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COMPANY**

# **REFERENCE BOOK**

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**ALLOY • ALUMINUM • BRASS • BRONZE  
CARBON • CAST IRON • CHROME • NICKEL  
STAINLESS • SUPER ALLOY • TITANIUM  
BAR • PIPE • PLATE • SHEET • TUBE**

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## TYPE 203S — FREE MACHINING

### STAINLESS BARS

#### UNS S20300

**Color Marking:** Bars — Ends White with Red Stripe

Type 203S is a chromium — nickel — manganese — copper stainless steel modified by the addition of sulphur to improve machinability. It is austenitic and non-magnetic in the annealed condition. This grade is equivalent to 303 in regard to corrosion resistance. Machinability is equal to or better than 303 with higher speeds possible on automatic machines resulting in better finishes.

#### ANALYSIS

C		P		Si
Max.	Mn	Max.	S	
.08	5.00/6.50	.04	.18/.35	.20/.70
			Mo	
Ni	Cr	Cu	Max.	
5.00/6.50	16.00/18.00	1.75/2.25	.50	

**SPECIFICATIONS** — The following specifications are generally applicable:  
AMS 5762, ASTM A 582, (XM1)

**APPLICATIONS** — The grade is used for parts requiring machining, grinding or polishing where good corrosion resistance is required. Provides an alternate choice to 303.

**PROPERTIES** — Mechanical properties, corrosion resistance, machinability, weldability, and formality are all equivalent to 303.



### TYPE 203S

**Condition A — Annealed**  
Stock Lengths 10' to 12'

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
<b>Cold Drawn</b>			<b>Ground</b>			<b>Ground (Continued)</b>		
1/8	.0418	.5012	1/8	.0418	.5012	1 1/16	3.017	36.21
3/16	.0940	1.128	5/32	.0653	.7831	1/8	3.383	40.59
1/4	.1671	2.005	3/16	.0940	1.128	1/4	4.176	50.12
5/16	.2610	3.132	7/32	.1279	1.535	5/16	4.604	55.25
3/8	.3759	4.510	1/4	.1671	2.005	3/8	5.053	60.64
7/16	.5116	6.139	9/16	.8457	10.15	1/2	6.014	72.17
1/2	.6682	8.019	5/8	1.044	12.53	3/4	8.186	98.23
9/16	.8457	10.15	1 1/16	1.263	15.16	2	10.69	128.3
5/8	1.044	12.53	3/4	1.504	18.04	1/4	13.53	162.4
1 1/16	1.263	15.16	13/16	1.765	21.17	1/2	16.71	200.5
3/4	1.504	18.04	7/8	2.046	24.56	3	24.06	288.7
			1	2.673	32.07			

## TYPE 301

### High Tensile Stainless Sheets

#### UNS S30100

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 insure 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	Mn	P	S	Si	Cr	Ni	Cu	Mo
Max.	Max.	Max.	Max.	Max.			Max.	Max.
.15	2.00	.045	.030	1.00	16.00/18.00	6.00/8.00	.50	.50

**SPECIFICATIONS** — The following specifications are generally applicable:

ASTM A 666, AMS 5518, AMS 5517.

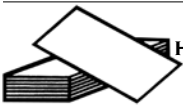
**APPLICATIONS** — Structural parts where a corrosion-resisting steel is required but where gas or arc welding and elevated temperatures are not involved. This material is used in application requiring higher strength characteristics that are found in annealed sheets.

**CORROSION RESISTANCE** — The corrosion-resisting properties of Type 301 are comparable to those of Type 304, data for which will be found on Page 4.

#### MECHANICAL PROPERTIES

	Tensile Strength (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%

**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 AND 1/2 HARD No. 2B Finish — Bright Cold Rolled Stock Size 36" x 120"

Thickness in Inches	Estimated Weight, Lbs.		Thickness in Inches	Estimated Weight, Lbs.	
	Per Sq. Ft.	Per Sheet		Per Sq. Ft.	Per Sheet
<b>Condition 1/4 Hard</b>			<b>Condition 1/2 Hard</b>		
.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	113.4
.125	5.250	157.5	.125	5.250	157.5

**TYPES 304 AND 304L**  
**Sheets, Plates, Bars, Angles**  
**UNS S30400, 30403**

**Color Marking**

Type 304 Bars, Angles — Pink and White

Type 304L Bars — Pink with Brown Stripe

Type 304 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 treatment. 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 304L except that Type 304L is modified by lowered carbon content. This provides good resistance to corrosion in welded construction where subsequent heat treatment is not practicable. Bars and Plates are available not only in the regular Type 304 analysis, but also in an extra low carbon analysis 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**

	<b>C</b>	<b>Mn</b>	<b>P</b>	<b>S</b>	<b>Si</b>	<b>Cr</b>	<b>Ni</b>	<b>Cu</b>	<b>Mo</b>
	<b>Max.</b>	<b>Max.</b>	<b>Max.</b>	<b>Max.</b>	<b>Max.</b>			<b>Max.</b>	<b>Max.</b>
304	.08	2.00	.040	.030	1.00	18.00/20.00	8.00/10.50	.75	.75
304L	.03	2.00	.040	.030	1.00	18.00/20.00	8.00/12.00	.75	.75

**SPECIFICATIONS** — The following specifications are generally applicable:

Sheets & Plates: AMS 5513, ASTM A 167, ASTM A 240

Bars: AMS 5639, ASTM A 276, ASTM A 479

**APPLICATIONS** — Used where corrosion resistance and good mechanical properties are primary requirements. These grades are widely accepted in such industries as dairy, beverage, and other food products 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 304 sheets are used in aircraft applications where corrosion resistance is required, but where gas or arc welding and elevated temperatures are not involved. Type 304L, as noted above, finds particular use in applications requiring welding.

**CORROSION RESISTANCE** — Types 304 and 304L 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° to 1500°F.

**RESISTANCE TO SCALING** — Excellent scale resistance at temperatures 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:

	<b>Tensile Strength (psi)</b>	<b>Min. Elongation in 2"</b>		
		<b>.015" Thick and Under</b>	<b>.016" Thick to .030"</b>	<b>.031" Thick and Over</b>
Type 304	100,000 Max.	40%	40%	40%

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

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

**MACHINABILITY** — Types 304 and 304L 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.

## TYPES 304 AND 304L STAINLESS (Continued)

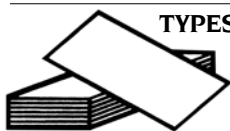
**WELDABILITY** — Easily welded by all the commercial processes except forging or hammer welding. The resulting weld had good toughness and ductility. Annealing is recommended after welding to maintain maximum corrosion resistance.

**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 sections. The stress relieving range is between 400° and 750°F.



### TYPES 304 & 304L 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

Width & Length Thick-ness Inches	Est. Wt. Lbs. per Sheet	Width & Length Thick-ness Inches	Est. Wt. Lbs. per Sheet	Width & Length Thick-ness Inches	Est. Wt. Lbs. per Sheet	Width & Length Thick-ness Inches	Est. Wt. Lbs. per Sheet
<b>.016" (28 Ga.)</b>		<b>.030" (22 Ga.)</b>		<b>.060" (16 Ga.)</b>		<b>.105" (12 Ga.)</b>	
.672 Lb. Sq. Ft.		1.260 Lb. Sq. Ft.		2.520 Lb. Sq. Ft.		4.410 Lb. Sq. Ft.	
36 x 120	20.2	36 x 96	30.2	36 x 96	60.5	36 x 96	105.8
		120	37.8	120	75.6	120	132.3
<b>.0161" (27 Ga.)</b>		48 x 96	40.3	48 x 96	90.7	48 x 96	141.1
.676 Lb. Sq. Ft.		120	50.4	48 x 96	80.6	120	176.4
36 x 120	20.3	<b>.0351" (20 Ga.)</b>		120	100.8	144	211.7
		1.474 Lb. Sq. Ft.		144	121.2	60 x 144	264.6
<b>.018" (26 Ga.)</b>		36 x 96	35.4	60 x 120	126.0	<b>.120" (11 Ga.)</b>	
.756 Lb. Sq. Ft.		120	44.2	<b>.075" (14 Ga.)</b>		5.040 Lb. Sq. Ft.	
36 x 96	18.1	48 x 96	47.2	3.150 Lb. Sq. Ft.		36 x 96	121.0
120	22.7	120	59.0	36 x 96	75.6	120	151.2
<b>.020" (25 Ga.)</b>		<b>.040" (20 Ga.)</b>		48 x 96	94.5	48 x 96	161.2
.840 Lb. Sq. Ft.		1.680 Lb. Sq. Ft.		48 x 96	100.8	120	201.6
36 x 120	25.2	36 x 120	50.4	120	126.0	144	241.9
<b>.024" (24 Ga.)</b>		<b>.048" (18 Ga.)</b>		144	151.2	60 x 120	252.0
1.008 Lb. Sq. Ft.		2.016 Lb. Sq. Ft.		<b>.090" (13 Ga.)</b>		<b>.135" (10 Ga.)</b>	
36 x 96	24.2	36 x 96	48.4	3.780 Lb. Sq. Ft.		36 x 96	136.1
120	30.2	120	60.5	36 x 96	90.7	120	170.1
48 x 96	32.3	48 x 96	64.5	120	113.4	48 x 96	181.4
120	40.3	120	80.6	48 x 96	121.0	120	226.8
		144	96.8	120	151.2	144	272.2
				60 x 120	283.5	60 x 120	283.5

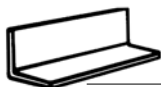


### TYPES 304 & 304L PLATES

**Hot Rolled,**

**Annealed, and Pickled**

Stocked in Thicknesses from 3/16" through 4 1/2",  
Widths from 48" to 96", and Lengths up to 20'.



### TYPES 304 & 304L ANGLES

**Hot Rolled, Annealed and Pickled**

**Stock Lengths 20" to 22"**

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

**TYPES 304 AND 304L STAINLESS (Continued)**

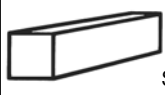


**TYPES 304 & 304L ROUNDS**  
**Conditioned A — Annealed**  
 Stock Lengths 10' to 12' and 20' to 22'

Size In Inches			Est. Wt., Lbs.			Size In Inches			Est. Wt., Lbs.			Size In Inches			Est. Wt., Lbs.		
Ann. & C.D.			Ann. & C.F.			Hot Rolled, Ann.,			Rough Turned								
Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar		
1/8	.0418	.5012	5/8	1.044	12.53	2 1/8	12.07	144.8	5	66.82	801.9						
5/32	.0653	.7831	3/4	1.504	18.04	3/16	12.79	153.5	1/4	73.67	884.0						
3/16	.0940	1.128	13/16	1.765	21.17	1/4	13.53	162.4	1/2	80.86	970.2						
7/32	.1279	1.535	7/8	2.046	24.56	5/16	14.29	171.5	3/4	88.37	1060						
1/4	.1671	2.005	15/16	2.349	28.19	3/8	15.08	180.9	6	96.22	1155						
5/16	.2610	3.132	1	2.673	32.07	1/2	16.71	200.5	1/4	104.4	1253						
11/32	.3158	3.790	1/16	3.017	36.21	5/8	18.42	221.0	1/2	112.9	1355						
3/8	.3759	4.510	1/8	3.383	40.59	3/4	20.21	242.6	3/4	121.8	1461						
7/16	.5116	6.139	3/16	3.769	45.23	7/8	22.09	265.1	7	131.0	1572						
1/2	.6682	8.019	1/4	4.176	50.12	3	24.06	288.7	1/4	140.5	1686						
9/16	.8457	10.15	5/16	4.604	55.25	1/8	26.10	313.2	1/2	150.4	1804						
5/8	1.044	12.53	3/8	5.053	60.64	1/4	28.23	338.8	3/4	160.5	1926						
11/16	1.263	15.16	7/16	5.523	66.28	3/8	30.45	365.3	8	171.1	2053						
3/4	1.504	18.04	1/2	6.014	72.17	1/2	32.74	392.9	1/4	181.9	2183						
			9/16	6.526	78.31	5/8	35.12	421.5	1/2	193.1	2317						
			5/8	7.058	84.70	3/4	37.59	451.0	9	216.5	2598						
			11/16	7.612	91.34	7/8	40.14	481.6	1/2	241.2	2895						
			3/4	8.186	98.23	4	42.77	513.2	10	267.3	3207						
			7/8	9.397	112.8	1/8	45.48	545.8	11	323.4	3881						
			15/16	10.03	120.4	1/4	48.28	579.3	12	384.9	4619						
			2	10.69	128.3	3/8	51.16	613.9	13	451.7	5421						
						1/2	54.13	649.5	14	523.9	6287						
						5/8	57.18	686.1									
						3/4	60.31	723.7									
						7/8	63.52	762.3									



**TYPES 304 & 304L C.D. HEXAGONS**  
**Cond. A — Annealed**  
 Stock Lengths 10' to 12'



**TYPES 304 & 304L SQUARES**  
**Cond. A — Annealed**  
 Stock Lengths 10' to 12'

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	Per Foot	12-Ft. Bar		
1/4	.1842	2.210	1 1/4	4.605	55.26	<b>Ann. &amp; C.D.</b>			<b>H.R., Ann. &amp; Pick.</b>		
5/16	.2878	3.454	3/8	5.572	66.87	3/16	.1196	1.436	2	13.61	163.4
3/8	.4145	4.973	1/2	6.631	79.56	1/4	.2127	2.552	1/4	17.23	206.7
7/16	.5641	6.769	5/8	7.783	93.39	5/16	.3323	3.988	1/2	21.27	255.2
1/2	.7368	8.842	3/4	9.026	108.3	3/8	.4786	5.743	3/4	25.74	308.8
9/16	.9325	11.19	7/8	10.36	124.3	7/16	.6514	7.817	3	30.63	367.5
5/8	1.151	13.82	2	11.79	141.5	1/2	.8508	10.21	1/4	35.95	431.4
11/16	1.393	16.72	7/8	10.36	124.3	5/8	1.329	15.95	1/2	41.69	500.3
3/4	1.658	19.89	1	11.79	141.5	3/4	1.914	22.97	3/4	47.86	574.3
13/16	1.946	23.35	1 1/4	14.92	179.0	7/8	2.606	31.27	4	54.45	653.4
7/8	2.257	27.08	1/4	14.92	179.0	1	3.403	40.84	1/2	68.91	827.0
1	2.947	35.37	1/2	18.42	221.0	1/8	4.307	51.69	5	85.08	1021
1 1/8	3.730	44.76	3/4	22.29	267.5	1/4	5.318	63.81	1/2	102.9	1235
			7/8	24.36	292.3	3/8	6.434	77.21	6	122.5	1470
			2	26.53	318.3	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			
						1/2	21.27	255.2			

**TYPES 304 AND 304L STAINLESS (Continued)**



**TYPES 304 & 304L FLATS**  
Hot Rolled, Annealed, & Pickled  
Stock Lengths 10' to 12'

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		Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar	
<b>1/8 x</b>			<b>5/16 x</b>			<b>1/2 x</b>			<b>1 x</b>								
1/4	.1060	1.280	3/8	.3988	4.786	3	5.105	61.26	3	10.21	122.5						
3/8	.1600	1.910	1/2	.5318	6.382	3 1/4	5.530	66.36	3 1/2	11.91	142.9						
1/2	.2127	2.552	5/8	.6647	7.976	3 1/2	5.956	71.47	4	13.61	163.4						
5/8	.2659	3.191	3/4	.7976	9.571	3 3/4	6.381	76.57	4 1/2	15.31	183.8						
3/4	.3191	3.829	1	1.064	12.76	4	6.806	81.68	5	17.02	204.2						
7/8	.3722	4.466	1 1/4	1.329	15.95	4 1/2	7.657	91.89	6	20.42	245.0						
1	.4254	5.105	1 1/2	1.595	19.14	5	8.508	102.1	8	27.23	326.7						
1 1/4	.5318	6.381	1 3/4	1.861	22.33	5 1/2	9.359	112.3	<b>1 1/4 x</b>								
1 1/2	.6381	7.657	2	2.127	25.52	6	10.21	122.5	1 1/2	6.381	76.57						
1 3/4	.7445	8.933	2 1/4	2.393	28.71	8	13.61	163.4	2	8.508	102.1						
2	.8508	10.21	2 1/2	2.659	31.91	<b>5/8 x</b>			2 1/2	10.64	127.6						
2 1/2	1.064	12.76	2 3/4	2.925	35.10	3/4	1.595	19.14	3	12.76	153.1						
3	1.276	15.31	3	3.191	38.29	1	2.127	25.52	3 1/2	14.89	178.7						
4	1.702	20.42	4	4.254	51.05	1 1/4	2.659	31.91	4	17.02	204.2						
6	2.552	30.62	5	5.318	63.82	1 1/2	3.191	38.29	5	21.27	255.2						
<b>3/16 x</b>			6	6.381	76.57	1 3/4	3.722	44.67	6	25.52	306.2						
1/4	.1600	1.910	<b>3/8 x</b>			2	4.254	51.05	<b>1 1/2 x</b>								
3/8	.2390	2.870	1/2	.6381	7.657	2 1/4	4.786	57.43	1 3/4	8.933	107.2						
1/2	.3191	3.829	5/8	.7976	9.571	2 1/2	5.318	63.81	2	10.21	122.5						
5/8	.3990	4.590	3/4	.9572	11.49	2 3/4	5.849	70.19	2 1/2	12.76	153.1						
3/4	.4786	5.743	1	1.276	15.31	3	6.381	76.57	3	15.31	183.8						
7/8	.5563	6.676	1 1/4	1.595	19.14	3 1/2	7.445	89.33	3 1/2	17.87	214.4						
1	.6381	7.657	1 1/2	1.914	22.97	4	8.508	102.1	4	20.42	245.0						
1 1/4	.7976	9.572	1 3/8	1.755	21.06	5	10.64	127.6	5	25.52	306.2						
1 1/2	.9572	11.49	1 1/2	1.914	22.97	6	12.76	153.1	6	30.63	367.6						
1 3/4	1.117	13.40	1 3/4	2.233	26.80	<b>3/4 x</b>			<b>1 3/4 x</b>								
2	1.276	15.31	2	2.552	30.63	1	2.552	30.63	2	11.91	142.9						
2 1/4	1.436	17.23	2 1/4	2.871	34.46	1 1/4	3.191	38.29	2 1/2	14.89	178.7						
2 1/2	1.595	19.14	2 1/2	3.191	38.29	1 1/2	3.829	45.94	3	17.87	214.4						
2 3/4	1.755	21.06	2 3/4	3.510	42.11	1 3/4	4.467	53.60	4	23.82	285.8						
3	1.914	22.97	3	3.829	45.94	2	5.105	61.26	6	35.73	428.8						
3 1/4	2.074	24.89	3 1/2	4.467	53.60	2 1/4	5.743	68.91	<b>2 x</b>								
3 1/2	2.233	26.80	4	5.105	61.26	2 1/2	6.381	76.57	2 1/2	17.02	204.2						
3 3/4	2.393	28.71	4 1/2	5.743	68.91	2 3/4	7.019	84.23	3	20.42	245.0						
4	2.552	30.63	5	6.381	76.57	3	7.657	91.89	4	27.23	326.7						
4 1/4	2.712	32.55	5 1/2	7.019	84.23	3 1/2	8.933	107.2	5	34.03	408.4						
4 1/2	2.871	34.46	6	7.657	91.89	4	10.21	122.5	6	40.84	490.1						
4 3/4	3.031	36.38	8	10.21	122.5	4 1/2	11.49	137.8	<b>2 1/2 x</b>								
5	3.191	38.29	<b>1/2 x</b>			5	12.76	153.1	3	25.52	306.2						
5 1/4	3.351	40.21	5/8	1.064	12.77	6	15.31	183.8	4	34.03	408.4						
5 1/2	3.510	42.11	3/4	1.276	15.31	8	20.42	245.0	5	42.54	510.5						
5 3/4	3.670	44.03	7/8	1.489	17.87	<b>1 x</b>			6	51.05	612.6						
6	3.829	45.95	1	1.702	20.42	1 1/4	4.254	51.05	3 x								
6 1/4	4.000	47.86	1 1/4	2.127	25.52	1 1/2	5.105	61.26	3 1/2	35.73	428.8						
6 1/2	4.160	49.77	1 1/2	2.552	30.63	1 3/4	5.956	71.47	4	40.84	490.1						
6 3/4	4.320	51.68	1 3/4	2.978	35.73	2	6.806	81.68	5	51.05	612.6						
7	4.480	53.59	2	3.403	40.84	2 1/4	7.657	91.89	6	61.26	735.1						
7 1/4	4.640	55.50	2 1/4	3.829	45.94	2 1/2	8.508	102.1									
7 1/2	4.800	57.41	2 1/2	4.254	51.05	2 3/4	9.359	112.3									
7 3/4	4.960	59.32	2 3/4	4.679	56.15												



## TYPES 303S and 303Se — FREE MACHINING

### Stainless Bars

#### UNS S30300, S30323

#### Color Marking

**Type 303S** — Annealed Bars and Pump Shafting: Ends painted Red  
High Tensile Bars (Condition B): Ends painted Gray & Orange

**Type 303Se** — Annealed Bars: 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 sulfur, 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	Mn	P	S	Se	Si	Cr	Ni	Mo	Cu
	Max.	Max.	Max.			Max.			Max.	Max.
303S	.15	2.00	.15	.15	Min.	1.00	17.00/19.00	8.00/10.00	.75	.75
303Se	.15	2.00	.17	.04	Max.	15/40	1.00	17.00/19.00	8.00/10.00	.75

**SPECIFICATIONS** — The following specifications are generally applicable:  
AMS 5640, ASTM A 314, ASTM A 320, 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 which are added to improve machinability, Type 303 has slightly less general corrosion resistance than the regular chromium-nickel grades such as Type 304. 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 Min. (psi)	Elongation in 2" Min.	Reduction of Area Min.	Brinell Hardness	
<b>Cond. A (Annealed)</b>						
1/2" and under	125,000	Max	—	—	140/255	
Over 1/2"	—	—	—	—	140/255	
<b>Cond. B (High Tensile)</b>						
Up to 3/4"	125,000	Min.	100,000	12%	35%	321 Max.
Over 3/4" to 1"	115,000	Min.	80,000	15%	35%	321 Max.
Over 1" to 1 1/4"	105,000	Min.	65,000	20%	35%	321 Max.
Over 1 1/4" to 1 1/2"	100,000	Min.	50,000	28%	45%	321 Max.
Over 1 1/2" to 3"	95,000	Min.	45,000	28%	45%	321 Max.

In practice, annealed bars 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 machinability rating of approximately 78% with 1212 rated 100%. Surface cutting speed on automatic screw machines is approximately 130 feet per minute.

**WELDABILITY** — This grade has only fair welding properties.

**FORMING** — This grade has fairly good forming 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 sections. The stress relieving range is between 400° and 750°F.

**TYPE 303 STAINLESS** (Continued)



**TYPES 303S & 303Se ROUNDS**

**Condition A — Annealed**

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

Size In Inches			Est. Wt., Lbs.			Size In Inches			Est. Wt., Lbs.			Size In Inches			Est. Wt., Lbs.			Size In Inches			Est. Wt., Lbs.		
In	Per Foot	12-Ft. Bar	In	Per Foot	12-Ft. Bar	In	Per Foot	12-Ft. Bar	In	Per Foot	12-Ft. Bar	In	Per Foot	12-Ft. Bar	In	Per Foot	12-Ft. Bar	In	Per Foot	12-Ft. Bar	In	Per Foot	12-Ft. Bar
<b>Cold Drawn</b>						<b>Cold Finished</b>						<b>Cold Finished (Continued)</b>						<b>Hot Rolled</b>					
Max. Brinell 235						Max. Brinell 223						(Continued)						<b>Rough Turned</b>					
1/16 .0104 .1248						9/16 .8457 10.15						1 13/16 8.781 105.4						Max Brinell 207					
3/32 .0235 .2820						5/8 1.044 12.53						7/8 9.397 112.8						3 1/2 32.74 392.9					
1/8 .0418 .5016						2 1/32 1.151 13.81						15/16 10.03 120.4						5/8 35.12 421.5					
5/32 .0653 .7831						1 1/16 1.263 15.16						2 10.69 128.3						3/4 37.59 451.0					
3/16 .0940 1.128						23/32 1.381 16.57						1/16 11.37 136.4						7/8 40.14 481.6					
7/32 .1279 1.535						3/4 1.504 18.04						1/8 12.07 144.8						4 42.77 513.2					
1/4 .1671 2.005						25/32 1.631 19.58						3/16 12.79 153.5						1/4 48.28 579.3					
9/32 .2114 2.537						13/16 1.765 21.17						1/4 13.53 162.4						3/8 51.16 613.9					
5/16 .2610 3.132						27/32 1.903 22.83						5/16 14.29 171.5						1/2 54.13 649.5					
11/32 .3158 3.790						7/8 2.046 24.56						3/8 15.08 180.9						5/8 57.18 686.1					
3/8 .3759 4.510						29/32 2.195 26.34						7/16 15.88 190.6						3/4 60.31 723.7					
13/32 .4411 5.293						15/16 2.349 28.19						1/2 16.71 200.5						7/8 63.52 762.3					
7/16 .5116 6.139						31/32 2.508 30.10						9/16 17.55 210.6						5 66.82 801.9					
15/32 .5873 7.048						1 2.673 32.07						5/8 18.42 221.0						1/4 73.67 884.0					
1/2 .6682 8.019						1/16 3.017 36.21						11/16 19.31 231.7						1/2 80.86 970.2					
17/32 .7544 9.052						1/8 3.383 40.59						3/4 20.21 242.6						3/4 88.37 1060					
9/16 .8457 10.15						3/16 3.769 45.23						7/8 22.09 265.1						6 96.22 1155					
19/32 .9423 11.31						1/4 4.176 50.12						15/16 23.06 276.8						1/4 104.4 1253					
5/8 1.044 12.53						5/16 4.604 55.25						3 24.06 288.7						1/2 112.9 1355					
21/32 1.151 13.81						7/16 5.523 66.28						<b>Hot Rolled</b>						3/4 121.8 1461					
11/16 1.263 15.16						1/2 6.014 72.17						<b>Rough Turned</b>						7 131.0 1572					
3/4 1.504 18.04						9/16 6.526 78.31						Max Brinell 207						1/4 140.5 1686					
						5/8 7.058 84.70						3 1/8 26.10 313.2						1/2 150.4 1804					
						11/16 7.612 91.34						1/4 28.23 338.8						3/4 160.5 1926					
						3/4 8.186 98.23						3/8 30.45 368.3						8 171.1 2053					
																		1/4 181.9 2183					
																		1/2 193.1 2317					
																		9 216.5 2598					
																		1/2 241.2 2895					
																		10 267.3 3207					
																		11 323.4 3881					
																		12 384.9 4619					

**TYPES 303S & 303Se COLD DRAWN ROUNDS**

**Cond. B — High Tensile**  
Stock Lengths 10' to 12'



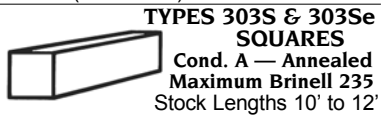
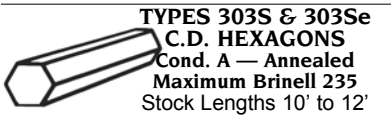
**TYPE 303S ROUNDS Accuracy Stock Ground & Polished**

Stock Lengths 10' to 12'



Size In Inches			Est. Wt., Lbs.			Size In Inches			Est. Wt., Lbs.			Size In Inches			Est. Wt., Lbs.		
In	Per Foot	12-Ft. Bar	In	Per Foot	12-Ft. Bar	In	Per Foot	12-Ft. Bar	In	Per Foot	12-Ft. Bar	In	Per Foot	12-Ft. Bar	In	Per Foot	12-Ft. Bar
3/16	.0940	1.128	1	2.673	32.07	1/8	.0418	.5016	3/4	1.504	18.04						
1/4	.1671	2.005	1/16	3.017	36.21	1/4	.1671	2.005	7/8	2.046	24.56						
5/16	.2610	3.132	1/8	3.383	40.59	5/16	.2610	3.132	1	2.673	32.07						
3/8	.3759	4.510	1/4	4.176	50.12	3/8	.3759	4.510	1/8	3.383	40.59						
7/16	.5116	6.139	3/8	5.053	60.64	7/16	.5116	6.139	1/4	4.176	50.12						
1/2	.6682	8.019	1/2	6.014	72.17	1/2	.6682	8.019	1/2	6.014	72.17						
9/16	.8457	10.15	5/8	7.058	84.70	5/8	1.044	12.53									
5/8	1.044	12.53	3/4	8.186	98.23	3/4	1.504	18.04									
11/16	1.263	15.16	7/8	9.397	112.8	13/16	1.765	21.17									
3/4	1.504	18.04	2	10.69	128.3	7/8	2.046	24.56									
			1/4	13.53	162.4	15/16	2.349	28.19									
			1/2	16.71	200.5												
			3/4	20.21	242.6												

**TYPE 303 STAINLESS (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		Per Foot	12-Ft. Bar	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar		
$\frac{3}{16}$	.1036	1.243	$\frac{1}{16}$	6.090	73.08	<b>Cold Drawn</b>						<b>Cold Drawn (Continued)</b>					
$\frac{1}{4}$	.1842	2.210	$\frac{1}{2}$	6.631	79.56	$\frac{1}{8}$	.0531	.6381	$\frac{1}{2}$	7.657	91.89	$\frac{5}{8}$	8.987	107.8	$\frac{3}{4}$	10.42	125.1
$\frac{5}{16}$	.2878	3.454	$\frac{5}{8}$	7.783	93.39	$\frac{3}{16}$	.1196	1.436	$\frac{3}{4}$	10.42	125.1	$\frac{7}{8}$	11.96	143.6	<b>2</b>	13.61	163.4
$\frac{3}{8}$	.4145	4.973	$\frac{11}{16}$	8.393	100.7	$\frac{1}{4}$	.2127	2.552	$\frac{1}{2}$	17.23	206.7	$\frac{1}{2}$	21.27	255.2			
$\frac{7}{16}$	.5641	6.769	$\frac{3}{4}$	9.026	108.3	$\frac{5}{16}$	.3323	3.988									
$\frac{1}{2}$	.7368	8.842	$\frac{7}{8}$	10.36	124.3	$\frac{3}{8}$	.4786	5.743									
$\frac{9}{16}$	.9325	11.19	$\frac{15}{16}$	11.06	132.8	$\frac{7}{16}$	.6514	7.817									
$\frac{5}{8}$	1.151	13.82	<b>2</b>	11.79	141.5	$\frac{1}{2}$	.8508	10.21									
$\frac{11}{16}$	1.393	16.72	$\frac{1}{8}$	13.31	159.7	$\frac{9}{16}$	1.077	12.92									
$\frac{3}{4}$	1.658	19.89	$\frac{3}{16}$	14.10	169.2	$\frac{5}{8}$	1.329	15.95									
$\frac{13}{16}$	1.946	23.35	$\frac{1}{4}$	14.92	179.0	$\frac{3}{4}$	1.914	22.97									
$\frac{7}{8}$	2.257	27.08	$\frac{5}{16}$	15.76	189.1	$\frac{7}{8}$	2.606	31.27									
$\frac{15}{16}$	2.590	31.08	$\frac{3}{8}$	16.62	199.5	<b>1</b>	3.403	40.84									
<b>1</b>	2.947	35.37	$\frac{1}{2}$	18.42	221.0	$\frac{1}{8}$	4.307	51.69									
$\frac{1}{16}$	3.327	39.93	$\frac{5}{8}$	20.31	243.7	$\frac{1}{4}$	5.318	63.81									
$\frac{1}{8}$	3.730	44.76	$\frac{3}{4}$	22.29	267.5	$\frac{3}{8}$	6.434	77.21									
$\frac{3}{16}$	4.156	49.87	$\frac{13}{16}$	23.31	279.8												
$\frac{1}{4}$	4.605	55.26	$\frac{7}{8}$	24.36	292.3												
$\frac{5}{16}$	5.077	60.93	<b>3</b>	26.53	318.3												
$\frac{3}{8}$	5.572	66.87															

**TYPES 303S & 303Se FLATS — CONDITION A — ANNEALED**



Cold Drawn or Hot Rolled Pickled  
Stock Lengths 10' to 12'

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		Per Foot	12-Ft. Bar	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar		
$\frac{1}{8}$ x			$\frac{1}{4}$ x			$\frac{1}{2}$ x			<b>1</b> x								
$\frac{3}{4}$	.1060	1.280	4	3.403	40.84	$3\frac{1}{2}$	5.956	71.47	2	6.806	81.68	$2\frac{1}{2}$	8.508	102.1			
$\frac{1}{4}$	.1600	1.910	5	4.254	51.05	4	6.806	81.68	3	10.21	122.5	3	10.21	122.5			
$\frac{1}{2}$	.2127	2.552	6	5.105	61.26	$4\frac{1}{2}$	7.657	91.89	$3\frac{1}{2}$	11.91	142.9	4	13.61	163.4			
$\frac{5}{8}$	.2659	3.191	$\frac{5}{16}$ x			5	8.508	102.1	4	13.61	163.4	5	17.04	204.2			
$\frac{3}{4}$	.3191	3.829	1	1.064	12.76	6	10.21	122.5	6	20.42	245.0	6	20.42	245.0			
<b>1</b>	.4254	5.105	1	$\frac{1}{2}$	1.595	19.14	$\frac{5}{8}$ x					$1\frac{1}{4}$ x					
$\frac{3}{16}$ x			2	2.127	25.52	1	1.595	19.14	1	6.381	76.57	1	$\frac{1}{2}$	6.381	76.57		
$\frac{1}{4}$	.1600	1.910	2	$\frac{1}{2}$	2.659	31.91	$\frac{3}{4}$	1.595	19.14	2	8.508	102.1	2	$\frac{1}{2}$	8.508	102.1	
$\frac{3}{8}$	.2390	2.870	3	3.191	38.29	3	2.127	25.52	1	10.64	127.6	3	12.76	153.1			
$\frac{1}{2}$	.3191	3.829	$\frac{3}{8}$ x			1	$\frac{1}{4}$	2.659	31.91	4	17.02	204.2	4	17.02	204.2		
$\frac{5}{8}$	.3990	4.590	$\frac{1}{2}$	.6381	7.657	1	$\frac{1}{2}$	3.191	38.29	5	21.27	255.2	5	21.27	255.2		
$\frac{3}{4}$	.4786	5.743	$\frac{3}{4}$	.9572	11.49	2	4.254	51.05	2	25.52	306.2	6	25.52	306.2			
<b>1</b>	.6381	7.657	1	1.276	15.31	$2\frac{1}{2}$	5.318	63.81	3	30.63	367.6	3	30.63	367.6			
$1\frac{1}{4}$	.7976	9.572	1	$\frac{1}{4}$	1.595	19.14	3	6.381	76.57	4	36.31	435.7	4	36.31	435.7		
$1\frac{1}{2}$	.9572	11.49	1	$\frac{1}{2}$	1.914	22.97	4	8.508	102.1	5	40.84	490.1	5	40.84	490.1		
$1\frac{3}{4}$	1.117	13.40	1	$\frac{3}{4}$	2.233	26.80	5	10.64	127.6	6	44.76	537.1	6	44.76	537.1		
<b>2</b>	1.276	15.31	2	2.552	30.63	1	$\frac{3}{4}$ x					$1\frac{1}{2}$ x					
$2\frac{1}{2}$	1.595	19.14	$2\frac{1}{2}$	3.191	38.29	1	2.552	30.63	2	10.21	122.5	2	$\frac{1}{2}$	10.21	122.5		
<b>3</b>	1.914	22.97	3	3.829	45.94	1	$\frac{1}{4}$	3.191	38.29	3	15.31	183.8	3	$\frac{1}{2}$	15.31	183.8	
$\frac{1}{4}$ x			3	$\frac{1}{2}$	4.467	53.60	1	$\frac{1}{2}$	3.829	45.94	4	20.42	245.0	4	20.42	245.0	
$\frac{3}{8}$	.3191	3.829	4	5.105	61.26	1	$\frac{1}{4}$	4.467	53.60	5	25.52	306.2	5	25.52	306.2		
$\frac{1}{2}$	.4254	5.105	5	6.381	76.57	1	$\frac{3}{8}$	4.467	53.60	6	30.63	367.6	6	30.63	367.6		
$\frac{5}{8}$	.5318	6.381	6	7.657	91.89	2	5.105	61.26	2	17.02	204.2	7	34.03	408.4			
$\frac{3}{4}$	.6381	7.657	$\frac{1}{2}$ x			2	$\frac{1}{2}$	6.381	76.57	3	20.42	245.0	8	40.84	490.1		
<b>1</b>	.8508	10.21	$\frac{3}{4}$	1.276	15.31	3	7.657	91.89	4	27.23	326.7	9	44.76	537.1			
$1\frac{1}{4}$	1.064	12.76	1	1.702	20.42	3	$\frac{1}{2}$	8.933	107.2	5	34.03	408.4	10	51.05	612.6		
$1\frac{1}{2}$	1.276	15.31	1	$\frac{1}{4}$	2.127	25.52	4	10.21	122.5	6	40.84	490.1	11	57.91	694.5		
$1\frac{3}{4}$	1.489	17.87	1	$\frac{1}{2}$	2.552	30.63	5	12.76	153.1	7	48.84	586.1	12	64.76	777.1		
<b>2</b>	1.702	20.42	1	$\frac{3}{4}$	2.978	35.73	6	15.31	183.8	8	54.76	657.1	13	70.68	848.1		
$2\frac{1}{2}$	2.127	25.52	2	3.403	40.84	2	<b>1</b> x					$2\frac{1}{2}$ x					
$3$	2.552	30.63	$2\frac{1}{2}$	4.254	51.05	1	$\frac{1}{4}$	4.254	51.05	1	40.84	490.1	3	40.84	490.1		
$3\frac{1}{2}$	2.978	35.73	<b>3</b>	5.105	61.26	1	$\frac{1}{2}$	5.105	61.26	4	61.26	735.1	4	61.26	735.1		
						1	$\frac{3}{4}$	5.956	71.47								

**TYPES 316 AND 316L**  
**Sheets, Plates, Bars, and Angles**  
**UNS S31600, S31603**  
**TYPES 317 and 317L**  
**Plates**  
**UNS S31700, S31703**

**Color Markings:**

Type 316 Bars — Ends Pink With Black Stripe  
 Type 316 Plate — Corner Striped Pink with Black Stripe  
 Type 316L Bars — Ends Pink with Blue Stripe  
 Type 316L Plate — Corner Striped Pink with Blue Stripe  
 Type 317 Plates — Corner Striped Blue with Pink Stripe  
 Type 317L Plates — Corner Striped Aluminum

Types 316 and 317 are "18-8" chromium-nickel stainless steels modified by the addition of molybdenum, which greatly increases the corrosion resistance as well as the mechanical properties at elevated temperatures. These grades are non-magnetic in the annealed condition and not hardenable by heat treatment. Since they have good cold forming and drawing properties, these grades are outstanding stainless steels suitable for a large number of applications. Manufactured by the electric-furnace process, these grades meet the exacting standards of the aircraft industry. Bars 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. Types 317 and 317L are available in plate and with increased chromium, nickel, and molybdenum contents can be used in even more severe corrosive and high temperature applications.

**ANALYSIS**

	<b>C</b>	<b>Mn</b>	<b>P</b>	<b>S</b>	<b>Si</b>	<b>Cr</b>
	<b>Max.</b>	<b>Max.</b>	<b>Max.</b>	<b>Max.</b>	<b>Max.</b>	
<b>316</b>	.08	2.00	.040	.030	1.00	16.00/18.00
<b>316L</b>	.03	2.00	.040	.030	1.00	16.00/18.00
<b>317</b>	.08	2.00	.045	.030	.75	18.00/20.00
<b>317L</b>	.03	2.00	.045	.030	.75	18.00/20.00

	<b>Ni</b>	<b>Mo</b>	<b>Cu</b>	<b>N</b>
			<b>Max.</b>	<b>Max.</b>
<b>316</b>	10.00/14.00	2.00/3.00	.75	.10
<b>316L</b>	10.00/14.00	2.00/3.00	.75	.10
<b>317</b>	11.00/15.00	3.00/4.00	—	.10
<b>317L</b>	11.00/15.00	3.00/4.00	—	.10

**SPECIFICATIONS** — The following specifications are generally applicable:

**Types 316 and 316L:**

Sheets & Plates: ASTM A 167, ASTM A 240, QQ-S-766, AMS 5524, AMS 5507

Bars & Angles: AMS 5648, AMS QQ-S-763, ASTM A 276, ASTM A 479

**Types 317 and 317L:**

Plates: ASTM A 240

**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 than 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. Types 317 and 317L, with higher alloy content, would be suitable for the more severe corrosion applications.

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## TYPES 316 AND 317 STAINLESS (Continued)

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**CORROSION RESISTANCE** — Types 316 and 317 are more resistant to atmospheric and general corrosive conditions than any of the other standard stainless steels. They have good resistance to the corrosive effects of sulphates, phosphates, and other salts as well as reducing acids such as sulphuric, sulphurous, and phosphoric. These grades are less susceptible to pitting in applications where acetic acid vapors or solutions of chlorides, bromides, or iodides are encountered. When heated to within the temperature range of 800°-1500°F, or when slowly cooled through this range, these grades are subject to intergranular corrosion. If the application requires this, then the low carbon version, Types 316L and 317L, should be used.

**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:

	<b>Tensile Strength (psi)</b>	<b>Yield Strength Min. (psi)</b>	<b>Elongation in 2" Min.</b>	<b>Reduction of Area Min.</b>
<b>Sheets</b>	75,000/100,000	30,000	40%	—
<b>H.R. Bars</b>	75,000/115,000	30,000	40%	50%
<b>C.F. Bars</b>				
1/2" & under	90,000/125,000	45,000	35%	45%
Over 1/2"	75,000 Min.	30,000	35%	50%

**MACHINABILITY** — Types 316 and 317 have 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. Annealing after welding is recommended to obtain maximum corrosion resistance.

**FORMING** — These grades have good drawing and stamping properties.

**FORGING** — Forge between 2100° and 2300°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 sections. The stress relieving range is between 400° and 750°F.

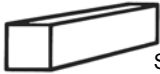
**TYPES 316 & 317 STAINLESS (Continued)**



**TYPES 316 & 316L ANGLES**

**Hot Rolled, Annealed, and Pickled**  
Stock Lengths 20' to 22'

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



**TYPE 316 SQUARES**  
**Annealed**

Stock Lengths 10' to 12'

Size In Inches	Est. Wt., Lbs.		Size In Inches	Est. Wt., Lbs.				
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar			
<b>Cold Drawn</b>			<b>Hot Rolled &amp; Pickled</b>					
3/16	.1196	1.436	2	13.61	163.4			
1/4	.2127	2.552						
5/16	.3323	3.988						
3/8	.4786	5.743						
7/16	.6514	7.817						
1/2	.8508	10.21						
5/8	1.329	15.95						
3/4	1.914	22.97				3/4	17.23	206.7
7/8	2.606	31.27				1/2	21.27	255.2
1	3.403	40.84				3/4	25.74	308.8
1/8	4.307	51.69	3	30.63	367.5			
1/4	5.318	63.81	1/2	41.69	500.3			
1/2	7.657	91.89						
3/4	10.42	125.1	4	54.45	653.4			



**TYPE 316 SHEETS**  
**No. 2B Finish**  
**Bright Cold Rolled**  
**Annealed and Pickled**

Thickness	Width and Length	Est. Wt., Lbs.	
		Per Sq. Ft.	Per Sheet
.024" (24 Ga.)	36 x 120	1.008	30.2
.030" (22 Ga.)	48 x 120	1.260	50.4
.0351" (20 Ga.)	48 x 120	1.474	59.0
.048" (18 Ga.)	48 x 120	2.016	80.6
.060" (16 Ga.)	36 x 120	2.520	75.6
	48 x 120	2.520	100.8
.075" (14 Ga.)	36 x 120	3.150	94.5
.105" (12 Ga.)	48 x 120	4.410	176.4
.120" (11 Ga.)	48 x 120	5.040	201.6
.135" (10 Ga.)	48 x 120	5.670	226.8
 <b>TYPES 316, 316L, 317, &amp; 317L PLATES</b> <b>Hot Rolled, Annealed, and Pickled</b>			
Stocked in Thickness from 3/16" through 4", Widths from 48" to 72", and Lengths up to 20'.			

**TYPES 316 & 317 STAINLESS (Continued)**

**TYPES 316 & 316L ROUNDS**

**Annealed**

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



Est. Wt., Lbs.			Est. Wt., Lbs.			Est. Wt., Lbs.			Est. Wt., Lbs.		
Size In Inches	Per Foot	12-Ft. Bar	Size In Inches	Per Foot	12-Ft. Bar	Size In Inches	Per Foot	12-Ft. Bar	Size In Inches	Per Foot	12-Ft. Bar
<b>Cold Drawn</b>			<b>Cold Fin. (Cont.)</b>			<b>Hot Rolled &amp; Rough Turned</b>					
1/8	.0418	.5012	7/8	2.046	24.56	2 1/8	12.07	144.8	4 5/8	57.18	686.2
3/16	.0940	1.128	15/16	2.349	28.19	3/16	12.79	153.5	3/4	60.31	723.7
1/4	.1671	2.005	<b>1</b>	2.673	32.07	1/4	13.53	162.4	7/8	63.52	762.3
5/16	.2610	3.132	1/16	3.017	36.21	3/8	15.08	180.9	<b>5</b>	66.82	801.9
3/8	.3759	4.510	1/8	3.383	40.59	1/2	16.71	200.5	1/4	73.67	884.0
7/16	.5116	6.139	3/16	3.769	45.23	5/8	18.42	221.0	1/2	80.86	970.2
1/2	.6682	8.019	1/4	4.176	50.12	3/4	20.21	242.6	3/4	88.37	1060
9/16	.8457	10.15	5/16	4.604	55.25	7/8	22.09	265.1	<b>6</b>	96.22	1155
5/8	1.044	12.53	3/8	5.053	60.64	15/16	23.06	276.8	1/4	104.4	1253
11/16	1.263	15.16	7/16	5.523	66.28	<b>3</b>	24.06	288.7	1/2	112.9	1355
3/4	1.504	18.02	1/2	6.014	72.17	1/8	26.10	313.2	3/4	121.8	1461
			9/16	6.526	78.31	1/4	28.23	338.8	<b>7</b>	131.0	1572
			5/8	7.058	84.70	3/8	30.45	365.3	1/4	140.5	1686
			11/16	7.612	91.34	1/2	32.74	392.9	1/2	150.4	1804
			3/4	8.186	98.23	5/8	35.12	421.5	3/4	160.5	1926
			7/8	9.397	112.8	3/4	37.59	451.0	<b>8</b>	171.1	2053
			15/16	10.03	120.4	7/8	40.14	481.6	1/2	193.1	2317
			<b>2</b>	10.69	128.3	<b>4</b>	42.77	513.2	<b>9</b>	216.5	2598
						1/4	48.28	579.3	1/2	241.2	2895
						3/8	51.16	613.9	<b>10</b>	267.3	3207
						1/2	54.13	649.5	<b>11</b>	323.4	3881
									<b>12</b>	384.9	4619

**PRECISION PUMP SHAFTING**



Stock Lengths 20' to 22'

**TYPE 316 HEXAGONS**  
**Annealed & Cold Drawn**



Stock Lengths 10' to 12'

Est. Wt., Lbs.			Est. Wt., Lbs.			Est. Wt., Lbs.			Est. Wt., Lbs.		
Size In Inches	Per Foot	20-Ft. Bar	Size In Inches	Per Foot	20-Ft. Bar	Size In Inches	Per Foot	12-Ft. Bar	Size In Inches	Per Foot	12-Ft. Bar
3/4	1.504	30.07	<b>2</b>	10.69	213.8	7/16	.5641	6.769	<b>1 1/4</b>	4.605	55.26
7/8	2.046	40.93	1/16	11.37	227.4	1/2	.7368	8.842	5/16	5.077	60.93
<b>1</b>	2.673	53.46	3/16	12.79	255.8	9/16	.9325	11.19	3/8	5.572	66.87
1/16	3.017	60.34	1/4	13.53	270.6	5/8	1.151	13.82	1/2	6.631	79.56
1/8	3.383	67.66	7/16	15.88	317.6	11/16	1.393	16.72	5/8	7.783	93.39
3/16	3.769	75.38	11/16	19.31	386.1	3/4	1.658	19.89	3/4	9.026	108.3
1/4	4.176	86.53	3/4	20.27	404.2	13/16	1.946	23.35	7/8	10.36	124.3
5/16	4.604	92.08	15/16	23.06	461.3	7/8	2.257	27.08	<b>2</b>	11.79	141.5
7/16	5.523	110.5	3 3/16	27.16	543.1	15/16	2.590	31.08	1/4	14.92	179.0
1/2	6.014	120.3	1/4	28.23	564.6	<b>1</b>	2.947	35.37	1/2	18.42	221.0
5/8	7.058	141.2	7/16	31.58	631.7	1/16	3.327	39.93	5/8	20.31	243.7
11/16	7.612	152.2	11/16	36.35	726.9	1/8	3.730	44.76	3/4	22.29	267.5
15/16	10.03	200.7	<b>4</b>	42.77	855.3	3/16	4.156	49.87	<b>3</b>	26.53	318.3

**TYPES 316 AND 317 STAINLESS (Continued)**



**TYPE 316 FLATS**  
**Hot Rolled, Annealed, & Pickled**  
 Stock Lengths 10' to 12'

Size In Inches	Est. Wt., Lbs.		Size In Inches	Est. Wt., Lbs.	
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar
<b>1/8 x</b>			<b>1/2 x</b>		
1/2	.2127	2.552	3/4	1.276	15.31
3/4	.3191	3.829	1	1.702	20.42
1	.4254	5.105	1 1/4	2.127	25.52
1 1/2	.6381	7.657	1 1/2	2.552	30.63
2	.8508	10.21	1 3/4	2.978	35.73
3	1.276	15.31	2	3.403	40.84
4	1.702	20.42	2 1/4	3.829	45.94
			2 1/2	4.254	51.05
<b>3/16 x</b>			2 3/4	4.679	56.15
1/2	.3191	3.829	3	5.105	61.26
3/4	.4786	5.743	3 1/2	5.956	71.47
1	.6381	7.657	4	6.806	81.68
1 1/4	.7976	9.572	5	8.508	102.1
1 1/2	.9572	11.49	6	10.21	122.5
2	1.276	15.31	<b>5/8 x</b>		
2 1/2	1.595	19.14	1	2.127	25.52
3	1.914	22.97	1 1/2	3.191	38.29
4	2.552	30.63	2	4.254	51.05
			2 1/2	5.318	63.81
<b>1/4 x</b>			3	6.381	76.57
1/2	.4254	5.105	4	8.508	102.1
3/4	.6381	7.657	<b>3/4 x</b>		
1	.8508	10.21	1	2.552	30.63
1 1/4	1.064	12.76	1 1/2	3.829	45.94
1 1/2	1.276	15.31	2	5.105	61.26
1 3/4	1.489	17.87	2 1/2	6.381	76.57
2	1.702	20.42	3	7.657	91.89
2 1/4	1.914	22.97	4	10.21	122.5
2 1/2	2.127	25.52	5	12.76	153.1
2 3/4	2.340	28.08	6	15.31	183.8
3	2.552	30.63	<b>1 x</b>		
3 1/2	2.978	35.73	1 1/2	5.105	61.26
4	3.403	40.84	2	6.806	81.68
5	4.254	51.05	2 1/2	8.508	102.1
6	5.105	61.26	3	10.21	122.5
			4	13.61	163.4
<b>3/8 x</b>			5	17.02	204.2
1/2	.6381	7.657	6	20.42	245.0
3/4	.9572	11.49	<b>1 1/4 x</b>		
1	1.276	15.31	2	8.508	102.1
1 1/4	1.595	19.14	3	12.76	153.1
1 1/2	1.914	22.97	4	17.02	204.2
1 3/4	2.233	26.80	<b>1 1/2 x</b>		
2	2.552	30.63	2	10.21	122.5
2 1/2	3.191	38.29	3	15.31	183.8
3	3.829	45.94	4	20.42	245.0
3 1/2	4.467	53.60	5	25.52	306.2
4	5.105	61.26	6	30.63	367.6
5	6.381	76.57	<b>2 x</b>		
6	7.657	91.89	3	20.42	245.0
			4	27.23	326.7
			6	40.84	490.1
			<b>3 x</b>		
			4	40.84	490.1



**TYPE 321**  
**Sheets, Plates, and Bars**  
**UNS S32100**

**Color Marking**

**Bars:** Ends painted Black

**Plates:** Corner Striped Black

Type 321 is "18-8" chromium-nickel stainless steel modified by the addition of titanium to overcome the danger of intergranular corrosion, common to other austenitic stainless steels during or after exposure to temperatures 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 electrical-furnace process to meet the rigid requirements of the aircraft industry.

**ANALYSIS**

C	Mn	P	S	Si	Cr	Ni	Ti	Cu	Mo
Max.	Max.	Max.	Max.	Max.				Max.	Max.
.08	2.00	.040	.030	1.00	17.0/19.0	9.00/12.00	5xC Min. .70 Max.	.75	.75

**SPECIFICATIONS** — The following specifications are generally applicable:

Sheets & Plates: QQ-S-766, AMS 5510, ASTM A 240

Bars: AMS 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. In aircraft, 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 304. It tends to form a light rust film in corrosive atmospheres, 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 Min. (psi)	Elongation in 2" Min.	Reduction of Area Min.
<b>Sheets &amp; Plates</b>	100,000 Max.	30,000	40%	—
<b>H.R. Bars</b>	75,000 Min.	30,000	40%	50%
<b>C.F. Bars</b>				
Up to 1/2" incl.	90,000 Min.	45,000	35%	45%
Over 1/2"	75,000 Min.	30,000	35%	50%

**MACHINABILITY** — Type 321 has a machinability rating of approximately 36% with 1212 rated 100%. Surface cutting speed on automatic screw machines is approximately 60 feet per minute.

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

**FORMING** — This grade has good forming and stamping properties.

**FORGING** — Forge between 2125° and 2275°F. Cool slowly. Do not forge below 1800°F.

**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 between 400° and 750°F.

**TYPE 321 STAINLESS (Continued)**



**TYPE 321 ROUNDS**  
**Condition A (Annealed)**  
 3/4" & under — Brinell 170-255  
 Over 3/4" — Brinell 140-241  
 Stock Lengths 10' to 12'

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
<b>Cold Drawn</b>								
1/8	.0418	.5012	<b>Ground (Cont.)</b>			<b>Hot Rolled &amp; Rough</b>		
3/16	.0940	1.128	1 3/8	5.053	60.64	<b>Turned (Cont.)</b>		
1/4	.1671	2.005	7/16	5.523	66.28	3 1/4	28.23	338.8
5/16	.2610	3.132	1/2	6.014	72.17	3/8	30.45	365.3
3/8	.3759	4.510	9/16	6.526	78.31	1/2	32.74	392.9
7/16	.5116	6.139	5/8	7.058	84.70	5/8	35.12	421.5
1/2	.6682	8.019	<b>Hot Rolled &amp; Rough</b>			3/4	37.59	451.0
<b>Ground</b>			<b>Turned</b>			4	42.77	513.2
9/16	.8457	10.15	1 9/16	6.526	78.31	1/4	48.28	579.3
5/8	1.044	12.53	5/8	7.058	84.70	1/2	54.13	649.5
11/16	1.263	15.16	3/4	8.186	98.23	3/4	60.31	723.7
3/4	1.504	18.04	7/8	9.397	112.8	5	66.82	801.9
13/16	1.765	21.17	2	10.69	128.3	1/4	73.67	884.0
7/8	2.046	24.56	1/8	12.07	144.8	1/2	80.86	970.2
15/16	2.349	28.19	1/4	13.53	162.4	3/4	88.37	1060
I	2.673	32.07	3/8	15.08	180.9	6	96.22	1155
1/16	3.017	36.21	1/2	16.71	200.5	1/4	104.4	1253
1/8	3.383	40.59	5/8	18.42	221.0	1/2	112.9	1355
3/16	3.769	45.23	3/4	20.21	242.6	7	131.0	1572
1/4	4.176	50.12	7/8	22.09	265.1	1/2	150.4	1804
5/16	4.604	55.25	3	24.06	288.7	8	171.1	2053
			1/8	26.10	313.2	9	216.5	2598
						10	267.3	3207



**TYPE 321 FLATS**  
**Hot Rolled, Annealed and Pickled**  
 Stock Lengths 10' to 12'

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
1/4 x 1/2	.425	5.11	1/2 x 3/4	1.276	15.31	1 x 1 1/4	4.254	51.05
3/4	.638	7.66	1	1.702	20.42	1 1/2	5.105	61.26
1	.851	10.21	1 1/4	2.127	25.52	1 3/4	5.956	71.47
1 1/4	1.064	12.76	1 1/2	2.552	30.63	2	6.806	81.68
1 1/2	1.276	15.31	1 3/4	2.978	35.73	2 1/2	8.508	102.1
1 3/4	1.489	17.87	2	3.403	40.84	3	10.21	122.5
2	1.702	20.42	2 1/2	4.254	51.05	4	13.61	163.4
2 1/2	2.127	25.52	3	5.105	61.26	6	20.42	245.0
3	2.552	30.63	4	6.806	81.68	1 1/4 x 2	8.508	102.1
4	3.403	40.84	6	10.21	122.5	2 1/2	10.64	127.6
6	5.105	61.26	5/8 x 1	2.127	25.52	3	12.76	153.1
3/8 x 1/2	.6381	7.657	1 1/4	2.659	31.91	4	17.02	204.2
3/4	.9572	11.49	1 1/2	3.191	38.29	1 1/2 x 2	10.21	122.5
1	1.276	15.31	2	4.254	51.05	3	15.31	183.8
1 1/4	1.595	19.14	3/4 x 1	2.552	30.63	4	20.42	245.0
1 1/2	1.914	22.97	1 1/4	3.191	38.29	1 1/2 x 3	15.31	183.8
2	2.552	30.63	1 1/2	3.829	45.94	2 x 3	20.42	245.0
2 1/2	3.191	38.29	1 3/4	4.467	53.60	4	27.23	326.7
3	3.829	45.94	2	5.105	61.26	3 x 4	40.84	490.1
4	5.105	61.26	2 1/2	6.381	76.57			
			3	7.657	91.89			
			4	10.21	122.5			
			6	15.31	183.8			

**TYPE 321 STAINLESS (Continued)**



**TYPE 321 SHEETS**  
**NO. 2D FINISH**  
 Dull Cold Rolled,  
 Annealed, & Pickled



**TYPE 321**  
**PLATES**  
 Hot Rolled, Annealed,  
 and Pickled

Thickness	Width and 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
	48x120	.840	33.6
.025" (24 Ga.)	36x120	1.050	31.5
.032" (22 Ga.)	36x120	1.344	40.3
	48x120	1.344	53.8
.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
	48x120	3.780	151.2
.109" (12 Ga.)	36x120	4.578	137.3
.125" (11 Ga.)	36x120	5.250	157.5
	48x120	5.250	210.0
.140" (10 Ga.)	36x120	5.880	176.4
	48x120	5.880	235.2
.156" (9 Ga.)	36x120	6.552	196.6

Stocked in  
 Thickness from  
 3/16" through 1-1/2",  
 Widths from 48" to 96",  
 and Lengths up to 20'



**TYPE 321 SQUARES**  
**Condition A (Annealed)**  
 3/4" & Under — Brinell 170-255  
 Over 3/4" — Brinell 140-241  
 Stock Lengths 10' to 12'

Size In Inches	Estimated Weight, Lbs.		Size In Inches	Estimated Weight, Lbs.	
	Per Foot	12-Ft. Length		Per Foot	12-Ft. Length
<b>Annealed and Cold Drawn</b>			<b>Hot Rolled, Annealed, &amp; Pickled</b>		
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



**TYPE 321 COLD DRAWN HEXAGONS**  
**Condition A (Annealed)**  
 Brinell same as shown above for squares.  
 Stock Lengths 10' to 12'

Size In Inches	Est. Wt., Lbs.		Size In Inches	Est. Wt., Lbs.		Size In Inches	Est. Wt., Lbs.		Size In Inches	Est. Wt., Lbs.	
	Per Foot	20-Ft. Bar		Per Foot	20-Ft. Bar		Per Foot	20-Ft. Bar		Per Foot	20-Ft. Bar
1/4	.1842	2.210	5/8	1.151	13.82	7/8	2.257	27.08	1 1/2	6.631	79.56
3/8	.4145	4.973	1 1/16	1.393	16.72	1	2.947	35.37	3/4	9.026	108.3
1/2	.7368	8.842	3/4	1.658	19.89	1/8	3.730	44.76	7/8	10.36	124.3
9/16	.9325	11.19	13/16	1.946	23.35	1/4	4.605	55.26	2	11.79	141.5

**TYPE 347**  
**Sheets, Plates, and Bars**  
**UNS S34700**

**Color Marking**

**Bars:** Ends painted White

**Plates:** Corner striped 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 the exacting requirements of the aircraft industry.

**ANALYSIS**

C	Mn	P	S	Si	Cr	Ni	Cb+Ta	Cu	Mo
Max.	Max.	Max.	Max.				Max.	Max.	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: QQ-S-766, AMS 5512, ASTM A 240, ASTM A 167

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

**APPLICATIONS** — Used for heavy welding assemblies which 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, such as aircraft exhaust stacks, manifolds and ring collectors. 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 resistant to intergranular corrosion. It has about the same general corrosion resistance as Type 304.

**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 Min. (psi)	Elongation in 2" Min.	Reduction of Area Min.
<b>Sheets &amp; Plates</b>	100,000 Max.	30,000	40%	—
<b>H.R. Bars</b>	75,000 Min.	30,000	40%	50%
<b>C.F. Bars</b>				
Up to 1/2" incl.	90,000 Min.	45,000	35%	45%
Over 1/2"	75,000 Min.	30,000	35%	50%

**MACHINABILITY** — Type 347 has a machinability rating of approximately 36% with 1212 rated 100%. Surface cutting speed on automatic screw machines is approximately 60 feet per minute.

**WELDABILITY** — Easily welded by all the commercial processes except forge of 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 STAINLESS (Continued)**



**TYPE 347 ROUNDS**  
 $\frac{3}{4}$ " & under — Brinell 170-255  
 $\frac{7}{8}$ " to  $1\frac{1}{2}$ " - Brinell 163-255  
 Over  $1\frac{1}{2}$ " — Brinell 140-241  
 Stock Lengths 10' to 12'

Size In Inches	Estimated Weight, Lbs.		Size In Inches	Estimated Weight, Lbs.	
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar
<b>Annealed &amp; Cold Drawn</b>			<b>Hot Rolled, Ann., &amp; Rough Turned</b>		
$\frac{1}{8}$	.0418	.5012	$1\frac{5}{8}$	7.058	84.70
$\frac{3}{16}$	.0940	1.128	$\frac{3}{4}$	8.186	98.23
$\frac{1}{4}$	.1671	2.005	$\frac{7}{8}$	9.397	112.8
$\frac{5}{16}$	.2610	3.132	<b>2</b>	10.69	128.3
$1\frac{1}{32}$	.3158	3.790	$\frac{1}{8}$	12.07	144.8
$\frac{3}{8}$	.3759	4.510	$\frac{1}{4}$	13.53	162.4
$1\frac{3}{32}$	.4411	5.293	$\frac{3}{8}$	15.08	180.9
$\frac{7}{16}$	.5116	6.139	$\frac{1}{2}$	16.71	200.5
$1\frac{5}{32}$	.5873	7.048	$\frac{5}{8}$	18.42	221.0
$\frac{1}{2}$	.6682	8.019	$\frac{3}{4}$	20.21	242.6
<b>Annealed &amp; Ground</b>			<b>3</b>	24.06	288.7
$\frac{1}{2}$	.6682	8.019	$\frac{1}{8}$	26.10	313.2
$1\frac{7}{32}$	.7544	9.052	$\frac{1}{4}$	28.23	338.8
$\frac{9}{16}$	.8457	10.15	$\frac{3}{8}$	30.45	365.3
$\frac{5}{8}$	1.044	12.53	$\frac{1}{2}$	32.74	392.9
$1\frac{1}{16}$	1.263	15.16	$\frac{5}{8}$	35.12	421.5
$\frac{3}{4}$	1.504	18.04	$\frac{3}{4}$	37.59	451.0
$1\frac{3}{16}$	1.765	21.17	<b>4</b>	42.77	513.2
$\frac{7}{8}$	2.046	24.56	$\frac{1}{4}$	48.28	579.3
$1\frac{5}{16}$	2.349	28.19	$\frac{1}{2}$	54.13	649.5
<b>1</b>	2.673	32.07	$\frac{3}{4}$	60.31	723.7
$\frac{1}{16}$	3.017	36.21	<b>5</b>	66.82	801.9
$\frac{1}{8}$	3.383	40.59	$\frac{1}{4}$	73.67	884.0
$\frac{1}{4}$	4.176	50.12	$\frac{1}{2}$	80.86	970.2
$\frac{5}{16}$	4.604	55.25	$\frac{3}{4}$	88.37	1060
$\frac{3}{8}$	5.053	60.64	<b>6</b>	96.22	1155
$\frac{1}{2}$	6.014	72.17	$\frac{1}{4}$	104.4	1253
$\frac{9}{16}$	6.526	78.31	$\frac{1}{2}$	112.9	1355
$\frac{5}{8}$	7.058	84.70	<b>7</b>	131.0	1572
			$\frac{1}{2}$	150.4	1804
			<b>8</b>	171.1	2053
			<b>9</b>	216.5	2598



**TYPE 347 HEXAGONS**  
**Condition A (Annealed)**  
 Brinell same as shown above for rounds.  
 Stock Lengths 10' to 12'

Size In Inches	Estimated Weight, Lbs.		Size In Inches	Estimated Weight, Lbs.	
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar
<b>Annealed &amp; Cold Drawn</b>			<b>Annealed &amp; Cold Drawn (Continued)</b>		
$\frac{3}{8}$	.4145	4.973	<b>1</b> $\frac{1}{2}$	6.631	79.56
$\frac{7}{16}$	.5641	6.769	$\frac{5}{8}$	7.783	93.39
$\frac{1}{2}$	.7368	8.842	$1\frac{1}{16}$	8.393	100.7
$\frac{9}{16}$	.9325	11.19	$\frac{3}{4}$	9.026	108.3
$\frac{5}{8}$	1.151	13.82	$\frac{7}{8}$	10.36	124.3
$1\frac{1}{16}$	1.393	16.72	$1\frac{5}{16}$	11.06	132.8
$\frac{3}{4}$	1.658	19.89	<b>2</b>	11.79	141.5
$1\frac{3}{16}$	1.946	23.35	$\frac{1}{8}$	13.31	159.7
$\frac{7}{8}$	2.257	27.08	$\frac{3}{16}$	14.10	169.2
$1\frac{5}{16}$	2.590	31.08	$\frac{1}{4}$	14.92	179.0
<b>1</b>	2.947	35.37	$\frac{3}{8}$	16.62	199.5
$\frac{1}{8}$	3.730	44.76	$\frac{1}{2}$	18.42	221.0
$\frac{1}{4}$	4.605	55.26	$\frac{5}{8}$	20.31	243.7
$\frac{3}{8}$	5.572	66.87	$\frac{3}{4}$	22.29	267.5
			$1\frac{3}{16}$	23.31	279.8
			$\frac{7}{8}$	24.36	292.3

**TYPE 347 STAINLESS (Continued)**



**TYPE 347 SHEETS  
NO. 2D FINISH  
Dull Cold Rolled,  
Annealed, & Pickled**

Thickness	Width and 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	3.630	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  
PLATES  
Hot Rolled, Annealed,  
and Pickled**

Stocked in

Thicknesses from

3/16" through 1",

Widths from 48" to 96",

and Lengths

up to 20'.



**TYPE 347 FLATS  
Dull Cold Rolled,  
Annealed, & Pickled  
Stock Lengths 10' to 12'**

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

## NITRONIC 50®

### Stainless Bars (UNS S20910)

**Color Marking:** Annealed Bars — Gold with White Stripe  
Pump Shafting — Yellow with White Stripe

Nitronic 50® is a chromium-nickel-manganese-molybdenum austenitic stainless steel that remains completely nonmagnetic after severe cold working or exposure to low temperatures. Its unique feature is the combination of higher strength and better corrosion resistance than the more widely used austenitic stainless grades.

#### ANALYSIS

C Max.	Mn	P Max.	S Max.	Si Max.	Cr
.06	4.00/6.00	.040	.030	1.00	20.5/23.5
Ni	Mo	N	Cb	V	
11.5/13.5	1.50/3.00	.20/.40	.10/.30	.10/.30	

**SPECIFICATIONS** — The following specifications are generally applicable:  
ASTM A276 & A479 Grade XM19, AMS 5764

**APPLICATIONS** — This grade is used for components and equipment where general corrosion resistance superior to that of Type 316 is required. Applications include pump and boat shafting, valves, fasteners, etc. It may be used in Food Contact Surfaces under the Provisions of various National Sanitation Foundation standards. Its low magnetic permeability, good mechanical properties, and corrosion resistance are useful in instrumentation components.

**CORROSION RESISTANCE** — Corrosion resistance to industrial and marine environments is generally better than that of Type 316 and 316L. Its resistance to intergranular attack in the heat affected zone of heavy weldments is excellent.

**RESISTANCE TO SCALING** — Excellent at temperatures up to 2000°F in continuous service.

**MECHANICAL PROPERTIES** — Applicable specifications require the following minimum properties in the annealed condition:

Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2" Min.	Reduction of Area	Brinell
100,000	55,000	35%	55%	293 Max.

**MACHINABILITY** — Machinability rating of Nitronic 50® is approximately 45% based on 1212 rated as 100%. Surface cutting speed on automatic screw machines is approximately 75 feet per minute.

**WELDABILITY** — Easily fusion welded by conventional methods with welded joints in the as-welded condition having a strength approaching that of the base metal.

**FORMING** — The same fabricated equipment and techniques that apply to the 300 series stainless grades may be used.

**ANNEALING** — Heat to 1950°F and cool rapidly. If as-welded material is to be used in strongly corrosive media, 2050°F is recommended.

**TYPE 410**  
**Sheets, Plates, and Bars**  
**UNS S41000**  
**Color Markings**

Heat Treated Bars . . . . . Green with Red Stripe  
 As Rolled & Annealed Bars . . . . . Green with Black Stripe

Type 410 is the basic chromium grade of stainless steel. It combines good corrosion resistance with the ability to develop hardness and mechanical properties by conventional heat treating methods that are similar to those of 4130 alloy steel. It is magnetic in all conditions.

**ANALYSIS**

C	Mn Max.	P Max.	S Max.	Si Max.	Cr	Ni Max.	Mo Max.	Cu Max.
.10/.15	1.00	.040	.030	1.00	11.50/13.50	.75	.50	.50

**SPECIFICATIONS** — The following specifications are generally applicable:

Sheets & Plates: AMS 5504, QQ-S-766, ASTM A 176, ASTM A 240

Bars: AMS 5613, AMS QQ-S-763, ASTM A 276, ASTM A 479

**APPLICATIONS** — This grade is used for applications requiring good mechanical properties and involving corrosive conditions that are not too severe, such as valve parts, cutlery, food industry machine parts, screws, bolts, pump rods and pistons, etc. In the annealed condition, it may be drawn or formed. In the aircraft industry, Type 410 is used for parts such as compressor shrouds, where oxidation resistance is required up to 1000°F. Useful at high temperatures only when stresses are low.

**CORROSION RESISTANCE** — This material is resistant to corrosion from the atmosphere, fresh water, iron-bearing mine waters, food acids, neutral and basic salts, mild acids and alkalis. Maximum corrosion resistance of this grade is obtained by hardening and polishing.

**RESISTANCE TO SCALING** — Resists scaling at temperatures up to approximately 1200° - 1300°F in continuous service. Over 1300°F it has relatively low strength, and resistance to oxidation is reduced.

**MECHANICAL PROPERTIES** — Specification AMS 5504 requires the following properties of sheets and plates in the annealed condition:

Tensile Strength (psi)	.030" thick and under	Elongation in 2" Over .030" thick
95,000 Max.	12% Min.	15% Min.

**HARDENABILITY** — Specification AMS 5504 requires that material <sup>3</sup>/<sub>8</sub>" thick and under, and <sup>3</sup>/<sub>8</sub>" specimens from heavier material, shall be capable of attaining hardness of Rockwell "C" 35-45 after being heated to 1750°F, held at heat to 15-30 minutes, and cooled in still air.

**MACHINABILITY** — Type 410 has better machining characteristics than the chromium-nickel grades. It has a machinability rating of 54%, with 1212 rated 100%. Surface cutting speed on automatic screw machines is approximately 90 feet per minute.

**WELDABILITY** — May be welded by all the commercial processes except forge or hammer welding. Large sections should be preheated prior to welding. Because of its air-hardening properties, annealing after welding is recommended to obtain maximum ductility and toughness.

**FORMING** — This grade has fair forming and stamping properties.

**FORGING** — Forge between 2000° and 2200°F. Do not forge below 1650°F. Cool slowly.

**ANNEALING** — Full annealing range is between 1550° and 1650°F. Cool slowly in furnace. Low annealing range is between 1200° and 1400°F. Cool in air.

**HARDENING** — Hardening range is between 1750° and 1850°. Quench large sections in oil. Small sections may be quenched in air. Temper to required hardness.



**TYPE 410 STAINLESS (Continued)**



**TYPE 410 ROUNDS**

**Annealed**  
Stock Lengths 10' to 12'

Cold Drawn Max. Brinell 241			Cold Finished Max. Brinell 241			Hot Rolled & Rough Turned Max. Brinell 235					
Size In Inches	Est. Wt., Lbs. Per Foot	12-Ft. Bar	Size In Inches	Est. Wt., Lbs. Per Foot	12-Ft. Bar	Size In Inches	Est. Wt., Lbs. Per Foot	12-Ft. Bar	Size In Inches	Est. Wt., Lbs. Per Foot	12-Ft. Bar
3/16	.0940	1.128	5/8	1.044	12.53	2 1/8	12.07	144.8	5	66.82	801.9
1/4	.1671	2.005	1 1/16	1.263	15.16	1/4	13.53	162.4	1/4	73.67	884.0
5/16	.2610	3.132	3/4	1.504	18.04	3/8	15.08	180.9	1/2	80.86	970.2
3/8	.3759	4.510	13/16	1.765	21.17	1/2	16.71	200.5	3/4	88.37	1060
7/16	.5116	6.139	7/8	2.046	24.56	5/8	18.42	221.0	6	96.22	1155
1/2	.6682	8.019	15/16	2.349	28.19	3/4	20.21	242.6	1/4	104.4	1253
9/16	.8457	10.15	1	2.673	32.07	7/8	22.09	265.1	1/2	112.9	1355
5/8	1.044	12.53	1 1/16	3.017	36.21	3	24.06	288.7	7	131.0	1572
1 1/16	1.263	15.16	1/8	3.383	40.59	1/8	26.10	313.2	1/2	150.4	1804
			1/4	4.176	50.12	1/4	28.23	338.8	8	171.1	2053
			5/16	4.604	55.25	1/2	32.74	392.9	1/4	181.9	2183
			3/8	5.053	60.64	5/8	35.12	421.5	1/2	193.1	2317
			1/2	6.014	72.17	3/4	37.59	451.0	9	216.5	2598
			5/8	7.058	84.70	4	42.77	513.2	1/2	241.2	2895
			3/4	8.186	98.23	1/4	48.28	579.3	10	267.3	3207
			7/8	9.397	112.8	1/2	54.13	649.5	11	323.4	3881
			2	10.69	128.3	3/4	60.31	723.7	12	384.9	4619

**Heat Treated — Brinell 248-302**  
Stock Lengths 10' to 12'

Ground			Hot Rolled								
1/4	.1671	2.005	1 1/4	4.176	50.12	3	24.06	288.7	5 1/4	73.67	884.0
5/16	.2610	3.132	3/8	5.053	60.64	1/4	28.23	338.8	1/2	80.86	970.2
3/8	.3759	4.510	1/2	6.014	72.17	1/2	32.74	392.9	3/4	88.37	1060
7/16	.5116	6.139	3/4	8.186	98.23	3/4	37.59	451.0	6	96.22	1155
1/2	.6682	8.019	7/8	9.397	112.8	4	42.77	513.2	1/2	112.9	1355
9/16	.8457	10.15	2	10.69	128.3	1/4	48.28	579.3	7	131.0	1572
5/8	1.044	12.53	1/4	13.53	162.4	1/2	54.13	649.5	1/2	150.4	1804
3/4	1.504	18.04	1/2	16.71	200.5	3/4	60.31	723.7	8	171.1	2053
13/16	1.765	21.17	3/4	20.21	242.6	5	66.82	801.9	1/2	193.1	2317
7/8	2.046	24.56							9	216.5	2598
1	2.673	32.07									
1 1/8	3.383	40.59									
1 1/4	4.176	50.12									



**TYPE 410 PLATES**  
Hot Rolled, Annealed,  
and Pickled

Stocked in Thicknesses  
from 3/16" through 3",  
Widths from 48" to 96",  
and Lengths up to 20'.



**Type 410 Sheets**  
Annealed & Pickled  
No. 2D Finish (Dull Cold Rolled)

Thickness	Width and Length	Est. Wt., Lbs.	
		Per Sq. Ft.	Per Sheet
.032" (22 Ga.)	36x120	1.318	39.5
.036" (20 Ga.)	36x120	1.483	44.5
.040" (20 Ga.)	36x120	1.648	49.4
.050" (18 Ga.)	36x120	2.060	61.8
.063" (16 Ga.)	36x120	2.596	77.9
.080" (14 Ga.)	36x120	3.296	98.9
.090" (13 Ga.)	36x120	3.708	111.2
.105" (12 Ga.)	36x120	4.326	129.8
.125" (11 Ga.)	36x120	5.150	154.5
.135" (10 Ga.)	36x120	5.562	166.9

## TYPE 416 — FREE MACHINING

### Stainless Bars UNS S41600

#### Color Markings:

Annealed Bars and Pump Shafting . . . . . Ends painted Green  
Heat Treated Bars . . . . . Green with Blue Stripe

Type 416 is a chromium grade of stainless steel modified by the addition of phosphorus and sulphur to produce a free-machining steel. It is the most readily machinable of all stainless steels. A wide range of mechanical properties may be obtained by conventional heat treating methods. It is magnetic in all conditions. Manufactured by the electric-furnace process, it is quality steel, free from all injurious defects, and meets the requirements of the aircraft industry.

#### ANALYSIS

C Max.	Mn Max.	P Max.	S	Si Max.	Cr	Ni Max.	Mo Max.	Cu Max.
.15	1.25	.060	.15/.40	1.00	12.00/13.50	.75	.60	.50

**SPECIFICATIONS** — The following specifications are generally applicable:  
AMS 5610, ASTM A 314, ASTM A 582

**APPLICATIONS** — Type 416 is used for applications demanding the mechanical properties and corrosion resistance of Type 410 combined with free machining properties. It can be turned, threaded, formed or drilled at speeds approaching those of screw stock.

**CORROSION RESISTANCE** — Corrosion resistance is similar to Type 410, and is resistant to atmosphere, fresh water, food acids, and neutral and basic salts. Maximum corrosion resistance of this grade is obtained by hardening and polishing.

**RESISTANCE TO SCALING** — Resists scaling at temperatures up to approximately 1200° - 1300°F in continuous service.

**MECHANICAL PROPERTIES** — Applicable specifications require the following properties of material in the annealed condition:

	Tensile Strength (psi)	Brinell Hardness Max
Hot Rolled Annealed	—	241
Annealed & Cold Finished		
Up to 1/2" incl.	85,000/120,000	241
Over 1/2"	—	241

**HARDENABILITY** — A 3/8" section quenched in oil from 1825°F will harden to a minimum of Rockwell "C" 35.

**MACHINABILITY** — Type 416 has a very good machining characteristics. It has a machinability rating on approximately 110%, with 1212 rated 100%. Surface cutting speed on automatic screw machines is approximately 180 feet per minute.

**WELDABILITY** — This grade has poor welding properties. Welds are brittle, with tendency to crack.

**FORGING** — Forge between 2100° and 2300°F. Do not forge below 1700°F. Cool slowly.

**ANNEALING** — Full annealing range is between 1550° and 1650°F. Cool Slowly in furnace. Low annealing range is between 1200° and 1400°F. Cool in air.

**HARDENING** — Hardening range is between 1750° and 1850°F. Quench large sections in oil. Small sections may be quenched in air. Temper to required hardness.

**TYPE 416 STAINLESS (Continued)**



**TYPE 416 ROUNDS**

Stock Lengths: Cold Drawn & Hot Rolled - 10' to 12' and 20' to 22'  
Ground & Pump Shafting — 20' to 22'

<b>Ann. &amp; C.F. (Brinell 241 Max.) or H. T. &amp; C. F. (Rockwell "C" 25-32)</b>						<b>Precision Pump Shafting</b>		
						Tolerances: 1/2 Standard Brinell: 207:245		
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	20-Ft. Bar
<b>Cold Drawn</b>			<b>Cold Finished (Cont.)</b>			5/8	1.044	20.88
1/16	.0104	.1253	<b>2</b>	10.69	128.3	3/4	1.504	30.07
3/32	.0235	.2819	1/16	11.37	136.4	13/16	1.765	35.29
1/8	.0418	.5012	1/8	12.07	144.8	7/8	2.046	40.93
5/32	.0653	.7831	3/16	12.79	153.5	<b>1</b>	2.673	53.46
3/16	.0940	1.128	1/4	13.53	162.4	1/8	3.383	67.66
7/32	.1279	1.535	3/8	15.08	180.9	3/16	3.769	75.38
1/4	.1671	2.005	7/16	15.88	190.6	1/4	4.176	83.53
9/32	.2114	2.537	1/2	16.71	200.5	3/8	5.053	101.1
5/16	.2610	3.132	5/8	18.42	221.0	7/16	5.523	110.5
11/32	.3158	2.790	3/4	20.21	242.6	1/2	6.014	120.3
3/8	.3759	4.510	7/8	22.09	265.1	11/16	7.612	152.2
13/32	.4411	5.293	<b>3</b>	24.06	288.7	3/4	8.186	163.7
7/16	.5116	6.139	<b>Hot Rolled, Annealed &amp; Rough Turned Brinell 241 Max.</b>			15/16	10.03	200.7
15/32	.5873	7.048	3 1/8	26.10	313.2	<b>2</b>	10.69	213.8
1/2	.6682	8.019	1/4	28.23	338.8	3/16	12.79	255.8
17/32	.7544	9.052	3/8	30.45	365.3	1/4	13.53	270.6
9/16	.8457	10.15	1/2	32.74	392.9	7/16	15.88	317.6
5/8	1.044	12.53	5/8	35.12	421.5	1/2	16.71	334.1
11/16	1.263	15.16	3/4	37.59	451.0	11/16	19.31	386.1
<b>Cold Finished</b>			<b>4</b>	42.77	513.2	3/4	20.21	404.3
3/4	1.504	18.04	1/4	48.28	579.3	13/16	21.14	422.9
25/32	1.631	19.58	1/2	54.13	649.5	15/16	23.06	461.3
13/16	1.765	21.17	3/4	60.31	723.7	<b>3</b>	24.06	481.1
27/32	1.903	22.83	<b>5</b>	66.82	801.9	3/16	27.16	543.1
7/8	2.046	24.56	1/4	73.67	884.0	1/4	28.23	564.6
29/32	2.195	26.34	1/2	80.86	970.2	7/16	31.58	631.7
15/16	2.349	28.19	3/4	88.37	1060	1/2	32.74	654.8
31/32	2.508	30.10	<b>6</b>	96.22	1155	11/16	36.35	726.9
<b>1</b>	2.673	32.07	1/4	104.4	1253	15/16	41.44	828.8
1/16	3.017	36.21	1/2	112.9	1355	<b>4</b>	42.77	855.3
1/8	3.383	40.56	3/4	121.8	1461	1/4	48.28	965.6
3/16	3.769	45.23	<b>7</b>	131.0	1572	7/16	54.13	1083
1/4	4.176	50.12	1/4	140.5	1686	<b>5</b>	66.82	1336
5/16	4.604	55.25	1/2	150.4	1804	1/2	80.86	1617
3/8	5.053	60.64	3/4	160.5	1926			
7/16	5.523	66.28	<b>8</b>	171.1	2053			
1/2	6.014	72.17	1/4	180.5	2165			
9/16	6.526	78.31	1/2	193.1	2317			
5/8	7.058	84.70	<b>9</b>	216.5	2598			
11/16	7.612	91.34	1/2	241.2	2895			
3/4	8.186	98.23	3/4	254.1	3049			
13/16	8.781	105.4	<b>10</b>	267.3	3207			
7/8	9.397	112.8						
15/16	10.03	120.4						

## TYPES 416 STAINLESS (Continued)



### TYPE 416 COLD DRAWN FLATS

Annealed

Stock Lengths 10' to 12'

Size In Inches	Estimated Weight, Lbs.		Size In Inches	Estimated Weight, Lbs.			
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar		
3/16 x	1	.6381	7.657	1/2 x	3/4	1.276	15.31
	1 1/2	.9572	11.49		1	1.702	20.42
	2	1.276	15.31		1 1/2	2.552	30.63
1/4 x	1/2	.4254	5.105	2	3.403	40.84	
	3/4	.6381	7.657	3/4 x	1	2.552	30.63
	1	.8508	10.21		1 1/2	3.829	45.94
	1 1/2	1.276	15.31	2	5.105	61.26	
3/8 x	2	1.702	20.42	1 x	1 1/2	5.105	61.26
	1	1.276	15.31	2	6.806	81.68	
	1 1/2	1.914	22.97	1 1/4 x	1 1/2	6.381	76.57
3/8 x	2	2.552	30.63	2	8.508	102.1	
	1 1/2	1.914	22.97	1 1/2 x	2	10.21	122.5
	2	2.552	30.63	3	15.31	183.8	



### TYPE 416 HEXAGONS

Annealed & Cold Drawn (Brinell 241 Max.)

Or Heat Treated & Cold Drawn (Rockwell "C" 25-32)

Stock Lengths 10' to 12'

Size In Inches	Est. Weight, Lbs.		Size In Inches	Est. Weight, Lbs.		Size In Inches	Est. Weight, Lbs.	
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar
1/4	.1842	2.210	13/16	1.946	23.35	1 1/2	6.631	79.56
5/16	.2878	3.454	7/8	2.257	27.08	5/8	7.783	93.39
3/8	.4145	4.973	15/16	2.590	31.08	3/4	9.026	108.3
7/16	.5641	6.769	1	2.947	35.37	7/8	10.36	124.3
1/2	.7368	8.842		1/16	3.327	39.93	2	11.79
9/16	.9325	11.19	1/8	3.730	44.76	1/4		14.92
5/8	1.151	13.82	1/4	4.605	55.26	1/2	18.42	221.0
11/16	1.393	16.72	5/16	5.077	60.93	3	26.53	318.3
3/4	1.658	19.89	3/8	5.572	66.87			



### TYPE 416 SQUARES

Annealed & Cold Drawn (Brinell 241 Max.)

Stock Lengths 10' to 12'

Size In Inches	Estimated Weight, Lbs.		Size In Inches	Estimated Weight, Lbs.		
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar	
3/16	.1196	1.436	1	15/16	2.991	35.89
1/4	.2127	2.552		1	3.403	40.84
5/16	.3323	3.988	1/4	3/8	6.434	77.21
3/8	.4786	5.743		1/2	7.657	91.89
7/16	.6514	7.817	3/4	3/4	10.42	125.1
1/2	.8508	10.21		2	13.61	163.4
5/8	1.329	15.95	2	1/2	21.27	255.2
3/4	1.914	22.97				
7/8	2.606	31.27				

**TYPE 418**  
**(Greek Ascoloy)**  
**Stainless Bars**  
**UNS S41800**

**Color Marking:** Annealed Bars — Purple with Green Stripe

Type 418 is a chromium grade of stainless steel similar in many respects to the basic 410 grade but modified by the addition of nickel and tungsten to improve high temperature properties. Up to 1100°F, its stress rupture strength is equal to or superior to the austenitic grades. A wide range of mechanical properties is available with conventional heat treated methods.

**ANALYSIS**

<b>C</b>	<b>Mn Max.</b>	<b>P Max.</b>	<b>S Max.</b>	<b>Si Max.</b>	<b>Cr</b>
.15/.20	.50	.04	.03	.50	12.00/14.00
<b>Ni</b>	<b>W</b>	<b>Mo Max.</b>	<b>Al Max.</b>	<b>Cu Max.</b>	<b>Sn Max.</b>
1.80/2.20	2.50/3.50	.50	.15	.50	.05

**SPECIFICATIONS** — The following specifications are generally applicable:  
 AMS 5616, AMS 2303, ASTM A 565

**APPLICATIONS** — Type 418 is used for applications requiring the mechanical properties and corrosion resistance of 410 as well as strength and oxidation resistance at elevated temperatures. Typical applications would be steam and gas turbine parts, jet engine components, compressor vanes and blades, fasteners, etc.

**CORROSION RESISTANCE** — Similar to Type 410 which means excellent resistance to corrosion in atmosphere, fresh water, food acids, neutral and basic salts, and mild acids and alkalis.

**RESISTANCE TO SCALING** — Resists scaling up to 1400°F and may be used in continuous service at 1100°F.

**MECHANICAL PROPERTIES** — Typical properties in the annealed condition:

<b>Strength (psi)</b>	<b>Strength (psi)</b>	<b>Tensile ation in 2"</b>	<b>Yield Elong- Rockwell Hardness</b>
115,000/150,000	85,000/120,000	18-22%	Rc 23 - 33

A wide range of mechanical properties is obtainable by hardening and tempuring. Hardness of Rockwell "C" 25-50 is possible with corresponding tensile strength.

**HARDENABILITY** — Specification AMS 5616 requires that material <sup>3</sup>/<sub>8</sub>" thick and under, and <sup>3</sup>/<sub>8</sub>" specimens from heavier sections shall be capable of attaining hardness of Rockwell "C" 45 minimum after being heated to 1750°F, held 25-30 minutes, and quenched in commercial paraffin oil at room temperature.

**MACHINABILITY** — Type 418 has fair machining characteristics in the annealed condition.

**WELDABILITY** — Type 418 can be welded by any of the commonly used processes; but since it is an air hardening grade, welded sections should be annealed or tempered for maximum ductility.

## TYPE 418 STAINLESS (Continued)

**FORGING**— Forge between 2000° - 2100°F. Do not forge below 1600°F. Cool slowly.

**ANNEALING**— Because of the sluggish transformation characteristics of Type 418, a full anneal is impractical. For maximum softness the material should be heated to 1215°-1255°F and held for six hours at temperature followed by air cooling. If a somewhat higher hardness of 277/311 BHN is not objectionable, a simpler treatment is to heat the material to 1300°-1350°F and air cool.

**HARDENING**— Hardening range is between 1750°-1900°F. Quench large sections in oil. Small sections may be quenched in air. Temper to required hardness.

### TYPE 418 ROUNDS



#### CONDITION A — ANNEALED

Stock Lengths 10' to 12'

Size In Inches	Estimated Wt., Lbs.		Size In Inches	Estimated Wt., Lbs.	
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar
	<b>Cold Drawn</b>			<b>Ground (Cont.)</b>	
1/4	.1671	2.005	1 1/2	6.014	
3/8	.3759	4.510	9/16	6.526	78.31
7/16	.5116	6.139	5/8	7.058	84.70
1/2	.6682	8.019	3/4	8.186	98.23
9/16	.8457	10.15	7/8	9.397	112.8
	<b>Ground</b>		2	10.69	128.3
5/8	1.044	12.53	1/8	12.07	144.8
1 1/16	1.263	15.16	1/4	13.53	162.4
3/4	1.504	18.04	3/8	15.08	180.9
7/8	2.046	24.56	1/2	16.71	200.5
<b>I</b>	2.673	32.07	3/4	20.21	242.6
1/8	3.383	40.59	3	24.06	288.7
1/4	4.176	50.12		<b>Hot Rolled, Rough Turned</b>	
3/8	5.053	60.64	4	42.77	513.2
7/16	5.523	66.28	1/2	54.13	649.5
			5	66.82	801.9

**TYPE 431**  
**Stainless Bars and Wire**  
**UNS S43100**  
**Color Marking**

Bars (Annealed): Ends painted Green and Yellow

Type 431 is a "16 chromium" stainless steel modified by the addition of nickel. It is designed to develop high mechanical properties by conventional heat treating methods. Its corrosion resistance is superior to such straight chromium grades as Types 410 and 416. It is magnetic in all conditions. Manufactured by the electric-furnace process, it meets the rigid requirements of the aircraft industry, particularly for parts which may be subject to magnetic (magna flux) inspection.

**ANALYSIS**

C	Mn	P Max.	S Max.	Si	Cr	Ni
.13/.17	.30/.80	.040	.030	.20/.60	15.50/16.50	2.00/3.00

**SPECIFICATIONS** — The following specifications are generally applicable:  
AMS-S-18732, ASTM A 276, AMS 5628

**APPLICATIONS** — Type 431 is used for applications requiring higher mechanical properties than can be obtained from Type 410 and where corrosive conditions are not too severe, such as valve parts, centrifuge bowls, chemical equipment, bolts, and screws.

**CORROSION RESISTANCE** — The corrosion resistance of Type 431 is superior to that of Type 410. This grade has excellent resistance to corrosion in all conditions of heat treatment from mild acids and alkalis, neutral and basic salts, food acids, and atmosphere. Maximum resistance is obtained by hardening and polishing.

**RESISTANCE TO SCALING** — Resists scaling at temperatures up to approximately 1400°F in continuous service.

**MECHANICAL PROPERTIES** — As required by Specification AMS-S-18732, this grade can be heat treated to meet the following minimum properties:

	Tensile Strength (psi)	Yield Strength (psi)	Elonga- tion in 2"	Reduc- tion of Area
HT-200 — Quenched in oil from 1875°F, cool to —100°F and double temper at 550° F	200,000	150,000	10%	40%

For further information, refer to Section Q.

**MACHINABILITY** — Type 431 has better machining characteristics than the chromium-nickel grades. It has a machinability rating of 45%, with 1212 rated 100%. Surface cutting speed on automatic screw machines is approximately 75 feet per minute.

**WELDABILITY** — May be welded by all the commercial processes except forge or hammer welding. Large sections should be preheated prior to welding. Because of air-hardening properties, this grade should be annealed after welding.

**FORGING** — Forge between 2100° and 2250°F. Cool slowly. Do not forge below 1700°F.

**ANNEALING** — Full annealing is impractical. The low annealing range is between 1150° and 1225°F.

**HARDENING** — Hardening range is between 1850° and 1950°F. Quench large sections in oil. Small sections may be quenched in air. Temper to required hardness.

## TYPE 440C

### Stainless Bars

#### UNS S44004

**Color Marking:** Ends painted Blue

This is a high carbon chromium stainless steel, capable of developing high hardness and mechanical properties by conventional heat treating methods. It exhibits best corrosion resistance in the hardened condition. It has excellent resistance to wear and abrasion and is magnetic in all conditions. It develops the highest hardness of the stainless steels.

#### ANALYSIS

C	Mn Max.	P Max.	S Max.	Si Max.	Cr	Mo Max.	Ni Max.	Cu Max.
.95/1.20	1.00	.040	.030	1.00	16.00/18.00	.65	.75	.50

**SPECIFICATIONS** — The following specifications are generally applicable:  
AMS 5630, AMS QQ-S-763, ASTM A 276

**APPLICATIONS** — Used for severe abrasion service such as in needle valves, balls and seats for check valves and ball bearings. Well adapted for pump parts which must resist corrosion encountered in the oil industry.

**CORROSION RESISTANCE** — Type 440C resists corrosion from fresh water steam, crude oil, gasoline, etc., and resists staining from fruit and food acids. Maximum resistance is obtained by hardening and polishing.

**RESISTANCE TO SCALING** — Resists scaling up to 1200°F in continuous service.

**MECHANICAL PROPERTIES** — Refer to Sec. Q.

**MACHINABILITY** — Type 440C has fair machining characteristics, with a machinability rating of 40%, with 1212 rated as 100%. Surface cutting speed on automatic screw machines is approximately 65 feet per minute.

**WELDABILITY** — Poor welding properties, due to high carbon content.

**FORMING** — This grade has poor forming and stamping properties.

**FORGING** — Forge between 1900° and 2100°F, not below 1650°F. Cool slowly.

**ANNEALING** — Full annealing range is 1550°-1650°F. Cool slowly in furnace.

**HARDENING** — Hardening range is between 1850° and 1950°F. Quench large sections in oil. Small sections may be quenched in air. Temper as required.

#### TYPE 440C ROUNDS

Annealed & Cold Drawn — Brinell Max.

Hot Rolled Annealed Rough Turned — Brinell 255 Max.

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



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											
<b>Annealed &amp; Cold Drawn</b>									<b>Annealed &amp; Ground (Cont.)</b>									<b>Hot Rolled, Annealed, &amp; Rough Turned</b>								
1/8	.0418	.5012	13/16	1.765	21.17	1 7/8	9.397	112.8	4 3/4	60.31	723.7															
5/32	.0653	.7836	7/8	2.046	24.56	2	10.69	128.3	5	66.82	801.9															
3/16	.0940	1.128	15/16	2.349	28.19	1 1/8	12.07	144.8	1/4	73.67	884.0															
7/32	.1279	1.535	1	2.673	32.07	1/4	13.53	162.4	1/2	80.86	970.2															
1/4	.1671	2.005	1 1/16	3.017	36.21	3/8	15.08	180.9	3/4	88.37	1060															
9/32	.2114	2.537	1/8	3.383	40.59	1/2	16.71	200.5	6	96.22	1155															
5/16	.2610	3.132	3/16	3.769	45.23	5/8	18.42	221.0	1/4	104.4	1253															
11/32	.3158	3.790	1/4	4.176	50.12	3/4	20.21	242.6	1/2	112.9	1355															
3/8	.3757	4.510	5/16	4.604	55.25	1	24.06	288.7	3/4	121.8	1461															
13/32	.4412	5.294	3/8	5.053	60.64	1 1/8	26.10	313.2	7	131.0	1572															
7/16	.5116	6.139	7/16	5.523	66.28	1/4	28.23	338.8	1/2	150.4	1804															
15/32	.5874	7.049	1/2	6.014	72.17	1/2	32.74	392.9	8	171.1	2053															
1/2	.6682	8.019	9/16	6.526	78.31	3/4	37.59	451.0	1/2	193.1	2317															
<b>Annealed &amp; Ground</b>																										
17/32	.7544	9.052	5/8	7.058	84.70	1	42.77	513.2	9	216.5	2598															
9/16	.8457	10.15	3/4	8.186	98.23	1 1/8	48.28	579.3	1/2	241.2	2895															
5/8	1.044	12.53	7/8	9.397	112.8	1 1/4	54.13	649.5	10	267.3	3207															
11/16	1.263	15.16	15/16	10.03	120.4																					
3/4	1.504	18.04	2	10.69	128.3																					
			1/4	13.53	162.4																					



## 13-8 VAR (CEVM)

### Precipitation Hardening Stainless Bars

#### UNS S13800

**Color Marking:** Ends painted Copper

13-8 VAR is another in the family of precipitation hardening stainless steels. It possesses the same advantages of 17-4 and 15-5 in that high strength may be developed by a single low temperature thermal treatment while retaining excellent corrosion resistance. It offers the same excellent transverse toughness and ductility, even in large sections, as 15-5. Due to the composition and controlled melting practice, 13-8 VAR has an essentially ferrite-free microstructure.

#### ANALYSIS

C Max.	Mn Max.	P Max.	S Max.	Si Max.
.05	.10	.010	.008	.10
	Cr	Ni	Mo	Al
	12.25/13.25	7.50/8.50	2.00/2.50	.90/1.35

**SPECIFICATIONS** — AMS 5629, AMS 2300, ASTM A 564 Type XM-13 are generally applicable.

**APPLICATIONS** — 13-8 is produced as a consumable electrode, vacuum arc remelted product and is ideal for applications requiring very high strength and toughness in light through heavy cross sections. This alloy is used when good general and stress corrosion cracking resistance and minimal property directionality are required. Suitable for aircraft structural parts, landing gear parts, shafts, valves, fittings, fasteners, and parts used in the petrochemical industry.

**MECHANICAL PROPERTIES** — The following may be considered as typical room temperature properties:

Condition	Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2" %	Reduction of Area		Rockwell "C" Hardness	V-Charpy Ft. Lbs.
				% Long	% Trans		
H 950	225	210	12	50	40	47	30
H 1050	190	180	15	55	55	43	60
H 1100	160	150	18	60	60	36	100
H 1150	145	105	20	63	63	33	110
H 1150M	130	85	22	70	70	28	120

AMS 5629 requires the following after precipitation hardening at 950°F:

Tensile Strength (psi)	Yield Strength (psi)	Elongation in 4D	Reduction of Area	
			% Long	% Trans
220,000 Min.	205,000 Min.	10% Min.	45 Min.	35 Min.

## 13-8 VAR (Continued)

**ANNEALING (Condition A)** — The solution annealing temperature is 1700°F. Oil or rapid air quench to below 60°F. Maximum Brinell hardness is 363.

### HARDENING —

Condition H 950 — 950°F for 4 hours, air cool. Rockwell "C" 48 Average.

Condition H 1050 — 1050°F for 4 hours, air cool. Rockwell "C" 43 Average.

Condition H 1100 — 1100°F for 4 hours, air cool. Rockwell "C" 36 Average.

Condition H 1150 — 1150°F for 4 hours, air cool. Rockwell "C" 33 Average.

Condition H 1150M — 1400°F for 2 hours, air cool. + 1150°F for 4 hours, air cool.  
Rockwell "C" 28 Average.

### MACHINABILITY, WELDABILITY, CORROSION RESISTANCE, AND FORGING —

Similar to 17-4, for which see Page 34 of this section.



**13-8 VAR ROUNDS**  
Condition A — Ground  
Stock Lengths 12' Approx.

Size In Inches	Estimated Wt., Lbs.		Size In Inches	Estimated Wt., Lbs.	
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar
3/16	.0940	1.128	1	2.673	32.07
1/4	.1671	2.005	1/8	3.383	40.59
.2600	.1807	2.168	3/16	3.769	45.23
5/16	.2610	3.132	1/4	4.176	50.12
.3225	.2780	3.336	3/8	5.053	60.64
3/8	.3759	4.510	7/16	5.523	66.28
.3850	.3961	4.753	1/2	6.014	72.17
7/16	.5116	6.139	5/8	7.058	84.70
1/2	.6682	8.019	3/4	8.186	98.23
.5100	.6952	8.342	7/8	9.397	112.8
9/16	.8457	10.15	2	10.69	128.3
.5725	.8762	10.51	1/8	12.07	144.8
5/8	1.044	12.53	1/4	13.53	162.4
.6350	1.078	12.94	1/2	16.71	200.5
11/16	1.263	15.16	3/4	20.21	242.6
3/4	1.504	18.04	3	24.06	288.7
13/16	1.765	21.17	1/4	28.23	338.8
7/8	2.046	24.56	1/2	32.74	392.9
15/16	2.349	28.19	3/4	37.59	451.0
			4	42.77	513.2
			1/4	48.28	579.3

# 17-4

## AISI 630 UNS S 17400

**Precipitation Hardening Stainless Bars and Plates**  
**Color Marking: Bars** — Ends painted Blue and Yellow  
**Plates** — Corner striped Blue and Yellow

This is a chromium-nickel grade of stainless steel that may be hardened by a single low-temperature precipitation-hardening heat treatment. Excellent mechanical properties at a high strength level may be obtained by such treatment. Scaling and distortion are minimized. This material should not be used in the solution treated condition.

The strength and corrosion resistance properties of 17-4 hold up well in service temperatures up to 800°F.

Fabrication techniques for this steel are similar to those established for the regular stainless steel grades. This material machines well, has excellent welding characteristics, and forges easily. The combination of excellent mechanical and processing properties makes this grade adaptable to a wide variety of applications.

### ANALYSIS

C Max.	Mn Max.	P Max.	S Max.	Si Max.	Cr	Ni	Cu	Cb +Ta
.07	1.00	.04	.03	1.00	15.00/17.50	3.00/5.00	3.00/5.00	5XC/.45

**SPECIFICATIONS** — AMS 5643 and ASTM A 564 Type 630 are generally applicable.

**APPLICATIONS** — Used where high strength and good corrosion resistance are required, as well as for applications requiring high fatigue strength, good resistance to galling, seizing and stress corrosion. Suitable for intricate parts requiring machining and welding, and/or where distortion in conventional heat treatment is a problem.

**CORROSION RESISTANCE** — The corrosion resistance of 17-4 is superior to that of hardenable straight chromium grades such as Type 410. It approaches the corrosion resistance of the chromium nickel grades. In many corrosive media it is equal to such grades as Type 304. Corrosion resisting properties will be affected by such conditions as surface finish and aging heat treatment.

**MECHANICAL PROPERTIES** — The following may be considered as average or typical room-temperature properties:

Condition	Tensile Strength (psi)	Yield Strength (psi)	Elonga- tion in 2"	Reduc- tion of Area	Rockwell "C" Hardness
A (Annealed)	150,000	110,000	10%	40%	34
H 900 (Hardened at 900°)	200,000	185,000	14%	50%	44
H 1150 (Hardened at 1150°)	145,000	125,000	19%	60%	33

AMS 5643 requires the following after precipitation heat treating at 900°F.

Tensile Strength (psi)	Yield Strength (psi)	Elonga- tion in 2"	Reduction of Area	
			3" Thick & Under	Over 3" to 8" Thick
190,000 Min.	170,000 Min.	10% Min.	40% Min.	35% Min.

**MACHINABILITY** — This grade has a machinability rating of 48% in the annealed condition (Condition A), with surface cutting speed of 80 feet per minute. In the overaged condition (H 1150-M), the machinability rating is 76%, with surface cutting speed of 125 feet per minute.

**WELDING** — Readily weldable by all the commercial processes. Preheating and post-heating practices used for the standard hardenable stainless grades are not required.

**FORGING** — Forge between 2050° and 2150°F. Do not forge below 1850°F. Forgings are air cooled to 90°F or lower. Large or intricate forgings should be equalized at some temperature between 1900°F and the forging temperature before air cooling.

**ANNEALING (Condition A)** — The annealing (solution treatment) temperature is 1900°F, followed by air cooling. Maximum Brinell hardness at mid-radius is 363.

### HARDENING —

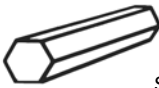
- Condition H 900 — 900°F for 1 hour, air cool. Rockwell "C" 44 Average.
- Condition H 1025 — 1025°F for 4 hours, air cool. Rockwell "C" 38 Average.
- Condition H 1150 — 1150°F for 4 hours, air cool. Rockwell "C" 33 Average.

**17-4 STAINLESS (Continued)**



**17-4 ROUNDS**  
**Condition A or Hardened**  
 Stock Lengths 10' to 12'

Est. Weight, Lbs.			Est. Weight, Lbs.			Est. Weight, Lbs.		
Size In Inches	Per Foot	12-Ft. Bar	Size In Inches	Per Foot	12-Ft. Bar	Size In Inches	Per Foot	12-Ft. Bar
<b>Cold Finished</b>			<b>Cold Finished (Cont.)</b>			<b>Rough Turned</b>		
3/32	.0235	.2820	1 1/4	4.176	50.12	3 1/8	26.10	313.2
1/8	.0418	.5012	5/16	4.604	55.25	1/4	28.23	338.8
5/32	.0653	.7831	3/8	5.053	60.64	3/8	30.45	365.3
3/16	.0940	1.128	7/16	5.523	66.28	1/2	32.74	392.9
7/32	.1279	1.535	1/2	6.014	72.17	5/8	35.12	421.5
1/4	.1671	2.005	9/16	6.526	78.31	3/4	37.59	451.0
9/32	.2114	2.537	5/8	7.058	84.70	4	42.77	513.2
5/16	.2610	3.132	11/16	7.612	91.34	1/4	48.28	579.3
11/32	.3158	3.790	3/4	8.186	98.23	1/2	54.13	649.5
3/8	.3759	4.510	13/16	8.781	105.4	3/4	60.31	723.7
13/32	.4411	5.293	7/8	9.397	112.8	5	66.82	801.9
7/16	.5116	6.139	15/16	10.03	120.4	1/4	73.67	884.0
15/32	.5873	7.048	2	10.69	128.3	1/2	80.86	970.2
1/2	.6682	8.019	1/16	11.37	136.4	3/4	88.37	1060
9/16	.8457	10.15	1/8	12.07	144.8	6	96.22	1155
19/32	.9423	11.31	3/16	12.79	153.5	1/4	104.4	1253
5/8	1.044	12.53	1/4	13.53	162.4	1/2	112.9	1355
11/16	1.263	15.16	5/16	14.29	171.5	3/4	121.8	1461
3/4	1.504	18.04	3/8	15.08	180.9	7	131.0	1572
13/16	1.765	21.17	7/16	15.88	190.6	1/4	140.5	1686
7/8	2.046	24.56	1/2	16.71	200.5	1/2	150.4	1804
15/16	2.349	28.19	5/8	18.42	221.0	3/4	160.5	1926
1	2.673	32.07	11/16	19.31	231.7	8	171.1	2053
1/16	3.017	36.21	3/4	20.21	242.6	1/4	181.9	2183
1/8	3.383	40.59	7/8	22.09	265.1	1/2	193.1	2317
3/16	3.769	45.23	15/16	23.06	276.8	3/4	204.6	2456
			3	24.06	288.7	9	216.5	2598
						1/2	241.2	2895
						10	267.3	3207
						11	323.4	3881
						12	384.9	4619



**17-4 HEXAGONS**  
**Condition A**  
**Ann. & Cold Drawn**  
 Stock Lengths 10' to 12'



**17-4 SQUARES**  
**C.D. & H.R., Ann.**  
**& Pickled**  
 Stock Lengths 10' to 14'

Est. Wt., Lbs.			Est. Wt., Lbs.			Est. Wt., Lbs.			Est. Wt., Lbs.		
Size In Inches	Per Foot	12-Ft. Bar	Size In Inches	Per Foot	12-Ft. Bar	Size In Inches	Per Foot	12-Ft. Bar	Size In Inches	Per Foot	12-Ft. Bar
1/2	.7368	8.842	1 1/4	4.605	55.26	1/4	2.127	2.552	1 3/4	10.42	125.1
9/16	.9325	11.19	5/16	5.077	60.93	5/16	.3323	3.988	2	13.61	163.4
5/8	1.151	13.82	3/8	5.572	66.87	3/8	.4786	5.743	1/4	17.23	206.7
11/16	1.393	16.72	1/2	6.631	79.56	1/2	.8508	10.21	1/2	21.27	255.2
3/4	1.658	19.89	5/8	7.783	93.39	5/8	1.329	15.95	3	30.63	367.5
13/16	1.946	23.35	3/4	9.026	108.3	3/4	1.914	22.97	1/2	41.69	500.3
7/8	2.257	27.08				7/8	2.606	31.27	4	54.45	653.4
1	2.947	35.37	2	11.79	141.5	1	3.403	40.84	5	85.08	1021
			1/4	14.92	179.0	1/4	5.318	63.81	6	122.5	1470
						1/2	7.657	91.89			

## 17-4 STAINLESS (Continued)

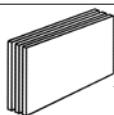
### 17-4 FLATS

**Hot Rolled, Annealed & Pickled**

Stock Lengths 10' to 14'



Size In Inches			Est. Weight, Lbs.		Size In Inches			Est. Weight, Lbs.		Size In Inches			Est. Weight, Lbs.				
			Per Foot	12-Ft. Bar				Per Foot	12-Ft. Bar				Per Foot	12-Ft. Bar			
1/8 x	3/4	.3191	3.829	1/2 x	5/8	1.064	12.77	1 x	2 1/2	8.508	102.1	1 x	2 1/2	8.508	102.1		
	1	.4254	5.105		3/4	1.276	15.31		3	10.21	122.5		3	10.21	122.5		
	1 1/2	.6381	7.657		1	1.702	20.42		3 1/2	11.91	142.9		3 1/2	11.91	142.9		
5/16 x	1 1/4	1.329	15.95	1 1/4 x	1 1/4	2.127	25.52	1 1/4 x	4	13.61	163.4	1 1/4 x	4	13.61	163.4		
	1 1/2	1.595	19.14		1 1/2	2.552	30.63		4 1/2	15.31	183.8		4 1/2	15.31	183.8		
	2 1/2	2.659	31.91		1 3/4	2.978	35.73		5	17.02	204.2		5	17.02	204.2		
3/16 x	1/2	.3191	3.829	2 x	2	3.403	40.84	2 x	6	20.42	245.0	2 x	6	20.42	245.0		
	3/4	.4786	5.743		2 1/2	4.254	51.05		7	23.82	285.8		7	23.82	285.8		
	1	.6381	7.657		3	5.105	61.26		8	27.23	326.7		8	27.23	326.7		
1/4 x	1 1/4	.7976	9.572	3 1/2 x	3 1/2	5.956	71.47	1 1/4 x	1 1/2	6.381	76.57	1 1/4 x	1 1/2	6.381	76.57		
	1 1/2	.9572	11.49		4	6.806	81.68		1 3/4	7.445	89.34		1 3/4	7.445	89.34		
	2	1.276	15.31		4 1/2	7.657	91.89		2	8.508	102.1		2	8.508	102.1		
5/16 x	3/4	.6381	7.657	5/8 x	3/4	1.595	19.14	1 1/2 x	2 1/2	10.64	127.6	1 1/2 x	2 1/2	10.64	127.6		
	1	.8508	10.21		1	2.127	25.52		3	15.31	183.8		3	15.31	183.8		
	1 1/4	1.064	12.76		1 1/4	2.659	31.91		4	20.42	245.0		4	20.42	245.0		
3/8 x	1 1/2	1.276	15.31	1 1/2 x	1 1/2	3.191	38.29	1 3/4 x	1 3/4	8.933	107.2	1 3/4 x	1 3/4	8.933	107.2		
	1 3/4	1.489	17.87		2	4.254	51.05		2	10.21	122.5		2	10.21	122.5		
	2	1.702	20.42		2 1/2	5.318	63.81		2 1/4	11.49	137.8		2 1/4	11.49	137.8		
5/16 x	2 1/2	2.127	25.52	3/4 x	3	6.381	76.57	2 x	3	15.31	183.8	2 x	3	15.31	183.8		
	3	2.552	30.63		4	8.508	102.1		4	20.42	245.0		4	20.42	245.0		
	4	3.403	40.84		5	10.64	127.6		5	25.52	306.2		5	25.52	306.2		
3/8 x	5	4.254	51.05	1 x	6	12.76	153.1	2 1/2 x	6	30.63	367.5	2 1/2 x	6	30.63	367.5		
	6	5.105	61.26		1	2.552	30.63		1 3/4 x	2	11.91		142.9	1 3/4 x	2	11.91	142.9
	2 1/2	2.659	31.91		1 1/4	3.191	38.29		2 1/4	13.40	160.8		2 1/4	13.40	160.8		
3/8 x	1 1/4	1.329	15.95	1 1/2 x	1 1/2	3.829	45.94	3 x	2 1/2	14.89	178.7	3 x	2 1/2	14.89	178.7		
	1 1/2	1.595	19.14		2	5.105	61.26		3	17.87	214.4		3	17.87	214.4		
	2	2.127	25.52		2 1/2	6.381	76.57		3 1/2	20.84	250.1		3 1/2	20.84	250.1		
3/8 x	2 1/2	2.659	31.91	7/8 x	3	7.657	91.89	2 x	4	23.82	285.8	2 x	4	23.82	285.8		
	3	3.191	38.29		3 1/2	8.933	107.2		2 1/2	17.02	204.2		2 1/2	17.02	204.2		
	3 1/2	3.191	38.29		4	10.21	122.5		3	20.42	245.0		3	20.42	245.0		
3/8 x	1/2	.6381	7.657	1 x	5	12.76	153.1	3 1/2 x	3 1/2	23.82	285.8	3 1/2 x	3 1/2	23.82	285.8		
	3/4	.9572	11.49		6	15.31	183.8		4	27.23	326.7		4	27.23	326.7		
	1	1.276	15.31		8	20.42	245.0		5	34.03	408.4		5	34.03	408.4		
3/8 x	1 1/4	1.595	19.14	1 1/4 x	2	5.956	71.47	2 1/2 x	6	40.84	490.1	2 1/2 x	6	40.84	490.1		
	1 1/2	1.914	22.97		3	8.933	107.2		3	25.52	306.3		3	25.52	306.3		
	1 3/4	2.233	26.80		3 1/2	10.21	122.5		4	34.03	408.4		4	34.03	408.4		
3/8 x	2	2.552	30.63	1 1/2 x	1 1/4	4.254	51.05	3 x	5	42.54	510.5	3 x	5	42.54	510.5		
	2 1/2	3.191	38.29		1 1/2	5.105	61.26		6	51.05	612.6		6	51.05	612.6		
	3	3.829	45.94		1 3/4	5.956	71.47		5	51.05	612.6		5	51.05	612.6		
3/8 x	4	5.105	61.26	2 1/4 x	2	6.806	81.68	6	6	61.26	735.1	6	6	61.26	735.1		
	5	6.381	76.57		2 1/4	7.657	91.89										
	6	7.657	91.89														



### 17-4 PLATES

**Hot Rolled, Annealed, and Pickled**

Stocked in Thicknesses from 3/16" through 2",  
Widths from 48" to 72", and Lengths up to 20'

# 15-5 VAR (CEVM)

## Precipitation Hardening Stainless Bars

### UNS S15500

**Color Marking:** Ends painted Gold with Blue Stripe

15-5 VAR is an improved version of the highly successful 17-4. It possesses the advantages of 17-4, in that high strength can be developed by a single low temperature thermal treatment. In addition it offers excellent transverse toughness and ductility, better mechanical properties in larger sections, and better forgeability.

The composition of 15-5 VAR results in an essentially ferrite-free microstructure, which accounts for the improved properties.

Fabrication practices for 15-5 VAR are generally the same as those established for 17-4.

15-5 VAR is produced as a consumable electrode, vacuum arc remelted product. Where the ultimate in quality and uniformity of properties, and transverse notch toughness in particular, are required, this product is recommended.

#### ANALYSIS

C Max.	Mn Max.	P Max.	S Max.	Si Max.	Cr	Ni	Cu	Cb +Ta
.07	1.00	.03	.015	1.00	14.00/15.50	3.50/5.50	2.50/4.50	.15/.45

**SPECIFICATIONS** — Specifications AMS 5659 is generally applicable.

**APPLICATIONS, CORROSION RESISTANCE, MECHANICAL PROPERTIES, & FABRICATION** — Similar to 17-4, for which see Page 37 of this section.

<b>15-5 VAR ROUNDS</b>											
Stock Lengths 10' to 13'											
Size In Inches	Est. Wt., Lbs.		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		Per Foot	12-Ft. Bar
<b>Annealed &amp; Ground Condition A</b>						<b>Hot Rolled, Rough Turned, Condition A</b>					
1/4	.1671	2.005	1 1/16	3.017	36.21	2 1/8	12.07	144.8	4 1/2	54.13	649.5
5/16	.2610	3.132	1/8	3.383	40.59	1/4	13.53	162.4	3/4	60.31	723.7
3/8	.3759	4.510	3/16	3.769	45.23	3/8	15.08	180.9	5	66.82	801.9
7/16	.5116	6.139	1/4	4.176	50.12	1/2	16.71	200.5	1/4	73.67	884.0
1/2	.6682	8.019	5/16	4.604	55.25	5/8	18.42	221.0	1/2	80.86	970.2
9/16	.8454	10.15	3/8	5.053	60.64	3/4	20.21	242.6	3/4	88.37	1060
5/8	1.044	12.53	7/16	5.523	66.28	3	24.06	288.7	6	96.22	1155
11/16	1.263	15.16	1/2	6.014	72.17	1/4	28.23	338.8	1/4	104.4	1253
3/4	1.504	18.04	5/8	7.058	84.70	1/2	32.74	392.9	1/2	112.9	1355
13/16	1.765	21.17	11/16	7.612	91.34	5/8	35.12	421.5	7	131.0	1572
7/8	2.046	24.56	3/4	8.186	98.23	3/4	37.59	451.0	1/2	150.4	1804
15/16	2.349	28.19	7/8	9.397	112.8	4	42.77	513.2	8	171.1	2053
1	2.673	32.07	2	10.69	128.3	1/4	48.28	579.3			

**17-7**  
**AISI 631 UNS S17700**

**Precipitation Hardening Stainless Sheets**

17-7 is a chromium-nickel stainless steel that has the easy-to-work advantages of the chromium-nickel stainless grades, and yet is capable of being hardened. In the annealed (Condition A) state, it has excellent fabricating properties, and it can be precipitation hardened by a simple heat treatment.

In the hardened condition, it possesses excellent mechanical properties both at room temperature and elevated temperatures up to 800°F.

Its corrosion resistance is definitely superior to that of the straight chromium grades, and in some environments it approaches the chromium-nickel grades.

**ANALYSIS**

C	Mn	P	S	Si	Cr	Ni	Al
Max.	Max.	Max.	Max.	Max.			
.09	1.00	.04	.03	1.00	16.00/18.00	6.50/7.75	.75/1.50

**SPECIFICATIONS** — The following specifications are generally applicable:  
AMS 5528, AMS 5529.

**APPLICATIONS** — 17-7 is used for applications requiring high strength and corrosion resistance and/or good mechanical properties at temperatures up to 800°F. It lends itself to fabrication of intricate parts, because they may be formed, drawn, or welded and then hardened with a minimum of distortion.

**CORROSION RESISTANCE** — In the precipitation hardened condition, the corrosion resistance of 17-7 is superior to such grades as Type 410. It is generally not quite as good as the Type 304. This applies to general atmospheric corrosion as well as corrosive chemical media, and such factors as aging heat treatment and surface condition have an effect.

**MECHANICAL PROPERTIES** —

Condition	Tensile	Yield	Elonga-	Rockwell Hardness
	Strength (psi)	Strength (psi)	tion in 2"	
A (Annealed)	150,000 Max.	55,000 Max.	20% Min.	Rb 92 Max.
TH 1050	180,000 Min.	150,000 Min.	6% Min.	Rc 38 Min.
RH 950	210,000 Min.	190,000 Min.	5% Min.	Rc 44 Min.

**MACHINABILITY** — 17-7 in Condition A has a machinability rating of approximately 45%, with 1212 rated as 100%. Surface cutting speed approaches 75 feet per minute. When machining material in the annealed condition, allowance must be made for dimensional changes occurring in heat treatment. When machining material in the hardened condition, lower speeds and more power are required.

**WELDING** — Easily welded by the arc and resistance techniques applicable to stainless steels. No preheating or other complex welding procedures are required. Excellent properties are obtained in weldments, and the choice of weld metal depends upon the properties desired at the weld.

## 17-7 STAINLESS (Continued)

**FORMING** — 17-7 in Condition A has good forming and drawing characteristics.

**FORGING** — Heat to 2150°/2250°F, air cool.

**ANNEALING (Condition A)** — Heat to 1950°F  $\pm$  25° and air cool. For forgings, heat to 1900°F  $\pm$  25° and water quench.

**HARDENING** —

Condition TH 1050 — Heat Condition A material to 1400°F and hold for 90 minutes. Cool to 60° within one hour and hold one-half hour. Heat to 1050°F and hold for 90 minutes. Cool in air to room temperature.

Condition RH 950 — Heat Condition A material to 1750° and hold for 10 minutes. Cool to minus 100°F and hold for 8 hours. Heat to 950° and hold for one hour. Cool in air to room temperature.

**For more information, ask for literature on Precipitation Hardening Steels.**



**17-7 SHEETS**  
No. 2D finish  
Condition A  
Dull Cold Rolled, Annealed, & Pickled

Thickness	Width and Length	Est. Wt., Lbs.		Thickness	Width and Length	Est. Wt., Lbs.	
		Per Sq. Ft.	Per Sheet			Per Sq. Ft.	Per Sheet
.0161" (27 Ga.)	36x120	.676	20.3	.071" (15 Ga.)	36x120	2.982	89.5
.020" (25 Ga.)	36x120	.840	25.2	.080" (14 Ga.)	36x120	3.360	100.8
.025" (24 Ga.)	36x120	1.050	31.5	.090" (13 Ga.)	36x120	3.780	113.4
.032" (22 Ga.)	36x120	1.344	40.3	.100" (12 Ga.)	36x120	4.200	126.0
.036" (20 Ga.)	36x120	1.512	45.4	.125" (11 Ga.)	36x120	5.250	157.5
.040" (20 Ga.)	36x120	1.680	50.4	.140" (10 Ga.)	48x120	5.880	235.2
.045" (19 Ga.)	36x120	1.890	56.7				
.050" (18 Ga.)	36x120	2.100	63.0		144	5.880	281.2
.063" (16 Ga.)	36x120	2.646	79.4	.160" (9 Ga.)	36x120	6.720	201.6



## A-286 VAR (CEVM)

### UNS S66286

#### Premium Quality High Temperature Bars

**Color Marking:** Solution Treated and Aged — Ends painted Aluminum with Brown Stripe  
Solution Treated — Aluminum and Orange

This grade is one of the most popular high temperature alloys and is widely used in jet engine and gas turbine applications. It is a precipitation hardening alloy and thus soft and ductile in the solution treated condition but develops high strength and hardness with a single precipitation or aging treatment. This grade is designed to provide high strength up to 1300°F and oxidation resistance up to 1500°F. Being austenitic in all conditions, it may be used in high strength non-magnetic applications due to its low magnetic permeability consumable electrode vacuum melting practice is used for this alloy resulting in a premium quality steel.

#### ANALYSIS

C	Mn	P	S	Si	Cr	Ni
Max.	Max.	Max.	Max.	Max.		
.08	2.00	.025	.025	1.00	13.50/16.00	24.00/27.00
Mo	Ti	V	Al	B	Cu	
			Max.		Max.	
1.00/1.50	1.90/2.35	.10/.50	.35	.003/.010	.50	

**SPECIFICATIONS** — The following specifications are generally applicable:  
AMS 5731, AMS 5732, PWAS 5732

**APPLICATIONS** — Used where high strength at elevated temperature is required. Also used in applications where oxidation resistance at elevated temperatures is a requirement. Suitable for parts such as buckets, bolts, fittings, rings and jet engine and steam turbine parts.

**CORROSION RESISTANCE** — Excellent resistance up to 1300°F in all atmospheres encountered in jet engine and turbo-supercharged applications. This alloy also has reasonably good resistance to salt spray corrosion.

**OXIDATION RESISTANCE** — This alloy has good oxidation resistance for intermittent service up to 1500°F and continuous service up to 1800°F. It is comparable to type 310 Stainless at 1800°F.

**MECHANICAL PROPERTIES** — AMS 5731 and AMS 5732 require the following after solution treatment at 1800°F, quenched in oil or water followed by precipitation heat treatment at 1325°F for a minimum of 16 hours and air cooled:

Tensile	Yield	Elonga-	Reduction
Strength	Strength	tion	of
(psi)	(psi)	in 4D	Area
130,000 Min.	85,000 Min.	15% Min.	20% Min.

Solution Treated Hardness — 201, BHN max.

Typical Hardness for solution treated at 1800°F and aged at 1325°F - 248/341 BHN

**MACHINABILITY** — This grade may be machined using the techniques and equipment employed for austenitic stainless grades. Since the material is soft and gummy in the solution treated condition, it is usually machined after complete heat treatment.

**WELDABILITY** — Material should be in the solution treated condition for welding. Small sections can be satisfactorily welded using spot, flash, butt welding and metallic arc utilizing coated electrodes or inert gas shielding. Large sections under restraint can lead to cracking.

**FORGING** — Forge between 1650°F and 2150°F. "Critical reductions" must be avoided to prevent excessive grain growth. To assist in this problem, as a general guide, all forging temperatures should be kept well in excess of 1800°F or heavy reductions during the final hot working operation of at least 15% must be given below 1800°F.

**ANNEALING** — Same as solution treating temperature of 1800°F, followed by quenching in oil or water.



#### A-286 VAR ROUNDS

Stock Lengths 10' TO 12'

Available in diameters 1/2" through 6"

## 6 AL — 4 V

### Titanium Alloy UNS R56400 AMS 4928

**Color Marking:** Ends painted Olive with Black Stripe

6AL-4V is an alpha-beta type titanium base alloy with 120,000 psi minimum yield strength in the annealed condition. This alloy has good forming characteristics, is weldable with proper shielding and can be heat treated to higher strength levels by a solution treatment and aging process. It has good elevated temperature strength, good creep resistance, and low temperature impact strength.

#### ANALYSIS

Al	V	Fe Max.	O Max.	C Max.	N Max.	H Max.	Ti
5.50/6.75	3.50/4.50	.30	.20	.10	.05	.0125	Remainder

**SPECIFICATIONS** — The following specifications are generally applicable:  
AMS 4928, MIL-T-9047, PWAS 4928.

**APPLICATIONS** — Aircraft structural parts, ordnance and missile components, gas turbine disks, rings and blades, and other uses where a high strength to weight ratio is required.

**CORROSION RESISTANCE** — Comparable to commercially pure titanium. Shows good resistance to sea water and marine atmospheres, as well as wet chlorine and chlorine dioxide.

**MECHANICAL PROPERTIES** — AMS 4928 requires the following minimum properties in the annealed condition:

Size	Tensile	Yield	Elonga-	Reduction
	Strength (psi)	Strength (psi)	tion in 2"	of Area
Thru 2"	135,000 min.	125,000 min.	10% min.	25% min.
Over 2" thru 4"	130,000 min.	120,000 min.	10% min.	25% min.
Over 4" thru 6"	130,000 min.	120,000 min.	10% min.	20% min.

Depending upon section size, this material can be solution treated and aged to produce typical properties of 140/170,000 psi tensile strength and 130/150,000 psi yield strength.

**MACHINABILITY** — To machine satisfactorily, care must be taken to use sharp tools, the correct tool angles, heavy feeds, slow speeds and sufficient coolant.

**WELDABILITY** — This alloy can be satisfactorily welded provided the weld is properly shielded from the atmosphere. In addition to the inert gas-shielded metal-arc welding, other methods, such as spot, seam, flash and pressure welding may also be used with excellent success.

**ANNEALING** — Annealing is accomplished by holding at 1350°F for one-half to two hours and air cooling.



#### 6 AL - 4 V TITANIUM ROUNDS

Stock Lengths 10' TO 12'

Available in diameters 1/2" through 4"



**For all your metal needs...**  
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