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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SECTION G

ALLOY STEELS

HARDENING GRADES

CARBURIZING GRADES

FOR AIRCRAFT QUALITY ALLOY STEELS - REFER TO SEC. H

4130

CHROMIUM-MOLYBDENUM STEEL

BARS AND PLATES

UNS G41300

Color Marking

As Rolled Rounds — Ends Olive and White
Heat Treated Bars — Ends Orange and Purple
As-Rolled Plates — Corner Striped Olive and White
Heat Treated Plates — Corner Striped Orange and Purple

This is a through-hardening alloy of great versatility. The chromium and molybdenum content is sufficient to provide through hardness penetration in fairly light sections. Good mechanical properties may be obtained by normalizing only where the required strength is not too high. This grade responds to nitriding for excellent wear and abrasion resistance.

Its carbon content causes this alloy to be considered as an oil hardening or water hardening grade. It also imparts a degree of weldability not found in the higher carbon alloys. Other processing characteristics, such as machinability and formability make it a widely accepted and useful alloy.

ANALYSIS

C	Mn	P	S	Si	Cr	Mo
.28/.33	.40/.60	.035 Max.	.040 Max.	.15/.35	.80/1.10	.15/.25

APPLICATIONS — Shafting, axles, gears, sprockets, piston rods, reamer bodies, well-head components, tool joints, fasteners, hand tools.

MECHANICAL PROPERTIES and HARDENABILITY — Refer To Sec. R.

MACHINABILITY — In the annealed condition, this grade has a machinability rating of 72% of 1212, with a surface cutting speed of 120 feet per minute.

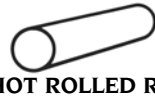
WELDABILITY — This grade may be welded by any of the common welding processes. Preheating and postheating are recommended for difficult weldments. The grade of welding rod to be used depends upon thickness of section, design, service requirements, etc.

FORGING — Heat to 2150º-2250ºF.

NORMALIZING — Heat to 1600º-1700ºF. Cool in air. Average Brinell Hardness, 167.

ANNEALING — Heat to 1500º-1600ºF. Cool slowly in furnace. Average Brinell Hardness, 149.

HARDENING — Hardening range is 1550º-1600ºF for water quench, and 1575º-1625º F for oil quench. A wide range of mechanical properties can be obtained by tempering between 400º and 1300ºF.



4130 HOT ROLLED ROUNDS

Stock Lengths 19' to 21'

Size In Inches	Estimated Weight, Lbs. Per Foot	20-Ft. Bar	Size In Inches	Estimated Weight, Lbs. Per Foot	20-Ft. Bar
1 3/8	5.053	101.1	5	66.82	1336
1/2	6.014	120.3	1/4	73.67	1473
5/8	7.058	141.2	1/2	80.86	1617
3/4	8.186	163.7	3/4	88.37	1767
7/8	9.397	187.9	6	96.22	1924
2	10.69	213.8	1/4	104.4	2088
1/8	12.07	241.4	1/2	112.9	2259
1/4	13.53	270.6	3/4	121.8	2426
3/8	15.08	301.5	7	131.0	2619
1/2	16.71	334.1	1/4	140.5	2810
5/8	18.42	368.4	1/2	150.4	3007
3/4	20.21	404.3	3/4	160.5	3211
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	4092
5/8	35.12	702.5	9	216.5	4330
3/4	37.59	751.7	1/2	241.2	4824
4	42.77	855.3	3/4	254.1	5082
1/4	48.28	965.6	10	267.3	5346
1/2	54.13	1083	11	323.4	6468
3/4	60.31	1206	13	451.7	9034

4130 HOT ROLLED PLATES

As Rolled or Heat Treated

Size In Inches	Estimated Weight, Lbs. Per Foot	20-Ft. Bar	Size In Inches	Estimated Weight, Lbs. Per Foot	20-Ft. Bar
1/2	.1418	20.42	2 3/4	.7799	112.3
5/8	.1773	25.52	3	.8508	122.5
3/4	.2127	30.63	1/4	.9217	132.7
7/8	.2481	35.73	1/2	.9926	142.9
1	.2836	40.84	3/4	1.064	153.1
1/4	.3545	51.05	4	1.134	163.4
1/2	.4254	61.26	1/2	1.276	183.8
3/4	.4963	71.47	5	1.418	204.2
2	.5672	81.68	6	1.702	245.0
1/4	.6381	91.89	7	1.985	285.9
1/2	.7090	102.1			

4140/42/45/50

UNS G41400, G41420, G41450, G41500
41L40/42, 41L50 (LEADED)
Chromium-Molybdenum Steel
Bars and Plates

Color Marking

4140/42/45: Annealed Bars – Ends painted Black and Red
Heat Treated Bars – Ends painted Brown and Gold
Plates – Corner Striped Gray

41L40/42: Annealed Bars – Ends painted Blue and Green
Heat Treated Bars – Ends painted Gray and Pink

4150: Annealed Bars – Ends painted purple with Olive Stripe
Heat Treated Bars – Ends painted Orange with Black Stripe

41L50: Annealed Bars – Ends painted Orange with White Stripe
Heat Treated Bars – Ends painted Orange with Black Stripe

These are oil-hardening steels of relatively high hardenability. Their chromium content provides good hardness penetration, and the molybdenum imparts uniformity of hardness and high strength. These grades are especially suitable for forging because they have self-scaling characteristics. They respond readily to heat treatment and are comparatively easy to machine in the heat treated condition. They resist creep in temperatures up to 1000º F and maintain their properties even after long exposure at these relatively high working temperatures. With a combination of such highly desirable properties as good strength and wear resistance, excellent toughness coupled with good ductility, and the ability to resist stress at elevated temperatures, it is understandable why these are widely used and highly successful alloy steels.

This material is also available as leaded steel. The addition of lead improves machinability without sacrificing other desirable properties, with the exception that the use of this material is not recommended for applications over 400º F, since at elevated temperature ductility is low.

The following specifications are generally applicable for 4140/42 Heat Treated Rounds: ASTM A 193, Grade B7; ASTM A 434, Grades BC and BD.

ANALYSIS

	C	Mn	P Max.	S Max.	Si	Cr	Mo
4140	.38/.43	.75/1.00	.035	.040	.15/.35	.80/1.10	.15/.25
4142	.40/.45	.75/1.00	.035	.040	.15/.35	.80/1.10	.15/.25
4145	.43/.48	.75/1.00	.035	.040	.15/.35	.80/1.10	.15/.25
4150	.48/.53	.75/1.00	.035	.040	.15/.35	.80/1.10	.15/.25

The analyses of the leaded grades are the same as above with the addition of .15/.35 Lead (Pb).

APPLICATIONS – Drill collars, kelly bars, bolts, subs, couplings, reamer bodies, rotary table shafting, oil well tool joints, axle shafts, valves, high-temperature bolts, sprockets, trailer axles, winch shafts, piston rods, rams, hydraulic machinery shafts, precision lead screws, chain links, spindles, stay bolts, tractor axles, tractor arms, zinc die-casting dies, etc.

MECHANICAL PROPERTIES and HARDENABILITY – Refer To Sec. R. Also see Bottom of Page 7 of this section for specific data on heat treated bars.

MACHINABILITY – 41L42 has a machinability rating in the annealed condition of approximately 77% of 1212, as compared with 66% for 4142 without lead. Surface cutting speed of 41L42 is approximately 127 feet per minute.

WELDABILITY – Difficult to weld, but can be welded by any of the common welding processes providing section is preheated, and stress relieved after welding. The grade of welding rod to be used depends upon thickness of section, design, service requirements, etc. When welding leaded material, adequate ventilation should be provided to prevent accumulation of fumes.

FORGING – Heat to 2100º-2200ºF.

NORMALIZING – Heat to 1600º-1700ºF. Cool in air. Average Brinell Hardness, 285.

ANNEALING – Heat to 1450º-1550ºF. Cool slowly in furnace. Average Brinell Hardness, 187.

HARDENING – Hardening range is between 1525º and 1625ºF. Quench in oil. A wide range of mechanical properties can be obtained by tempering between 400º and 1300ºF.

For 4140 AIRCRAFT QUALITY BARS, refer to Section H.

4140/42/45/50 AND 41L40/42/50
HOT ROLLED ANNEALED ROUNDS*
Machine straightened – Maximum Brinell 212

Stock Lengths 20' Approx.

Size In Inches	Est. Wt., Lbs. Per Foot	20-Ft. Bar	Size In Inches	Est. Wt., Lbs. Per Foot	20-Ft. Bar	Size In Inches	Est. Wt., Lbs. Per Foot	20-Ft. Bar	Size In Inches	Est. Wt., Lbs. Per Foot	20-Ft. Bar
3/8	.3759	7.517	3	24.06	481.1	8	171.1	3421	16	684.26	13685
1/2	.6682	13.36	1/8	26.10	522.0	1/4	181.9	3638	1/4	705.81	14116
9/16	.8457	16.91	1/4	28.23	564.6	1/2	181.9	3862	1/2	727.70	14554
5/8	1.044	20.88	3/8	30.45	608.9	3/4	204.6	4093	17	772.47	15449
11/16	1.263	25.27	1/2	32.74	654.8	9	216.5	4330	1/4	795.35	15907
3/4	1.504	30.07	5/8	35.12	702.5	1/4	228.7	4574	18	866.02	17320
7/8	2.046	40.93	3/4	37.59	751.7	1/2	241.2	4824	1/4	890.24	17805
1	2.673	53.46	7/8	40.14	802.7	3/4	254.1	5082	19	964.92	19298
1/8	3.383	67.66	4	42.77	855.3	10	267.3	5346	1/2	1016.37	20327
1/4	4.176	83.53	1/8	45.48	909.6	1/4	280.8	5616	3/4	1042.60	20852
5/16	4.604	92.09	1/4	48.28	965.6	1/2	294.7	5894	20	1069.16	21383
3/8	5.053	101.1	1/2	54.13	1083	11	323.4	6468	1/2	1123.29	22466
7/16	5.523	110.5	5/8	57.18	1143	1/2	353.5	7070	3/4	1150.85	23017
1/2	6.014	120.3	3/4	60.31	1206	12	384.9	7698	21	1178.75	23575
5/8	7.058	141.2	5	66.82	1336	1/4	401.1	8022	1/4	1206.98	24140
3/4	8.186	163.7	1/8	70.21	1404	1/2	417.6	8353	1/2	1235.55	24711
7/8	9.397	187.9	1/4	73.67	1473	13	451.72	9034	22	1293.68	25874
2	10.69	213.8	3/8	77.22	1544	1/4	469.26	9385	3/4	1383.39	27668
1/8	12.07	241.4	1/2	80.86	1617	1/2	487.14	9743	23	1413.96	28279
1/4	13.53	270.6	3/4	88.37	1767	14	523.89	10478	1/4	1444.87	28897
3/8	15.08	301.5	6	96.22	1924	3/8	552.33	11047	1/2	1476.11	29522
1/2	16.71	334.1	1/4	104.4	2088	1/2	561.98	11240	24	1539.59	30792
5/8	18.42	368.4	1/2	112.9	2259	3/4	581.52	11630	26	1806.88	36138
3/4	20.21	404.3	3/4	121.8	2436	7/8	591.42	11828	1/2	1877.04	37541
7/8	22.09	441.9	7	131.0	2619	15	601.40	12028	28	2095.55	41911
			1/4	140.5	2810	1/2	642.16	12843	30	2405.61	48112
			1/2	150.4	3007	7/8	673.61	13472	32	2737.05	54741
			3/4	160.5	3211						

4140/42 and 41L40/42/50
ANNEALED and COLD DRAWN ROUNDS
Maximum Brinell 235 – Stock Lengths 12' Approx.

Size In Inches	Estimated Weight, Lbs. Per Foot	12-Ft. Bar	Size In Inches	Estimated Weight, Lbs. Per Foot	12-Ft. Bar
3/16	.0940	1.130	1 11/16	7.612	91.34
1/4	.1671	2.005	3/4	8.186	98.23
5/16	.2610	3.132	13/16	8.781	105.4
3/8	.3759	4.510	7/8	9.397	112.8
7/16	.5116	6.139	15/16	10.03	120.4
1/2	.6682	8.019	2	10.69	128.3
9/16	.8457	10.15	1/8	12.07	144.8
5/8	1.044	12.53	3/16	12.79	153.5
11/16	1.263	15.16	1/4	13.53	162.4
3/4	1.504	18.04	3/8	15.08	180.9
13/16	1.765	21.17	7/16	15.88	190.6
7/8	2.046	24.56	1/2	16.71	200.5
15/16	2.349	28.19	5/8	18.42	221.0
1	2.673	32.07	3/4	20.21	242.6
1/16	3.017	36.21	7/8	22.09	265.1
1/8	3.383	40.59	15/16	23.06	276.8
3/16	3.769	45.23	3	24.06	288.7
1/4	4.176	50.12	1/8	26.10	313.2
5/16	4.604	55.25	1/4	28.23	338.8
3/8	5.053	60.64	1/2	32.74	392.9
7/16	5.523	66.28	3/4	37.59	451.0
1/2	6.014	72.17	4	42.77	513.2
9/16	6.526	78.31	1/4	48.28	579.3
5/8	7.058	84.70	1/2	54.13	649.5
			5	66.82	801.9

***For press forged rough turned add 1/4".**

4140/42/50 AND 41L40/42/50

HOT ROLLED HEAT TREATED ROUNDS

Quenched and Tempered – Machine Straightened

For mechanical properties, see bottom of opposite page

Stock Lengths 20' Approx.

Size In Inches	Est. Wt., Lbs. Per Foot	Est. Wt., Lbs. 12-Ft. Bar
1/4	.1671	3.341
5/16	.2610	5.220
3/8	.3759	7.517
7/16	.5116	10.23
1/2	.6682	13.36
9/16	.8457	16.91
5/8	1.044	20.88
11/16	1.263	25.27
3/4	1.504	30.07
7/8	2.046	40.93
1	2.673	53.46
1/16	3.017	60.35
1/8	3.383	67.66
3/16	3.769	75.38
1/4	4.176	83.53
5/16	4.064	92.09
3/8	5.053	101.1
7/16	5.523	110.5
1/2	6.014	120.3
5/8	7.058	141.2
3/4	8.186	163.7
7/8	9.397	187.9
2	10.69	213.8
1/8	12.07	214.4
1/4	13.53	270.6
2 3/8	15.08	301.5
1/2	16.71	334.1
5/8	18.42	368.4
3/4	20.21	404.3
7/8	22.09	441.9
3	24.06	481.1
1/8	26.10	522.0
1/4	28.23	564.6
3/8	30.45	608.9
1/2	32.74	654.8
5/8	35.12	702.5
3/4	37.59	751.7
7/8	40.14	802.7
4	42.77	855.3
1/8	45.48	909.6
1/4	48.28	965.6
1/2	54.13	1083
5/8	57.18	1143
3/4	60.31	1206
7/8	63.52	1270
5	66.82	1336
1/4	73.67	1473
1/2	80.86	1617
3/4	88.37	1767
6	96.22	1924
6 1/4	104.4	2088
1/2	112.9	2259
3/4	121.8	2436
7	131.0	2619
1/4	140.5	2810
1/2	150.4	3007
3/4	160.5	3211
8	171.1	3421
1/4	181.9	3638
1/2	193.1	3862
3/4	204.6	4093
9	216.5	4330
1/4	228.7	4574
1/2	241.2	4824
3/4	254.1	5082
10	267.3	5346
1/4	280.8	5616
1/2	294.7	5894
11	323.4	6468
1/2	353.5	7070
12	384.9	7698
1/2	417.6	8353

Size	OD	Hot Rolled Wt./Ft.	Hot Rolled WT 20 FT Bar	Press Forged Rough Turned 1/4" Over	Press Forged Wt./Ft.	Press Forged WT 20 FT Bar
13	13.000	451.72	9034	13.250	469.26	9385
1/4	13.250	469.26	9385	13.500	487.14	9743
1/2	13.500	487.14	9743	13.750	505.35	10107
14	14.000	523.89	10478	14.250	542.77	10855
3/8	14.375	552.33	11047	14.625	571.71	11434
1/2	14.500	561.98	11240	14.750	581.52	11630
3/4	14.750	581.52	11630	15.000	601.40	12028
7/8	14.875	591.42	11828	15.125	611.47	12229
15	15.000	601.40	12028	15.250	621.62	12432
1/2	15.500	642.16	12843	15.750	663.05	13261
7/8	15.875	673.61	13472	16.125	695.00	13900
16	16.000	684.26	13685	16.250	705.81	14116
1/4	16.250	705.81	14116	16.500	727.7	14554
1/2	16.500	727.70	14554	16.750	749.92	14998
17	17.000	772.47	15449	17.250	795.35	15907
1/4	17.250	795.35	15907	17.500	818.58	16372
18	18.000	866.02	17320	18.250	890.24	17805
1/4	18.250	890.24	17805	18.500	914.80	18296
19	19.000	964.92	19298	19.250	990.48	19810
1/2	19.500	1016.37	20327	19.750	1042.60	20852
3/4	19.750	1042.60	20852	20.000	1069.16	21383

4140/42/50 AND 41L40/42/50

HOT ROLLED HEAT TREATED ROUNDS

Quenched and Tempered – Machine Straightened

For mechanical properties, see bottom of opposite page

Stock Lengths 20' Approx.

Size	OD	Hot Rolled Wt./Ft.	Hot Rolled WT 20 FT Bar	Press Forged Rough Turned 1/4" Over	Press Forged Wt./Ft.	Press Forged WT 20 FT Bar
20	20.000	1069.16	21383	20.250	1096.06	21921
1/2	20.500	1123.29	22466	20.750	1150.85	23017
3/4	20.750	1150.85	23017	21.000	1178.75	23575
21	21.000	1178.75	23575	21.250	1206.98	24140
1/4	21.250	1206.98	24140	21.500	1235.55	24711
1/2	21.500	1235.55	24711	21.750	1264.45	25289
22	22.000	1293.68	25874	22.250	1323.25	26465
3/4	22.750	1383.39	27668	23.000	1413.96	28279
23	23.000	1413.96	28279	23.250	1444.87	28897
1/4	23.250	1444.87	28897	23.500	1476.11	29522
1/2	23.500	1476.11	29522	23.750	1507.68	30154
24	24.000	1539.59	30792	24.250	1571.83	31437
26	26.000	1806.88	36138	26.250	1841.80	36836
1/2	26.500	1877.04	37541	26.750	1912.63	38253
28	28.000	2095.55	41911	28.250	2133.14	42663
30	30.000	2405.61	48112	30.250	2445.87	48917
32	32.000	2737.05	54741	32.250	2779.98	55600

4140/42 AND 41L40/42

HEAT TREATED COLD DRAWN OR G & P ROUNDS

For mechanical properties, see bottom of opposite page.

Stock Lengths 12' and 20'

Size In Inches	Estimated Weight, Lbs. Per Foot	12-Ft. Bar
1/4	.1671	2.005
5/16	.2610	3.132
3/8	.3759	4.510
7/16	.5116	6.139
1/2	.6682	8.019
9/16	.8457	10.15
5/8	1.044	12.53
11/16	1.263	15.16
3/4	1.504	18.04
13/16	1.765	21.17
7/8	2.046	24.56
15/16	2.349	28.19
1	2.673	32.07
1/16	3.017	36.21
1/8	3.383	40.59
3/16	3.769	45.23
1/4	4.176	50.12
5/16	4.604	55.25
3/8	5.053	60.64
7/16	5.523	66.28
1/2	6.014	72.17
9/16	6.526	78.31
5/8	7.058	84.70

Size In Inches	Estimated Weight, Lbs. Per Foot	12-Ft. Bar
1 11/16	7.612	91.34
3/4	8.186	98.23
13/16	8.781	105.4
7/8	9.397	112.8
15/16	10.03	120.4
2	10.69	128.3
1/8	12.07	144.8
1/4	13.53	162.4
5/16	14.29	171.5
3/8	15.08	180.9
7/16	15.88	190.6
1/2	16.71	200.5
5/8	18.42	221.0
3/4	20.21	242.6
15/16	23.06	276.8
3	24.06	288.7
1/8	26.10	313.2
3/16	27.16	325.9
1/4	28.23	338.8
3/8	30.45	365.4
1/2	32.74	392.9
3/4	37.59	451.0
15/16	41.44	497.3
4	42.77	513.2

4140 ANNEALED AND COLD DRAWN HEXAGONS

Maximum Brinell 235

Stock Lengths 12' Approx.

Size In Inches	Est. Wt., Lbs. Per Foot	12-Ft. Bar	Size In Inches	Est. Wt., Lbs. Per Foot	12-Ft. Bar
7/16	.5641	6.769	1 3/8	5.572	66.87
1/2	.7368	8.842	7/16	6.090	73.08
9/16	.9325	11.19	1/2	6.631	79.56
5/8	1.151	13.82	5/8	7.783	93.39
11/16	1.393	16.72	11/16	8.393	100.7
3/4	1.658	19.89	3/4	9.026	108.3
13/16	1.946	23.35	7/8	10.36	124.3
7/8	2.257	27.08	2	11.79	141.5
15/16	2.590	31.08	1/8	13.31	159.7
1	2.947	35.37	1/4	14.92	179.0
1/16	3.327	39.93	1/2	18.42	221.0
1/8	3.730	44.76	3/4	22.29	267.5
1/4	4.605	55.26	3	26.53	318.3
5/16	5.077	60.93			

4140/42 SQUARES

Hot Rolled Heat Treated			Annealed & Cold Drawn		
Size In Inches	Est. Wt., Lbs. Per Foot	12-Ft. Bar	Size In Inches	Est. Wt., Lbs. Per Foot	12-Ft. Bar
1	3.403	68.06	1/4	.2127	2.552
1/8	4.307	86.14	3/8	.4786	5.743
1/4	5.318	106.4	7/16	.6514	7.817
1/2	7.657	153.1	1/2	.8508	10.21
3/4	10.42	208.4	9/16	1.077	12.92
2	13.61	272.3	5/8	1.329	15.95
1/4	17.23	344.6	3/4	1.914	22.97
3/8	19.20	383.9	7/8	2.606	31.27
1/2	21.27	425.4	1	3.403	40.84
3/4	25.74	514.7	1/8	4.307	51.69
3	30.63	612.6	1/4	5.318	63.81
1/2	41.69	833.8	3/8	6.434	77.21
4	54.45	1089	1/2	7.657	91.89
1/2	68.91	1378	3/4	10.42	125.1
			2	13.61	163.4
			1/4	17.23	206.7
			1/2	21.27	255.2
			3	30.63	367.5

4140 HOT ROLLED PLATES

Thickness In Inches	Est. Wt., Lbs. Per Foot	12-Ft. Bar
1/4	.0709	10.21
3/8	.1064	15.31
1/2	.1418	20.42
5/8	.1773	25.52
3/4	.2127	30.63
7/8	.2481	35.73
1	.2836	40.84
1/8	.3191	45.94
1/4	.3545	51.05
3/8	.3900	56.16
1/2	.4254	61.26
3/4	.4963	71.47
2	.5672	81.68
1/4	.6381	91.89
1/2	.7090	102.1
3/4	.7799	112.3
3	.8508	122.5
1/4	.9217	132.7
1/2	.9926	142.9
3/4	1.064	153.1
4	1.134	163.4
1/4	1.204	173.6
1/2	1.276	183.8
3/4	1.347	194.0
5	1.418	204.2
1/2	1.560	224.6
6	1.702	245.0
1/2	1.843	265.5
7	1.985	285.9
1/2	2.127	306.3
8	2.269	326.7
1/2	2.411	347.1
9	2.552	367.6
10	2.836	408.4
11	3.119	449.2
12	3.403	490.1
13	3.687	530.9
14	3.970	571.7
16	4.538	653.4

MECHANICAL PROPERTIES OF 4142 AND 41L42 HEAT TREATED BARS – ASTM A 434*

	Tensile Strength (psi) Minimum	Yield Strength (psi) Minimum	Elongation in 2" Minimum	Reduction of Area Minimum	Surface Brinell Hardness
1 1/2" and under	130,000	110,000	16%	50%	269-321
Over 1 1/2" to 2 1/2"	125,000	105,000	16%	50%	269-321
Over 2 1/2" to 4"	115,000	95,000	16%	45%	269-321
Over 4" to 7"	135,000	105,000	14%	35%	285-341
Over 7" to 9 1/2"	130,000	100,000	14%	35%	285-341

***Also stocked in ASTM A 193 Grade B7 and ASTM A434 Grade BD.**

4340

Nickel-Chromium-Molybdenum Steel

Bars and Plates

UNS G43400

Color Marking

Annealed Bars – Ends Red and Yellow
Heat Treated Bars – Ends Black and Blue
Annealed Plates – Corner Striped Red and Yellow

This is the "king" of the hardening grades of constructional alloy steels. Because of richer alloy content, 4340 possesses much deeper hardenability than the 4100 series. This advantage is realized principally where high strength is required in heavy sections. In addition, unusually high hardenability insures maximum toughness and ductility at the desired strength level. The fatigue-tensile ratio makes this grade ideal for highly stressed parts. It maintains its strength, ductility, and toughness at relatively high temperatures. It has remarkable non-distorting properties for an alloy steel. Thus, for high strength in heavy sections, or for highly stressed parts operating under the most severe conditions, or where the greatest margin of safety is desired, this is the steel to use.

ANALYSIS

C	Mn	P Max.	S Max.	Si	Cr	Ni	Mo
.38/.43	.60/.80	.035	.040	.15/.35	.70/.90	1.65/2.00	.20/.30

APPLICATIONS – Automotive and marine crank shafts, diesel engine crank shafts and other heavy-duty shafting, axle shafts, dies, subs, gear shafts, gears, mine-drilling parts, oil-well fishing tools, perforating gun bodies, master hobs, etc.

MECHANICAL PROPERTIES and HARDENABILITY – For complete data on this grade, see Sec. R.

MACHINABILITY – This Material has a machinability rating in the annealed condition of approximately 57% of 1212. Surface cutting speed is approximately 95 feet per minute.

WELDABILITY – Difficult to weld, but can be welded by any of the common welding processes providing the section is preheated and stress relieved after welding. The grade of welding rod to be used depends upon thickness of section, design, service requirements, etc.

FORGING – Heat to 2200º-2300ºF.

NORMALIZING – Heat to 1600º-1700ºF. Cool in air. Average Brinell Hardness, 363.

ANNEALING – Heat to 1500º-1600ºF. Cool slowly in furnace. Average Brinell Hardness, 197.

HARDENING – Standard hardening range is between 1475º-1575º F. Quench in oil. A wide range of mechanical properties can be obtained by tempering between 400º and 1200ºF.

For E-4340 AIRCRAFT QUALITY BARS, refer to Section H

4340 HOT ROLLED ANNEALED ROUNDS

Machine Straightened
Maximum Brinell 235
Stock Lengths 20' Approx.

Size In Inches	Estimated Weight, Lbs. Per Foot	20-Ft. Bar	Size In Inches	Estimated Weight, Lbs. Per Foot	20-Ft. Bar
11/16	1.263	25.27	5	66.82	1336
3/4	1.504	30.07	1/4	73.67	1473
7/8	2.046	40.93	1/2	80.86	1617
1	2.673	53.46	3/4	88.37	1767
1/8	3.383	67.66	6	96.22	1924
1/4	4.176	83.53	1/4	104.4	2088
3/8	5.053	101.1	1/2	112.9	2259
1/2	6.014	120.3	3/4	121.8	2436
5/8	7.058	141.2	7	131.0	2619
3/4	8.186	163.7	1/4	140.5	2810
7/8	9.397	187.9	1/2	150.4	3007
2	10.69	213.8	3/4	160.5	3211
1/8	12.07	241.4	8	171.1	3421
1/4	13.53	270.6	1/4	181.9	3638
3/8	15.08	301.5	1/2	193.1	3862
1/2	16.71	334.1	3/4	204.6	4093
5/8	18.42	368.4	9	216.5	4330
3/4	20.21	404.3	1/4	228.7	4574
7/8	22.09	441.9	1/2	241.2	4824
3	24.06	481.1	3/4	254.1	5082
1/8	26.10	522.0	10	267.3	5346
1/4	28.23	564.6	1/2	294.7	5894
1/2	32.74	654.8	11	323.4	6468
5/8	35.12	702.5	1/4	338.3	6766
3/4	37.59	751.7	1/2	353.5	7070
4	42.77	855.3	12	384.9	7698
1/4	48.28	965.6	1/2	417.6	8353
1/2	54.13	1083	13	451.7	9034
3/4	60.31	1206	1/2	487.1	9743

4340 HOT ROLLED ANNEALED PLATES

Thickness In Inches	Estimated Weight, Lbs. Per Sq. Inch	20-Ft. Sq. Foot	Thickness In Inches	Estimated Weight, Lbs. Per Sq. Inch	20-Ft. Sq. Foot
1/2	.1418	20.42	3 1/2	.9926	142.9
5/8	.1773	25.52	4	1.134	163.4
3/4	.2127	30.63	1/2	1.276	183.8
1	.2836	40.84	5	1.418	204.2
1/4	.3545	51.05	1/2	1.560	224.6
1/2	.4254	61.26	6	1.702	245.0
3/4	.4963	71.47	1/2	1.843	265.5
2	.5672	81.68	7	1.985	285.9
1/4	.6381	91.89	8	2.269	326.7
1/2	.7090	102.1	9	2.552	367.6
3/4	.7799	112.3	10	2.836	408.4
3	.8508	122.5	11	3.119	449.2
1/4	.9217	132.7	12	3.403	490.1

5160 SPRING STEEL

Carbon-Chromium Steel

Hot Rolled Bars (As Rolled)

UNS G51600

Color Marking: Ends painted White and Yellow

This is a carbon-chromium grade of spring steel. It has a high yield-tensile strength ratio, excellent toughness, and high ductility. In its production, special care is exercised in rolling and cooling in order to obtain satisfactory cold shearing, punching, and trimming qualities. Its principal use is for automotive leaf springs.

ANALYSIS

C	Mn	P	S	Si	Cr
.55/.65	.75/1.00	.035 Max.	.04 Max.	.15/.35	.70/.90

APPLICATIONS – As the name implies, this grade is primarily used in the manufacture of automotive leaf springs. Other uses include scrapers, equalizers, bumpers, etc.

FORMING and HEAT TREATING – Usual practice for leaf springs is as follows:
Hot form at 1650ºF.
Quench in oil at 1525ºF.
Temper to 38-44 Rockwell "C".

MECHANICAL PROPERTIES – The following values are average and may be considered as representative of this grade:

	Tensile Strength (psi)	Yield Strength (psi)	Elong-ation in 2"	Reduc-tion of Area	Brinell Hard-ness	Izod Impact Ft./Lbs.
Normalized	165,000	97,000	15%	36%	321	6
Annealed	111,000	59,000	18%	42%	229	8
Oil Quenched and Tempered at 1000ºF	198,000	180,000	12%	38%	388	24

MACHINABILITY – This grade is very difficult to machine in the as-rolled condition and it should be annealed prior to machining.

WELDABILITY – This grade, due to carbon and chromium content, is not readily welded. It can, however, be welded by either gas or arc welding process, provided section involved is preheated and stress relieved after welding. The grade of welding rod to be used depends on thickness of section, design, service requirements, etc.

FORGING – Heat to 2100º-2200ºF.

NORMALIZING – Heat to 1600º-1700ºF. Cool in air.

ANNEALING – Heat to 1450º-1550ºF. Cool in furnace.

HARDENING – This grade should be hardened in oil. The recommended quenching temperature is 1525ºF. A wide range of mechanical properties can be obtained by tempering between 800º and 1300ºF.

5160 HOT ROLLED SPRING STEEL FLATS

Double Concave, Round Edge

Stock Lengths 20' to 22'

Thickness		Width	Est. Wt., Lbs.		Thickness		Width	Est. Wt., Lbs.	
Dec. Inches	Nearest Frac.	In Inches	Per Foot	20-Ft. Length	Dec. Inches	Nearest Frac.	In Inches	Per Foot	20-Ft. Length
.214	7/32	1 1/2	1.08	21.6	.360	23/64	1 3/4	2.11	42.2
		2 1/2	1.79	35.8			2	2.41	48.2
.220	7/32	1 3/4	1.28	25.6			2 1/4	2.71	54.2
		2	1.48	29.6			2 1/2	3.01	60.2
		2 1/4	1.66	33.2			3	3.61	72.2
		2 1/2	1.84	36.8			3 1/2	4.22	84.4
.238	15/64	1 1/2	1.20	24.0			4	4.82	96.4
		1 3/4	1.39	27.8	.375	3/8	1 3/4	2.20	44.0
		2	1.60	32.0			2	2.51	50.2
		2 1/4	1.80	36.0			2 1/4	2.83	56.6
		2 1/2	1.99	39.8			2 1/2	3.14	62.8
		2 3/4	2.20	44.0			3	3.77	75.4
.250	1/4	1 3/4	1.46	29.2			3 1/2	4.39	87.8
		2	1.68	33.6			4	5.03	100.6
		2 1/4	1.88	37.6			6	7.54	150.8
		2 1/2	2.09	41.8	.401	3/8	1 3/4	2.35	47.0
		3	2.51	50.2			2	2.69	53.8
		3 1/2	2.93	58.6			2 1/4	3.02	60.4
		4	3.35	67.0			2 1/2	3.36	67.2
.262	17/64	1 3/4	1.54	30.8			3	4.03	80.6
		2	1.75	35.0			3 1/2	4.70	94.0
		2 1/4	1.98	39.6			4	5.38	107.6
		2 1/2	2.20	44.0	.438	7/16	2 1/4	3.30	66.0
		3	2.63	52.6			2 1/2	3.67	73.4
		3 1/2	3.07	61.4			3	4.40	88.0
		4	3.50	70.0			3 1/2	5.14	102.8
.284	9/32	1 3/4	1.67	33.4			4	5.87	117.4
		2	1.90	38.0	.447	29/64	2 1/2	3.74	74.8
		2 1/4	2.14	42.8			3	4.49	89.8
		2 1/2	2.38	47.6			3 1/2	5.24	104.8
.291	19/64	1 3/4	1.70	34.0			4	5.99	119.8
		2	1.94	38.8	.500	1/2	3	5.03	100.6
		2 1/4	2.20	44.0			3 1/2	5.86	117.2
		2 1/2	2.44	48.8			4	6.70	134.0
		3	2.93	58.6			5	8.38	167.6
.312	5/16	1 3/4	1.82	36.4			6	10.04	200.8
		2	2.09	41.8	.558	9/16	4	7.48	149.6
		2 1/4	2.35	47.0	.625	5/8	3	6.28	125.6
		2 1/2	2.62	52.4			3 1/2	7.32	146.4
		3	3.13	62.6			4	8.38	167.6
		3 1/2	3.66	73.2			5	10.46	209.2
		4	4.18	83.6			6	12.55	251.0
.323	21/64	1 3/4	1.90	38.0	.750	3/4	4	10.04	200.8
		2	2.16	43.2			5	12.55	251.0
		2 1/4	2.44	48.8			6	15.07	301.4
		2 1/2	2.70	54.0	.788	25/32	4	10.55	211.0
		3	3.24	64.8			5	13.19	263.8
		3 1/2	3.78	75.6	.875	7/8	5	14.65	293.0
		4	4.33	86.6	1.000	1	4	13.39	267.8
.340	11/32	2	2.28	45.6			6	20.09	401.8
		2 1/2	2.84	56.8					

6150

Chromium-Vanadium Steel
Bars and Plates
UNS G61500

Color Marking: Ends painted Gold with Aluminum Stripe

This high carbon chromium vanadium alloy is a fine-grained material of importance when rugged abrasive conditions are encountered. Its useful heat treated hardness and strength is higher than that in 4142. In the heat treated condition, it has good wear and abrasion resistance. It possesses excellent toughness and shock resistance, making it a good alloy for highly stressed heavy machinery parts exposed to shock and vibrations.

ANALYSIS

C	Mn	P Max.	S Max.	Si	Cr	V Min.
.48/.53	.70/.90	.035	.040	.15/.35	.80/1.10	.15

APPLICATIONS – Gears, pinions, shafting, axles, machinery parts, springs, heavy duty pins, bolting, and hand tools.

MECHANICAL PROPERTIES and HARDENABILITY – For complete data on this grade, see Sec. R.

MACHINABILITY – This grade has a machinability rating in the annealed condition of approximately 60% of 1212. Surface cutting speed is approximately 110 feet per minute.

WELDABILITY – Difficult to weld, but weldable by any of the common processes providing section is preheated and stress-relieved after welding. Welding rod to be used depends upon section thickness, strength required, design, service requirements, etc.

FORGING – 2150º-2300ºF. Cool slowly.

NORMALIZING – 1600º-1700ºF. Cool in air. Average Brinell Hardness, 262.

ANNEALING – 1500º-1600ºF. Cool slowly. Average Brinell Hardness, 197.

HARDENING – 1550º-1625ºF. Oil quench. Temper to desired hardness.

6150 HOT ROLLED ANNEALED PLATES

Thickness In Inches	Estimated Weight, Lbs. Per Sq. Inch	Per Sq. Foot	Thickness In Inches	Estimated Weight, Lbs. Per Sq. Inch	Per Sq. Foot
1/2	.1418	20.42	2 1/4	.6381	91.89
5/8	.1773	25.52	1/2	.7090	102.1
3/4	.2127	30.63	3/4	.7799	112.3
7/8	.2481	35.73	3	.8508	122.5
1	.2836	40.84	1/4	.9215	132.7
1/8	.3191	45.94	1/2	.9926	142.9
1/4	.3545	51.05	4	1.134	163.4
1/2	.4254	61.26	1/2	1.276	183.8
5/8	.4609	66.36	5	1.418	204.2
3/4	.4963	71.47	6	1.702	245.0
2	.5672	81.68	8	2.269	326.7

6150 HOT ROLLED ANNEALED SQUARES

Maximum Brinell 212

Stock Lengths 16' Approx.

Size In Inches	Estimated Weight, Lbs. Per Foot	16-Ft. Bar	Size In Inches	Estimated Weight, Lbs. Per Foot	16-Ft. Bar
1/2	.8508	13.61	2 1/4	17.23	275.7
5/8	1.329	21.26	1/2	21.27	340.3
3/4	1.914	30.62	3	30.63	490.1
1	3.403	54.45	1/2	41.69	667.0
1/4	5.318	85.09	4	54.45	871.2
1/2	7.657	122.5	1/2	68.91	1103
3/4	10.42	166.7	5	85.08	1361
2	13.61	217.8	6	122.5	1960
			8	217.8	3485

6150 HOT ROLLED ANNEALED ROUNDS

Machine Straightened – Maximum Brinell 212

Stock Lengths 20' Approx.

Size In Inches	Est. Weight, Lbs. Per Foot	20-Ft. Bar
1/4	.1671	3.341
3/8	.3759	7.517
1/2	.6682	13.36
9/16	.8457	16.91
5/8	1.044	20.88
3/4	1.504	30.07
7/8	2.046	40.93
1	2.673	53.46
1/8	3.383	67.66
1/4	4.176	83.53
5/16	4.604	92.09
3/8	5.053	101.1
1/2	6.014	120.3
5/8	7.058	141.2
3/4	8.186	163.7
7/8	9.397	187.9
2	10.69	213.8
1/8	12.07	241.4
1/4	13.53	270.6
3/8	15.08	301.5
1/2	16.71	334.1
5/8	18.42	368.4
2 3/4	20.21	404.3
7/8	22.09	441.9
3	24.06	481.1
1/8	26.10	522.0
1/4	28.23	564.6
3/8	30.45	608.9
1/2	32.74	654.8
5/8	35.12	702.5
3/4	37.59	751.7
7/8	40.14	802.7
4	42.77	855.3
1/8	45.48	909.6
1/4	48.28	965.6
3/8	51.16	1023
1/2	54.13	1083
5/8	57.18	1143
3/4	60.31	1206
7/8	63.52	1270
5	66.82	1336
1/4	73.67	1473
1/2	80.86	1617
3/4	88.37	1767
5 7/8	92.26	1845
6	96.22	1924
1/4	104.4	2088
1/2	112.9	2259
3/4	121.8	2436
7	131.0	2619
1/4	140.5	2810
1/2	150.4	3007
3/4	160.5	3211
7/8	165.8	3316
8	171.1	3421
1/4	181.9	3638
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
13	451.7	9034

6150 HOT ROLLED ANNEALED FLATS

Maximum Brinell 212

Stock Lengths 16' Approx.

Size In Inches	Est. Weight, Lbs. Per Foot	16-Ft. Bar
1/2 x		
1	1.702	27.23
1 1/4	2.127	34.03
1 1/2	2.552	40.83
2	3.403	54.45
2 1/2	4.254	68.06
3	5.105	81.68
3 1/2	5.956	95.30
4	6.806	108.9
5	8.508	136.1
6	10.21	163.4
5/8 x		
1 1/4	2.659	42.54
1 1/2	3.191	51.06
2	4.254	68.06
5	10.64	170.2
3/4 x		
1	2.552	40.83
1 1/4	3.191	51.06
1 1/2	3.829	61.26
2	5.105	81.68
2 1/4	5.743	91.89
2 1/2	6.381	102.1
3	7.657	122.5
4	10.21	163.4
1 x		
1 1/4	4.254	68.06
1 1/2	5.105	81.68
1 3/4	5.956	95.30
2	6.806	108.9
2 1/2	8.508	136.1
2 3/4	9.359	149.7
3	10.21	163.4
3 1/2	11.91	190.6
4	13.61	217.8
5	17.02	272.3
1 x		
6	20.42	326.7
8	27.23	435.7
10	34.03	544.5
1 1/4 x		
1 1/2	6.381	102.1
2	8.508	136.1
2 1/2	10.64	170.2
3	12.76	204.2
3 1/2	14.89	238.2
4	17.02	272.3
5	21.27	340.3
6	25.52	408.3
8	34.03	544.5
1 1/2 x		
1 3/4	8.933	142.9
2	10.21	163.4
2 1/2	12.76	204.2
2 3/4	14.04	224.6
3	15.31	245.0
3 1/2	17.87	285.9
4	20.42	326.7
4 1/2	22.97	367.5
5	25.52	408.3
6	30.63	490.1
8	40.84	653.4
1 3/4 x		
2	11.91	190.6
2 1/4	13.40	214.4
2 1/2	14.89	238.2
3	17.87	285.9
3 1/2	20.84	333.4
4	23.82	381.1
5	29.78	476.5
7	41.69	667.0
8	47.64	762.2
2 x		
2 1/2	17.02	272.3
3	20.42	326.7
3 1/2	23.82	381.1
4	27.23	435.7
4 1/2	30.63	490.1
5	34.03	544.5
6	40.84	653.4
8	54.45	871.2
10	68.06	1089
2 1/2 x		
3	25.52	408.3
3 1/2	29.78	476.5
4	34.03	544.5
4 1/2	38.29	612.6
5	42.54	680.6
5 1/2	46.79	748.6
6	51.05	816.8
8	68.06	1089
3 x		
3 1/2	35.73	571.7
4	40.84	653.4
5	51.05	816.8
6	61.26	980.2
3 1/2 x		
4	47.64	762.2
4 1/2	53.60	857.6
5	59.56	953.0
6	71.47	1144
8	95.29	1525
4 x		
5	68.06	1089
6	81.68	1307
8	108.9	1742

8620
UNS G86200
8620 (Leaded)
Chromium-Nickel-Molybdenum Steel
Bars and Plates

Color Marking
8620: Ends painted Blue and White
86L20: Ends painted Orange and White

These are "triple alloy" carburizing steels. The nickel imparts good toughness and ductility, and the chromium and molybdenum contribute increased hardness penetration and wear. They are readily carburized, and the well-balanced alloy content permits hardening to produce a strong, tough core and high case hardness. They have excellent machinability and respond well to polishing operations. Because of the fine combination of properties that may be developed, as well as the ease with which it may be processed, this material is ideal for a wide variety of applications. In the leaded analysis, machinability is improved without the sacrifice of other desirable properties, with the exception that the use of this material is not recommended for applications over 400ºF since at elevated temperature ductility is low.

ANALYSIS

	C	Mn	P Max.	S Max.	Si	Cr	Ni	Mo
8620	.18/.23	.70/.90	.035	.040	.15/.35	.40/.60	.40/.70	.15/.25

The analysis of the leaded grade is the same as above, with the addition of .15/.35 Lead (Pb).

APPLICATIONS – Gears, pinions, spline shafts, piston pins, oil pump piston rods and liners, cams, oil tool slips, gauges, jigs, plastic molds, jaws, etc.

MECHANICAL PROPERTIES and HARDENABILITY – Refer to Sec. R.

MACHINABILITY – 86L20 has a machinability rating of approximately 77% of 1212, as compared with a rating of 66% for the same analysis without lead. Surface cutting speed is approximately 127 feet per minute.

WELDABILITY – Easily welded by any of the common welding procedures, with the rod to be used dependent upon the section, design, service requirements, etc. Preheating and stress-relieving is recommended. When welding leaded material, adequate ventilation should be provided to prevent accumulation of fumes.

FORGING – Heat to 2150º-2250ºF.

NORMALIZING – Heat to 1650º-1750ºF. Air cool. Average Brinell, 187.

ANNEALING – Heat to 1550º-1600ºF. Furnace cool. Average Brinell, 156.

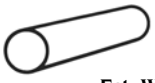
CARBURIZING – Standard treatment, carburize 1650º-1700º F for eight hours oil quench. Temper between 300º-450ºF.

8620 HOT ROLLED PLATES

Thickness In Inches	Estimated Weight, Lbs. Per Sq. Inch	Per Sq. Foot	Thickness In Inches	Estimated Weight, Lbs. Per Sq. Inch	Per Sq. Foot
1/2	.1418	20.42	3	.8508	122.5
5/8	.1773	25.52	1/4	.9217	132.7
3/4	.2127	30.63	1/2	.9926	142.9
7/8	.2481	35.73	4	1.1344	163.4
1	.2836	40.84	1/2	1.2762	183.8
1/8	.3191	45.94	5	1.4180	204.2
1/4	.3545	51.05	1/2	1.5598	224.6
3/8	.3900	56.15	6	1.7016	245.0
1/2	.4254	61.26	1/2	1.8434	265.5
3/4	.4963	71.47	7	1.9852	285.9
2	.5672	81.68	8	2.2688	326.7
1/4	.6381	91.89	9	2.5524	367.6
1/2	.7090	102.1	10	2.8360	408.4
3/4	.7799	112.3			

8620 and 86L20 (Leaded)
HOT ROLLED ROUNDS
Stock Lengths 20' Approx.

Size In Inches	Est. Weight, Lbs. Per Foot	20-Ft. Bar	Size In Inches	Est. Weight, Lbs. Per Foot	20-Ft. Bar	Size In Inches	Est. Weight, Lbs. Per Foot	20-Ft. Bar
1/2	.6682	13.36	2 3/4	20.21	404.3	6 1/4	104.4	2088
5/8	1.044	20.88	7/8	22.09	441.9	1/2	112.9	2259
11/16	1.263	25.27	3	24.06	481.1	3/4	121.8	2436
3/4	1.504	30.07	1/8	26.10	522.0	7	131.0	2619
7/8	2.046	40.93	1/4	28.23	564.6	1/4	140.5	2810
1	2.673	53.46	3/8	30.45	608.9	1/2	150.4	3007
1/16	3.017	60.35	1/2	32.74	654.8	3/4	160.5	3211
1/8	3.383	67.66	5/8	35.12	702.5	8	171.1	3421
1/4	4.176	83.53	3/4	37.59	751.7	1/4	181.9	3638
5/16	4.604	92.09	7/8	40.14	802.7	3/8	187.5	3750
3/8	5.053	101.1	4	42.77	855.3	1/2	193.1	3862
1/2	6.014	120.3	1/4	48.28	965.6	3/4	204.6	4093
5/8	7.058	141.2	3/8	51.16	1023	9	216.5	4330
3/4	8.186	163.7	1/2	54.13	1083	1/4	228.7	4574
7/8	9.397	187.9	5/8	57.18	1143	1/2	241.2	4824
2	10.69	213.8	3/4	60.31	1206	3/4	254.1	5082
1/8	12.07	241.4	5	66.82	1336	10	267.3	5346
1/4	13.53	270.6	1/8	70.21	1404	1/2	294.7	5894
3/8	15.08	301.5	1/4	73.67	1473	11	323.4	6468
7/16	15.88	317.6	1/2	80.86	1617	1/2	294.7	5894
1/2	16.71	334.1	3/4	88.37	1767	12	384.9	7698
5/8	18.42	368.4	6	96.22	1924	1/2	417.6	8353
						13	451.7	9034
						1/2	487.1	9743



8620 and 86L20 (Leaded)
COLD DRAWN ROUNDS
Stock Lengths 10' to 12'

Size In Inches	Est. Weight, Lbs. Per Foot	12-Ft. Bar	Size In Inches	Est. Weight, Lbs. Per Foot	12-Ft. Bar	Size In Inches	Est. Weight, Lbs. Per Foot	12-Ft. Bar
1/4	.1671	2.005	1 3/8	5.053	60.64	2 9/16	17.55	210.6
5/16	.2610	3.132	7/16	5.523	66.28	5/8	18.42	221.0
3/8	.3759	4.510	1/2	6.014	72.17	3/4	20.21	242.6
7/16	.5116	6.139	9/16	6.526	78.31	13/16	21.14	253.7
1/2	.6682	8.019	5/8	7.058	84.70	7/8	22.09	265.1
9/16	.8457	10.15	11/16	7.612	91.34	15/16	23.06	276.8
5/8	1.044	12.53	3/4	8.186	98.23	3	24.06	288.7
11/16	1.263	15.16	13/16	8.781	105.4	1/8	26.10	313.2
3/4	1.504	18.04	7/8	9.397	112.8	1/4	28.23	338.8
13/16	1.765	21.17	15/16	10.03	120.4	5/16	29.33	351.9
7/8	2.046	24.56	2	10.69	128.3	3/8	30.45	365.3
15/16	2.349	28.19	1/16	11.37	136.4	1/2	32.74	392.9
1	2.673	32.07	1/8	12.07	144.8	3/4	37.59	451.0
1/16	3.017	36.21	3/16	12.79	153.5	7/8	40.14	481.6
1/8	3.383	40.59	1/4	13.53	162.4	4	42.77	513.2
3/16	3.769	45.23	3/8	15.08	180.9	1/4	48.28	579.3
1/4	4.176	50.12	7/16	15.88	190.6	1/2	54.13	649.5
5/16	4.604	55.25	1/2	16.71	200.5	3/4	60.31	723.7

"e.t.d." 150®

Cold Finished Bars

Color Marking: Ends painted Pink and Yellow

"e.t.d." 150® is a 4100 H Modified alloy steel having a high tensile and yield strength produced by Elevated Temperature Drawing. This material is produced to AMS 6378 specification. Residual stresses from cold working are reduced in these bars since a controlled die practice is used. Problems of warpage and distortion are eliminated. The mechanical properties of the bar are uniform from surface to center of each bar. If higher strength is needed in selected areas, a Rockwell "C" of 57 to 60 is obtainable through conventional surface hardening treatments. These bars have excellent machining qualities for their high strength. In standard practice the machinability of "e.t.d." 150® is comparable to that of annealed 4142 alloy bars. The Elevated Temperature Drawing process is patented by the La Salle Steel Co., a subsidary of Niagra Corporation.

ANALYSIS

C	Mn	P Max.	S Max.	Si	Cr	Mo	Se
.39/.48	.70/1.10	.040	.040	.15/.35	.75/1.20	.15/.25	.03/.06

APPLICATIONS – Gears, shafts, pinions, fasteners, axles, and other parts to replace heat treated alloy parts.

MECHANICAL PROPERTIES

Tensile Strength (psi)	Yield Strength (psi)	Mean Elongation in 2"	Mean Reduction of Area	Hardness Rockwell	Hardness Brinell
150,000 min.	130,000 min.	10%	37%	C32 min.	302 min.

MACHINABILITY – "e.t.d." 150® machines approximately 75% as fast as 1212 Screw Stock. Average surface cutting speed is 125 feet per minute.

WELDABILITY – Difficult to weld, but can be welded by any of the common welding processes providing section is preheated, and stress relieved after welding. The grade of welding rod to be used depends upon thickness of section, design, service requirements, etc.

"e.t.d." 150®
COLD DRAWN ROUNDS

Stock Lengths 12'

Size In Inches	Estimated Weight, Lbs. Per Foot	Estimated Weight, Lbs. 12-Ft. Bar	Size In Inches	Estimated Weight, Lbs. Per Foot	Estimated Weight, Lbs. 12-Ft. Bar
7/16	.5116	6.139	1 11/16	7.612	91.34
1/2	.6682	8.019	3/4	8.186	98.23
9/16	.8457	10.15	13/16	8.781	105.4
5/8	1.044	12.53	7/8	9.397	112.8
11/16	1.263	15.16	15/16	10.03	120.4
3/4	1.504	18.04	2	10.69	128.3
13/16	1.765	21.17	1/8	12.07	144.8
7/8	2.046	24.56	3/16	12.79	153.5
15/16	2.349	28.19	1/4	13.53	162.4
1	2.673	32.07	3/8	15.08	180.9
1/16	3.017	36.21	7/16	15.88	190.6
1/8	3.383	40.59	1/2	16.71	200.5
3/16	3.769	45.23	5/8	18.42	221.0
1/4	4.176	50.12	11/16	19.31	231.7
5/16	4.604	55.25	3/4	20.21	242.6
3/8	5.053	60.64	7/8	22.09	265.1
7/16	5.523	66.28	15/16	23.06	276.8
1/2	6.014	72.17	3	24.06	288.7
9/16	6.526	78.31	1/8	26.10	313.2
5/8	7.058	84.70	1/4	28.23	338.8
			1/2	32.74	392.9

Strain Tempered
41L45 (Leaded)
Cold Drawn

Color Marking: Ends painted Brown and Green

This is the regular leaded chrome-moly analysis produced by a special process of drawing and furnace treatment. The result is a cold finished bar dimensionally uniform with a minimum of distortion. The process produces high tensile and yield strengths which are consistent throughout the bar. The combination of the leaded alloy and special processing results in significant advantages in machinability. Thus, Strain Tempered 41L45 Leaded bars provide the mechanical properties of a heat treated alloy with machinability approaching that of an annealed leaded alloy.

ANALYSIS

C	Mn	P	S	Si	Cr	Mo	Pb
.43/.48	.75/1.00	.035 Max.	.040 Max.	.15/.35	.80/1.10	.15/.25	.15/.35

APPLICATIONS – Studs, worm shafts, hydraulic piston rods, machinery shafts, axles, pins, and other parts commonly made from heat treated alloys or from annealed alloys with the parts subsequently heat treated.

MECHANICAL PROPERTIES

	Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2"	Reduction of Area	Hardness Rockwell	Hardness Brinell
3" and Under (minimum)	150,000	130,000	-	-	C 32	302
Over 3" (typical)	130,000	120,000	10%	35%	C 29	277

MACHINABILITY – This grade machines approximately 60% as fast as 1212, with an average surface cutting speed of 100 feet per minute.

WELDABILITY – Difficult to weld, but can be welded by any of the common welding processes providing section is preheated, and stress relieved after welding. The grade of welding rod to be used depends upon thickness of section, design, service requirements, etc.

STRAIN TEMPERED
41L45 (Leaded)
COLD DRAWN ROUNDS

Stock Lengths 12' Approx.

Size In Inches	Estimated Weight, Lbs. Per Foot	12-Ft. Bar	Size In Inches	Estimated Weight, Lbs. Per Foot	12-Ft. Bar
1	2.673	32.07	2 1/4	13.53	162.4
1/8	3.383	40.59	3/8	15.08	180.9
1/4	4.176	50.12	1/2	16.71	200.5
3/8	5.053	60.64	5/8	18.42	221.0
1/2	6.014	72.17	3/4	20.21	242.6
5/8	7.058	84.70	7/8	22.09	265.1
3/4	8.186	98.23	3	24.06	288.7
7/8	9.397	112.8	1/4	28.23	338.8
2	10.69	128.3	1/2	32.74	392.9
1/8	12.07	144.8			

4150 MODIFIED RESULPHURIZED

Heat Treated Bars

Color Marking: Ends painted Red with Green Stripe

4150 Modified Resulphurized is a free-machining chromium-molybdenum alloy steel. It is a relatively high hardenability alloy so that in the heat treated condition it has good overall strength and toughness. Being a resulphurized steel, it machines easily. It is supplied in the heat treated condition to a Brinell hardness of 262-311.

ANALYSIS – Typical

Carbon	Manganese	Sulphur	Chromium	Molybdenum
.50	1.25	.08	.70	.18

APPLICATIONS – A general purpose alloy machinery steel used where greater strength and toughness is required than is available in many carbon machinery steels. Typical applications include gears, shafts, pinions, spindles, arbors, bolting, link pins, axles, etc.

MECHANICAL PROPERTIES – The following mechanical properties are typical in the heat treated condition:

	Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2"	Reduction of Area	Brinell Hardness
1" Round	136,000	119,000	20.5%	55.0%	285
5" Round	137,000	116,000	17.0%	50.0%	293

MACHINABILITY – 4150 Modified Resulphurized machines approximately 40% as fast as 1212 Screw Stock. Average surface cutting speed is 65 feet per minute.

WELDABILITY – Difficult to weld because it is resulphurized and has definite air-hardening characteristics, but can be welded by any of the standard welding methods. Shielded arc welding, low hydrogen electrodes, pre-heating and post-heating is preferred and recommended.

HEAT-TREATING – Temperatures and response is similar to those of 4142-4150.

4150 MOD RESULPHURIZED HOT ROLLED HEAT TREATED ROUNDS

Stock Lengths 20' Approx.

Size In Inches	Est. Weight, Lbs. Per Foot	Est. Weight, Lbs. 20-Ft. Bar
1/2	.6682	13.36
5/8	1.044	20.88
3/4	1.504	30.07
7/8	2.046	40.93
1	2.673	53.46
1/8	3.383	67.66
1/4	4.176	83.53
3/8	5.053	101.1
1/2	6.014	120.3
5/8	7.058	141.2
3/4	8.186	163.7
7/8	9.397	187.9
2	10.69	213.8
1/8	12.07	241.4
1/4	13.53	270.6
3/8	15.08	301.5
1/2	16.71	334.1
5/8	18.42	368.4
3/4	20.21	404.3
7/8	22.09	441.9
3	24.06	481.1
1/8	26.10	522.0
1/4	28.23	564.6
1/2	32.74	654.8
5/8	35.12	702.5
3/4	37.59	751.7
4	42.77	855.3
1/4	48.28	965.6
1/2	54.13	1083
3/4	60.31	1206
5	66.82	1336
1/4	73.67	1473
1/2	80.86	1617
3/4	88.37	1767
6	96.22	1924
1/4	104.4	2088
1/2	112.9	2259
3/4	121.8	2436
7	131.0	2619
1/4	140.5	2810
1/2	150.4	3007
3/4	160.5	3211
8	171.1	3421
1/4	181.9	3638
1/2	193.1	3862
3/4	204.6	4093
9	216.5	4330
1/2	241.2	4824
10	267.3	5346
PRESSED ROUNDS Heat Treated		
11	323.4	6468
12	384.9	7698
1/2	417.6	8353
13	451.7	9034
1/2	487.1	9743
14	523.9	10478
15	601.4	12028
16	684.3	13685
1/2	727.7	14554
17 1/2	818.6	16371
18	866.0	17320

9 CHROME 1 MOLY

Chrome-Molybdenum Steel

Bars and Tubes

UNS K90941

Color Marking: Green-Black-Pink Stripe

Tubing Tolerances ASTM A 519

Chemistry below and ASTM A 213

This alloy was originally designed for super heater and boiler applications. Quench and tempered conditions have found wide spread use in oilfield completion equipment. The grade has been effectively used in socalled "sour services" environments as specified in NACE MR-O1-75 when heat treated to minimum yield and maximum hardness requirements.

ANALYSIS

C	Mn	P Max.	S Max.	Si	Cr	Mo
.09/.15	.30/.60	.030	.030	.25/1.00	8.0/10.0	.90/1.10

APPLICATIONS – Down hole oilfield tools in the heat treated condition.

MECHANICAL PROPERTIES – The following mechanical properties are typical in the heat treated condition:

Tensile	Yield	Minimum Elongation	Minimum Reduction In Area	Maximum BHN 237
95ksi Min.	80ksi-110K	20%	20%	(Rockwell C 22)

MACHINABILITY – In the HT condition, this grade has a machinability rating of approximately 50% of 1212. Surface cutting speed is approximately 90 feet per minute.

WELDABILITY – This grade can be welded with proper preparation and the use of the appropriate rod.

FORGING – Material to be used in HT condition.

HARDENING – Stock material is in the Quench and Tempered Condition.

9 CHROME 1 MOLY – BAR & TUBE

Stock Lengths 20' Approx.

9 CHROME ROUND TUBE				9 CHROME ROUND BAR	
OD	ID	Wall	Wt./Ft.	OD	Wt./Ft.
2.375	1.375	0.500	10.013	1.875	9.397
2.375	1.250	0.563	10.889		
2.710	1.750	0.480	11.432	2.000	10.692
2.710	1.625	0.543	12.558		
2.910	1.937	0.487	12.592	2.250	13.532
3.000	1.813	0.594	15.254		
3.000	1.625	0.688	16.980	2.375	15.077
3.062	1.937	0.563	15.016	2.500	16.706
3.062	1.750	0.656	16.857		
3.220	2.000	0.610	17.004	2.750	20.214
3.250	2.250	0.500	14.685		
3.250	1.625	0.813	21.151	3.000	24.056
3.500	1.750	0.875	24.531	3.250	28.233
3.625	2.000	0.813	24.405		
3.668	2.500	0.584	19.235	3.500	32.743
3.668	2.375	0.647	20.862		
3.750	2.375	0.688	22.486	3.750	37.588
3.750	2.125	0.813	25.490	4.000	42.766
3.750	1.625	1.063	30.496		
3.950	2.500	0.725	24.971	4.500	54.126
4.000	2.750	0.625	22.528	4.750	60.307
4.000	2.714	0.643	23.053		
4.000	2.125	0.938	30.663	5.000	66.823
4.250	3.250	0.500	20.025		
4.375	2.562	0.907	33.580	5.250	73.672
4.500	2.875	0.813	31.998		
4.625	3.500	0.563	24.405	5.500	80.855
4.750	3.125	0.813	34.168	6.000	96.224
4.750	3.000	0.875	36.212		
4.750	2.750	1.000	40.050	6.250	104.410
4.750	2.313	1.219	45.957		
4.875	3.000	0.938	39.424	6.750	121.784
5.000	4.000	0.500	24.030		
5.000	3.000	1.000	42.720	7.250	140.494
5.000	2.687	1.157	47.473	8.000	171.066
5.250	2.750	1.250	53.400		
5.500	3.500	1.000	48.060	8.500	193.117
5.515	3.625	0.945	46.123		
6.125	(3.499)	1.313	67.478	8.750	204.644
6.750	3.500	1.625	88.944	9.500	241.229
8.155	5.037	1.559	109.824		

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