



**EARLE M. JORGENSEN
COMPANY**

REFERENCE BOOK

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

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H

SECTION H

AIRCRAFT ALLOY STEELS

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Aircraft alloy steels are grades intended for important or highly stressed parts and components in the aerospace industry. Special steelmaking practices, more rigid inspection techniques, and more restrictive selection are necessary to meet the necessarily rigid quality standards.

There are three levels of quality which have been accepted by producers and users of aircraft steel:

AIRCRAFT QUALITY-This is the most commonly specified quality for general aerospace applications. It is defined in SAE specification AMS 2301, which outlines the procedure for determining compliance with cleanliness requirements by the magnetic particle inspection method.

SPECIAL AIRCRAFT QUALITY-This level of quality places minimum values on ductility in the transverse direction. It is also known as "High Transverse Quality", as the steel is evaluated by a number of tension tests normal to the direction of rolling (transverse) performed to obtain a comprehensive sampling of a heat of steel.

PREMIUM AIRCRAFT QUALITY-This is the ultimate quality that can currently be obtained in production quantities and is usually applied to the most critical parts and components. Steel conforming to this quality level is produced by the consumable electrode vacuum arc remelting technique. Specification AMS 2300 defines this quality and outlines testing requirements. Steels described herein which meet this quality are designated by the letters VAR (Vacuum Arc Remelt) or CEVM.

TO THE AIRCRAFT INDUSTRY

We Specialize in aircraft quality alloy and stainless steels. The items listed in the following two sections represent one of the largest and most complete service center stocks in North America. We endeavor to serve the aircraft industry by stocking the types and sizes recommended by the National Aircraft Standards Committee, as well as other items which are in common use.

Your attention is invited to the following pertinent information:

REVISIONS OF SPECIFICATIONS

The specifications (Military, Army-Navy, Federal, etc.) shown herein are the latest in effect at the time of publication of this stock list. In the event a specification is revised or supplemented by the issuing agency, steel for our stock will be ordered accordingly. We shall be pleased to furnish certified documents stating the exact specification to which our steel conforms.

CERTIFIED TEST REPORTS

Certified chemical and physical test reports for the heat treated grades listed herein, and certified chemical reports for other grades, are supplied automatically to purchasers of aircraft steels.

ULTRASONIC TESTING

This testing is performed when required by specification or when material is intended for a critical application.

High-frequency sound waves, generated by a crystal, are transmitted through the material to be tested. If a discontinuity, such as pipe, internal rupture, or inclusion is encountered, the waves reflect in such a way that a "picture" indicating the extent of the defect can be read on an oscilloscope. Testing can be performed by the "immersion" method (where the sound waves are transmitted through a liquid medium) or by the "dry contact" method (where waves pass directly from the crystal to the material to be tested).

Please contact us for further details if your application requires ultrasonic testing.

CLASSIFICATION OF PHYSICAL AND SURFACE CONDITIONS OF AIRCRAFT ALLOY STEELS

Following is a summary of the symbols used in military (MIL) specifications to designate various conditions of materials.

Physical Condition

- A – As Forged
- B – As Rolled
- C – Annealed
- D – Normalized
- E – Normalized & Tempered
- F – Quenched & Tempered

Surface condition

- 1 – As Forged or Rolled
- 2 – Pickled or Blast Cleaned
- 3 – Rough Turned
- 4 – Cold Finished
- 5 – Turned, Ground, & Polished

4130
AIRCRAFT QUALITY ALLOY BARS
UNS G41300
AMS-S-6758 AMS 6370 AMS 2301

Color Marking

Normalized Bars-Ends painted Pink
Heat Treated Bars-Ends painted White

This chromium-molybdenum alloy is one of the most widely used aircraft steels because of its combination of weldability, ease of fabrication, and mild hardenability. In relatively thin sections it will respond to heat treatment to high strength levels and yet in the normalized condition it has adequate strength for many applications. When resistance to wear and abrasion is required, it may be nitrided.

This grade is a quality product melted under the best steelmaking practices for aircraft quality steels. It is vacuum degassed to meet the magnetic particle inspection standards of AMS 2301.

ANALYSIS

C	Mn	P Max.	S Max.	Si	Cr	Ni Max.	Mo
.28/.33	.40/.60	.025	.025	.15/.35	.80/1.10	.25	.15/.25

APPLICATIONS — Intended for use in the manufacture of parts and components with sections 1/2" thick or less at time of heat treatment which require a through-hardening steel capable of developing hardness as high as Rockwell "C" 35, and also for parts with greater thickness requiring proportionately lower hardness. It may be used for parts requiring fusion welding. Hardenability and weldability are considered equivalent to 8630.

HARDENABILITY — As required by AMS-S-6758, minimum end-quench hardenability values for this grade are Rockwell "C" 35 at 5/16" and Rockwell "C" 28 at 8/16".

MECHANICAL PROPERTIES — The following properties apply to material in Physical Condition F (hardened and tempered):

Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2"	Reduction of Area Min.
125,000 Min.	100,000 Min.	17% Min.	55% Min.

HEAT TREATMENT

Normalize-1600°/1700°F Quench-Oil
Austenitize-1500°/1600°F Temper-700°/1250°F



4130 AIRCRAFT SQUARES

Stock Lengths 12' and 20'

Heat Treated, Cold Finished & Stress Relieved Physical Conditions F Surface Condition 4			Hot Rolled Normalized Physical Condition D Surface Condition 1		
Size in Inches	Estimated Weight, Lbs.		Size in Inches	Estimated Weight, Lbs.	
	Per Foot	12-Ft. Bar		Per Foot	20-Ft. Bar
1/4	.2127	2.552	1 3/4	10.42	208.4
5/16	.3323	3.988	2	13.61	272.3
3/8	.4786	5.743	1/4	17.23	344.6
7/16	.6514	7.817	1/2	21.27	425.4
1/2	.8508	10.21	3	30.63	612.6
5/8	1.329	15.95	1/2	41.69	833.8
3/4	1.914	22.97	4	54.45	1089
7/8	2.606	31.27	5	85.08	1702
1	3.403	40.84	6	122.5	2405
1/8	4.307	51.69			
1/4	5.318	63.81			
3/8	6.434	77.21			
1/2	7.657	91.89			

4130 AIRCRAFT BARS AMS-S-6758 (Continued)



4130 AIRCRAFT ROUNDS

Stock Lengths 12' and 20'

Normalized & Cold Finished Physical Condition D Surface Condition 4			Heat Treated, Cold Fin. & Stress Relieved Physical Condition F Surface Condition 4			Hot Rolled Normalized Physical Condition D Surface Condition 1		
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	20-Ft. Bar
1/8	.0418	.5012	1/8	.0418	.5012	3/4	1.504	30.07
3/16	.0940	1.128	3/16	.0940	1.128	13/16	1.765	35.29
1/4	.1671	2.005	1/4	.1671	2.005	7/8	2.046	40.93
9/32	.2115	2.538	5/16	.2610	3.132	15/16	2.349	46.98
5/16	.2610	3.132	3/8	.3759	4.510	1	2.673	53.46
3/8	.3759	4.510	7/16	.5116	6.139	1/8	3.383	67.66
13/32	.4410	5.290	9/16	.8457	10.15	1/4	4.176	83.53
7/16	.5116	6.139	11/16	1.263	15.16	3/8	5.053	101.1
1/2	.6682	8.019	13/16	1.765	21.17	1/2	6.014	120.3
9/16	.8457	10.15	7/8	2.046	24.56	5/8	7.058	141.2
5/8	1.044	12.53	15/16	2.349	28.19	3/4	8.186	163.7
11/16	1.263	15.16	1	2.673	32.07	7/8	9.397	187.9
3/4	1.504	18.04	1/16	3.017	36.21	2	10.69	213.8
13/16	1.765	21.17	1/8	3.383	40.59	1/8	12.07	241.4
7/8	2.046	24.56	3/16	3.769	45.23	1/4	13.53	270.6
15/16	2.349	28.19	1/4	4.176	50.12	3/8	15.08	301.5
1	2.673	32.07	5/16	4.604	55.25	1/2	16.71	334.1
1/16	3.017	36.21	3/8	5.053	60.64	5/8	18.42	368.4
1/8	3.383	40.59	7/16	5.523	66.28	3/4	20.21	404.3
3/16	3.769	45.23	1/2	6.014	72.17	7/8	22.09	441.9
1/4	4.176	50.12	5/8	7.058	84.70	3	24.06	481.1
5/16	4.604	55.25	3/4	8.186	98.23	1/8	26.10	522.0
3/8	5.053	60.64	7/8	9.397	112.8	1/4	28.23	564.6
7/16	5.523	66.28	1	2.673	32.07	3/8	30.45	608.9
1/2	6.014	72.17	1/16	3.017	36.21	1/2	32.74	654.8
5/8	7.058	84.70	1/8	3.383	40.59	5/8	35.12	702.5
3/4	8.186	98.23	3/16	3.769	45.23	3/4	37.59	751.7
7/8	9.397	112.8	1/4	4.176	50.12	4	42.77	855.3
2	10.69	128.3	5/16	4.604	55.25	1/4	48.28	965.6
1/8	12.07	144.8	3/8	5.053	60.64	1/2	54.13	1083
1/4	13.53	162.4	7/16	5.523	66.28	3/4	60.31	1206
3/8	15.08	180.9	1/2	6.014	72.17	5	66.82	1336
1/2	16.71	200.5	5/8	7.058	84.70	1/4	73.67	1473
5/8	18.42	221.0	3/4	8.186	98.23	1/2	80.86	1617
3/4	20.21	242.6	7/8	9.397	112.8	3/4	88.37	1767
3	24.06	288.7	1	2.673	32.07	6	96.22	1924
1/2	32.74	392.9	1/16	3.017	36.21	1/4	104.4	2088
			1/8	3.383	40.59	1/2	112.9	2259
			3/16	3.769	45.23	3/4	121.8	2436
			1/4	4.176	50.12	7	131.0	2619
			5/16	4.604	55.25	1/2	150.4	3007
			3/8	5.053	60.64	8	171.1	3421
			7/16	5.523	66.28	1/4	181.9	3638
			1/2	6.014	72.17	1/2	193.1	3862
						9	216.5	4330
						1/2	241.2	4824
						10	267.3	5346
						1/2	294.7	5894
						11	323.4	6468
						1/2	353.5	7070
						12	384.9	7698
						1/2	417.6	8353
						13	451.7	9034
						1/2	487.1	9743

4130 AIRCRAFT BARS AMS-S-6758 (Continued)



4130 AIRCRAFT HEXAGONS

Stock Lengths 12' Approx.

Heat Treated & Cold Finished Physical Condition F Surface Condition 4						Normalized & Cold Fin. Physical Condition D Surface Condition 4		
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	15/16	2.590	31.08	1/4	.1842	2.210
5/16	.2878	3.454	1	2.947	35.37	3/8	.4145	4.973
3/8	.4145	4.973		1/16	3.327	39.93	1/2	.7368	8.842
7/16	.5641	6.769	1/8	3.730	44.76	9/16	.9325	11.19
1/2	.7368	8.842	3/16	4.156	49.87	5/8	1.151	13.82
9/16	.9325	11.19	1/4	4.605	55.26	3/4	1.658	19.89
5/8	1.151	13.82	5/16	5.077	60.93	7/8	2.257	27.08
11/16	1.393	16.72	3/8	5.572	66.87	1	2.947	35.37
3/4	1.658	19.89	7/16	6.090	73.08		1/4	4.605	55.26
13/16	1.946	23.35	1/2	6.631	79.56	3/8	5.572	66.87
7/8	2.257	27.08	5/8	7.783	93.39	1/2	6.631	79.56
						3/4	9.026	108.3
						2	11.79	141.5



4130 AIRCRAFT FLATS

Stock Lengths: Cold Finished - 12'
Hot Rolled - 20'

Heat Treated & Cold Finished — Physical Condition F—Surface Condition 4 or Normalized & Cold Finished — Physical Condition D—Surface Condition 4									
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 x 1/2	.4254	5.105	1/2 x 5	8.508	102.1	1 1/4 x 1/2	6.381	76.57	
3/4	.6381	7.657	6	10.21	122.5	1 3/4	7.445	89.33	
1	.8508	10.21	5/8 x 1	2.127	25.52	2	8.508	102.1	
1 1/4	1.064	12.76	1 1/4	2.659	31.91	2 1/2	10.64	127.6	
1 1/2	1.276	15.31	1 1/2	3.191	38.29	3	12.76	153.1	
1 3/4	1.489	17.87	1 3/4	3.722	44.67	4	17.02	204.2	
2	1.702	20.42	2	4.254	51.05	1 1/2 x	1 3/4	8.933	178.7
2 1/2	2.127	25.52	2 1/2	5.318	63.81		2	10.21	122.5
3	2.552	30.63	3	6.381	76.57	2 1/2	12.76	153.1	
4	3.403	40.84	4	8.508	102.1	3	15.31	183.8	
5	4.254	51.05	5	10.64	127.6	4	20.42	245.0	
3/8 x	1/2	.6381	7.657	3/4 x 1	2.552	30.63	5	25.52	306.3
	3/4	.9572	11.49	1 1/4	3.191	38.29	6	30.63	367.5
1	1.276	15.31	1 1/2	3.829	45.94	Hot Rolled Normalized Physical Condition D Surface Condition 1			
1 1/4	1.595	19.14	1 3/4	4.467	53.60	1 x	6	20.42	408.4
1 1/2	1.914	22.97	2	5.105	61.26	1 3/4 x	3	17.89	357.3
1 3/4	2.233	26.80	2 1/2	6.381	76.57		6	35.73	714.7
2	2.552	30.63	2 3/4	7.019	84.23		2 x	2 1/2	17.02	340.3
2 1/2	3.191	38.29	3	7.657	91.89	3		20.42	408.4
3	3.829	45.94	4	10.21	122.5	4	27.23	544.5	
4	5.105	61.26	5	12.76	153.1	5	34.03	680.6	
5	6.381	76.57	6	15.31	183.8	6	40.84	816.8	
6	7.657	91.89	1 x 1 1/4	51.05	4.254	2 1/2 x	3	25.52	510.5
1/2 x	3/4	1.276	15.31	1 1/2	5.105		61.26	4	34.03	680.6
	1	1.702	20.42	1 5/8	5.530	66.36	3 x	4	40.84	816.8
1 1/4	2.127	25.52	1 3/4	5.956	71.47	5		51.05	1021
1 1/2	2.552	30.63	2	6.806	81.68	6	61.26	1225	
1 3/4	2.978	35.73	2 1/2	8.508	102.1	4 x	6	81.68	1634
2	3.403	40.84	3	10.21	122.5				
2 1/2	4.254	51.05	4	13.61	163.4				
3	5.105	61.26	5	17.02	204.2				
4	6.806	81.68	6	20.42	245.0				

4140

AIRCRAFT QUALITY ALLOY BARS

UNS G41400

AMS-S-5626 AMS 6382 AMS 2301

Color Marking

Normalized Bars — Ends painted Gray
 Annealed Bars — Ends painted Brown

This chromium molybdenum alloy is a deep hardening steel used where strength and impact toughness are required. It has high fatigue strength making it suitable for critical stressed applications at normal as well as elevated temperatures. For increased resistance to wear and abrasion, it may be nitrided.

This grade is a quality product melted under the best of steelmaking practices for aircraft quality steels. It is vacuum degassed to meet the magnetic particle inspection standards of AMS 2301.

ANALYSIS

C	Mn	P	S	Si	Cr	Mo
.38/.43	.75/1.00	.025 Max.	.025 Max.	.20/.35	.80/1.10	.15/.25

APPLICATIONS — Intended for general use for parts with sections 1/2" or less in thickness at time of heat treatment which require a through-hardening steel capable of developing hardness as high as Rockwell "C" 50; also for fittings and forgings of greater hardness or variation in thickness at proportionately lower hardness. It is frequently used in applications in which 8640 is specified.

HARDENABILITY — End-quench hardenability values for this grade are Rockwell "C" 50 minimum at 6/16" and Rockwell "C" 44 minimum at 9/16".

HEAT TREATMENT

Normalize — 1600°/1700°F
 Austenitize — 1525°/1600°F
 Quench — Oil
 Temper — 700°/1300°F



4140 AIRCRAFT SQUARES

Stock Lengths 12' and 20'

Annealed & Cold Fin. Physical Condition C Surface Condition 4 Maximum Brinell 241			Hot Rolled Normalized Physical Condition D Surface Condition 1		
Size in Inches	Estimated Weight, Lbs.		Size in Inches	Estimated Weight, Lbs.	
	Per Foot	12-Ft. Bar		Per Foot	20-Ft. Bar
3/8	.4790	5.74	1 3/4	10.42	208.4
1/2	.8508	10.21	2	13.61	272.3
5/8	1.329	15.95	1/4	17.23	344.6
3/4	1.914	22.97	1/2	21.27	425.4
1	3.403	40.84	3	30.63	612.6
			1/2	41.69	833.8
1/4	5.318	63.81	4	54.45	1089
1/2	7.657	91.89	5	85.08	1702
			6	122.5	2450

4140 AIRCRAFT BARS AMS-S-5626 (Continued)



4140 AIRCRAFT ROUNDS
Stock Lengths 12' to 20'

Ann. & Cold Finished Physical Condition C Surface Condition 4 Maximum Brinell 241			Hot Rolled Normalized Physical Condition D Surface Condition 1					
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	20-Ft. Bar		Per Foot	20-Ft. Bar
1/4	.1671	2.005	1	2.673	53.46	4	42.77	855.3
5/16	.2610	3.132	1/8	3.383	67.66	1/4	48.28	956.6
3/8	.3759	4.510	1/4	4.176	83.53	1/2	54.13	1083
7/16	.5116	6.139	3/8	5.053	101.1	3/4	60.31	1206
1/2	.6682	8.019	1/2	6.014	120.3	5	66.82	1336
9/16	.8457	10.15	5/8	7.058	141.2	1/4	73.67	1473
5/8	1.044	12.53	3/4	8.186	163.7	1/2	80.86	1617
11/16	1.263	15.16	7/8	9.397	187.9	6	96.22	1924
3/4	1.504	18.04	2	10.69	213.8	1/4	104.4	2088
13/16	1.765	21.17	1/8	12.07	241.4	1/2	112.9	2259
7/8	2.046	24.56	1/4	13.53	270.6	7	131.0	2619
15/16	2.349	28.19	3/8	15.08	301.5	1/2	150.4	3007
1	2.673	32.07	1/2	16.71	334.1	8	171.1	3421
1/16	3.017	36.21	5/8	18.42	368.4	1/2	193.1	3862
1/8	3.383	40.59	3/4	20.21	404.3	9	216.5	4330
3/16	3.769	45.23	7/8	22.09	441.9	10	267.3	5346
1/4	4.176	50.12	3	24.06	481.1	1/2	294.7	5894
5/16	4.604	55.25	1/4	28.23	564.6	11	323.4	6468
3/8	5.053	60.64	1/2	32.74	654.8	12	384.9	7698
7/16	5.523	66.28	3/4	37.59	751.7			
1/2	6.014	72.17						
5/8	7.058	84.70						
3/4	8.186	98.23						
7/8	9.397	112.8						
2	10.69	128.3						
1/4	13.53	162.4						
1/2	16.71	200.5						
3/4	20.21	242.6						
3	24.06	288.7						



4140 AIRCRAFT FLATS

Stock Lengths: C.F. — 12'
H.R. — 20'

Annealed & Cold Finished
Physical Condition C — Surface Condition 4
Maximum Brinell 241

Size in Inches	Est. Weight, Lbs.		Size in Inches	Est. Weight, Lbs.	
	Per Foot	12-Ft. Bar		Per Foot	20-Ft. Bar
3/8 x 2	2.552	30.63	1 1/4 x 2	8.508	102.1
1/2 x 1	1.702	20.42	2 1/2	10.64	127.6
1 1/2	2.552	30.63	3	12.76	153.1
2	3.403	40.84	4	17.02	204.2
2 1/2	4.254	51.05	6	25.52	306.3
3	5.105	61.26	1 1/2 x 2	10.21	122.5
4	6.806	81.68	2 1/2	12.76	153.1
5	8.508	102.1	3	15.31	183.8
6	10.21	122.5	4	20.42	245.0
3/4 x 1	2.552	30.63	5	25.52	306.3
1 1/4	3.191	38.29	6	30.63	367.5
1 1/2	3.829	45.94			
2	5.105	61.26			
2 1/2	6.381	76.57			
3	7.657	91.89			
4	10.21	122.5			
5	12.76	153.1			
6	15.31	183.8			
1 x 1 1/4	4.254	51.05			
1 1/2	5.105	61.26			
1 3/4	5.956	71.47			
2	6.806	81.68			
2 1/2	8.508	102.1			
3	10.21	122.5			
4	13.61	163.4			
5	17.02	204.2			
6	20.42	245.0			



4140 AIRCRAFT HEXAGONS

Stock Lengths 12' Approx.

Ann. & Cold Finished
Physical Condition C
Surface Condition 4
Maximum Brinell 241

Size in Inches	Est. Weight, Lbs.		Hot Rolled Normalized Phys. Cond. D, Surf. Cond. 1	
	Per Foot	12-Ft. Bar	Per Foot	20-Ft. Bar
1/2	.7368	8.842	2 x 2 1/2	17.02 340.3
9/16	.9325	11.19	3	20.42 408.4
5/8	1.151	13.82	4	27.23 544.5
3/4	1.658	19.89	5	34.03 680.6
7/8	2.257	27.08	6	40.84 816.8
15/16	2.590	31.08	2 1/2 x 3	25.52 510.5
1	2.947	35.37	4	34.03 680.6
1/4	4.605	55.26	6	51.05 1021
3/8	5.572	66.87	3 x 4	40.84 816.8
1/2	6.631	79.56	5	51.05 1021
5/8	7.783	93.39	6	61.26 1225
3/4	9.026	108.3	4 x 5	40.84 816.8
7/8	10.36	124.3	6	51.05 1021
2	11.79	141.5	6	61.26 1225

E-4340

UNS G43406

AIRCRAFT QUALITY BARS

AMS-S-5000 AMS 2301

Color Marking: Ends painted Yellow

E-4340 VAR (CEVM)

PREMIUM AIRCRAFT QUALITY

AMS 6414 AMS 2300

Color Marking: Ends painted Red with Gold Stripe

This Chromium nickel molybdenum alloy is widely used deep-hardening constructional steel. It is used at a variety of strength levels and at each level possesses remarkable ductility and toughness. With its high alloy content uniform hardness is developed by heat treatment in relatively heavy sections. High fatigue strength makes E-4340 ideal for highly stressed parts. It maintains its strength and hardness at elevated temperatures.

This grade is available as electric furnace vacuum degassed steel to meet the high aircraft quality standards of AMS 2301. Thus, it is suitable for the fabrication of parts which may be subjected to magnetic particle inspection.

This grade is also available as a Premium Aircraft Quality product. The regular aircraft quality material is remelted in a vacuum using consumable electrode practice. This results in a much cleaner steel meeting the magnetic particle test requirements of AMS-2300 and insures a steel of the highest quality with excellent transverse ductility and toughness at high strength levels.

ANALYSIS

C	Mn	P	S	Si	Cr	Ni	Mo
.38/.43	.65/.85	.025 Max.	.025 Max.	.15/.30	.70/.90	1.65/2.00	.20/.30

APPLICATIONS — Intended for parts with sections $3\frac{1}{2}$ " or less in thickness at time of heat treatment, which require a through-hardening steel capable of developing minimum hardness of Rockwell "C" 30. Premium Aircraft Quality is intended for use in the manufacturing of highly stressed parts at higher strength levels, such as 260/280,000 psi and where a much cleaner steel is desired.

HARDENABILITY — End-quench hardenability values for this grade are Rockwell "C" 50 minimum at $2\frac{0}{16}$ " and Rockwell "C" 45 minimum at $3\frac{2}{16}$ ".

HEAT TREATMENT

Normalize — 1650°F

Austenitize — 1500°F

Quench — Oil, 140°F maximum

Temper — 400/500°F for 260,000 psi strength level
725°F minimum for lower strength levels

E-4340 AIRCRAFT BARS AMS-S-5000 (Continued)



E-4340 AIRCRAFT SQUARES

Stock Lengths: Cold Finished — 12'
Hot Rolled — 20'

Norm. & Temp. C.F. Phys. Cond. E, Surf. Cond. 4 Maximum Brinell 265			H.R. Norm. & Temp. Phys. Cond. E. Surf. Cond. 1 Maximum Brinell 235		
Size in Inches	Estimated Weight, Lbs.		Size in Inches	Estimated Weight, Lbs.	
	Per Foot	12-Ft. Bar		Per Foot	20-Ft. Bar
5/8	1.329	15.59	1 3/4	10.42	208.4
			2	13.61	272.3
3/4	1.914	22.97	1/4	17.23	344.6
			1/2	21.27	425.4
1	3.403	40.84	3/4	25.74	514.7
			3	36.63	612.6
1/4	5.318	63.81	1/2	41.69	833.8
			4	54.45	1089
1/2	7.657	91.89	5	85.08	1702
			6	122.5	2450



E-4340 AIRCRAFT ROUNDS

Special Quality
Stock Lengths 12' and 20'

Norm. & Temp. C.F. Phys. Cond. E, Surf. Cond. 4 Maximum Brinell 265			H.R. Norm. & Temp. Phys. Cond. E. Surf. Cond. 1 Maximum Brinell 235					
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	20-Ft. Bar		Per Foot	20-Ft. Bar
1/4	.1671	2.005	3/4	1.504	30.07	4	42.77	855.3
5/16	.2610	3.132				1/4	48.28	965.6
3/8	.3759	4.510				1/2	54.13	1083
7/16	.5116	6.139	1	2.673	53.46	3/4	60.31	1206
1/2	.6682	8.019				5	66.82	1336
9/16	.8457	10.15	1/8	3.383	67.66			
5/8	1.044	12.53	1/4	4.176	83.53	1/4	73.67	1474
11/16	1.263	15.16	3/8	5.053	101.1	1/2	80.86	1617
3/4	1.504	18.04	1/2	6.014	120.3	3/4	88.37	1767
13/16	1.765	21.17				6	96.22	1924
7/8	2.046	24.56	5/8	7.058	141.2			
15/16	2.349	28.19	3/4	8.186	163.7	1/4	104.4	2088
1	2.673	32.07	7/8	9.397	187.9	1/2	112.9	2259
1/16	3.017	36.21				3/4	121.8	2436
1/8	3.383	40.59	2	10.69	213.8			
3/16	3.769	45.23	1/8	12.07	241.4	7	131.0	2619
1/4	4.176	50.12	1/4	13.53	270.6	1/2	150.4	3007
5/16	4.604	55.25	3/8	15.08	301.5	8	171.1	3421
3/8	5.053	60.64				1/2	193.1	3862
7/16	5.523	66.28	1/2	16.71	334.1	3/4	204.6	4093
1/2	6.014	72.17	5/8	18.42	368.4			
9/16	6.526	78.31	3/4	20.21	404.3	9	216.5	4330
5/8	7.058	84.70				1/2	241.2	4824
3/4	8.186	98.23	7/8	22.09	441.9			
7/8	9.397	112.8				10	267.3	5346
2	10.69	128.3	3	24.06	481.1	1/2	294.7	5894
1/8	12.07	144.8						
1/4	13.53	162.4	1/8	26.10	522.0	11	323.4	6468
3/8	15.08	180.9	1/4	28.23	564.6	1/2	353.5	7070
1/2	16.71	200.5						
3/4	20.21	242.6	3/8	30.45	608.9	12	384.9	7698
7/8	22.09	265.1				1/2	417.6	8353
3	24.06	288.7	1/2	32.74	654.8			
1/4	28.23	338.8	5/8	35.12	702.5	13	451.7	9034
1/2	32.74	392.9						
3/4	37.59	451.0	3/4	37.59	751.7	14	523.9	10478
4	42.77	513.2						



E-4340 AIRCRAFT HEXAGONS

Stock Lengths 12' Approx.

Normalized & Tempered Cold Finished
Physical Condition E - Surface Condition 4
Maximum Brinell 265

Size in Inches	Estimated Weight, Lbs.		Size in Inches	Estimated Weight, Lbs.	
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar
1/2	.7368	8.842	1 1/4	4.605	55.26
5/8	1.151	13.82	3/8	5.572	66.87
3/4	1.658	19.89	1/2	6.631	79.56
7/8	2.257	27.08	5/8	7.783	93.39
15/16	2.590	31.08	3/4	9.026	108.3
1	2.947	35.37	2	11.79	141.5
1/16	3.327	39.93	1/4	14.92	179.0
1/8	3.730	44.76	1/2	18.42	221.0



E-4340 AIRCRAFT FLATS

Stock Lengths 12' and 20'

Normalized & Tempered Cold Finished
Physical Condition E - Surface Condition 4
Maximum Brinell 265

H.R. Norm. & Temp.
Phys. Cond. E. Surf. Cond. 1
Maximum Brinell 235

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	20-Ft. Bar
1/4 x			1 x			1 1/2 x		
1	.8508	10.21	1 1/4	4.254	51.05	2 1/2	12.76	255.2
2	1.702	20.42	1 1/2	5.105	61.26	4	20.42	408.4
3/8 x			1 3/4	5.956	71.47	2 x		
1	1.276	15.31	2	6.806	81.68	2 1/2	17.02	340.3
1 1/2	1.914	22.97	2 1/2	8.508	102.1	3	20.42	408.4
2	2.552	30.63	3	10.21	122.5	3 1/2	23.82	476.4
1/2 x			4	13.61	163.4	4	27.23	544.5
1	1.702	20.42	5	17.02	204.2	5	34.03	680.6
1 1/2	2.552	30.63	6	20.42	245.0	6	40.84	816.8
2	3.403	40.84	1 1/4 x			2 1/2 x		
2 1/2	4.254	51.05	1 1/2	6.381	76.57	3	25.52	510.5
3	5.105	61.26	2	8.508	102.1	3 1/2	29.78	595.6
4	6.806	81.68	2 1/2	10.64	127.6	4	34.03	680.6
5	8.508	102.1	3	12.76	153.1	6	51.05	1021
6	10.21	122.5	3 1/2	14.89	178.7	3 x		
5/8 x			4	17.02	204.2	4	40.84	816.8
1	2.127	25.52	5	21.27	255.2	5	51.05	1021
1 1/2	3.191	38.29	6	25.52	306.3	6	61.26	1225
2	4.254	51.05	1 1/2 x			3 1/2 x		
3/4 x			2	10.21	122.5	6	71.47	1429
1	2.552	30.63	2 1/2	12.76	153.1	4 x		
1 1/2	3.829	45.94	3	15.31	183.8	5	68.06	1361
2	5.105	61.26	4	20.42	245.0	6	81.68	1634
2 1/2	6.381	76.57	5	25.52	306.3			
3	7.657	91.89	6	30.63	367.5			
4	10.21	122.5						
5	12.76	153.1						
6	15.31	183.8						

E-4340
AIRCRAFT ALLOY PLATES
UNS G43406
AMS 6359

Color Marking: Corner striped Aluminum

These plates are rolled from highest quality steel, manufactured by the electric furnace process, to meet the rigid standards of the aircraft industry. They are uniform in quality and condition and are free from internal and external defects that would be detrimental to the fabrication or performance of parts.

The plates are produced by rolling on large "sheared plate" mills. As the slab is reduced in thickness, it is cross-worked to produce a quality plate that is sound and dense with excellent properties in both longitudinal and transverse directions.

ANALYSIS

C	Mn	P	S	Si	Cr	Ni	Mo
.38/.43	.60/.80	.025 Max.	.025 Max.	.15/.35	.70/.90	1.65/2.00	.20/.30

APPLICATIONS — Intended for use in the manufacturing of highly stressed aircraft parts requiring good hardenability as well as parts requiring high ultimate tensile strength.

FORMABILITY — This material in thicknesses up to $\frac{3}{4}$ " shall withstand being bent 90° around a diameter equal to its nominal thickness, both perpendicular and parallel to the direction of rolling.

HEAT TREATMENT — To develop the highest strength (260,000 psi minimum ultimate) with the best combination of mechanical properties in both transverse and longitudinal directions, the following thermal treatment is recommended:

Normalize — 1650°F ± 25°

Austenitize — 1500°F ± 25°

Quench — Oil, 140°F maximum

Temper — 400/500°F for 260,000 psi strength level

725°F minimum for lower strength levels

For lower strength levels, higher tempering temperatures may be used.



E-4340 AIRCRAFT ALLOY PLATES
Hot Rolled, Annealed and Descaled

Thickness In Inches	Per Square Inch	Per Square Foot
.250	.0709	10.21
.375	.1064	15.31
.500	.1418	20.42
.625	.1773	25.52
.750	.2127	30.63
.875	.2481	35.73
1.00	.2836	40.84
1.25	.3545	51.05
1.50	.4254	61.26
1.75	.4963	71.47
2.00	.5672	81.68
2.25	.6381	91.89
2.50	.7090	102.1
2.75	.7799	112.3
3.00	.8508	122.5
3.50	.9926	142.9
4.00	1.1344	163.4
4.50	1.2762	183.8
5.00	1.4180	204.2
6.00	1.7016	245.0

4620

AIRCRAFT QUALITY ALLOY BARS

UNS G46200

AMS 6294 AMS 2301

Color Marking: Ends painted Purple

This nickel molybdenum alloy is a carburizing steel capable of developing high case hardness and core toughness. It responds well to carburizing and hardening to produce a case of uniform hardness with relative freedom from distortion.

It is produced by the best steelmaking practice for aircraft quality steels, and is then vacuum degassed to meet the magnetic particle inspection standards of AMS 2301.

ANALYSIS

C	Mn	P	S	Si	Ni	Mo
.17/.22	.45/.65	.025 Max.	.025 Max.	.15/.35	1.65/2.00	.20/.30

APPLICATIONS — Intended for use in the manufacturing of carburized parts where core strength and toughness is desired.

HARDENABILITY — Test Specimens $1/8$ " and $3/8$ " in thickness will develop Rockwell "C" hardness of 32 to 48 when normalized and oil quenched from 1550°F.

HEAT TREATMENT

Normalize — 1700°F

Carburize — 1700°F

Austenitize — 1550°F

Quench — Oil

Temper — 300°F for maximum strength and hardness

450°F for maximum core toughness



4620 AIRCRAFT QUALITY ROUNDS

Stock Lengths 12' Approx.

Cold Drawn Physical Condition B Surface Condition 4			Hot Rolled Physical Condition B Surface Condition 1						
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	
$5/16$	.2610	3.132	1	$1/8$	3.383	40.59	3	24.06	288.7
$3/8$.3759	4.510		$1/4$	4.176	50.12		$1/4$	28.23	338.8
$7/16$	.5116	6.139		$3/8$	5.053	60.64	$1/2$	32.74	392.9
$1/2$	.6682	8.019		$1/2$	6.014	72.17	$3/4$	37.59	451.0
$9/16$	.8457	10.15		$5/8$	7.058	84.70	4	42.77	513.2
$5/8$	1.044	12.53		$3/4$	8.186	98.23		$1/4$	48.28	579.3
$11/16$	1.263	15.16		$7/8$	9.397	112.8	$1/2$	54.13	649.5
$3/4$	1.504	18.04	2		10.69	128.3	$3/4$	60.31	723.1
$7/8$	2.046	24.56		$1/8$	12.07	144.8	5	66.82	801.9
1	2.673	32.07	$1/4$	13.53	162.4	$1/2$		80.86	970.2
	$1/8$	3.383	40.59	$3/8$	15.08	180.9	6	96.22	1155
$1/4$	4.176	50.12	$1/2$	16.71	200.5	$1/2$		112.9	1355
$3/8$	5.053	60.64	$5/8$	18.42	221.0	7	131.0	1572	
$1/2$	6.014	72.17	$3/4$	20.21	242.6		$3/4$	171.1	2053
			$7/8$	22.09	265.1	8			

9310

UNS G93106

MIL-S-7393 AMS 6260 AMS 2301

Color Marking: Ends painted Red and White

9310 VAR (CEVM)

PREMIUM AIRCRAFT QUALITY ALLOY BARS

MIL-S-7393 AMS 6265 AMS 6267 AMS 2300

Color Marking: Ends painted Purple with Yellow Stripe

This chromium nickel molybdenum alloy is primarily a carburizing grade capable of attaining high case hardness with high core strength and toughness. Its high alloy content makes it suitable for components with relatively heavy sections. The combination of high alloy content and low carbon makes it possible to achieve a high core hardness with a narrow hardness range between heavier and thinner sections.

It is an alloy that offers strength with excellent toughness and ductility, and it may be used to advantage without carburizing. Carburized, a highly wear resistant case is produced which is useful in extremely difficult applications.

The AIRCRAFT QUALITY grade is produced following the best electric furnace steel making practices. It is vacuum degassed to insure meeting the magnetic particle standards of AMS 2301.

This grade is also available as a Premium Aircraft Quality product using the consumable electrode vacuum remelting process. This results in a much cleaner steel meeting the magnetic particle test requirements of AMS 2300 and insures a steel of the highest quality with excellent transverse ductility and toughness at high strength levels.

ANALYSIS

C	Mn	P	S	Si	Cr	Ni	Mo
.07/13	.40/70	.025 Max.	.025 Max.	.15/35	1.00/1.40	3.00/3.50	.08/15

APPLICATIONS — Intended primarily for critical carburized parts requiring high minimum core hardness with a relatively narrow hardness range. Also where rigid magnetic particle inspection standards are utilized in final inspection.

Premium Aircraft Quality is used where even more stringent cleanliness is required, as well as for highly stressed parts requiring greater transverse ductility and toughness.

HARDENABILITY — End-quench hardenability values are Rockwell "C" 43 maximum at $1/16$ " and Rockwell "C" 31 minimum at $6/16$ ".

HEAT TREATMENT

Normalize — 1700°F

Carburize — 1700°F

Austenitize — 1500°F

Quench — Oil

Temper — 300°F for maximum strength and hardness

450°F for maximum core toughness

9310 (Continued)



9310 AIRCRAFT ROUNDS
 Normalized & Tempered or Annealed
 Stock Lengths 12' to 20' Approx.

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	20-Ft. Bar		Per Foot	20-Ft. Bar
Cold Drawn or C.G. Physical Condition E Surface Condition 4			Hot Rolled Physical Condition E Surface Condition 1			Hot Rolled Physical Condition E Surface Condition 1		
1/2	.6682	8.019	1 1/2	6.014	120.3	5	66.82	1336
5/8	1.044	12.53	5/8	7.058	141.2	1/4	73.67	1473
3/4	1.504	18.04	3/4	8.186	163.7	1/2	80.86	1617
7/8	2.046	24.56	2	10.69	213.8	3/4	88.37	1767
1	2.673	32.07	1/8	12.07	241.4	6	96.22	1924
1/8	3.383	40.59	1/4	13.53	270.6	1/4	104.4	2088
1/4	4.176	50.12	3/8	15.08	301.5	1/2	112.9	2259
3/8	5.053	60.64	1/2	16.71	334.1	3/4	121.8	2436
1/2	6.014	72.17	5/8	18.42	368.4	7	131.0	2619
5/8	7.058	84.70	3/4	20.21	404.3	1/2	150.4	3007
3/4	8.186	98.23	3	24.06	481.1	8	171.1	3421
			1/4	28.23	564.6	1/2	193.1	3862
			1/2	32.74	654.8	3/4	204.6	4093
			3/4	37.59	751.7	9	216.5	4336
			4	42.77	855.3	1/2	241.2	4824
			1/4	48.28	965.6	3/4	254.1	5082
			1/2	54.13	1083	10	267.3	5346
			3/4	60.31	1206			

E-52100
AIRCRAFT QUALITY ALLOY BARS
UNS G15216 G52986
AMS-S-7420 AMS 6440 AMS 2301 ASTM A295

Color Marking: Ends painted Gold and Green

This high carbon, high chromium alloy is produced by the electric furnace process and then vacuum degassed to meet the rigid standards of the aircraft industry for bearing applications. This steel develops high hardness and has exceptional resistance to wear and abrasion. In smaller sections it has high compressive strength. Because of high carbon content, bars are furnished in the spheroidize annealed condition in order to provide the best possible machinability.

ANALYSIS

C	Mn	P	S	Si	Cr
.95/1.10	.25/.45	.025 Max.	.025 Max.	.15/.35	1.30/1.60

APPLICATIONS — Intended for use in ball or roller bearings and similar applications.

HEAT TREATMENT

- Anneal — 1400°F/1450°F very slow cool
- Austenitize — 1525°F/1575°F
- Quench — Oil, 140°F maximum
- Temper — 350°/450°F for maximum hardness



E-52100 AIRCRAFT ROUNDS
Spheroidize Annealed
 Stock Lengths 12' and 20'

Cold Drawn Physical Condition E Surface Condition 4						Hot Rolled Physical Condition E Surface Condition 1					
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	20-ft. Bar		Per Foot	20-ft. Bar
1/4	.1671	2.005	1 1/16	3.017	36.21	1 1/4	4.176	83.53	4 1/4	48.28	965.6
5/16	.2610	3.132	1/8	3.383	40.59	3/4	8.186	163.7	1/2	54.13	1083
3/8	.3759	4.510	3/16	3.769	45.23	7/8	9.397	189.9	3/4	60.31	1206
7/16	.5116	6.139	1/4	4.176	50.12	2	10.69	213.8	5	66.82	1336
1/2	.6682	8.019	5/16	4.604	55.25	1/4	13.53	270.6	1/4	73.67	1473
9/16	.8457	10.15	3/8	5.053	60.64	1/2	16.71	334.1	1/2	80.86	1617
5/8	1.044	12.53	7/16	5.523	66.28	5/8	18.42	368.4	3/4	88.37	1767
11/16	1.263	15.16	1/2	6.014	72.17	3/4	20.21	404.3	6	96.22	1924
3/4	1.504	18.04	5/8	7.058	84.70	7/8	22.09	441.9	1/4	104.4	2088
13/16	1.765	21.17	3/4	8.186	98.23	3	24.06	481.1	1/2	112.9	2259
7/8	2.046	24.56	7/8	9.397	112.8	1/4	28.23	564.6	7	131.0	2619
15/16	2.349	28.19	2	10.69	128.3	1/2	32.74	654.8	1/2	150.4	3007
1	2.673	32.07	3	24.06	288.7	3/4	37.59	751.7	8	171.1	3421
						4	42.77	855.3	1/2	193.1	3862
									9	216.5	4330

4330 MODIFIED V A R
PREMIUM AIRCRAFT QUALITY BARS
AMS 6411 AMS 6427 AMS 2300

Color Marking: Ends painted gold with Pink Stripe

This Grade is a chromium-nickel-molybdenum alloy modified by the addition of vanadium. It is a high strength alloy with good ductility and impact strength. The lowering of the carbon content from the more common .40 percent level improves its toughness and ductility, and it also limits the strength level to which the alloy can be used.

It is available as a consumable electrode vacuum remelted product. This method of melting improves the transverse ductility of the grade at its high usable strength. It also improves the non-metallic cleanliness, making it the most appropriate for the fabrication of parts subjected to magnetic particle inspection.

ANALYSIS

C	Mn	P Max.	S Max.	Si	Cr	Ni	Mo	V
.23/.33	.80/1.00	.015	.015	.20/.35	.75/.95	1.65/2.00	.35/.50	.05/.10

APPLICATIONS — Intended for high strength structural applications with good ductility and relatively high impact strength. In order to insure through-hardening characteristics when oil quenched, it may be used in section thicknesses up to 2 1/2" diameter round at time of heat treatment.

HARDENABILITY — End-quench hardenability values are Rockwell "C" 49 minimum at 1 1/16" and Rockwell "C" 45 minimum at 2 1/16".

MECHANICAL PROPERTIES — Response to heat treatment and transverse ductility of this alloy are evaluated by means of tension tests performed on samples taken from mid-radius location of the top and bottom of marker billets. After heat treatment, the following transverse tensile properties are attained:

Cross Section Area Square Inches	Tensile Strength psi min.	Yield Strength psi. min.	% Reduction of Area		
			Average All Tests	Lowest Single Test	V-Charpy of Area % Ft. Lbs.
Up to 144", incl.	220,000	185,000	35 min.	30	
Over 144" to 225"	220,000	185,000	30 min.	25	
Over 225"	220,000	185,000	25 min.	20	
			Elongation % in 2"		
Longitudinal properties	220,000	185,000	10 min.	35 min.	15 min.

HEAT TREATMENT

Normalize — 1700°F; Austenitize — 1600°F; Quench — Oil, 150°F maximum
 Temper — 575°F minimum for 220,000 min. psi strength level
 850°F minimum for 180,000 min. psi strength level



4330 MOD VAR PREMIUM AIRCRAFT QUALITY ROUNDS
Normalized and Tempered
Physical Condition E
 Stock Lengths 12' Approx.

Size in Inches	Estimated Weight, Lbs.		Size in Inches	Estimated Weight, Lbs.	
	Per Foot	12-Ft. Bar		Per Foot	12-Ft. Bar
Centerless Ground Surface Condition 4			Hot Rolled Surface Condition 1		
1/2	.6682	8.019	2	10.69	128.3
5/8	1.044	12.53	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
1	2.673	32.07	5/8	18.42	221.0
	1/8	3.383	40.59	3/4	20.21	242.6
1/4	4.176	50.12	7/8	22.09	265.1
3/8	5.053	60.64	3	24.06	288.7
1/2	6.014	72.17		1/4	28.23	338.8
5/8	7.058	84.70	1/2	32.74	392.9
3/4	8.186	98.23	4	42.77	513.2
7/8	9.397	112.8		1/2	54.13	649.5
			5	66.82	801.9
			6	96.22	1155

300M V A R (CEVM)
(E4340 Modified)
AMS 6417 AMS 2300

Color Marking: Ends painted Brown and Yellow Stripe

This steel is a chromium-nickel-molybdenum alloy similar to 4340, but modified by the addition of vanadium and a higher silicon content. The silicon acts to displace the 500° F temper embrittlement range to higher temperatures. The overall alloy content acts to produce higher strength levels without the necessity of increasing the carbon content. Thus, this alloy offers a combination of toughness and ductility at high strength levels. It is a deep hardening steel with excellent torque properties. It has high fatigue and creep characteristics and maintains its strength at moderately high temperatures.

This grade is available as a consumable electrode vacuum remelted product. This insures a steel of the highest quality with excellent transverse ductility and toughness at high strength levels. It also insures the non-metallic cleanliness of this alloy meeting AMS 2300, thus making it most suitable for the fabrication of parts subjected to magnetic particle inspection.

ANALYSIS

C	Mn	P Max.	S Max.	Si	Cr	Ni	Mo	V
.40/.43	.65/.90	.010	.010	1.45/1.80	.70/.95	1.65/2.00	.35/.45	.05/.10

APPLICATIONS — Intended for ultra high strength structural applications with sections 3" or less in thickness at the time of heat treatment in order to insure through-hardening characteristics.

HARDENABILITY — End-Quench hardenability values are Rockwell "C" 55 minimum at ⁸/₁₆" and Rockwell "C" 53 minimum at ²⁰/₁₆".

MECHANICAL PROPERTIES — Response to heat treatment and transverse ductility of this alloy are assured by means of tension tests performed on samples taken from mid-radius and center location of the top and bottom of billets or bars. After heat treatment, the following properties are attained:

Nominal Area	Tensile Strength psi min.	Yield Strength psi. min.	% Reduction of Area	
			Average All Tests	Lowest Single Test
Up to 100 sq. in.	280,000	230,000	30 min.	25
100 to 144 sq. in.	280,000	230,000	25 min.	20

HEAT TREATMENT

- Normalize-1700° F
- Austenitize-1600° F
- Quench-Oil, 140° F maximum
- Temper-500°/600° F for 270,000 psi strength level



300M VAR Aircraft Rounds
Normalized and Tempered
 Physical Condition E
 Stock Lengths 12' Approx.

Centerless Ground Surface Condition 4			Hot Rolled Surface Condition 1					
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
1/2	.6682	8.019	1 1/4	4.176	50.12	3	24.06	288.7
3/4	1.504	18.04	7/16	5.523	66.28	1/4	28.23	338.8
1	2.673	32.07	1/2	6.014	72.17	1/2	32.74	392.9
1/8	3.383	40.59	5/8	7.058	84.70	3/4	37.59	451.0
1/4	4.176	50.12	3/4	8.186	98.23	4	42.77	513.2
3/8	5.053	60.64	2	10.69	128.3	1/4	48.28	579.3
1/2	6.014	72.17	1/4	13.53	162.4	1/2	54.13	649.5
5/8	7.058	84.70	1/2	16.71	200.5	5	66.82	801.9
3/4	8.186	98.23	3/4	20.21	242.6	1/2	80.86	970.2
						6	96.22	1155

NITRIDING #3 (135 Modified)
AIRCRAFT QUALITY ALLOY BARS
AMS-S-6709 AMS 6472 AMS 2301

Color Marking: Ends painted Blue and Orange

Nitriding #3 (135 Modified) is a chromium-molybdenum aluminum alloy steel that can be heat treated to develop high core strength and then nitrided to produce extremely high case hardness. This combination of properties is useful when requirements call for high surface hardness for wear and abrasion, for strength and hardness at temperatures up to approximately 1000°F, and for increased fatigue strength and resistance to corrosion.

ANALYSIS

C	Mn	P	S	Si	Cr	Mo	Al
.38/.43	.50/.70	.025 Max.	.025 Max.	.20/.40	1.40/1.80	.30 / .40	
.95/1.30							

APPLICATIONS — Used for nitrided parts requiring high surface hardness, resistance to heat, and less distortion than parts fabricated from steel requiring quenching to case harden.

HARDENABILITY — End quench hardenability values are Rockwell “C” 50 maximum at ⁸/₁₆” and Rockwell “C” 45 minimum at ¹²/₁₆”.

MECHANICAL PROPERTIES — The following properties apply to material in Physical Conditions F (hardened and tempered):

Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2”	Reduction of Area
112,000 Min.	90,000 Min.	16% Min.	50% Min.



NITRIDING #3 (Modified)
AIRCRAFT QUALITY ROUNDS
 Stock Lengths 12' Approx.

Heat Treated and Cold Finished						Hot Rolled					
Physical Condition E						Physical Condition E					
Surface Condition 4						Surface Condition 1					
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	20-ft. Bar		Per Foot	20-ft. Bar
3/8	.3759	4.510	1 3/8	5.053	60.64	1 5/8	7.058	141.2	3 1/4	28.23	564.6
1/2	.6682	8.019	1/2	6.014	72.17	3/4	8.186	163.7	1/2	32.74	654.8
5/8	1.044	12.53	5/8	7.058	84.70	7/8	9.397	189.9	3/4	37.59	751.7
3/4	1.504	18.04	3/4	8.186	98.23	2	10.69	213.8	4	42.77	855.3
7/8	2.046	24.56	2	10.69	128.3	1/8	12.07	241.4	1/4	48.28	965.6
1	2.673	32.07	1/4	13.53	162.4	1/4	13.53	270.6	1/2	54.13	1083
1/8	3.383	40.59	1/2	16.71	200.5	3/8	15.08	301.5	5	66.82	1336
3/16	3.769	45.23	3/4	20.21	242.6	1/2	16.71	334.1	1/2	80.86	1617
1/4	4.176	50.12	1/2	16.71	200.5	3/4	20.21	404.3	6	96.22	1924
			3/4	20.21	242.6	3	24.06	481.1	1/2	112.9	2259

HS 220-18
SPECIAL QUALITY AIRCRAFT ALLOY BARS
AMS S 7108 AMS 6418 AMS 2301 DMS 1841

Color Marking: Ends painted Purple with Pink Stripe

HS 220-18 is a low carbon, high silicon, chromium-nickel-molybdenum alloy steel. It was one of the first grades developed in the high strength class, combining strength with toughness and ductility. It has relatively high impact resistance because of its low notch sensitivity at the high hardness at which this alloy is commonly used. It is available as a basic electric furnace air melt and vacuum degassed product to meet the high aircraft quality standards of AMS 2301. In addition, this alloy is produced as Special Aircraft Quality to insure transverse ductility and toughness.

ANALYSIS

C	Mn	P Max.	S Max.	Si	Cr	Ni	Mo
.23/.28	1.20/1.50	.025	.025	1.30/1.70	.20/.40	1.65/2.00	.35/.45

APPLICATIONS — Intended for use in the manufacturing of parts and components requiring high strength and good ductility with relatively high impact strength at room and lower temperatures.

HARDENABILITY — End-quench hardenability values are Rockwell “C” 47 minimum at ⁸/₁₆” and Rockwell “C” 45 minimum at ²⁴/₁₆”.

MECHANICAL PROPERTIES — Response to heat treatment and transverse ductility of this alloy are assured by tension tests performed on samples taken from the mid-radius and center location of the top and bottom of the first, middle, and last ingots of a heat. Results of the center tests are for information only. Results of the mid-radius tests after heat treatment are:

Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2” %	% Reduction of Area		V-Charpy Ft. Lbs.
			Average of All Tests	Lowest Single Value	
220/245,000	185,000 Min.	5 Min.	20 Min.	15	12 Min.

HEAT TREATMENT

Normalize — 1725°F
 Austenitize — 1600°F

Quench — Oil, 140°F maximum
 Temper — 550/575°F

HS 220-18 Aircraft Rounds
Hot Rolled Normalized and Tempered
 Physical Condition E
 Surface Condition I
 Stock Lengths 20’ Approx.



Size in Inches	Estimated Weight, Lbs.		Size in Inches	Estimated Weight, Lbs.	
	Per Foot	20-Ft. Bar		Per Foot	20-Ft. Bar
1/2	.6682	13.36	2	10.69	213.8
3/4	1.504	30.07		1/4	13.53	207.6
1	2.673	53.46	1/2	16.71	334.1
1/4	4.176	83.53	3/4	20.21	404.3
1/2	6.014	120.3	3	24.06	481.1
5/8	7.058	141.2	1/2	32.74	654.8
3/4	8.186	163.7	3/4	37.59	751.7
7/8	9.397	187.9	4	42.77	855.3

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