combination of high strength and good corrosion resistance at elevated temperatures is required. In aircraft applications, Type 316 is used for parts requiring good corrosion resistance and low magnetic permeability.

Corrosion Resistance

Type 316 is more resistant to atmospheric and general corrosive conditions than any of the other standard stainless steels. It has good resistance to the corrosive effects of sulphates, phosphates and other salts as well as reducing acids such as sulphuric, sulphurous and phosphoric. It is less susceptible to pitting in applications where acetic acid vapors to within the temperature range of 800°-1500°F, or when slowly cooled through this range, this grade is subject to intergranular corrosion.

Resistance to Scaling

This grade has excellent scale resistance at temperatures up to 1600°F in continuous service.

Mechanical Properties

Applicable specifications require the following properties of material in the annealed condition:

	Tensile Strength (psi)	Elongation in 2"	Reduction of Area
Sheets	75,000/100,000	40% Min.	—
H.R. Bars	75,000/115,000	40% Min.	50% Min.
C.F. Bars			
1/2" & Under	90,000/115,000	35% Min.	45% Min.
Over 1/2"	75,000/115,000	40% Min.	50% Min.

Machinability

Type 316 has a machinability rating of approximately 42% with 1212 rated 100%. Surface cutting speed on automatic screw machines is approximately 70 feet per minute.

Weldability

Easily welded by all the commercial processes except forge or hammer welding. Annealing after welding is recommended to obtain maximum corrosion resistance.

Forging

Forge between 2100° and 2300°F. Do not forge below 1700°F.

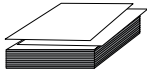
Forming

This grade has good drawing and stamping properties.

Annealing

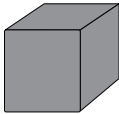
Annealing range between 1850° and 2050°F. Cool rapidly. Water should be used for heavier sections; air for lighter sections. The stress relieving range is between 400° and 750°F.

Type 316 Sheets No. 2B Finish ~ Bright Cold Rolled/ Annealed & Pickled



Thickness	Width & Length	Est. Wt. Lbs. per Sheet	Thickness	Width & Length	Est. Wt. Lbs. per Sheet	Thickness	Width & Length	Est. Wt. Lbs. per Sheet
0.16" (28 Ga.)			.0351" (20 Ga.)			48 x 120	126.0	
.672 Lb. Sq. Ft			1.474 Lb Sq Ft			60 x 144	189.0	
30 x 96	13.4		36 x 120	44.2		.105" (12 Ga.)		
.018" (26 Ga.)			48 x 120	59.0		4.410 Lb Sq Ft		
.756 Lb. Sq. Ft.			.048" (18 Ga.)			36 x 120	132.3	
36 x 96	18.1		2.016 Lb. Sq. Ft.			48 x 120	176.4	
120	22.7		30 x 120	40.4		144	211.7	
48 x 120	30.2		36 x 120	60.5		60 x 120	220.5	
0.24" (24 Ga)			48 x 120	80.6		144	264.6	
1.008 Lb. Sq. Ft.			144	96.8		.120" (11 Ga.)		
36 x 96	24.2		.060" (16 Ga.)			5.040 Lb Sq Ft		
120	30.2		2.520 Lb Sq Ft			36 x 120	151.2	
48 x 120	40.3		30 x 120	63.1		48 x 120	201.6	
.030" (22 Ga.)			36 x 120	75.6		.135" (10 Ga.)		
1.260 Lb Sq Ft			48 x 120	100.8		5.670 Lb Sq Ft		
30 x 120	31.3		60 x 120	126.0		36 x 120	170.1	
36 x 120	37.8		144	151.2		48 x 120	226.8	
48 x 120	50.4		.075" (14 Ga.)			144	272.2	
			3.150 Lb Sq Ft			60 x 120	283.5	
			36 x 120	94.5		144	340.2	

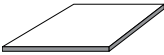
Type 316 Squares ~ Annealed & Cold Drawn



Size in Inches	Est.Wt., Lbs.		Size in Inches	Est.Wt., Lbs.	
	Per Sq. Foot	12 Ft. Bar		Per Sq. Foot	12 Ft. Bar
1/4	.213	2.55	3/4	1.914	22.97
3/8	.479	5.74	7/8	2.606	31.27
1/2	.851	10.21	1	3.403	0.84
5/8	1.329	15.95	1/2	7.657	91.89
			2	13.61	163.4

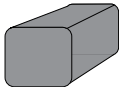
Note: Stock Lengths 10' to 12'

Type 316 & 316L Plates H.R. ~ Ann. & Pickled



Thickness & Width (For Weights, see page 6 of this section)						
3/16	x	36		60		48
		48		72		72
		60		84		84
		72		96		96
		84	1/2	x	36	1 1/8 x 72
		96		48		1 1/4 x 36
1/4	x	36		60		48
		48		72		72
		60		84		84
		72		96		96
		84	5/8	x	36	1 1/2 x 36
		96		48		48
5/16	x	36		72		72
		48		84		84
		60		96		96
		72	3/4	x	36	1 3/4 x 72
		84		48		2 x 36
		96		72		48
3/8	x	36		84		72
		48		96		84
			1	x	36	96

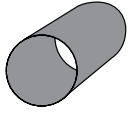
Note: Stock Lengths up to 20'



Type 316 & 316L Billets

Refer to Page 99

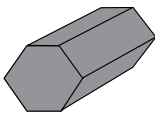
Type 316 Rounds



Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.	
	Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar
Ann. & Cold Drawn			7/16	5.523	66.28	3	24.06	288.7
1/8	.0418	.5012	1/2	6.014	72.17	1/4	28.23	338.8
3/16	.0940	1.128	5/8	7.058	84.70	1/2	32.74	392.9
13/64	.1103	1.323	11/16	7.612	91.34	3/4	37.59	451.0
1/4	.1671	2.005	3/4	8.186	98.23	4	42.77	513.2
5/16	.2610	3.132	7/8	9.397	112.8	1/4	48.28	579.3
3/8	.3759	4.510	15/16	10.03	120.4	1/2	54.13	649.5
13/32	.4411	5.293	2	10.69	128.3	3/4	60.31	723.7
7/16	.5116	6.139	1/8	12.07	144.8	5	66.82	801.9
1/2	.6682	8.019	3/16	12.79	153.5	1/4	73.67	884.0
Annealed & Ground			1/4	13.53	162.4	1/2	80.86	970.2
9/16	.8457	10.15	3/8	15.08	180.9	3/4	88.37	1060
5/8	1.044	12.53	1/2	16.71	200.5	6	96.22	1155
11/16	1.263	15.16	5/8	18.42	221.0	1/4	104.4	1253
3/4	1.504	18.04	3/4	20.21	242.6	1/2	112.9	1355
13/16	1.765	21.17	7/8	22.09	265.1	7	131.0	1572
7/8	2.046	24.56	3	24.06	288.7	1/	150.4	1804
15/16	2.349	28.19	1/4	28.23	388.9	3/4	160.5	1926
1	2.673	32.07	1/2	32.74	392.92	8	171.1	2053
1/16	3.017	36.21	3/4	37.59	451.0	1/2	193.1	2317
1/8	3.383	40.59	4	42.77	513.2	9	216.5	2598
3/16	3.769	45.23	H.R., Ann. & Pickled			1/2	241.2	2895
1/4	4.176	50.12	2 1/4	13.53	162.4	11	323.4	3881
5/16	4.604	55.25	1/2	16.71	200.5	12	384.9	4619
3/8	5.053	60.64	3/4	20.21	242.6	14	523.9	6287

Note: Stock Lengths 10' to 12' and 20' to 22'

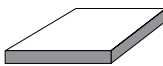
Type 316 Hexagons



Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.	
	Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar
Ann. & Cold Drawn			7/8	2.257	27.08
3/8	.4145	4.973	1	2.947	35.37
7/16	.5641	6.769		3.730	44.76
1/2	.7368	8.842	1/4	4.605	55.26
9/16	.9325	11.19	3/8	5.572	66.87
5/8	1.151	13.82	1/2	6.631	79.56
11/16	1.393	16.72	3/4	9.026	108.3
3/4	1.658	19.89	2	11.79	141.5

Note: Stock Lengths 10' to 12'

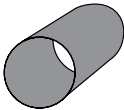
Type 316 Flats ~ Hot Rolled, Annealed, & Pickled



Size in Inches		Est. Wt. Lbs.		Size in Inches		Est. Wt. Lbs.	
		Per Sq. Foot	12-Ft. Bar			Per Sq. Foot	12-Ft. Bar
1/8 x	1/2	.2127	2.552	1		1.276	15.31
	3/4	.3191	3.829	1 1/8		1.436	17.23
	1	.4254	5.105	3/8 x	1 1/2	1.914	22.97
2		.8508	10.21		2	2.552	30.63
1/4 x	1	.8508	10.21	3		3.829	45.94
	1 ½	1.276	15.31	4		5.105	61.26
	2	1.702	20.42	1/2 x	1	1.702	20.42
2½		2.127	25.52		1 1/2	2.552	30.63
3		2.552	30.63		2	3.403	40.84
4		3.403	40.84	3		5.105	61.26
3/8 x	1/2	.6381	7.657	4		6.806	81.68
	3/4	.9572	11.49				

Note: Stock Lengths 10' to 12'

Type 316 Precision Pump Shafting



Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.	
	Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar
3/4	1.504	30.07	3/4	8.186	163.7
7/8	2.046	40.93	15/16	10.03	200.7
1	2.673	53.46	2	10.69	213.8
1/8	3.383	67.66	3/16	12.79	255.8
3/16	3.769	75.38	1/4	13.53	270.6
1/4	4.176	83.53	7/16	15.88	317.6
7/16	5.523	110.5	1/2	16.71	334.1
1/2	6.014	120.3	3/4	20.21	404.3
11/16	7.612	152.2			

Note: Stock Lengths 20' to 22'

Types 321 UNS S32100

Sheets, Plates, Bars, Billets

Color Markings (Bars and Billets)

Ends painted Black.

Type 321 is “18-8” chromium stainless steel is modified by the addition of titanium to overcome the danger of intergranular corrosion, common to other austenitic stainless steels during or after exposure to temperature of 800° to 1500°F. This type is non-magnetic in the annealed condition and not hardenable by heat treatment. It is manufactured by the electric-furnace process to meet rigid industry requirements.

Analysis

C Max	Mn Max	P Max.	S Max	Si Max.	Cr	Ni	Ti	Cu Max.	Mo Max
.08	2.00	.040	.030	1.00	17.00/19.00	9.00/12.00	6 x C Min. .70 Max.	.50	.70

Specifications

The following specifications are generally applicable:

Sheets & Plates: MIL-S-6721, AMS-5510, ASTM A 240, ASTM A 167

Bars & Billets: QQ-S-763, AMS-5645, ASTM A 276, ASTM A 314, ASTM A 479

Applications

Used where freedom from intergranular corrosion is desired and milder corrosive conditions exist. It is used in parts subjected to sustained heating in or slow cooling through the range of 800°to 1500°F. It is well suited for cold-drawing and forming operations. It is used particularly for such applications as exhaust stacks, manifolds and ring collectors.

Corrosion Resistance

Type 321 is resistant to intergranular corrosion. Its general corrosion resistance is somewhat less than that of Type 302. It tends to form a light rust film in corrosive atmosphere, but this rusting is not progressive.

Resistance to Scaling

Excellent scale resistance at temperatures up to 1650°F in continuous service.

Mechanical Properties

Applicable specifications require the following properties of material in the annealed condition:

	Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2"	Reduction of Area
Sheets & Plates	100,000 Max.	—	40% Min.	—
H.R. Bars	75,000 Min.	30,000 Min.	40% Min.	50% Min.
C.F. Bars				
Up to 1/2" Incl.	90,000 Min.	45,000 Min.	35% min.	45% Min.
Over 1/2"	75,000 Min.	30,000 Min.	40% Min.	50% Min.

Machinability

Type 321 has a machinability rating of approximately 45%, with 1212 rated 100%. Surface cutting speed on automatic screw machines is approximately 75 feet per minute.

Forging

Forging between 2125° and 2275°F. Cool slowly. Do not forge below 1800°F.

Forming

This grade has good drawing and stamping properties.

Weldability

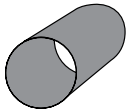
Easily welded by all the commercial processes except forge or hammer welding.

Annealing

Annealing range is 1750° - 1950°F. Cool rapidly. Water should be used for heavier sections; air for lighter sections. The stress relieving range is 400° - 750°F.

Type 321 ROUNDS ~ Type A (Annealed)

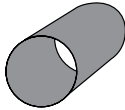
3/4" & under - Brinell 170-255
Over 3/4" - Brinell 140-241



Est. Wt. Lbs.			Est. Wt. Lbs.		
Size in Inches	Per Sq. Foot	12-Ft. Bar	Size in Inches	Per Sq. Foot	12-Ft. Bar
Annealed and Cold Drawn			13/16	1.765	21.17
1/8	.0418	.5012	7/8	2.046	24.56
3/16	.0940	1.128	15/16	2.349	28.19
1/4	.1671	2.005	1	2.673	32.07
5/16	.2610	3.132	1/16	3.017	36.21
3/8	.3759	4.510	1/8	3.383	40.59
7/16	.5116	6.139	3/16	3.769	45.23
1/2	.6682	8.019	1/4	4.176	50.12
Annealed and Ground			5/16	4.604	55.25
9/16	.8457	10.15	3/8	5.053	60.64
5/8	1.044	12.53	1/2	6.014	72.17
11/16	1.263	15.16	9/16	6.526	78.31
3/4	1.504	18.04	5/8	7.058	84.70

Note: Stock Lengths 10' to 12'

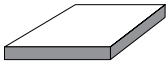
Type 321 Rounds (Continued)



Est. Wt. Lbs.				Est. Wt. Lbs.			
Size in Inches		Per Sq. Foot	12-Ft. Bar	Size in Inches	Per Sq. Foot	12-Ft. Bar	
Hot Rolled, Annealed & Pickled				5/8	35.12	421.5	
1	3/4	8.186	98.23	3/4	37.59	451.0	
	7/8	9.397	112.8	4	42.77	513.2	
2		10.69	128.3	1/4	48.28	579.3	
	1/8	12.07	144.8	1/2	54.13	649.5	
	1/4	13.53	162.4	3/4	60.31	723.7	
	3/8	15.08	180.9	5	66.82	801.9	
	1/2	16.71	200.5	1/4	73.67	884.0	
	4/8	18.42	221.0	1/2	80.86	970.2	
	3/4	20.21	242.6	3/4	88.37	1060	
3		24.06	288.7	6	96.22	1155	
	1/8	26.10	313.2	1/2	112.9	1355	
	1/4	28.23	338.8	7	131.0	1572	
	3/8	30.45	365.3	1/2	150.4	1804	
	1/2	32.74	392.9	8	171.1	2053	

Note: Stock Lengths 10' to 12'

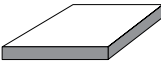
Type 321 Flats ~ Hot Rolled, Annealed & Pickled



Est. Wt. Lbs.				Est. Wt. Lbs.				Est. Wt. Lbs.			
Size in Inches		Per Sq. Foot	12-Ft. Bar	Size in Inches	Per Sq. Foot	12-Ft. Bar		Size in Inches	Per Sq. Foot	12-Ft. Bar	
1/4 x	1/2	.425	5.11	2	1.702	20.42		3/4	.9572	11.49	
	3/4	.638	7.66	2 1/2	2.127	25.52		1	1.276	15.31	
	1	.851	10.21	3	2.552	30.63		1 1/4	1.595	19.14	
	1 1/4	1.064	12.76	4	3.403	40.84		1 1/2	1.914	22.97	
	1 1/2	1.276	15.31	6	5.105	61.26		2	2.552	30.63	
	1 3/4	1.489	17.87	3/8 x	1/2	.6381	7.657	2 1/2	3.191	38.29	

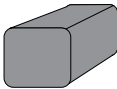
Note: Stock Lengths 10' to 12'

Type 321 Flats (Continued)



Est. Wt. Lbs.				Est. Wt. Lbs.				Est. Wt. Lbs.			
Size in Inches		Per Sq. Foot	12-Ft. Bar	Size in Inches		Per Sq. Foot	12-Ft. Bar	Size in Inches		Per Sq. Foot	12-Ft. Bar
3		3.829	45.94	1 1/2		3.191	38.29	2		6.806	81.68
4		5.105	61.26	2		4.254	51.05	2 1/2		8.508	102.1
1/2 x	3/4	1.276	15.31	3/4 x	1	2.552	30.63	3		10.21	122.5
1		1.702	20.42	1 1/4		3.191	38.29	4		13.61	163.4
1 1/4		2.127	25.52	1 1/2		3.829	45.94	6		20.42	245.0
1 1/2		2.552	30.63	1 3/4		4.467	53.60	1 1/4 x	2	8.508	102.1
1 3/4		2.978	35.73	2		5.105	61.26	2 1/2		10.64	127.6
2		3.403	40.84	2 1/2		6.381	76.57	3		12.76	153.1
2 1/2		4.254	51.05	3		7.657	91.89	4		17.02	204.2
3		5.105	61.26	4		10.21	122.5	1 1/2 x	2	10.21	122.5
4		6.806	81.68	6		15.31	183.8	3		15.31	183.8
6		10.21	122.5	1 x	1 1/4	4.254	51.05	2 x	3	20.42	245.0
5/8 x	1	2.127	25.52	1 1/2		5.105	61.26	4		27.23	326.7
1 1/4		2.659	31.91	1 3/4		5.956	71.47	3 x	4	40.84	490.1

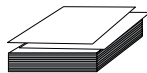
Note: Stock Lengths 10' to 12'



Type 321 Billets

Refer to Page 99

Type 321 Sheets ~ No. 2D Finish Dull Cold Rolled, Annealed, & Pickled



Thickness		Width & Length	Est. Wt. Lbs.		Thickness		Width & Length	Est. Wt. Lbs.	
			Per Sq. Foot	12-Ft. Bar				Per Sq. Foot	12-Ft. Bar
.012"	(30 Ga.)	36x120	.504	15.1	.063"	(16 Ga.)	36x120	2.646	79.4
.016"	(28 Ga.)	36x120	.672	20.2			48x120	2.646	105.8
.0161"	(27 Ga.)	36x120	.676	20.3	.080"	(14 Ga.)	36x120	3.360	100.8
.020"	(25 Ga.)	36x120	.840	25.2			48x120	3.360	134.4
		48x120	.840	33.6	.090"	(13 Ga.)	36x120	3.780	113.4
.025"	(24 Ga.)	36x120	1.050	31.5			48x120	3.780	151.2
.032"	(22 Ga.)	36x120	1.344	40.3	.109"	(12 Ga.)	36x120	4.578	137.3
		48x120	1.344	53.8	.125"	(11 Ga.)	36x120	5.250	157.5
.036"	(20 Ga.)	36x120	1.512	45.4			48x120	5.250	210.0
.040"	(20 Ga.)	36x120	1.680	50.4	.140"	(10 Ga.)	36x120	5.880	176.4
.045"	(19 Ga.)	36x120	1.890	56.7			48x120	5.880	235.2
.050"	(18 Ga.)	36x120	2.100	63.0	.156"	(9 Ga.)	36x120	6.552	196.6
		48x120	2.100	84.0					

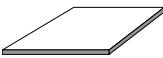
Type 321 Plates ~ Hot Rolled, Annealed, & Pickled



Thickness & Width (For Weights, see page 6 of this Section)						
3/16 x	36	60	84	1/2 x	36	60
	48	72	96		48	72
	60	84	3/8 x	36	60	84
	72	96	48	72	96	
	84	5/16 x	36	60	84	3/4 x
	96	48	72	96	48	
1/4 x	36	60	84	5/8 x	36	72
	48	72	96	48	84	

Note: Stock Lengths up to 20'

Type 321 Plates (Continued)



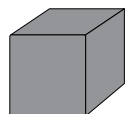
Thickness & Width (For Weights, see page 6 of this Section)					
3/4 x 96	72	1 1/2 x 36	84	48	
1 x 36	84	48	96	72	
48	96	72	2 x 36	3 x 36	
72	1 1/4 x 36	84	48	48	
84	48	96	72	72	
96	72	1 3/4 x 36	84		
1 1/8 x 36	84	48	96		
48	96	72	2 1/2 x 36		

Note: Stock Lengths up to 20'

Type 321 Squares ~ Type A (Annealed)

3/4" & under - Brinell 170-255

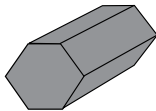
Over 3/4" - Brinell 140-241



Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.	
	Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar
Annealed & Cold Down			Hot Rolled, Annealed, & Pickled		
1/4	.2127	2.552	1 5/8	8.987	107.8
3/8	.4786	5.743	3/4	10.42	125.1
1/2	.8508	10.21	2	13.61	163.4
5/8	1.329	15.95	1/4	17.23	206.7
3/4	1.914	22.97	1/2	21.27	255.2
7/8	2.606	31.27	3/4	25.74	308.8
1	3.403	40.84	3	30.63	367.5
1/4	5.318	63.81	1/2	41.69	500.3
1/2	7.657	91.89	4	54.45	653.4

Note: Stock Lengths 10' to 12'

Type 321 Cold Drawn Hexagons ~ Type A (Annealed)



Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.		
	Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar	
1/4	.1842	2.210	3/4	1.658	19.89	1	1/4	4.605	55.26
3/8	.4145	4.973	7/8	2.257	27.08		1/2	6.631	79.56
1/2	.7368	8.842	1	2.947	35.37	3/4	9.026	108.3	
5/8	1.151	13.82		1/8	3.730		44.76	2	11.79

Note: Stock Lengths 10'to 12'

Types 347 - UNS S34700

Sheets, Plates, Bars, Billets

Color Markings (Bars and Billets)

Ends painted White.

Type 347 is “18-8” chromium-nickel stainless steel modified by the addition of columbium and tantalum to overcome the dangers of intergranular corrosion common to other austenitic stainless steels during or after exposure to temperatures of 800° to 1500°F. It is non-magnetic in the annealed condition and not hardenable by heat treatment. This is an electric-furnace product and meets exacting industry requirements.

Analysis

C Max	Mn Max	P Max.	S Max	Si Max.	Cr	Ni	Cb-Ta Min.	Cu Max.	Mo Max
.08	2.00	.040	.030	.50/1.00	17.00/19.00	9.00/12.00	10xC/1.00	.50	.75

Specifications

The following specifications are generally applicable:

Sheets & Plates: MIL-S-6721, AMS-5512, ASTM A 240, ASTM A 167

Bars & Billets: QQ-S-763, AMS-5646, ASTM A 276, ASTM A 314, ASTM A 479

Applications

Used for heavy welded assemblies that cannot be annealed after welding. Also used where operating conditions cause exposure within the temperature range between 800° and 1500°F and where corrosive conditions are severe. It is used to advantage in combatting corrosion cracking resulting from stress in corrosive media due to vibration or other causes.

Corrosion Resistance

Type 347 is resistance to intergranular corrosion. It has about the same general corrosion resistance as Type 302.

Resistance to Scaling

Excellent scale resistance at temperatures up to 1650°F in continuous service.

Mechanical Properties

Applicable specifications require the following properties of material in the annealed condition:

	Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2"	Reduction of Area
Sheets & Plates	100,000 Max.	—	40% Min.	—
H.R. Bars	75,000 Min.	30,000 Min.	40% Min.	50% Min.
C.F. Bars				
Up to 1/2" Incl.	90,000 Min.	45,000 Min.	35% Min.	45% Min.
Over 1/2"	75,000 Min.	30,000 Min.	40% Min.	50% Min.

Machinability

Type 347 has a machinability rating of approximately 45%, with 1212 rated 100%. Surface cutting speed on automatic screw machines is approximately 75 feet per minute.

Weldability

Easily welded by all the commercial processes except forge or hammer welding.

Forming

This grade has good drawing and stamping properties.

Forging

Forge between 2100° and 2300°F. Do not forge below 1800°F.

Annealing

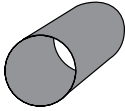
Annealing range is between 1850° and 2050°F. Cool rapidly. Water should be used for heavier sections; air for lighter sections. The stress relieving range is between 400° and 750°F.

Type 347 Rounds

3/4" & under - Brinell 170-255

7/8" to 1 1/2" - Brinell 163-255

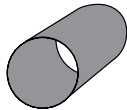
Over 1 1/2" - Brinell 140-241



Size in Inches	Est. Wt. Lbs.		Size in Inches	Est. Wt. Lbs.	
	Per Sq. Foot	12-Ft. Bar		Per Sq. Foot	12-Ft. Bar
Annealed & Cold Drawn			Annealed & Ground (Contd.)		
1/8	.0418	.5012	9/16	6.526	78.31
3/16	.0940	1.128	5/8	7.058	84.70
1/4	.1671	2.005	13/16	8.781	105.4
5/16	.2610	3.132	7/8	9.397	112.8
11/32	.3158	3.790	2 3/16	12.79	153.5
3/8	.3759	4.510	7/16	15.88	190.6
13/32	.4411	5.293	5/8	18.42	221.0
7/16	.5116	6.139	Hot Rolled, Annealed, Pickled		
15/32	.5873	7.048	1 3/4	8.186	98.23
1/2	.6682	8.019	7/8	9.397	112.8
Annealed & Ground			2	10.69	128.3
1/2	.6682	8.019	1/8	12.07	144.8
17/32	.7544	9.052	1/4	13.53	162.4
9/16	.8457	10.15	3/8	15.08	180.9
5/8	1.044	12.53	1/2	16.71	200.5
11/16	1.263	15.16	5/8	18.42	221.0
3/4	1.504	18.04	3/4	20.21	242.6
13/16	1.765	21.17	3	24.06	288.7
7/8	2.046	24.56	1/8	26.10	313.2
1	2.673	32.07	1/4	28.23	338.8
1/16	3.017	36.21	3/8	30.45	365.3
1/8	3.383	40.59	1/2	32.74	392.9
1/4	4.176	50.12	3/4	37.59	451.0
3/8	5.053	60.64	4	42.77	513.2
1/2	6.014	72.17	1/4	48.28	579.3

Note: Stock Lengths 10' to 12'

Type 347 Rounds (Continued)

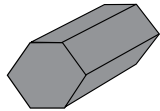


Size in Inches		Est. Wt. Lbs.		Size in Inches		Est. Wt. Lbs.	
		Per Sq. Foot	12-Ft. Bar			Per Sq. Foot	12-Ft. Bar
Hot Rolled, Annealed, Pickled				3/4		88.37	1060
4	1/2	54.13	649.5	6		96.22	1155
	3/4	60.31	723.7		1/2	112.9	1355
5		66.82	801.9	7		131.0	1572
	1/4	73.67	884.0	8		171.1	2053
	1/2	80.86	970.2				

Note: Stock Lengths 10' to 12'

Type 347 Hexagons ~ Type A (Annealed)

Brinell same as shown above for rounds.

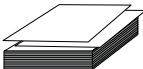


Size in Inches		Est. Wt. Lbs.		Size in Inches		Est. Wt. Lbs.	
		Per Sq. Foot	12-Ft. Bar			Per Sq. Foot	12-Ft. Bar
Annealed & Cold Drawn				1	1/2	6.631	79.56
	3/8	.4145	4.973		5/8	7.783	93.39
	7/16	.5641	6.769		11/16	8.393	100.7
	1/2	.7368	8.842		3/4	9.026	108.3
	9/16	.9325	11.19		7/8	10.36	124.3
	5/8	1.151	13.82		15/16	11.06	132.8
	11/16	1.393	16.72	2		11.79	141.5
	3/4	1.658	19.89		1/8	13.31	159.7
	13/16	1.946	23.35		3/16	14.10	169.2
	7/8	2.257	27.08		1/4	14.92	179.0
	15/16	2.590	31.08		3/8	16.62	199.5
1		2.947	35.37		1/2	18.42	221.0
	1/8	3.730	44.76		5/8	20.31	243.7
	3/16	4.156	49.87		3/4	22.29	267.5
	1/4	4.605	55.26		13/16	23.31	279.8
	3/8	5.572	66.87		7/8	24.36	292.3

Note: Stock Lengths 10' to 12'

Type 347 Sheets ~ No. 2D Finish

Dull Cold Rolled, Annealed, & Pickled



Thickness		Width & Length	Est. Wt. Lbs.	
			Per Sq. Ft.	Per Sheet
.012"	(30 Ga.)	36x120	.504	15.1
.016"	(28 Ga.)	36x120	.672	20.2
.0161"	(27 Ga.)	36x120	.676	20.3
.020"	(25 Ga.)	36x120	.840	25.2
.025"	(24 Ga.)	36x120	1.050	31.5
.032"	(22 Ga.)	36x120	1.344	40.3
.036"	(20 Ga.)	36x120	1.512	45.4
.040"	(20 Ga.)	36x120	1.680	50.4
.045"	(19 Ga.)	36x120	1.890	56.7
.050"	(18 Ga.)	36x120	2.100	63.0
		48x120	2.100	84.0
.063"	(16 Ga.)	36x120	2.646	79.4
		48x120	2.646	105.8
.080"	(14 Ga.)	36x120	3.360	100.8
		48x120	3.360	134.4
.090"	(13 Ga.)	36x120	3.780	113.4
.125"	(11 Ga.)	36x120	5.250	157.5
		36x144	5.250	189.0
		48x120	5.250	210.0
.160"	(9 Ga.)	36x120	6.720	201.6

Type 347 Flats ~ Hot Rolled, Annealed, & Pickled



Size in Inches		Est. Wt. Lbs.		Size in Inches		Est. Wt. Lbs.	
		Per Sq. Foot	12-Ft. Bar			Per Sq. Foot	12-Ft. Bar
1/4 x	1	.8508	10.21	3		5.105	61.26
	1 1/2	1.276	15.31	5/8 x	1	2.127	25.52
	2	1.702	20.42	3/4 x	1	2.552	30.63
3/8 x	1	1.276	15.31		2	5.105	61.26
	2	2.552	30.63		3	7.657	91.89
1/2 x	1	1.702	20.42	1 x	1 1/2	5.105	61.26
	1 1/2	2.552	30.63		2	6.806	81.68
	2	3.403	40.84	1 1/2 x	2	10.21	122.5

Note: Stock Lengths 10' to 12'

Type 347 Plates ~ Hot Rolled, Annealed, & Pickled



Thickness & Width		Billing Wt. Per Lineal Ft.	Thickness & Width		Billing Wt. Per Lineal Ft.	Thickness & Width		Billing Wt. Per Lineal Ft.
3/16 x	36	25.74		84	78.13		60	82.48
	48	34.32		96	89.30		72	98.98
	60	42.90	5/16 x	36	41.24		84	115.47
	72	51.47		48	54.98		96	131.97
	84	60.05		60	68.73	1/2 x	36	64.99
	96	68.63		72	82.48		48	86.65
1/4 x	36	33.49		84	96.22		60	108.32
	48	44.65		96	109.97		72	129.98
	60	55.81	3/8 x	36	49.49		84	151.64
	72	66.97		48	65.98		96	173.30

Note: Stock length up to 20'

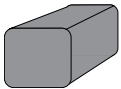
Type 347 Plates (Continued)



Thickness & Width		Billing Wt. Per Lineal Ft.	Thickness & Width		Billing Wt. Per Lineal Ft.	Thickness & Width		Billing Wt. Per Lineal Ft.
5/8 x	36	80.49		60	213.33	2 x	36	252.02
	48	107.32		72	255.99		48	336.03
	60	134.16		84	298.66		60	420.04
	72	160.99		96	341.32		72	504.05
	84	187.82		1 1/4 x 36	159.00		84	588.06
	96	214.65		48	212.00		96	672.06
	3/4 x 36	96.37		60	265.01		2 1/2 x 36	315.34
	48	128.49		72	318.01		48	420.45
	60	160.62		1 1/2 x 36	190.01		72	630.68
	72	192.74		48	253.35		3 x 36	378.90
	84	224.86		60	316.69		48	505.20
	96	256.98		72	380.02		72	757.81
	1 x 36	128.00		84	443.36			
	48	170.66		96	506.70			

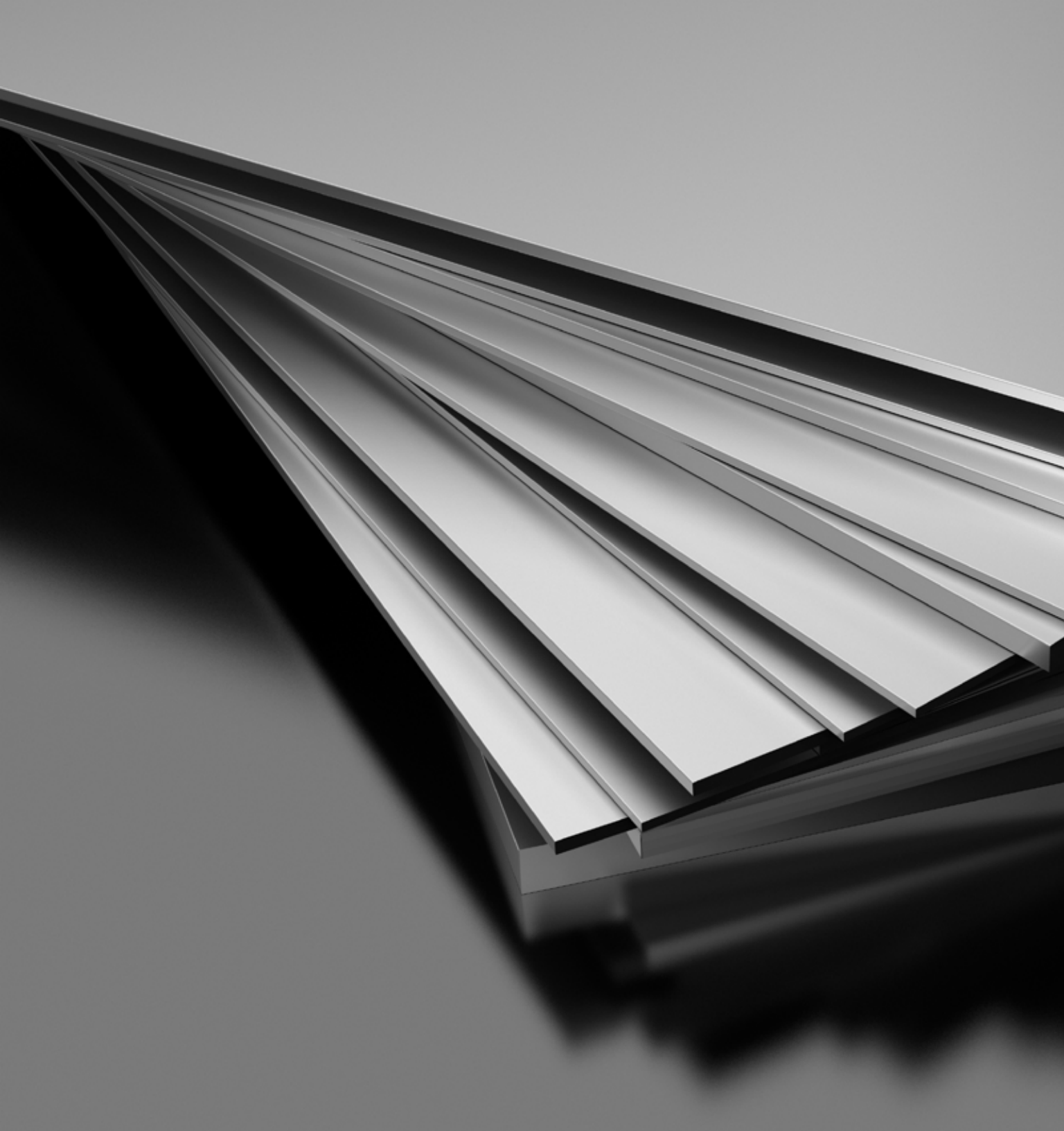
Note: Stock lengths up to 20'.

For Weights per Square Inch and Square Foot, refer to Page 6 of this section.



Type 347 Billets

Refer to Page 99





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