

# PRODUCTS

Admiral  
STEEL

*“Committed to total customer satisfaction.”*





Dear Friends,

Welcome to our new and greatly improved buyers guide and reference book.

We've expended a great deal of time and energy to make this more than just another catalog. We have tried to create what we hope will become an indispensable reference – a tool to help make your lives easier.

This printing marks an important milestone for Admiral Steel – the celebration of our 50<sup>th</sup> year in business. While many things have changed over the years, one thing remains same – our commitment to quality and service. Our quality policy is quite simple, "Admiral Steel is committed to total customer satisfaction."

As we look to the future, we are excited about the possibilities. The internet has forever changed our lives. The possibilities it beholds are the reason why we were one of the first in our business to set up shop on the world wide web. We have always believed that innovation is the key to success. Those who innovate will continue to succeed, while those who don't will always remain a step behind. While much of our competition has been consumed with merger mania – hoping that bigger really is better, we remain a family business, committed to family values not just P/E ratios.

As we begin this new millennium, we'd like to thank those of you who have been a part of our family over the first 50 years and welcome those of you joining us for the next 50. We look forward to continuing to serve your needs now, and forever.

Sincerely,

Mark J. Tolliver  
President

## Table of Contents – Products

### Carbon Steels

1095 – Blue Tempered & Polished .....	4-5
1095 – Cold Rolled Annealed.....	6
1095 – Hot Rolled As Rolled & Annealed.....	7
1084 – Hot Rolled As Rolled .....	8
1074/1075 – Scaleless Blue Tempered.....	10-11
1074/1075 – Cold Rolled Annealed.....	12
1074/1075 – Hot Rolled As Rolled & Annealed.....	13
1074/1075 – Cold Rolled Hard Rolled .....	14
1074/1075 – Cold Rolled Special Temper.....	15
1050 – Cold Rolled Annealed.....	16
1050 – Hot Rolled As Rolled & Annealed.....	17
1035 – Hot Rolled As Rolled .....	18
1020 – Cold Rolled Soft .....	20
1020 – Hot Rolled As Rolled .....	21
1008/1010 – Cold Rolled Dead Soft.....	22
1008/1010 – Cold Rolled Soft.....	23
1008/1010 - Cold Rolled Quarter Hard .....	24
1008/1010 - Cold Rolled Half Hard .....	25
1008/1010 - Cold Rolled Hard.....	26
1008/1010 - Cold Rolled Hard Shim.....	27

### Alloy Steels

6150 - Hot Rolled Annealed .....	28
5160 - Hot Rolled As Rolled.....	29-31
4130 – Cold Rolled Annealed – ACQ.....	32
4130 – Hot Rolled Annealed – ACQ & CQ.....	33

### Shim Steels

Admiral Hard Shim – Die Liner Steel.....	34
------------------------------------------	----

### Tool Steels

O-1.....	35
A-2.....	36
D-2.....	37
S-1 .....	38
S-7 .....	39
H-13.....	40
Low Carbon.....	41
4140 H.T. Alloy .....	42

## Blue Tempered & Polished SAE/AISI 1095 Spring Steel

UNS# G10950

A hardened, tempered, & polished steel designed to meet the most exacting requirements. Top quality can be counted on coil after coil. Recommended for various types coiled and flat mechanical springs.

**TYPICAL ANALYSIS:** C .90/1.04 Mn .30/.50 P .025 max. S .050 max Si.15/.30

**TYPICAL HARDNESS:** Rockwell C 48-51

**TYPICAL APPLICATIONS:** Ignition vibrator springs, springs for timing devices, springs for electrical & electronic applications, tapes, & rules

**FINISH:** Deep blue, polished

**AVAILABLE FORMS:** Stock size sheets and coils. Material may also be Slit, Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred, and/or Reflattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

### STOCK GAUGES & SIZES – *Contact our office for availability of other gauges!*

Size	Lbs Per	Size	Lbs Per	Size	Lbs Per	Size	Lbs Per
.002 X 1	.68	.005 X 1/4	.43	.006 X 1	2.04	.008 X 1/4	.68
.002 X 2	1.36	.005 X 3/8	.64	.006 X 1-1/2	3.06	.008 X 5/16	.85
.002 X 3	2.04	.005 X 1/2	.85	.006 X 2	4.08	.008 X 3/8	1.02
		.005 X 3/4	1.27	.006 X 2-1/4	4.59	.008 X 1/2	1.36
.003 X 1/2	.51	.005 X 1	1.69	.006 X 2-1/2	5.10	.008 X 5/8	1.70
.003 X 5/8	.64	.005 X 1-1/2	2.55	.006 X 3	6.12	.008 X 3/4	2.04
.003 X 3/4	.77	.005 X 2	3.40	.006 X 6	12.24	.008 X 1	2.72
.003 X 1	1.02	.005 X 2-1/2	4.25			.008 X 1-1/2	4.08
.003 X 2	2.04	.005 X 3	5.10	.007 X 1/4	.60	.008 X 2	5.44
.003 X 3	3.06	.005 X 4	6.80	.007 X 3/8	.89	.008 X 3	8.16
		.005 X 5	8.50	.007 X 1/2	1.19	.008 X 4	10.88
.004 X 1/4	.34	.005 X 6	10.20	.007 X 3/4	1.79	.008 X 6	16.32
.004 X 3/8	.51			.007 X 1	2.38		
.004 X 1/2	.85	.006 X 1/4	.51	.007 X 1-1/2	3.57	.009 X 4	12.24
.004 X 3/4	1.02	.006 X 3/8	.77	.007 X 3	7.14	.009 X 6	18.36
.004 X 1	1.36	.006 X 1/2	1.02	.007 X 6	14.28		
.004 X 2	2.72	.006 X 3/4	1.53				
.004 X 3	4.08						

Size	Lbs Per	Size	Lbs Per	Size	Lbs Per	Size	Lbs Per
.010 X 1/4	.85	.016 X 5/8	3.40	.025 X 5/16	2.66	.035 X 1-1/2	17.85
.010 X 5/16	1.06	.016 X 3/4	4.08	.025 X 3/8	3.19	.035 X 2	23.80
.010 X 3/8	1.28	.016 X 1	5.44	.025 X 7/16	3.72	.035 X 3	35.70
.010 X 7/16	1.49	.016 X 1-1/2	8.16	.025 X 1/2	4.25	.035 X 4	47.60
.010 X 1/2	1.70	.016 X 2	10.88	.025 X 5/8	4.31	.035 X 6	74.10
.010 X 5/8	2.13	.016 X 3	16.32	.025 X 3/4	6.38	.035 X 12-3/8	147.26
.010 X 3/4	2.55	.016 X 4	21.76	.025 X 7/8	7.44		
.010 X 7/8	7.98	.016 X 6	32.64	.025 X 1	8.50	.042 X 1/4	3.57
.010 X 1	3.40			.025 X 1-1/4	10.63	.042 X 5/16	4.46
.010 X 1-1/4	4.25	.018 X 1/4	1.53	.025 X 1-1/2	12.75	.042 X 3/8	5.36
.010 X 1-1/2	5.10	.018 X 5/16	1.91	.025 X 2	17.00	.042 X 7/16	6.29
.010 X 2	6.80	.018 X 3/8	2.30	.025 X 3	25.50	.042 X 1/2	7.14
.010 X 2-1/4	7.65	.018 X 1/2	3.06	.025 X 4	34.00	.042 X 5/8	8.93
.010 X 2-1/2	8.50	.018 X 5/8	3.83	.025 X 6	51.00	.042 X 3/4	10.71
.010 X 3	10.20	.018 X 3/4	4.59	.025 X 12-3/8	105.88	.042 X 1	12.28
.010 X 4	13.60	.018 X 7/8	5.36			.042 X 1-1/4	17.85
.010 X 6	20.40	.018 X 1	6.12	.028 X 1/4	2.38	.042 X 1-1/2	21.42
.010 X 12	40.80	.018 X 1-1/2	9.18	.028 X 5/16	2.98	.042 X 2	28.56
		.018 X 2	12.24	.028 X 3/8	3.57	.042 X 3	42.84
.012 X 1/4	1.02	.018 X 3	18.36	.028 X 1/2	4.76	.042 X 4	57.12
.012 X 5/16	1.28	.018 X 4	24.48	.028 X 5/8	5.95	.042 X 6	85.68
.012 X 3/8	1.53	.018 X 6	36.72	.028 X 3/4	7.14	.042 X 12-3/8	176.70
.012 X 7/16	1.79	.018 X 12-3/8	75.74	.028 X 1	9.52		
.012 X 1/2	2.04			.028 X 2	19.04	.050 X 1/4	4.25
.012 X 5/8	2.55	.020 X 1/4	1.70	.028 X 3	28.56	.050 X 5/16	5.31
.012 X 3/4	3.06	.020 X 5/16	2.13	.028 X 4	38.08	.050 X 3/8	6.38
.012 X 1	4.08	.020 X 3/8	2.55	.028 X 6	57.12	.050 X 1/2	8.50
.012 X 1-1/4	4.18	.020 X 1/2	3.40			.050 X 5/8	10.63
.012 X 2	8.16	.020 X 5/8	2.25	.030 X 6	61.20	.050 X 3/4	12.75
.012 X 3	12.24	.020 X 3/4	5.10	.030 X 12-3/8	126.23	.050 X 7/8	14.88
.012 X 4	16.32	.020 X 7/8	5.95			.050 X 1	17.00
.012 X 6	24.48	.020 X 1	6.80	.032 X 1/4	2.72	.050 X 1-1/4	21.25
.012 X 12	48.96	.020 X 1-1/2	10.20	.032 X 5/16	3.40	.050 X 1-1/2	25.55
		.020 X 2	13.60	.032 X 3/8	4.08	.050 X 2	34.00
.015 X 1/4	1.28	.020 X 3	20.40	.032 X 7/16	4.76	.050 X 3	51.00
.015 X 5/16	1.59	.020 X 4	27.20	.032 X 1/2	5.44	.050 X 4	68.00
.015 X 3/8	1.91	.020 X 6	40.80	.032 X 5/8	6.80	.050 X 6	102.00
.015 X 7/16	2.23	.020 X 12-3/8	84.15	.032 X 3/4	8.16	.050 X 12-3/8	210.35
.015 X 1/2	2.55			.032 X 7/8	9.52		
.015 X 5/8	3.19	.022 X 1/4	1.87	.032 X 1	10.88	.062 X 1/4	5.27
.015 X 3/4	3.83	.022 X 5/16	2.34	.032 X 1-1/4	13.60	.062 X 3/8	7.91
.015 X 7/8	4.46	.022 X 3/8	2.81	.032 X 1-1/2	16.32	.062 X 7/16	9.22
.015 X 1	5.10	.022 X 1/2	3.74	.032 X 2	21.76	.062 X 1/2	10.54
.015 X 1-1/4	6.38	.022 X 5/8	4.68	.032 X 3	32.64	.062 X 5/8	13.18
.015 X 1-1/2	7.65	.022 X 3/4	5.61	.032 X 4	43.52	.062 X 3/4	15.81
.015 X 2	10.20	.022 X 7/8	6.55	.032 X 6	65.28	.062 X 7/8	18.45
.015 X 3	15.30	.022 X 1	7.48	.032 X 12-3/8	136.64	.062 X 1	21.08
.015 X 4	20.40	.022 X 1-1/4	9.35			.062 X 1-1/4	26.35
.015 X 6	30.60	.022 X 1-1/2	11.22	.035 X 1/4	2.98	.062 X 2	42.32
.015 X 12	61.20	.022 X 2	14.96	.035 X 5/16	3.72	.062 X 2-1/2	52.70
		.022 X 3	22.44	.035 X 3/8	4.46	.062 X 3	63.24
.016 X 1/4	1.36	.022 X 4	29.92	.035 X 1/2	5.95	.062 X 4	84.32
.016 X 5/16	1.70	.022 X 6	44.88	.035 X 5/8	7.44	.062 X 6	126.48
.016 X 3/8	2.04			.035 X 3/4	8.93	.062 X 12-3/8	260.83

# Cold Rolled Spheroidized Annealed SAE/AISI 1095 Spring Steel

UNS# G10950

This material has the highest elastic limit and fatigue values of the commonly used spring steels. It is particularly suitable for high quality intricate shapes that can not be formed from pre-tempered steel. This is a top quality material that is rolled to the closest possible gauge tolerances. Generally used where SAE hardening and tempering after forming is desired, but fatigue values and elastic limits are not critical. Good grain structure makes this type of annealed spring steel adaptable for forming with or against the grain with good hardening qualities.

**STANDARD SPECIFICATIONS:** ASTM A682 & A684, AMS 5121, QQS 700. *See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .90/1.04 Mn .30/.50 P .020 max. S .025 max Si.15/.30

**TYPICAL HARDNESS:** Rockwell B 88 max.

**TYPICAL APPLICATIONS:** Flat & coil springs, hand tools, rule dies, cutting blades, knives, scrapers, & trowels

**FINISH:** #2

**AVAILABLE FORMS:** Stock size sheets and coils. Material may also be Slit, Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred, and/or Reflattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

<b>STOCK GAUGES</b> – <i>Contact our office for availability of other gauges!</i>					
Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.010	.41	.040	1.63	.083	3.39
.012	.49	.042	1.71	.093	3.79
.015	.61	.045	1.84	.100	4.09
.020	.82	.048	1.92	.109	4.45
.022	.90	.050	2.04	.120	5.00
.025	1.00	.058	2.36	.125	5.10
.028	1.14	.062	2.53	.134	5.47
.030	1.22	.065	2.65	.156	6.26
.032	1.30	.072	2.94	.187	7.63

**Hot Rolled As Rolled  
Hot Rolled P&O Spheroidized Annealed  
SAE/AISI 1095 Spring Steel  
UNS# G10950**

The highest of the carbon grades, this is a continuous cast, fine grain, fully killed steel (#5 or better). Material is low phosphorus, low sulfur, calcium treated to enhance internal cleanliness. In the as-rolled condition, material is well suited for abrasion resistant applications. In the annealed condition, the material may be cold formed (hot forming suggested for critical bends) with excellent heat treat results.

**STANDARD SPECIFICATIONS:** ASTM A568 (sheets) A830 (plates)  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .90/1.04 Mn .30/.50 P .020 max. S .025 max Si.15/.30

**TYPICAL HARDNESS:** As rolled: Rockwell C 15-45  
Annealed: Rockwell B 95 max

**TYPICAL APPLICATIONS:** Blades, hand tools, knives, shims, & springs

**AVAILABLE FORMS:** Stock size sheets and plates. Material may also be Sheared, Laser Cut, Blanked, Edged, Deburred, and/or Re flattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

<b>STOCK GAUGES – Contact our office for availability of other gauges!</b>					
<b>AS ROLLED</b>			<b>ANNEALED</b>		
Gauge Decimal	Gauge Number	Lbs/Sq. Ft.	Gauge Decimal	Gauge Number	Lbs/Sq. Ft.
.122	11 Ga.	5.00	.122	11 Ga.	5.00
.184	7 Ga.	7.50	.184	7 Ga.	7.50
.250	-	10.20	.250	-	10.20
.312	-	12.76			
.375	-	15.32			

*For accuracy, always refer to the decimal thickness when ordering!*

## Hot Rolled As Rolled SAE/AISI 1084 ME Strips & Flats

UNS# G10840

A high carbon, fully killed steel with a mill produced edge. Excellent abrasion resistance and hardening capabilities. Hot forming is suggested for moderate to severe bends.

**STANDARD SPECIFICATIONS:** ASTM A749 (.125" - .187") ASTM A29 (.250")  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .80/.94 Mn .60/.90 P .040 max. S .050 max Si .15/.30

**TYPICAL HARDNESS:** Rockwell C 10-40

**TYPICAL APPLICATIONS:** Bumpers, guide bars, hand tools, leaf springs, & scrapers

**AVAILABLE FORMS:** ME strips and flats. Material may also be Cut to length.

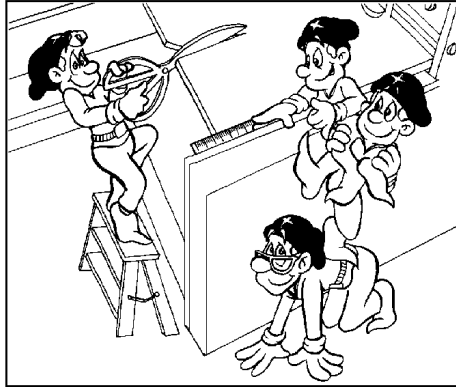
See our reference section for information regarding edge conditions, finish descriptions, gauge tolerances, heat treating, hardness conversions and physical properties.

### STOCK SIZES – *Contact our office for availability of other gauges!*

Size	Lbs/Bar	Size	Lbs/Bar	Size	Lbs/Bar
.125 X 1 X 240"	8.50	.187 X 3/4 X 192"	7.65	.250 X 1 X 240"	17.00
.125 X 1-1/4 X 240"	10.62	.187 X 1 X 240"	12.76	.250 X 1-1/4 X 240"	21.20
.125 X 1-1/2 X 240"	12.76	.187 X 1-1/4 X 240"	15.94	.250 X 1-3/4 X 240"	29.80
		.187 X 1-1/2 X 240"	19.12		



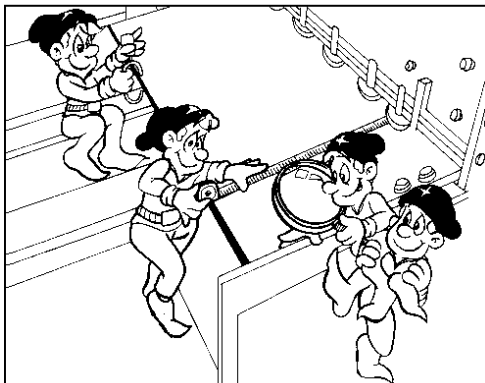
## “Committed to **total** customer satisfaction”



**No order's too big – No order's too small.** Too often, big orders get good service and immediate attention while the smaller orders often go ignored. Not at Admiral Steel. We welcome order of all sizes and treat them all with the same amount of importance. While we like big orders just as much as the next guy, we like small orders just as much. Whether you need 10 lbs or 10,000 – give us a call. Come see why many other service centers turn to us for their small quantity needs.

### **Need it in a hurry? Give us a call.**

Our large inventories mean you get your steel when you need it. We realize that sometimes fast isn't fast enough - that's why we introduced our priority service. Sure, it might cost a little more – but when the line goes down, or that urgent job comes in, we'll stay late to make sure you get your steel ASAP. Call us today to discuss your needs!!!



### **Top quality – everytime.**

Quality has always been our top priority. We've always purchased the finest quality materials available – never a secondary. Our ISO 9002 registration represents our on-going commitment to providing the best possible products and services – not just something that looks nice on the stationary. At Admiral Steel we were committed to total customer satisfaction – a commitment we don't take lightly.

## Scaleless Blue Tempered SAE/AISI 1074/1075 Spring Steel

UNS# G10740/G10750

Previously known as Black Oil Temper. Looks and acts much like Blue Tempered and Polished 1095, the difference being that Scaleless Blue is of medium high carbon, has been oil tempered, and has better forming qualities. Used where the higher carbon content and polished surface aren't needed.

**TYPICAL ANALYSIS:** C .69/.80 Mn .40/.80 P .020 max. S .025 max Si .15/.30

**TYPICAL HARDNESS:** Rockwell C 44-47 (.010" - .062")  
Rockwell C 44-50 (.094" - .125")

**TYPICAL APPLICATIONS:** Hold down springs, lock springs, snap springs, & trap springs

**FINISH:** Dull blue/grey

**AVAILABLE FORMS:** Stock size sheets and coils. Material may also be Slit, Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred, and/or Re flattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

### STOCK GAUGES & SIZES – *Contact our office for availability of other gauges!*

Size	Lbs Per	Size	Lbs Per	Size	Lbs Per
.010 X 1/4	.85	.012 X 3	12.24	.016 X 6	32.64
.010 X 5/16	1.06	.012 X 6	24.48		
.010 X 3/8	1.28	.012 X 12-3/8	50.48	.018 X 1/4	1.53
.010 X 1/2	1.70	.012 X 21-3/8	87.20	.018 X 5/16	1.91
.010 X 5/8	2.13			.018 X 3/8	2.30
.010 X 3/4	2.55	.015 X 1/4	1.28	.018 X 1/2	3.06
.010 X 1	3.40	.015 X 5/16	1.59	.018 X 5/8	3.83
.010 X 4	13.60	.015 X 3/8	1.91	.018 X 3/4	4.559
.010 X 6	20.40	.015 X 7/16	2.23	.018 X 1	6.12
.010 X 12	40.80	.015 X 1/2	2.55	.018 X 6	36.72
.010 X 21-3/8	72.66	.015 X 5/8	3.19	.018 X 12-3/8	75.76
		.015 X 3/4	3.83	.018 X 21-3/8	130.80
.012 X 1/4	1.02	.015 X 1	5.10		
.012 X 5/16	1.28	.015 X 1-1/2	7.65	.020 X 1/4	1.70
.012 X 3/8	1.53	.015 X 2	10.20	.020 X 5/16	2.13
.012 X 1/2	2.04	.015 X 6	30.60	.020 X 3/8	2.55
.012 X 5/8	2.50	.015 X 12-3/8	63.43	.020 X 7/16	2.98
.012 X 1	4.08	.015 X 21-3/8	109.00	.020 X 1/2	3.40

Size	Lbs Per	Size	Lbs Per	Size	Lbs Per
.020 X 5/8	4.25	.032 X 1	10.88	.062 X 1/4	5.27
.020 X 3/4	5.10	.032 X 1-1/4	13.66	.062 X 5/16	6.59
.020 X 7/8	5.95	.032 X 1-1/2	16.32	.062 X 3/8	7.91
.020 X 1	6.80	.032 X 2	21.76	.062 X 1/2	10.54
.020 X 1-1/4	8.50	.032 X 3	32.64	.062 X 5/8	13.18
.020 X 1-1/2	10.20	.032 X 4	43.52	.062 X 3/4	15.81
.020 X 2	13.60	.032 X 6	65.28	.062 X 7/8	18.45
.020 X 3	20.40	.032 X 12-3/8	136.64	.062 X 1	21.08
.020 X 6	40.80	.032 X 21-3/8	232.53	.062 X 1-1/4	26.35
.020 X 12-3/8	84.15			.062 X 1-1/2	31.62
.020 X 21-3/8	145.34	.035 X 1/4	2.98	.062 X 2	42.16
		.035 X 5/16	3.72	.062 X 2-1/2	522.70
.022 X 1/4	1.87	.035 X 3/8	4.46	.062 X 3	63.24
.022 X 5/16	2.34	.035 X 7/16	5.21	.062 X 4	84.32
.022 X 3/8	2.81	.035 X 1/2	5.95	.062 X 6	126.48
.022 X 1/2	3.74	.035 X 5/8	7.44	.062 X 8	168.64
.022 X 5/8	4.68	.035 X 3/4	8.93	.062 X 10	210.78
.022 X 3/4	5.61	.035 X 1	11.90	.062 x 12-3/8	260.84
.022 X 1	7.48	.035 X 1-1/4	14.88	.062 x 21-3/8	450.53
.022 X 6	44.88	.035 X 2	23.80		
.022 X 12-3/8	92.57	.035 X 3	35.70	.094 X 1/4	8.14
		.035 X 6	71.40	.094 X 1/2	15.95
.025 X 1/4	2.13	.035 X 12-3/8	147.26	.094 X 5/8	19.95
.025 X 5/16	2.66	.035 X 21-3/8	254.34	.094 X 3/4	24.00
.025 X 3/8	3.19			.094 X 1	32.00
.025 X 7/16	3.72	.042 X 1/4	3.57	.094 X 1-1/2	47.90
.025 X 1/2	4.25	.042 X 5/16	4.46	.094 X 2	64.60
.025 X 5/8	5.31	.042 X 3/8	5.36	.094 X 2-1/2	80.00
.025 X 3/4	6.38	.042 X 1/2	7.14	.094 X 3	96.00
.025 X 1	8.50	.042 X 5/8	8.93	.094 X 4	129.20
.025 X 2	17.00	.042 X 3/4	10.71	.094 X 5	161.50
.025 X 3	25.50	.042 X 1	14.28		
.025 X 6	51.00	.042 X 1-1/2	21.42	.125 X 1/2	21.50
.025 X 12-3/8	105.19	.042 X 2	28.56	.125 X 3/4	31.88
.025 X 21-3/8	181.67	.042 X 3	42.84	.125 X 7/8	37.20
		.042 X 6	85.68	.125 X 1	42.50
.028 X 1/4	2.38	.042 X 12-3/8	176.72	.125 X 1-1/4	53.16
.028 X 3/4	7.14	.042 X 21-3/8	305.20	.125 X 1-1/2	63.80
.028 X 7/8	8.33				
.028 X 1	9.52	.050 X 1/4	4.25		
.028 X 2	19.04	.050 X 5/16	5.31		
.028 X 6	57.12	.050 X 3/8	6.38		
.028 X 12-3/8	117.81	.050 X 1/2	8.50		
.028 X 21-3/8	203.47	.050 X 5/8	10.63		
		.050 X 3/4	12.75		
.030 X 1	10.20	.050 X 7/8	14.88		
.030 X 6	61.20	.050 X 1	17.00		
.030 X 12-3/8	126.23	.050 X 1-1/4	21.25		
.030 X 21-3/8	218.00	.050 X 1-1/2	25.50		
		.050 X 2	34.00		
.032 X 1/4	2.72	.050 X 3	51.00		
.032 X 3/8	4.08	.050 X 6	102.00		
.032 X 1/2	5.44	.050 x 12-3/8	210.35		

## Cold Rolled Spheroidized Annealed SAE/AISI 1074/1075 Spring Steel

UNS# G10740/G10750

A general purpose medium carbon grade of cold rolled annealed spring steels. It has toughness and elasticity adaptable for difficult forming and will provide excellent results in the hardened and tempered condition. This is a top quality, killed, fine grain (#5 or finer) material that is rolled to the closest possible gauge tolerances.

**STANDARD SPECIFICATIONS:** ASTM A682 & A684, AMS 5120,  
QQS 700. *See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .69/.80 Mn .40/.80 P .020 max. S .025 max Si .15/.30

**TYPICAL HARDNESS:** Rockwell B 84 max.

**TYPICAL APPLICATIONS:** Blades, clips, brackets, brake discs, clutches, springs,  
washers, wear strips

**FINISH:** #2

**AVAILABLE FORMS:** Stock size sheets and coils. Material may also be Slit,  
Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred,  
and/or Reflattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

### STOCK GAUGES – *Contact our office for availability of other gauges!*

Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.010	.41	.040	1.63	.078	3.18
.012	.49	.042	1.71	.083	3.39
.015	.61	.045	1.84	.093	3.79
.018	.73	.048	1.92	.100	4.09
.020	.82	.050	2.04	.109	4.45
.022	.90	.055	2.24	.120	5.00
.025	1.00	.058	2.36	.125	5.10
.028	1.14	.062	2.53	.134	5.47
.030	1.22	.065	2.65	.156	6.26
.032	1.30	.072	2.94	.187	7.63

**Hot Rolled As Rolled**  
**Hot Rolled P&O Spheroidized Annealed**  
**SAE/AISI 1074/1075 Spring Steel**  
 UNS# G10740/G10750

A continuous cast, fine grain, fully killed steel (#5 grain or better). Material can be heat treated to meet design specifications. Material is low phosphorus, low sulfur, calcium treated to enhance internal cleanliness.

**STANDARD SPECIFICATIONS:** ASTM A568 (sheets) A830 (plates)  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .69/.80 Mn .40/.80 P .020 max. S .025 max Si.15/.30

**TYPICAL HARDNESS:** As rolled: Rockwell C 10-40  
 Annealed: Rockwell B 95 max

**TYPICAL APPLICATIONS:** Blades, brackets, clutches, hand tools, springs, scrapers, washers, & wear strips

**AVAILABLE FORMS:** Stock size sheets and plates. Material may also be Sheared, Laser Cut, Blanked, Edged, Deburred, and/or Re flattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

<b>STOCK GAUGES – Contact our office for availability of other gauges!</b>					
<b>AS ROLLED</b>			<b>ANNEALED</b>		
Gauge Decimal	Gauge Number	Lbs/Sq. Ft.	Gauge Decimal	Gauge Number	Lbs/Sq. Ft.
.090	13 Ga.	3.75	.090	13 Ga.	3.75
.104	12 Ga.	4.38	.104	12 Ga.	4.38
.122	11 Ga.	5.00	.122	11 Ga.	5.00
.132	10 Ga.	5.63	.132	10 Ga.	5.63
.152	9 Ga.	6.25	.152	9 Ga.	6.25
.182	7 Ga.	7.50	.182	7 Ga.	7.50
.250	-	10.20	.219	-	8.94
.312	-	12.76	.250	-	10.20
.375	-	15.32	.312 *	-	12.76
			.375 *	-	15.32

\* This gauge is box annealed. Typical hardness is Rockwell B 100 max.  
*For accuracy, always refer to the decimal thickness when ordering!*

## Cold Rolled Special Temper SAE/AISI 1074/1075 Spring Steel

UNS# G10740/G10750

Cold Rolled Special Temper is a product produced through a combination of cold reducing and normalizing. The hardness range is just under Blue Tempered and is a cheaper substitute for flat or limited forming applications.

**STANDARD SPECIFICATIONS:** ASTM A682  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .69/.80 Mn .40/.80 P .020 max. S .025 max Si.15/.30

**TYPICAL HARDNESS:** Rockwell C 33-40

**TYPICAL APPLICATIONS:** Shims, blades, templates, flat springs, washers, spacers

**FINISH:** #2

**AVAILABLE FORMS:** Stock size coils and sheets. Material may also be Slit,  
Sheared, Laser Cut, Blanked, Edged, Deburred,  
and/or  
Reflattened to your specifications.

### STOCK GAUGES – *Contact our office for availability of other gauges!*

Gauge Decimal	Lbs/Sq. Ft.
.015	.612
.020	.816
.032	1.265
.050	2.040

## Cold Rolled Hard Rolled SAE/AISI 1074/1075 Spring Steel

UNS# G10740/G10750

Cold Rolled Hard Rolled achieves its hardness through cold reduction only. It is ideal for flat applications where a higher heat treated tensile strength is not required.

**STANDARD SPECIFICATIONS:** ASTM A682  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .69/.80 Mn .40/.80 P .020 max. S .025 max Si.15/.30

**TYPICAL HARDNESS:** Rockwell C 24-33

**TYPICAL APPLICATIONS:** Spacers, shims, blades, scrapers, rule dies

**FINISH:** #2

**AVAILABLE FORMS:** Stock size coils and sheets. Material may also be Slit,  
Sheared, Laser Cut, Blanked, Edged, Deburred,  
and/or  
Reflattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

<b>STOCK GAUGES</b> – <i>Contact our office for availability of other gauges!</i>			
Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.015	.612	.045	1.836
.020	.816	.050	2.040
.025	1.020	.062	2.530
.032	1.306	.083	3.386
.035	1.428	.093	3.794

## Cold Rolled Spheroidized Annealed SAE/AISI 1050 Spring Steel

UNS# G10500

This is the most economical grade of the heat treatable annealed spring steels. This is a top quality, killed, fine grain (#5 or finer) material that is rolled to the closest possible gauge tolerances. Generally used where SAE hardening and tempering after forming is desired, but fatigue values and elastic limits are not critical. Good grain structure makes this type of annealed spring steel adaptable for forming with or against the grain with good hardening qualities.

**STANDARD SPECIFICATIONS:** ASTM A682 & A684, AMS 5085, QQS 700.

*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .47/.55 Mn .60/.90 P .020 max. S .025 max Si .15/.30

**TYPICAL HARDNESS:** Rockwell B 82 max.

**TYPICAL APPLICATIONS:** Blades, clips, brackets, brake discs, clutches, springs, washers, wear strips

**FINISH:** #2

**AVAILABLE FORMS:** Stock size sheets and coils. Material may also be Slit, Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred, and/or Reflattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

<b>STOCK GAUGES – Contact our office for availability of other gauges!</b>					
Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.010	.41	.040	1.63	.078	3.18
.012	.49	.042	1.71	.083	3.39
.015	.61	.045	1.84	.093	3.79
.018	.73	.048	1.92	.100	4.09
.020	.82	.050	2.04	.109	4.45
.022	.90	.055	2.24	.120	5.00
.025	1.00	.058	2.36	.125	5.10
.028	1.14	.062	2.53	.134	5.47
.030	1.22	.065	2.65	.156	6.26
.032	1.30	.072	2.94	.165	6.73



# Hot Rolled As Rolled Hot Rolled P&O Spheroidized Annealed SAE/AISI 1050 Spring Steel

UNS# G10500

A continuous cast, fine grain, fully killed steel (#5 grain or better). Material can be cold formed and heat treated to meet design specifications. Material is low phosphorus, low sulfur, calcium treated to enhance internal cleanliness.

**STANDARD SPECIFICATIONS:** ASTM A568 (sheets) A830 (plates)  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .31/.38 Mn .60/.90 P .020 max. S .025 max Si.15/.30

**TYPICAL HARDNESS:** As Rolled: Rockwell B 70-90  
Annealed: Rockwell B 85 max

**TYPICAL APPLICATIONS:** Blades, brackets, clutches, hand tools, springs, scrapers, & washers

**AVAILABLE FORMS:** Stock size sheets and plates. Material may also be Sheared, Laser Cut, Blanked, Edged, Deburred, and/or Re flattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

<b>STOCK GAUGES – Contact our office for availability of other gauges!</b>					
<b>AS ROLLED</b>			<b>ANNEALED</b>		
Gauge Decimal	Gauge Number	Lbs/Sq. Ft.	Gauge Decimal	Gauge Number	Lbs/Sq. Ft.
.075	14 Ga.	3.13	.090	13 Ga.	3.75
.090	13 Ga.	3.75	.104	12 Ga.	4.38
.104	12 Ga.	4.38	.122	11 Ga.	5.00
.120	11 Ga.	5.00	.132	10 Ga.	5.63
.132	10 Ga.	5.63	.154	9 Ga.	6.25
.154	9 Ga.	6.25	.165	8 Ga.	6.88
.165	8 Ga.	6.88	.180	7 Ga.	7.35
.180	7 Ga.	7.35	.187	-	7.64
.187	-	7.64	.198	-	8.00
.250	-	10.20	.219	-	8.95
.312	-	12.76	.250	-	10.20
.375	-	15.32	.312 *	-	12.76
.437	-	17.87	.375 *	-	15.32

\* This gauge is box annealed. Typical hardness is Rockwell B 90 max.  
*For accuracy, always refer to the decimal thickness when ordering!*

## Hot Rolled As Rolled SAE/AISI 1035 Spring Steel

UNS# G10350

A continuous cast, fine grain, fully killed steel (#5 grain or better). Material can be cold formed and heat treated to meet design specifications. Material is low phosphorus, low sulfur, calcium treated to enhance internal cleanliness.

**STANDARD SPECIFICATIONS:** ASTM A568 (sheets) A830 (plates)  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .31/.38 Mn .60/.90 P .020 max. S .025 max Si.15/.30

**TYPICAL HARDNESS:** Rockwell B 70-90

**TYPICAL APPLICATIONS:** Blades, brackets, clutches, hand tools, springs, scrapers, & washers

**AVAILABLE FORMS:** Stock size sheets and plates. Material may also be Sheared, Laser Cut, Blanked, Edged, Deburred, and/or Re flattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

### STOCK GAUGES – *Contact our office for availability of other gauges!*

Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.122	5.00	.250	10.20



The warehouse that never closes!!!

- Expanded Product Information
- Technical Information
- Secure On-line Ordering
- Metals Industry Links

## Cold Rolled Soft SAE/AISI 1020 Strip Steel

UNS# G10200

A low carbon steel produced to cold rolled strip specifications for finish and gauge. Material is well suited for cold forming and case hardening applications.

**STANDARD SPECIFICATIONS:** ASTM A109, AMS 5062, QQS 698  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .17/.23 max Mn .30/.60 P .020 max. S .025 max

**TYPICAL HARDNESS:** Rockwell B 65 max.

**TYPICAL APPLICATIONS:** Base plates, brackets, washers

**FINISH:** #2

**AVAILABLE FORMS:** Stock size sheets and coils. Material may also be Slit, Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred, and/or Reflattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

### STOCK GAUGES – *Contact our office for availability of other gauges!*

Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.032	1.30	.078	3.18	.125	5.10
.042	1.71	.090	3.67	.145	5.92
.050	2.04	.105	4.28	.187	7.63

## Hot Rolled As Rolled SAE/AISI 1020 Spring Steel

UNS# G10200

A fine grain, continuous cast, killed steel. Designed for case hardening applications, may also be cold formed. Material is low phosphorus, low sulfur, calcium treated to enhance internal cleanliness.

**STANDARD SPECIFICATIONS:** ASTM A568 (sheets) A830 (plates)  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .17/.23 Mn .30/.60 P .020 max. S .025 max Si.15/.30

**TYPICAL HARDNESS:** Rockwell B 60-80.

**TYPICAL APPLICATIONS:** Brackets, washers, & hand tools

**AVAILABLE FORMS:** Stock size sheets and plates. Material may also be Sheared, Laser Cut, Blanked, Edged, Deburred, and/or Re flattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge tolerances, heat treating information, hardness conversion tables and physical properties.

### STOCK GAUGES – *Contact our office for availability of other gauges!*

Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.122	5.00	.184	7.50
.134	5.63	.250	10.20

## Cold Rolled Dead Soft SAE/AISI 1008/1010 Strip Steel

UNS# G10080/G10100

No. 5 (Dead Soft Temper) is a soft, ductile, fully killed, cold rolled strip produced without definite control of stretcher straining and fluting. It is suitable for difficult drawing applications where such surface disturbances are not objectionable. It is suitable for bending flat upon itself in an direction.

**STANDARD SPECIFICATIONS:** ASTM A109, AMS 5040, QQS 700.  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .13 max Mn .30/.60 P .020 max. S .025 max

**TYPICAL HARDNESS:** Rockwell B 55 max.

**TYPICAL APPLICATIONS:** Drawn or spun parts, cups, boxes, etc.

**FINISH:** #2

**AVAILABLE FORMS:** Stock size sheets and coils. Material may also be Slit, Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred, and/or Reflattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge tolerances, heat treating, hardness conversions and physical properties.

### STOCK GAUGES – *Contact our office for availability of other gauges!*

Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.008	.33	.040	1.63	.090	3.67
.010	.41	.042	1.71	.093	3.79
.012	.49	.045	1.84	.100	4.09
.015	.61	.048	1.92	.109	4.45
.018	.73	.050	2.04	.120	5.00
.020	.82	.058	2.36	.125	5.10
.025	1.00	.060	2.45	.134	5.47
.028	1.14	.062	2.53	.156	6.36
.030	1.22	.065	2.65	.187	7.63
.032	1.30	.072	2.94		

## Cold Rolled Soft SAE/AISI 1008/1010 Strip Steel

UNS# G10080/G10100

No. 4 (Skin Rolled or Soft Temper) is a soft, ductile, fully killed, cold rolled strip suitable for fairly deep drawing where surface disturbances, such as stretcher strains, are objectionable. It is capable of being bent flat upon itself in any direction. Skin rolled and pinch passed are equivalent terms with respect to temper.

**STANDARD SPECIFICATIONS:** ASTM A109, AMS 5040, QQS 700.  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .13 max Mn .30/.60 P .020 max. S .025 max

**TYPICAL HARDNESS:** Rockwell B 65 max.

**TYPICAL APPLICATIONS:** Base plates, brackets, stampings, & washers

**FINISH:** #2

**AVAILABLE FORMS:** Stock size sheets and coils. Material may also be Slit, Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred, and/or Reflattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge tolerances, heat treating, hardness conversions and physical properties.

### STOCK GAUGES – *Contact our office for availability of other gauges!*

Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.010	.41	.042	1.71	.090	3.67
.012	.49	.045	1.84	.093	3.79
.015	.61	.048	1.92	.100	4.09
.018	.73	.050	2.04	.109	4.45
.020	.82	.058	2.36	.120	5.00
.025	1.00	.060	2.45	.125	5.10
.028	1.14	.062	2.53	.134	5.47
.030	1.22	.065	2.65	.156	6.36
.032	1.30	.072	2.94	.187	7.63
.035	1.43	.078	3.19		

## Cold Rolled Quarter Hard SAE/AISI 1008/1010 Strip Steel

UNS# G10080/G10100

No. 3 (Quarter Hard Temper) is a medium soft, ductile, fully killed, cold rolled strip suitable for limited bending, forming, and drawing. It is capable of being bent 180 degrees across the direction of rolling and 90 degrees in the direction of rolling around a radius equal to the thickness.

**STANDARD SPECIFICATIONS:** ASTM A109, AMS 5062, QQS 698  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .13 max Mn .30/.60 P .020 max. S .025 max

**TYPICAL HARDNESS:** Rockwell B 60-75

**TYPICAL APPLICATIONS:** Brackets, frames, stampings, washers, & wheels

**FINISH:** #2

**AVAILABLE FORMS:** Stock size sheets and coils. Material may also be Slit, Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred, and/or Reflattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge tolerances, heat treating, hardness conversions and physical properties.

### STOCK GAUGES – *Contact our office for availability of other gauges!*

Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.010	.41	.042	1.71	.093	3.79
.012	.49	.048	1.92	.100	4.09
.015	.61	.050	2.04	.109	4.45
.018	.73	.058	2.36	.120	5.00
.020	.82	.060	2.45	.125	5.10
.025	1.00	.062	2.53	.134	5.47
.028	1.14	.065	2.65	.156	6.36
.030	1.22	.072	2.94	.187	7.63
.032	1.30	.078	3.19		



## Cold Rolled Half Hard SAE/AISI 1008/1010 Strip Steel

UNS# G10080/G10100

No. 2 (Half Hard Temper) is a moderately stiff cold rolled strip suitable for limited bending. Strip of this temper may be bent 90 degrees across the direction of rolling around around a radius equal to the thickness.

**STANDARD SPECIFICATIONS:** ASTM A109, AMS 5044, QQS 698.  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .13 max Mn .30/.60 P .020 max. S .025 max

**TYPICAL HARDNESS:** Rockwell B 70-85.

**TYPICAL APPLICATIONS:** Brackets, shims, stampings, & washers

**FINISH:** #2

**AVAILABLE FORMS:** Stock size sheets and coils. Material may also be Slit, Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred, and/or Reflattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

### STOCK GAUGES – *Contact our office for availability of other gauges!*

Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.010	.41	.042	1.71	.093	3.79
.012	.49	.048	1.92	.100	4.09
.015	.61	.050	2.04	.109	4.45
.018	.73	.058	2.36	.120	5.00
.020	.82	.060	2.45	.125	5.10
.025	1.00	.062	2.53	.134	5.47
.028	1.14	.065	2.65	.156	6.36
.030	1.22	.072	2.94	.187	7.63
.032	1.30	.078	3.19		

## Cold Rolled Hard SAE/AISI 1008/1010 Strip Steel

UNS# G10080/G10100

No. 1 (Hard Temper) is a very stiff, springy, cold rolled strip intended for flat work only.

**STANDARD SPECIFICATIONS:** ASTM A109, AMS 5062, QQS 698  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .13 max Mn .30/.60 P .020 max. S .025 max

**TYPICAL HARDNESS:** Rockwell B 65 max.

**TYPICAL APPLICATIONS:** Gaskets, shims, & washers

**FINISH:** #2

**AVAILABLE FORMS:** Stock size sheets and coils. Material may also be Slit, Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred, and/or Reflattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge tolerances, heat treating, hardness conversions and physical properties.

<b>STOCK GAUGES</b> – <i>Contact our office for availability of other gauges!</i>					
Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.010	.41	.045	1.84	.093	3.79
.012	.49	.048	1.92	.100	4.09
.015	.61	.050	2.04	.109	4.45
.018	.73	.058	2.36	.120	5.00
.020	.82	.060	2.45	.125	5.10
.025	1.00	.062	2.53	.134	5.47
.028	1.14	.065	2.65	.156	6.36
.030	1.22	.072	2.94	.187	7.63
.032	1.30	.078	3.19		
.035	1.43	.083	3.39		

## Cold Rolled Hard SAE/AISI 1008/1010 Shim Steel

UNS# G10080/G10100

This product is rolled specifically to restricted gauge tolerances equal to +/- 10% of the thickness. It is a low carbon, full hard, cold rolled strip product used where combined hardness, flatness, and accuracy is important.

**STANDARD SPECIFICATIONS:** ASTM A109, AMS 5062, QQS 698  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .13 max Mn .30/.60 P .020 max. S .025 max

**TYPICAL HARDNESS:** Rockwell B 90 min.

**TYPICAL APPLICATIONS:** Transmission shims, drive train shims, gaskets, tool & die alignment, arbor spacers

**FINISH:** #2

**AVAILABLE FORMS:** Stock size coils. Material may also be Slit and/or cut to length to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge tolerances, heat treating, hardness conversions and physical properties.

### STOCK GAUGES – *Contact our office for availability of other gauges!*

Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.001	.0408	.006	.2448
.002	.0816	.007	.2856
.003	.1224	.008	.3264
.004	.1632	.009	.3672

# Hot Rolled P&O Spheroidized Annealed SAE/AISI 6150 Alloy

UNS# G61500

This is a medium carbon, chrome-vanadium, fine grain, killed alloy. In the heat treated condition it has good wear and abrasion resistance. Excellent toughness and shock resistance make it a good alloy for parts exposed to stress, shock, and vibration.

**STANDARD SPECIFICATIONS:** ASTM A829. *See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .48/.53 Mn .70/.90 P .035 max. S .040 max Si.15/.35  
Cr .80/1.10 V .15 min

**TYPICAL HARDNESS:** Rockwell B 95 max.

**TYPICAL APPLICATIONS:** Springs, blades, gears, hand tools, & machinery parts

**AVAILABLE FORMS:** Stock size sheets and plates. Material may also be Sheared, Laser Cut, Blanked, Edged, Deburred, and/or Re flattened to your specifications.

Sheet gauges are stocked in Cold Rolled Annealed condition.

See our reference section for information regarding edge conditions, finish descriptions, gauge

<b>STOCK GAUGES – Contact our office for availability of other gauges!</b>					
Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lb/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.062 *	2.53	.235	9.59	.500	20.42
.125 *	5.10	.250	10.21	.625	25.52
.187 *	7.63	.312	12.76	.750	30.63

\* Stocked in Cold Rolled Annealed condition. Meets ASTM A505, & A506

## Hot Rolled As Rolled SAE/AISI 5160 Alloy Round Edge Bars UNS# G51600

This is a fine grain chromium alloy. It is produced with a hot rolled round edge ideal for flat spring applications. Chromium aids wear and shock resistance and promotes better heat treat penetration.

**STANDARD SPECIFICATIONS:** ASTM A689 & A304. *See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .56/.64 Mn .75/1.00 P .035 max. S .040 max Si.15/.30  
Cr .70/.90

**TYPICAL HARDNESS:** Rockwell C 25-35

**TYPICAL APPLICATIONS:** Leaf springs, wear strips, guide bars, hand tools

**AVAILABLE FORMS:** Round edge bars. Can be cut to length.

See our reference section for information regarding edge conditions, finish descriptions, gauge

<b>STOCK SIZES – Contact our office for availability of other sizes!</b>							
Width	Thickness	Fraction	Lbs/Ft.	Width	Thickness	Fraction	Lbs/Ft.
1	.250*	1/4	.84	1-3/4	.237	15/64	1.39
	.250	1/4	.84		.262	17/64	1.54
	.312*	5/16	1.04		.291	19/64	1.71
	.312	5/16	1.04		.323	21/64	1.90
1-1/4	.250*	1/4	1.05	2	.360	23/64	2.11
		1/4	1.05		.401	13/32	2.35
		5/16	1.30		.437	7/16	2.59
		3/8	1.55		.499	1/2	2.93
	.375	3/8	1.55		.562	9/16	3.27
1-1/2	.204*	13/64	1.03	.625	5/8	3.66	
	.214	7/32	1.08	.750	3/4	4.26	
	.237	15/64	1.20	2	.204	13/64	1.37
	.262	17/64	1.32		.214	7/32	1.44
	.291	19/64	1.47		.237	15/64	1.59
	.312	5/16	1.57		.250	1/4	1.72
.375	3/8	1.89	.262		17/64	1.76	
.499	1/2	2.44	.291		19/64	1.95	
1-3/4	.204	13/64	1.20	.323	21/64	2.17	
				.360	23/64	2.42	

\* Indicates an annealed size

**STOCK SIZES – Contact our office for availability of other sizes!**

Width	Thickness	Fraction	Lbs/Ft.	Width	Thickness	Fraction	Lbs/Ft.
2	.401	13/32	2.69	3	.204	13/64	2.08
	.447	29/64	3.00		.237	15/64	2.38
	.499	1/2	3.35		.250	1/4	2.51
	.625	5/8	4.19		.262	17/64	2.64
	.788	25/32	5.28		.291	19/64	2.93
	1.00	1	6.45		.323	21/64	3.25
	1.25	1-1/4	8.08		.341	-	3.42
2-1/4	.214	7/32	1.62	.360	23/64	3.62	
	.237	15/64	1.79	.375	3/8	3.77	
	.262	17/64	1.98	.401	13/32	4.05	
	.291	19/64	2.20	.447	29/64	4.50	
	.323	21/64	2.43	.499	1/2	5.02	
	.360	23/64	2.72	.558	9/16	5.61	
	.401	13/32	3.03	.590	19/32	5.93	
	.447	29/64	3.37	.625	5/8	6.28	
	.499	1/2	3.76	.662	-	6.65	
	.558	9/16	4.21	.702	45/64	7.05	
	.590	19/32	4.44	.788	25/32	7.92	
	.625	5/8	4.71	.812	-	8.09	
	.788	25/32	5.94	.887	7/8	8.80	
	2-1/2	.125*	1/8	1.05	.938	15/16	9.28
.204		13/64	1.71	1.000	1	10.05	
.214		7/32	1.80	1.250	1-1/4	12.56	
.237		15/64	1.99	1.375	1-3/8	13.81	
.250		1/4	2.13	3-1/2	.262	17/64	3.08
.262		17/64	2.20		.291	19/64	3.41
.291		19/64	2.44		.323	21/64	3.79
.312		5/16	2.64		.360	23/64	4.22
.323		21/64	2.71		.375	3/8	4.40
.341		-	2.87		.401	13/32	4.70
.360		23/64	3.02		.447	29/64	5.24
.375		3/8	3.14		.499	1/2	5.85
.380		-	3.22		.558	9/16	6.54
.401		13/32	3.36		.625	5/8	7.33
.447		29/64	3.74		.660	-	7.72
.499		1/2	4.18		.788	25/32	9.24
.558		9/16	4.68		4	.250	1/4
.625		5/8	5.23	.323		21/64	4.33
.710		-	5.87	.360		23/64	4.82
.744		47/64	6.17	.375		3/8	5.03
.770	49/64	6.44	.401	13/32		5.38	
.788	25/32	6.60	.423	-		5.66	
.840	-	7.08	.447	29/64		5.99	
.941	-	7.93	.499	1/2		6.69	
1.000	1	8.18	.558	9/16	7.48		
1.060	1-1/16	8.59	.625	5/8	8.37		

\* Indicates an annealed size

**STOCK SIZES – Contact our office for availability of other sizes!**

Width	Thickness	Fraction	Lbs/Ft.	Width	Thickness	Fraction	Lbs/Ft.
4	.887	7/8	11.72	5	1.500	1-1/2	25.11
	1.000	1	13.40				
	1.127	1-1/8	14.89	5-1/2	.500	1/2	9.21
	1.210	-	15.89				
4-1/2	.500	1/2	7.54	6	.375	3/8	7.54
					.401	13/32	8.06
.437	7/16	8.78					
.499	1/2	10.03					
5	.375	3/8	6.28	.558	9/16	11.21	
	.437	7/16	7.32	.625	5/8	12.56	
	.499	1/2	8.36	.750	3/4	15.07	
	.625	5/8	10.47	1.000	1	20.09	
	.702	-	11.75	1.250	1-1/4	25.11	
	.750	3/4	12.56	1.375	1-3/8	27.63	
	.788	25/32	13.20	1.500	1-1/2	30.13	
	.887	7/8	14.86	8	.500	1/2	14.27
	1.000	1	16.74				
	1.125	1-1/8	18.84				

**STOCK METRIC SIZES – Contact our office for availability of other sizes!**

Width	Thickness	Decimal	Lbs/Ft.	Width	Thickness	Decimal	Lbs/Ft.	
60 mm	6 mm	2.362 X .236	1.87	80 mm	8 mm	3.150 X .315	3.33	
	7 mm	2.362 X .276	2.19		10 mm	3.150 X .394	4.16	
	8 mm	2.362 X .315	2.49		11 mm	3.150 X .433	4.57	
	9 mm	2.362 X .354	2.83		12 mm	3.150 X .472	4.98	
	10 mm	2.362 X .394	3.32		13 mm	3.150 X .512	5.40	
	11 mm	2.362 X .433	3.43		14 mm	3.150 X .552	5.83	
	12 mm	2.362 X .472	3.73		15 mm	3.150 X .591	6.24	
	13 mm	2.362 X .512	4.05		16 mm	3.150 X .630	6.65	
	14 mm	2.362 X .551	4.37		22 mm	3.150 X .866	9.05	
	16 mm	2.362 X .630	5.00		90 mm	24 mm	3.543 X .945	11.20
	70 mm	6 mm	2.756 X .236					
7 mm		2.756 X .276	2.55	11 mm	3.938 X .433	5.71		
8 mm		2.756 X .315	2.91	12 mm	3.938 X .472	6.23		
9 mm		2.756 X .354	3.27	13 mm	3.938 X .512	6.76		
10 mm		2.756 X .394	3.64	14 mm	3.938 X .552	7.28		
11 mm		2.756 X .433	4.00	20 mm	3.938 X .787	10.27		
12 mm		2.756 X .472	4.36	21 mm	3.938 X .826	10.85		
13 mm		2.756 X .512	4.73	22 mm	3.938 X .866	11.42		
14 mm		2.756 X .552	5.10	120 mm	14 mm	4.724 X .551	8.78	
16 mm		2.756 X .630	5.81		16 mm	4.724 X .630	9.96	
18 mm		2.756 X .709	6.55		18 mm	4.724 X .709	11.23	
19 mm	2.756 X .748	6.91	20 mm		4.724 X .787	12.40		
22 mm	2.756 X .866	7.81						

## Cold Rolled Spheroidized Annealed Aircraft Quality SAE/AISI 4130 Alloy Strip Steel UNS# G41300

A chrome-moly aircraft quality alloy for general use where welding, forming, and moderate tensile properties are required. Material is carefully rolled and inspected to be free from laminations, tears, and seams.

**STANDARD SPECIFICATIONS:** ASTM A505 & A506, AMS 5062,6350 & 6351  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .28/.33 Mn .40/.60 P .020 max. S .025 max Si .20/.35  
Cr .80/1.00 Mo .15/.25

**TYPICAL HARDNESS:** Rockwell B 85 max.

**TYPICAL APPLICATIONS:** Aircraft parts, cargo hardware, seatbelts, & washers

**FINISH:** #2

**AVAILABLE FORMS:** Stock size sheets and coils. Material may also be Slit, Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred, and/or Re flattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge tolerances, heat treating, hardness conversions and physical properties

### STOCK GAUGES – *Contact our office for availability of other gauges!*

Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.020	.82	.061	2.49	.109	4.45
.025	1.00	.072	2.94	.120	5.00
.032	1.30	.080	3.26	.125	5.10
.042	1.71	.091	3.71	.187	7.63



# Hot Rolled P&O Spheroidized Annealed Aircraft & Commercial Quality SAE/AISI 4130 Alloy Steel

UNS# G41300

A chrome-moly alloy with relatively low carbon for general use where welding and moderate tensile properties are required. This is a continuous cast, fine grain, material that is produced to meet the exacting standards of the aircraft industry.

**STANDARD SPECIFICATIONS:** ACQ: AMS G350 & G351,  
CQ: ASTM A506 (sheets) A829 (plates)  
*See page 64 for foreign specifications.*

**TYPICAL ANALYSIS:** C .28/.33 Mn .40/.60 P .020 max. S .025 max Si.20/.35  
Cr .80/1.00 Mo .15/.25

**TYPICAL HARDNESS:** Rockwell B 85 max.

**TYPICAL APPLICATIONS:** Aircraft brakes, seatbelts, cargo hardware, gears, sprockets, tools, & machinery parts

**AVAILABLE FORMS:** Stock size sheets and plates. Material may also be Sheared, Laser Cut, Blanked, Edged, Deburred, and/or Re flattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

<b>STOCK GAUGES – Contact our office for availability of other gauges!</b>			
<b>AIRCRAFT QUALITY</b>		<b>COMMERCIAL QUALITY</b>	
Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.125	5.10	.134	5.63
.156	6.36	.164	6.88
.187	7.50	.187	7.50
.250	10.20	.250	10.20
		.312 *	12.73

\* This gauge is box annealed. Typical hardness is B 90 max.

## Admiral Hard Spring Steel Shim Forge Hammer Shim Steel – Die Liner Steel Hot Rolled Floor Annealed Spring Steel

Intended for flat shim applications where hardness and malleability are critical. Primarily used for die shims in forge hammers and presses. Can be furnished as strips, blanks, circles or rings to meet your application.

**TYPICAL HARDNESS:** Rockwell C 10-40

**TYPICAL APPLICATIONS:** Die shims

**AVAILABLE FORMS:** Stock size sheets and plates. Material may also be Sheared, Laser Cut, Leveled, Blanked, Edged, Deburred, and/or Re flattened to your specifications.

See our reference section for information regarding edge conditions, finish descriptions, gauge

<b>STOCK GAUGES</b> – <i>Contact our office for availability of other gauges!</i>					
Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.	Gauge Decimal	Lbs/Sq. Ft.
.015	.61	.062	2.53	.156	6.26
.020	.82	.075	3.06	.187	7.63
.025	1.00	.093	3.79	.250	10.20
.032	1.30	.109	4.45	.312	12.76
.042	1.71	.125	5.10	.375	15.32

# SAE/AISI O-1 Tool Steel

UNS# T31501

O-1 is an oil hardened steel. It is most popular for general tool room use due to its versatility and overall ease of handling. It has good non-deforming qualities. Low hardening temperatures allow in-plant heat treatment even where facilities are limited.

**TYPICAL ANALYSIS:** C .95 Mn 1.20 Si .30 Cr .50 Va .20 W .50

**TYPICAL APPLICATIONS:** Tools & dies requiring moderate abrasion resistance

**AVAILABLE FORMS:** Ground flats, rounds, squares, plates, drill rod

**HEAT TREATMENT:**

Forging	1925°-1500° F
Annealing	1400°-1440° F
Preheating	1200°-1250° F
Hardening	1450°-1500° F
Tempering	350°-450° F

**EFFECT OF TEMPERING:**

As Hardened	Rockwell C 63-65
400° F	Rockwell C 61-63
600° F	Rockwell C 55-57
800° F	Rockwell C 48-50

## STOCK SIZES – Contact our office for availability of other sizes!

Description	Available Sizes	Tolerances	Stock Lengths
Flats, Squares	1/64" - 4" Thick, 1/4" - 12" Wide	+.015/+.035 thick, +.015/+.065 wide	18", 36"
Plates	1/2" - 5" Thick, 43" Wide	+.015/+.035 thick	96"
Decarb Free Rounds	1/4" - 1" Diameter	+.005/+.015	18", 36"
	1.001" - 1.999" Diameter	+.007/+.020	18", 36"
	2.000" - 2.999" Diameter	+.015/+.046	18", 36"
	3.000" - 5.999" Diameter	+.062/+.109	18", 36"
	6.000" - 11.999" Diameter	+.093/+.140	18", 36"
	12.000" - 21.250" Diameter	+.109/+.187	18", 36"
Drill Rod	.062" - .124" Diameter	+/- .0003	36", 144"
	.125" - .499" Diameter	+/- .0005	36", 144"

# SAE/AISI A-2 Tool Steel

UNS# T30102

A-2 is an air hardening tool steel which offers excellent stability during heat treatment. A-2 has gained popularity for applications where a high risk of distortion or cracking exists. Increased toughness, wear, & abrasion resistance improve die life significantly over that of basic oil hardening grades.

**TYPICAL ANALYSIS:** C 1.00 Mn .60 Si .30 Cr 5.20 Va .30 Mo 1.10

**TYPICAL APPLICATIONS:** Blanking, punches, machine parts

**AVAILABLE FORMS:** Ground flats, rounds, squares, drill rod

**HEAT TREATMENT:**

Forging	2100°-1650° F
Annealing	1550°-1600° F
Preheating	1450°-1500° F
Hardening	1750°-1800° F
Tempering	400°-650° F

**EFFECT OF TEMPERING:**

As Hardened	Rockwell C 63-65
400° F	Rockwell C 60-62
600° F	Rockwell C 58-60
800° F	Rockwell C 57-59

## STOCK SIZES – Contact our office for availability of other sizes!

Description	Available Sizes	Tolerances	Stock Lengths
Flats, Squares	1/64" - 4" Thick, 3/16" - 12" Wide	+0.015/+0.035 thick, +0.015/+0.065 wide	18", 36"
Plates	1/2" - 6" Thick, 43" Wide	+0.015/+0.035"	96"
Decarb Free Rounds	5/16" - 1" Diameter	+0.005/+0.015	18", 36"
	1.001" - 1.999" Diameter	+0.007/+0.020	18", 36"
	2.000" - 2.999" Diameter	+0.015/+0.046	18", 36"
	3.000" - 5.999" Diameter	+0.062/+0.109	18", 36"
	6.000" - 11.999" Diameter	+0.093/+0.140	18", 36"
Drill Rod	12.000" - 21.250" Diameter	+0.109"/+0.187	18", 36"
	.062" - .124" Diameter	+/- .0003	36", 144"
	.125" - .499" Diameter	+/- .0005	36", 144"

## SAE/AISI D-2 Tool Steel

UNS# T30402

A high carbon, high chromium type tool steel, D-2 combines exceptional wear resisting properties with maximum toughness at high hardness in sections of all sizes. Minimum tendency to distort during heat treatment makes D-2 ideal for intricate die designs and other applications where extreme stability during heat treatment is required. D-2 is commonly used for high volume production applications where long die life is desired.

**TYPICAL ANALYSIS:** C 1.50 Mn .40 Si .40 Cr 12.00 Va .95 Mo .90

**TYPICAL APPLICATIONS:** Bushings, punches, forming dies

**AVAILABLE FORMS:** Ground flats, rounds, squares, plates, drill rod

**HEAT TREATMENT:**

Forging	2100°-1700° F
Annealing	1600°-1650° F
Preheating	1450°-1500° F
Hardening	1800°-1875° F
Tempering	400°-600° F

**EFFECT OF TEMPERING:**

As Hardened	Rockwell C 62-64
400° F	Rockwell C 60-62
600° F	Rockwell C 58-60
800° F	Rockwell C 57-59

### STOCK SIZES – Contact our office for availability of other sizes!

Description	Available Sizes	Tolerances	Stock Lengths
Flats, Squares	1/8" - 1" Thick, 1/2" - 6" Wide	+ .015/+ .035 thick, + .015/+ .065 wide	18", 36"
Plates	1/2" - 8" Thick, 43" Wide	+ .015/+ .035 thick	96"
Decarb Free Rounds	3/8" - 1" Diameter	+ .005/+ .015	18", 36"
	1.001" - 1.999" Diameter	+ .007/+ .020	18", 36"
	2.000" - 2.999" Diameter	+ .015/+ .046	18", 36"
	3.000" - 5.999" Diameter	+ .062/+ .109	18", 36"
	6.000" - 11.999" Diameter	+ .093/+ .140	18", 36"
	12.000" - 25.999" Diameter	+ .109/+ .187	18", 36"
Drill Rod	26.000" - 32.500" Diameter	+ .187/+ .312	18", 36"
	.062" - .124" Diameter	+/- .0003	36", 144"
	.125" - .499" Diameter	+/- .0005	36", 144"

# SAE/AISI S-1 Tool Steel

UNS# T41901

S-1 is an air hardened steel. It has an exceptionally good combination of toughness and abrasion resistance. It performs well on moderately severe hot work requirements as well as on a wide variety of cold work assignments.

**TYPICAL ANALYSIS:** C .55 Mn .30 Si .90 Cr .60 max Mo 1.55

**AVAILABLE FORMS:** Rounds

**HEAT TREATMENT:**

Annealing	1475°-1500° F
Hardening	1650°-1850° F
Tempering	400°-1150° F
Forging	1650°-2000° F

**EFFECT OF TEMPERING:**

As Quenched	Rockwell C 57-59
400° F	Rockwell C 56-58
500° F	Rockwell C 55-57
600° F	Rockwell C 53-55
700° F	Rockwell C 51-53
800° F	Rockwell C 49-51

## STOCK SIZES – Contact our office for availability of other sizes!

Description	Available Sizes	Tolerances	Stock Lengths
Decarb Free Rounds	1/2" - 1" Diameter	+.005/+.015	18", 36"
	1.001" - 1.999" Diameter	+.007/+.020	18", 36"
	2.000" - 2.999" Diameter	+.015/+.046	18", 36"
	3.000" - 5.999" Diameter	+.062/+.109	18", 36"

# SAE/AISI S-7 Tool Steel

UNS# T41901

S-7 is an air hardened steel. It is a good general purpose, shock resisting steel ideal for applications requiring exceptional toughness, wear resistance, and dimensional stability.

**TYPICAL ANALYSIS:** C .50 Mn .70 Si .30 Cr 3.25

**TYPICAL APPLICATIONS:** Blanking, Forming Dies

**AVAILABLE FORMS:** Plates, rounds, flats, & squares

**HEAT TREATMENT:**

Forging	1800°-2100° F
Annealing	1500°-1600° F
Hardening	1725°-1850° F
Tempering	400°-1150° F

**EFFECT OF TEMPERING:**

As Hardened	Rockwell C 59-61
400° F	Rockwell C 51-59
600° F	Rockwell C 54-56
800° F	Rockwell C 52-54
1000° F	Rockwell C 50-52

## STOCK SIZES – Contact our office for availability of other sizes!

Description	Available Sizes	Tolerances	Stock Lengths
Flats, Squares	1/8" - 1/2" Thick, 1/2" - 6" Wide	+ .015/+ .035 thick, + .015/+ .065 wide	18", 36"
Plates	1/2" - 5" Thick, 43" Wide	+ .015/+ .035 thick	96"
Decarb Free Rounds	3/8" - 1" Diameter	+ .005/+ .015	18", 36"
	1.001" - 1.999" Diameter	+ .007/+ .020	18", 36"
	2.000" - 2.999" Diameter	+ .015/+ .046	18", 36"
	3.000" - 5.999" Diameter	+ .062/+ .109	18", 36"
	6.000" - 11.999" Diameter	+ .093/+ .140	18", 36"
	12.000" - 18.000" Diameter	+ .109/+ .187	18", 36"
Drill Rod	.062" - .124" Diameter	+/- .0003	36", 144"
	.125" - .499" Diameter	+/- .0005	36", 144"

## SAE/AISI H-13 Tool Steel

UNS# T20813

H-13 is a "hot work" tool steel designed to retain hardness at elevated temperatures and to withstand the effects of alternate heating and cooling. With its exceptional toughness and resiliency, H-13 is used extensively in aluminum extrusion, aluminum die casting, and forging die applications.

**TYPICAL ANALYSIS:** C .38 Mn .35 Si 1.00 Cr 5.25 Va 1.05 Mo 1.35

**TYPICAL APPLICATIONS:** Die casting dies, forging dies, shear blades

**AVAILABLE FORMS:** Ground flats, rounds, plates

**HEAT TREATMENT:**

Forging	1950°-2100° F
Annealing	1550°-1650° F
Preheating	1300°-1500° F
Hardening	1825°-1900° F
Tempering	1000°-1200° F

**EFFECT OF TEMPERING:**

As Hardened	Rockwell C 51-54
400° F	Rockwell C 49-50
600° F	Rockwell C 50-51
800° F	Rockwell C 52-54
1000° F	Rockwell C 51-53

### STOCK SIZES – Contact our office for availability of other sizes!

Description	Available Sizes	Tolerances	Stock Lengths
Flats, Squares	1/64" - 4" Thick, 1/4" - 12" Wide	+0.015/+0.035 thick, +0.015/+0.065 wide	18", 36"
Plates	1/2" - 5" Thick, 43" Wide	+0.015/+0.035 thick	96"
Decarb Free Rounds	1/2" - 1" Diameter	+0.005/+0.015	18", 36"
	1.001" - 1.999" Diameter	+0.007/+0.020	18", 36"
	2.000" - 2.999" Diameter	+0.015/+0.046	18", 36"
	3.000" - 5.999" Diameter	+0.062/+0.109	18", 36"



## Low Carbon Tool Steel

Low Carbon tool steel is easily machined, has excellent weldability and uniformity to case hardening. The manganese content provides greater strength and hardness compared to other carbon steels.

**TYPICAL ANALYSIS:** C .18 Mn .75 Si .30 P .040 max S .050 max

**TYPICAL APPLICATIONS:** Punch pads, stripper plates, and back-up plates

**AVAILABLE FORMS:** Ground flats, squares

**HEAT TREATMENT:**

Forging	2100°-1650° F
Annealing	1550°-1600° F
Preheating	1450°-1500° F
Hardening	1750°-1800° F
Tempering	400°-650° F

**EFFECT OF TEMPERING:**

As Hardened	Rockwell C 63-65
400° F	Rockwell C 61-63
600° F	Rockwell C 55-57
800° F	Rockwell C 48-50

### STOCK SIZES – Contact our office for availability of other sizes!

Description	Available Sizes	Tolerances	Stock Lengths
Flats, Squares	1/64" - 4" Thick, 1/4" - 12" Wide	+ .015/+ .035 thick, + .015/+ .065 wide	18", 36"
Plates	1/2" - 5" Thick, 43" Wide	+ .015/+ .035 thick	96"
Decarb Free Rounds	1/4" - 1" Diameter	+ .005/+ .015	18", 36"
	1.001" - 1.999" Diameter	+ .007/+ .020	18", 36"
	2.000" - 2.999" Diameter	+ .015/+ .046	18", 36"
	3.000" - 5.999" Diameter	+ .062/+ .109	18", 36"
	6.000" - 11.999" Diameter	+ .093/+ .140	18", 36"
Drill Rod	12.000" - 21.250" Diameter	+ .109/+ .187	18", 36"
	.062" - .124" Diameter	+/- .0003	36", 144"
	.125" - .499" Diameter	+/- .0005	36", 144"

## SAE/AISI 4140 H.T. Alloy

UNS# G41400

4140 is a heat treated alloy steel which has been normalized and tempered to a Brinell hardness of 262 – 321. This material has been cross rolled and is decarb free with a machineability equal to 85% of a 1.00 carbon steel.

**TYPICAL ANALYSIS:** C .40 Mn .85 Si .25 Cr .95 Mo .20

**TYPICAL HARDNESS:** Rockwell C 26.6-34.3

**TYPICAL APPLICATIONS:** Drill collars, bolts, reamer bodies, sprockets, rams, spindles, valves & axle shafts

**AVAILABLE FORMS:** Ground flats, plates. Widths available from 1" to 43". Lengths upto 96". Can be saw cut to size.

See our reference section for information regarding edge conditions, finish descriptions, gauge tolerances, heat treating information, hardness conversion tables and physical properties.

### STOCK GAUGES – *Contact our office for availability of other gauges!*

Thickness	Lbs/Sq. Ft.	Thickness	Lbs/Sq. Ft.
1/4	10.19	1-3/4	71.39
3/8	15.29	2	81.60
1/2	20.40	2-1/4	91.79
5/8	25.50	2-1/2	101.99
3/4	30.60	2-3/4	112.19
7/8	35.70	3	122.39
1	40.80	3-1/2	142.78
1-1/8	45.89	4	163.18
1-1/4	51.00	4-1/2	183.58
1-3/8	56.09	5	203.98

**REFERENCE**

**Admiral**   
**STEEL**

*“Committed to total customer satisfaction.”*



## Table of Contents – Reference

### Reference

AMS Specifications.....	63
ASTM Specifications.....	61-62
Alloy Steel Composition.....	50-51
Camber Tolerances.....	47
Carbon Steel Composition.....	48-49
Decimal & Metric Conversions.....	66-67
Edge Descriptions.....	45
Effects of Alloying Elements.....	52-53
Finish Descriptors.....	45
Foreign Specifications.....	64
Gauge Equivalents.....	65
Gauge Tolerances.....	46
Glossary.....	68-83
Hardness Conversion Tables.....	58-60
Heat Treating Information.....	57
Physical Properties.....	54-56
QQS Specifications.....	63
Trade Customs.....	84
Weight Tolerances.....	47
Width Tolerances.....	48

*The material in this reference section is provided “as-is”. This material has been compiled from several industry sources. While every effort has been made to insure its accuracy, Admiral Steel LLC makes no warranty of any kind with respect to the subject matter or the accuracy of the information contained herein.*

*Admiral Steel LLC specifically disclaims all warranties of any kind, express, implied, or otherwise. We do not guarantee the performance of specific products for specific applications.*

*In no event shall Admiral Steel LLC be liable for damages including special, incidental, indirect, consequential, loss of use or otherwise for situations resulting from the use of information contained within this catalog.*

## Edge & Finish Descriptions

### Edge Descriptions

No. 1 Edge	This is a prepared edge of a specified contour (round, square, beveled) with very accurate width and suitable for plating.
No. 2 Edge	A natural mill edge.
No. 3 Edge	Is a square edge produced by slitting or shearing.
No. 4 Edge	A round edge produced by edge rolling.
No. 5 Edge	An approximate square edge produced by rolling or filing of a slit edge or a deburred edge.

### Finish Descriptions

No. 1	Also known as a satin finish. This is a finish without luster, produced by rolling on rolls roughened by mechanical or chemical means. This finish is especially suitable for lacquer or paint adhesion, and is beneficial in aiding drawing operations by reducing the contact friction between the die and the strip.
No. 2	Also known as a regular bright finish. This is a luster finish produced by rolling on rolls having a moderately high finish. It is suitable for many requirements, but not generally applicable to plating unless ground and buffed.
No. 3	Also known as a best bright finish. This is a high luster finish normally used for critical plating applications with minimal surface preparation.

## Standard Gauge & Width Tolerances

### Gauge Tolerances

Type of Material	Gauge Range	Gauge Tolerance
Cold Rolled (Strip Quality)	.002" - .007" .008" - .019" .020" - .029" .030" - .059" .060" - .125"	+/- 10% of gauge +/- .00075" +/- .001" +/- .0015" +/- .002"
Hot Rolled Carbon Sheet & Plate	.060" - .098" .099" - .179" .180" - .230" .231" - .300" .301" - .360"	+/- .007" +/- .008" +/- .009" +/- .010" +/- .011"
Blue Tempered Spring Steel	.002" .003" .004" .005" .006" .007" - .0123" .0124" - .0157" .0158" - .0196" .0197" - .0247" .0248" - .0314" .0315" - .0393" .0394" - .0491" .0492" - .0629" .094"	+/- .0002" +/- .00024" +/- .00028" +/- .00035" +/- .00039" +/- .00043" +/- .00047" +/- .00055" +/- .00067" +/- .00079" +/- .00091" +/- .00102" +/- .00126" +/- .002"

### Width Tolerances

Type of Processing	Gauge Range	Width Tolerance
Slitting	Up to .093" .094" - .125"	+/- .005" +/- .010"
Shearing	Up to .200" .201" - .300"	+/- .015" +/- .032"
Stock Size Sheets, Plates & Coils	All	+.750"/-.000"

# Standard Camber & Weight Tolerances

## Camber Tolerances

Camber is the greatest deviation of a side edge from a straight line. Camber varies according to width and length. Camber is measured by placing an 8 foot straight edge on the concave side and measuring the maximum in distance between the strip edge and the straight edge.

Standard camber tolerances: Over 1-1/2" wide = 1/4" in any 8 feet  
Over 1/2" – 1-1/2" wide = 1/2" in any 8 feet

To calculate the standard camber tolerance for lengths other than 8 feet, the following formula may be used:

$$CD=(D^2 \times c)/d^2$$

CD = Camber in desired length  
c = Camber in known length  
d = Original length of known camber  
D = desired length

For example: If standard camber is 1/4" in 8 feet for a particular width, what is the camber in 30 feet?

$$CD=(30^2 \times 1/4)/8^2 = (900 \times 1/4)/64 = 3.51 \text{ inches}$$

## Weight Tolerances

Due to the constraints of processing, it is not always possible to deliver exact weights on individual items. For this reason, the following tolerances for under

Item Weight	Tolerance
1000 lbs or more	+ 10% - 10%
300 – 999 lbs	+ 15% - 10%
100 – 299 lbs	+ 20% - 10%
1 – 99 lbs	+ 30% - 10%

## Carbon Steel Composition

SAE or AISI NO.	C	Mn	P Max	S Max
1005	0.06 max.	0.35 max.	0.040	0.050
1006	0.08 max.	0.45 max.	0.040	0.050
1008	0.10 max.	0.50 max.	0.040	0.050
1009	0.15 max.	0.60 max.	0.040	0.050
1010	0.08-0.13	0.30-0.60	0.040	0.050
1011	0.08-0.13	0.60-0.90	0.040	0.050
1012	0.10-0.15	0.30-0.60	0.040	0.050
1013	0.11-0.16	0.50-0.80	0.040	0.050
1014	0.13-0.18	0.30-0.60	0.040	0.050
1015	0.12-0.18	0.30-0.60	0.040	0.050
1016	0.12-0.18	0.60-0.90	0.040	0.050
1017	0.14-0.20	0.30-0.60	0.040	0.050
1018	0.14-0.20	0.60-0.90	0.040	0.050
1019	0.14-0.20	0.70-1.00	0.040	0.050
1020	0.17-0.23	0.30-0.60	0.040	0.050
1021	0.17-0.23	0.60-0.90	0.040	0.050
1022	0.17-0.23	0.70-1.00	0.040	0.050
1023	0.19-0.25	0.30-0.60	0.040	0.050
1024	0.18-0.25	1.30-1.65	0.040	0.050
1025	0.22-0.28	0.30-0.60	0.040	0.050
1026	0.22-0.28	0.60-0.90	0.040	0.050
1027	0.22-0.29	1.20-1.55	0.040	0.050
1029	0.25-0.31	0.60-0.90	0.040	0.050
1030	0.27-0.34	0.60-0.90	0.040	0.050
1031	0.28-0.34	0.30-0.60	0.040	0.050
1033	0.29-0.36	0.70-1.00	0.040	0.050
1034	0.32-0.38	0.50-0.80	0.040	0.050
1035	0.31-0.38	0.60-0.90	0.040	0.050
1036	0.30-0.38	1.20-1.55	0.040	0.050
1037	0.31-0.38	0.70-1.00	0.040	0.050
1038	0.34-0.42	0.60-0.90	0.040	0.050
1039	0.36-0.44	0.70-1.00	0.040	0.050
1040	0.36-0.44	0.60-0.90	0.040	0.050
1041	0.36-0.45	1.30-1.65	0.040	0.050
1042	0.39-0.47	0.60-0.90	0.040	0.050
1043	0.39-0.47	0.70-1.00	0.040	0.050
1044	0.43-0.50	0.30-0.60	0.040	0.050
1045	0.42-0.50	0.60-0.90	0.040	0.050
1046	0.42-0.50	0.70-1.00	0.040	0.050

**REFERENCE**  
Carbon steel composition



## Carbon Steel Composition

SAE or	C	Mn	P	S
1049	0.45-0.53	0.60-0.90	0.040	0.050
1050	0.47-0.55	0.60-0.90	0.040	0.050
1051	0.45-0.56	0.85-1.15	0.040	0.050
1052	0.46-0.55	1.20-1.55	0.040	0.050
1053	0.48-0.55	0.70-1.00	0.040	0.050
1054	0.50-0.60	0.50-0.80	0.040	0.050
1055	0.50-0.60	0.60-0.90	0.040	0.050
1059	0.55-0.65	0.50-0.80	0.040	0.050
1060	0.55-0.66	0.60-0.90	0.040	0.050
1061	0.54-0.65	0.75-1.05	0.040	0.050
1064	0.59-0.70	0.50-0.80	0.040	0.050
1065	0.59-0.70	0.60-0.90	0.040	0.050
1066	0.60-0.71	0.85-1.15	0.040	0.050
1069	0.65-0.75	0.40-0.70	0.040	0.050
1070	0.65-0.76	0.60-0.90	0.040	0.050
1071	0.65-0.76	0.75-1.05	0.040	0.050
1072	0.65-0.76	1.00-1.30	0.040	0.050
1074	0.69-0.80	0.50-0.80	0.040	0.050
1075	0.69-0.80	0.40-0.70	0.040	0.050
1078	0.72-0.86	0.30-0.60	0.040	0.050
1080	0.74-0.88	0.60-0.90	0.040	0.050
1084	0.80-0.94	0.60-0.90	0.040	0.050
1085	0.80-0.94	0.70-1.00	0.040	0.050
1086	0.80-0.94	0.30-0.50	0.040	0.050
1090	0.84-0.98	0.60-0.90	0.040	0.050

When silicon is required, the following ranges and limits are commonly used:

- Up to 1014    0.10 Max
- 1015 – 1025    0.10 max, 0.10-0.25, or 0.15-0.30
- Over 1025    0.10-0.25 or 0.15-0.30

## Alloy Steel Composition

AISI Or SAE	C	Mn	P	S	Si	Ni	Cr	Mo	V
4118	0.18-0.23	0.70-0.90	0.035	0.040	0.15-0.30	-	0.40-0.60	0.08-0.15	-
4130	0.28-0.33	0.40-0.60	0.035	0.040	0.15-0.30	-	0.80-1.10	0.15-0.25	-
4135	0.33-0.38	0.70-0.90	0.035	0.040	0.15-0.30	-	0.80-0.25	0.15-0.25	-
4137	0.35-0.40	0.70-0.90	0.035	0.040	0.15-0.30	-	0.80-1.10	0.15-0.25	-
4140	0.38-0.43	0.75-1.00	0.035	0.040	0.15-0.30	-	0.80-1.10	0.15-0.25	-
4142	0.40-0.45	0.75-1.00	0.035	0.040	0.15-0.30	-	0.80-1.10	0.15-0.25	-
4145	0.43-0.48	0.75-1.00	0.035	0.040	0.15-0.30	-	0.80-1.10	0.15-0.25	-
4147	0.45-0.50	0.75-1.00	0.035	0.040	0.15-0.30	-	0.80-1.10	0.15-0.25	-
4150	0.48-0.53	0.75-1.00	0.035	0.040	0.15-0.30	-	0.80-1.10	0.15-0.25	-
4161	0.56-0.64	0.75-1.00	0.035	0.040	0.15-0.30	-	0.70-0.90	0.25-0.35	-
4320	0.17-0.22	0.45-0.65	0.035	0.040	0.15-0.30	1.65-2.00	0.40-0.60	0.20-0.30	-
4340	0.38-0.43	0.60-0.80	0.035	0.040	0.15-0.30	1.65-2.00	0.70-0.90	0.20-0.30	-
4419	0.18-0.23	0.45-0.65	0.035	0.040	0.15-0.30	-	-	0.45-0.60	-
4422	0.20-0.25	0.70-0.90	0.035	0.040	0.15-0.30	-	-	0.35-0.45	-
4427	0.24-0.29	0.70-0.90	0.035	0.040	0.15-0.30	-	-	0.35-0.45	-
4615	0.13-0.18	0.45-0.65	0.035	0.040	0.15-0.30	1.65-2.00	-	0.20-0.30	-
4617	0.15-0.20	0.45-0.65	0.035	0.040	0.15-0.30	1.65-2.00	-	0.20-0.30	-
4620	0.17-0.22	0.45-0.65	0.035	0.040	0.15-0.30	1.65-2.00	-	0.20-0.30	-
4621	0.18-0.23	0.70-0.90	0.035	0.040	0.15-0.30	1.65-2.00	-	0.20-0.30	-
4626	0.24-0.29	0.45-0.65	0.035	0.040	0.15-0.30	0.70-1.00	-	0.15-0.25	-
4718	0.16-0.21	0.70-0.90	-	-	0.15-0.30	0.90-1.20	0.35-0.55	0.30-0.40	-
4720	0.17-0.22	0.50-0.70	0.035	0.040	0.15-0.30	0.90-1.20	0.35-0.55	0.15-0.25	-
4815	0.13-0.18	0.40-0.60	0.035	0.040	0.15-0.30	3.25-3.75	-	0.20-0.30	-
4817	0.15-0.20	0.40-0.60	0.035	0.040	0.15-0.30	3.25-3.75	-	0.20-0.30	-
4820	0.18-0.23	0.50-0.70	0.035	0.040	0.15-0.30	3.25-3.75	-	0.20-0.30	-
5015	0.12-0.17	0.30-0.50	0.035	0.040	0.15-0.30	-	0.30-0.50	-	-
50B40	0.38-0.43	0.75-1.00	0.035	0.040	0.15-0.30	-	0.40-0.60	-	-
50B44	0.43-0.48	0.75-1.00	0.035	0.040	0.15-0.30	-	0.40-0.60	-	-
5046	0.43-0.48	0.75-1.00	0.035	0.040	0.15-0.30	-	0.20-0.35	-	-
5060	0.56-0.64	0.75-1.00	0.035	0.040	0.15-0.30	-	0.40-0.60	-	-
5115	0.13-0.18	0.70-0.90	0.035	0.040	0.15-0.30	-	0.70-0.90	-	-
5120	0.17-0.22	0.70-0.90	0.035	0.040	0.15-0.30	-	0.70-0.90	-	-
5130	0.28-0.33	0.70-0.90	0.035	0.040	0.15-0.30	-	0.80-1.10	-	-
5132	0.30-0.35	0.60-0.80	0.035	0.040	0.15-0.30	-	0.75-1.10	-	-
5135	0.33-0.38	0.60-0.80	0.035	0.040	0.15-0.30	-	0.80-1.05	-	-
5140	0.38-0.43	0.70-0.90	0.035	0.040	0.15-0.30	-	0.70-0.90	-	-
5145	0.43-0.48	0.70-0.90	0.035	0.040	0.15-0.30	-	0.70-0.90	-	-
5147	0.46-0.51	0.70-0.95	0.035	0.040	0.15-0.30	-	0.85-1.15	-	-
5150	0.48-0.53	0.70-0.90	0.035	0.040	0.15-0.30	-	0.70-0.90	-	-
5155	0.51-0.59	0.70-0.90	0.035	0.040	0.15-0.30	-	0.70-0.90	-	-
5160	0.56-0.64	0.75-1.00	0.035	0.040	0.15-0.30	-	0.70-0.90	-	-
51B60	0.56-0.64	0.75-1.00	0.035	0.040	0.15-0.30	-	0.70-0.90	-	-
50100	0.98-1.10	0.25-0.45	0.025	0.025	0.15-0.30	-	0.40-0.60	-	-

## Alloy Steel Composition

AISI Or SAE	C	Mn	P	S	Si	Ni	Cr	Mo	V
52100	0.98-1.10	0.25-0.45	0.025	0.025	0.15-0.30	-	0.30-1.60	-	-
6118	0.16-0.21	0.50-0.70	0.035	0.040	0.15-0.30	-	0.50-0.70	-	0.10-0.15
6150	0.48-0.53	0.70-0.90	0.035	0.040	0.15-0.30	-	0.80-1.10	-	0.15 min.
8115	0.13-0.18	0.70-0.90	0.035	0.040	0.15-0.30	0.20-0.40	0.30-0.50	0.08-0.15	-
8615	0.13-0.18	0.70-0.90	0.035	0.040	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	-
8617	0.15-0.20	0.70-0.90	0.035	0.040	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	-
8620	0.18-0.23	0.70-0.90	0.035	0.040	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	-
8622	0.20-0.25	0.70-0.90	0.035	0.040	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	-
8625	0.23-0.28	0.70-0.90	0.035	0.040	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	-
8627	0.25-0.30	0.70-0.90	0.035	0.040	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	-
8630	0.28-0.33	0.70-0.90	0.035	0.040	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	-
8637	0.35-0.40	0.75-1.00	0.035	0.040	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	-
8640	0.38-0.43	0.75-1.00	0.035	0.040	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	-
8642	0.40-0.45	0.75-1.00	0.035	0.040	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	-

**REFERENCE**  
Alloy steel composition

## Effects of Alloying Elements

### ALUMINUM

Aluminum is probably the most active deoxidizer in common use in producing steel. It is used in controlling inherent grain size.

### CARBON

When a small amount of carbon is added to iron, the properties that give steel its great value begin to appear. As the amount of carbon increases up to 80% or 90%, the metal becomes harder, possesses greater tensile strength and, what is most important, becomes increasingly responsive to heat treatment with corresponding development of very high strength and hardness.

If carbon were to be increased beyond certain limits in plain carbon steel, the ability to be worked either hot or cold would disappear almost entirely and it would begin to assume the characteristic of cast iron. In cast iron the carbon usually ranges from 1.7% to 4.5%.

### CHROMIUM

Chromium increases the response of steel to heat treatment. It also increases the depth of hardness penetration. Most chromium bearing alloys contain .50% to 1.50% chromium. Stainless steels contain chromium in large quantities (12% to 25%), frequently in combination with nickel, and possess increased resistance to oxidation and corrosion.

### IRON

Iron is the chief element of steel, normally commercial iron contains other elements present in varying quantities which produce the required physical properties. Iron lacks strength, is very ductile and soft and does not respond to heat treatment to any appreciable degree. It can be hardened somewhat by cold working, but not nearly as much as even a plain low carbon steel.

### LEAD

Lead increases the machinability of steel. A process has been developed that assures a uniform dispersion of finely divided lead that has no effect upon the physical properties of the steel, but greatly increases the rate at which it can be machined. The lead is usually added in amounts from .15% to .30%.

### MANGANESE

Next in importance to carbon is manganese. It is normally present in all steel and functions both as a deoxidizer and also to impart strength and responsiveness to heat treatment. Manganese is usually present in quantities from ½% to 2%, but certain special steels are made in range of 10% to 15%.

### MOLYBDENUM

Molybdenum adds greatly to the penetration of hardness and increases toughness. Molybdenum tends to help steel resist softening at high temperatures and is an important means of assuring high creep strength. It is generally used in comparatively small quantities ranging

## Effects of Alloying Elements

from .10% to .40%.

### NICKEL

Nickel increases strength and toughness but is one of the least effective elements with respect to increasing hardenability. The most general quantity addition is from 1% to 4%, although for certain applications, percentages as high as 36% are used. Steels containing nickel usually have more impact resistance, especially at low temperatures. Certain stainless steels employ nickel up to about 10%.

### PHOSPHORUS

Phosphorus is present in some quantity in all steel. In addition to increasing yield strength and reducing ductility at low temperature, phosphorus is believed to increase resistance to atmospheric corrosion

### SILICON

Silicon is one of the common deoxidizers used during the process of manufacture. It also may be present in varying quantities up to 1% in the finished steel and has a beneficial effect on certain properties such as tensile strength. It is also used in special steels in the range of 1.5% to 2.5% silicon to improve the hardenability in higher percentages. Silicon is added as an alloy to produce certain electrical steels and also finds certain applications in some tool steels where it seems to have a hardening and toughening effect.

### SULFUR

Sulfur is an important element in steel because when present in relatively large quantities, it increases machinability. The amount generally used for this purpose is from .08% to 30%. Sulfur is detrimental to the hot forming properties.

### TUNGSTEN

Tungsten is used as an alloying element in tool steel and tends to produce a fine dense grain and keen cutting edge when used in relatively small quantities. When used in relatively small quantities of .17% to .20% and in combination with other alloys, it produces a high speed steel which retains its hardness at the high temperatures developed in high speed cutting. Tungsten is also used in certain heat resisting steel where the retention of strength at high temperatures is important. It is usually used in combinations with chrome or some other alloying elements.

### VANADIUM

Vanadium retards grain growth, even after hardening from high temperatures or after periods of extended heating. Vanadium is usually added in quantities from .15% to .20%. Tool steel containing vanadium seem to resist shock better than those which do not contain this element.

## Typical Physical Properties

SAE/AISI	CONDITION	AUSTENITIZING		BRINELL	TENSILE		YIELD		% ELONG	% RA
		C	F		HB	KSI	MPA	KSI		
1015	AS ROLLED NORMALIZED	- 925	- 1700	126 121	61.0 61.5	420.6 424.0	45.5 47.0	313.7 324.1	39.0 37.0	61.0 69.6
1020	AS ROLLED NORMALIZED	- 870	- 1600	143 131	65.0 64.0	448.2 441.3	48.0 50.3	330.9 346.5	36.0 35.8	59.0 67.9
1022	AS ROLLED NORMALIZED	- 925	- 1700	149 143	73.0 70.0	503.3 482.6	52.0 52.0	358.5 358.5	35.0 34.0	67.0 67.5
1030	AS ROLLED NORMALIZED	- 925	- 1700	179 149	80.0 75.5	551.6 520.6	50.0 50.0	344.7 344.7	32.0 32.0	57.0 60.8
1040	AS ROLLED NORMALIZED	- 900	- 1650	201 170	90.0 85.5	620.5 589.5	60.0 54.3	413.7 374.0	25.0 28.0	50.0 54.9
1050	AS ROLLED NORMALIZED	- 900	- 1650	229 217	105.0 108.5	723.9 748.1	60.0 62.0	413.7 427.5	20.0 20.0	40.0 39.4
1060	AS ROLLED NORMALIZED	- 900	- 1650	241 229	118.0 112.5	813.6 775.7	70.0 61.0	482.6 420.6	17.0 18.0	34.0 37.2
1080	AS ROLLED NORMALIZED	- 900	- 1650	293 293	140.0 146.5	965.3 1010.1	85.0 76.0	586.1 524.0	12.0 11.0	17.0 20.6
1095	AS ROLLED NORMALIZED	- 900	- 1650	293 293	140.0 147.0	965.3 1013.5	83.0 72.5	572.3 499.9	9.0 9.5	18.0 13.5

REFERENCE  
Typical Physical Properties

# Typical Physical Properties

SAE/AISI	CONDITION	AUSTENITIZING TEMPERATURE		BRINELL HARDNESS	TENSILE STRENGTH		YIELD STRENGTH		% ELONG	% RA
		C	F		KSI	MPA	KSI	MPA		
1117	AS ROLLED NORMALIZED	-	-	143	70.6	486.8	44.3	305.4	33.0	63.0
		900	1650	137	67.8	467.1	44.0	303.4	33.5	63.8
1118	AS ROLLED NORMALIZED	-	-	149	75.6	521.2	45.9	316.5	32.0	70.0
		925	1700	143	69.3	477.8	46.3	319.2	33.5	65.9
1137	AS ROLLED NORMALIZED	-	-	192	91.0	627.4	55.0	379.2	28.0	61.0
		900	1650	197	97.0	668.8	57.5	396.4	22.5	48.5
1141	AS ROLLED NORMALIZED	-	-	192	98.0	675.7	52.0	358.5	22.0	38.0
		900	1650	201	102.5	706.7	58.8	405.4	22.7	55.5
1144	AS ROLLED NORMALIZED	-	-	212	102.0	703.3	61.0	420.6	21.0	41.0
		900	1650	197	96.8	667.4	58.0	399.9	21.0	40.4
1340	NORMALIZED ANNEALED	870	1600	248	121.3	836.3	81.0	558.5	22.0	62.9
		800	1475	207	102.0	703.3	83.3	436.4	25.5	57.3
3140	NORMALIZED ANNEALED	870	1600	262	129.3	891.5	87.0	599.8	19.7	57.3
		815	1500	197	100.0	689.5	61.3	422.6	24.5	50.8
4130	NORMALIZED ANNEALED	870	1600	197	97.0	668.8	63.3	436.4	25.5	59.5
		865	1585	156	81.3	560.5	52.3	360.6	28.2	55.6
4140	NORMALIZED ANNEALED	870	1600	302	148.0	1020.4	95.0	655.0	17.7	46.8
		815	1500	197	95.0	655.0	60.5	417.1	25.7	56.9
4150	NORMALIZED ANNEALED	870	1600	321	167.5	1154.9	106.5	734.3	11.7	30.8
		815	1500	197	105.8	729.5	55.0	379.2	20.2	40.2

# Typical Physical Properties

SAE/AISI	CONDITION	AUSTENITIZING TEMPERATURE		BRINELL HARDNESS	TENSILE STRENGTH		YIELD STRENGTH		% ELONG	% RA
		C	F		KSI	MPA	KSI	MPA		
4320	NORMALIZED ANNEALED	895	1640	235	115.0	792.9	67.3	464.0	20.8	50.7
		850	1560	163	84.0	579.2	61.6	609.5	29.0	58.4
4340	NORMALIZED ANNEALED	970	1600	363	195.5	1279.0	125.0	861.8	12.2	36.3
		810	1490	217	108.0	744.6	68.5	472.3	22.0	49.9
4620	NORMALIZED ANNEALED	900	1650	174	83.3	574.3	53.1	366.1	29.0	66.7
		855	1575	149	74.3	512.3	54.0	372.3	31.3	60.3
4820	NORMALIZED ANNEALED	860	1580	229	109.5	75.0	70.3	484.7	24.0	59.2
		815	1500	197	98.8	681.2	67.3	464.0	22.3	58.8
5140	NORMALIZED ANNEALED	870	1600	229	115.0	792.9	68.5	472.3	22.7	59.2
		830	1525	167	83.0	572.3	42.5	293.0	28.6	57.3
5150	NORMALIZED ANNEALED	870	1600	255	126.3	870.8	76.8	529.5	20.7	58.7
		825	1520	-17	98.0	675.7	51.8	357.1	22.0	43.7
5160	NORMALIZED ANNEALED	855	1575	269	138.8	957.0	77.0	530.9	17.5	44.8
		815	1495	197	104.8	722.6	40.0	275.8	17.2	30.6
6150	NORMALIZED ANNEALED	870	1600	269	136.3	939.8	89.3	615.7	21.8	61.0
		815	1500	197	96.8	667.4	59.8	412.3	23.0	48.4
8620	NORMALIZED ANNEALED	915	1675	183	91.8	632.9	81.8	357.1	26.3	59.7
		870	1600	149	77.8	536.4	55.9	385.4	31.3	62.1
8630	NORMALIZED ANNEALED	870	1600	187	94.3	650.2	62.3	429.5	23.5	53.5
		845	1550	156	81.8	564.0	54.0	372.3	29.0	58.9
8650	NORMALIZED ANNEALED	870	1600	302	148.5	1023.9	99.8	688.1	14.0	40.4
		795	1465	212	103.8	715.7	56.0	386.1	22.5	46.4



## Heat Treating Information

This information covers Annealed high carbon spring steel for working springs which must be formed before heat treatment. In the annealed condition, this material is capable of being bent flat upon itself either with or across the grain in thicknesses under .050". Heat material according to chart. Quench in oil (quench 1095 in water). The spring should then be drawn to the hardness best suited for the application. The proper drawing range and cycle times should be determined to develop those properties best suited for the application.

Formed Springs Requiring Heat Treatment	SAE/AISI 1050	SAE/AISI 1065	SAE/AISI 1075	SAE/AISI 1095
	Normalizing Temperature Annealing Temperature Hardening Temperature As Quenched Hardness	1550° -1650°F 1400° -1500°F 1475° -1550°F R/C 58	1550° -1650°F 1400° -1500°F 1475° -1550°F R/C 62	1550° -1650°F 1400° -1500°F 1475° -1550°F R/C 65
Drawing Temperature 400°F	Rockwell Rc 52	Rockwell Rc 57	Rockwell Rc 59	Rockwell Rc 62
Drawing Temperature 600°F	Tensile PSI 250,000	Tensile PSI 295,000	Tensile PSI 305,000	Tensile PSI 320,000
Drawing Temperature 700°F	Rockwell Rc 45	Rockwell Rc 50	Rockwell Rc 53	Rockwell Rc 55
Drawing Temperature 800°F	Rockwell Rc 39	Rockwell Rc 46	Rockwell Rc 47	Rockwell Rc 49
Drawing Temperature 900°F	Rockwell Rc 35	Rockwell Rc 42	Rockwell Rc 44	Rockwell Rc 45
Drawing Temperature 1000°F	Rockwell Rc 31	Rockwell Rc 39	Rockwell Rc 40	Rockwell Rc 41
Drawing Temperature 1100°F	Rockwell Rc 27	Rockwell Rc 35	Rockwell Rc 36	Rockwell Rc 38
	Rockwell Rc 22	Rockwell Rc 28	Rockwell Rc 32	Rockwell Rc 34
	Tensile PSI 124,000	Tensile PSI 160,000	Tensile PSI 162,000	Tensile PSI 155,000

The above information is provided "as-is". Admiral Steel makes no warranty of any kind with respect to the subject matter or its accuracy. Admiral Steel makes no warranties of any kind, expressed, implied, or otherwise with respect to merchantability and/or fitness for use for a specific applications.

## Rockwell Hardness Tables

Although conversion tables dealing with hardness can only be approximate and never mathematically exact, it is of considerable value to be able to compare different hardness scales in a general way.

This table is based on the assumption that the metal tested is homogeneous to a depth several times as great as the depth of the indentation because different loads and different shapes of penetrators would, in metal not homogeneous, penetrate, or at least meet the resistance of, metals of varying hardness, depending upon the depth of the indentation. Hence, no recorded hardness value could be valid to an extent that could be confirmed by another person unless the shape of penetrator and actual load applied are both specified.

The indentation hardness values measured on the various scales depend on the work hardening behavior of the material during the test and this in turn depends on the degree of previous cold working of the material. The B-scale relationships in the table are based largely on annealed metals for the low values and cold worked metals for the higher values. Therefore, annealed metals of high B-scale hardness such as austenitic stainless steels, nickel and high nickel alloys do not conform closely to these general tables. Neither do cold worked metals of low B-scale hardness such as aluminum and the softer alloys. Special correlations are needed for more exact relationships in these cases.

The 15-T, 30-T, 45-T, 15-N, 30-N, & 45-N values are in scales of the Rockwell Superficial Hardness Tester, a specialized form of Rockwell tester, having lighter loads and more sensitive depth reading system, used where for one reason or another the indentation must be exceptionally shallow.

Material Description	Single Thickness .040" & Up	Single Thickness .039" -	Single Thickness .024" -	Single Thickness .014" -	Double Thickness .006" &
Scaleless Blue Tempered 1074/1075	C-Scale	C-Scale	30N-Scale	15N-Scale	15N-Scale
Blue Tempered & Polished 1095	C-Scale	C-Scale	30N-Scale	15N-Scale	15N-Scale
Cold Rolled Annealed 1050 - 1095	B-Scale	30T-Scale	15T-Scale	15T-Scale	15T-Scale
Cold Rolled Hard Rolled 1075	C-Scale	C-Scale	30N-Scale	15N-Scale	15N-Scale

# Rockwell Hardness Tables

Brinell Hardness	Rockwell Hardness Number						Rockwell Superficial Hardness Number						Tensile Strength
	A Scale	B Scale	C Scale	D Scale	E Scale	F Scale	15-N Scale	30-N Scale	45-N Scale	15-T Scale	30-T Scale	45-T Scale	
10-mm Sld. Ball 3000-kgf load	Diamond Penetrator 60-kgf load	1.588-mm 1/16" Ball 100-kgf load	Diamond Penetrator 150-kgf load	Diamond Penetrator 100-kgf load	3.175-mm 1/8" Ball 100-kgf load	1.588-mm 1/16" Ball 60-kgf load	Superficial Diamond Penetrator 30-kgf load	Superficial Diamond Penetrator 30-kgf load	Superficial Diamond Penetrator 45-kgf load	1.588-mm 1/16" Ball 15-kgf load	1.588-mm 1/16" Ball 30-kgf load	1.588-mm 1/16" Ball 45-kgf load	KSI
750	85.0	—	66.0	76.0	—	—	93.0	83.0	73.0	—	—	—	—
710	84.0	—	64.0	74.0	—	—	92.0	81.0	71.0	—	—	—	—
682	83.0	—	92.0	73.0	—	—	91.0	79.0	69.0	—	—	—	—
653	81.0	—	60.0	71.0	—	—	90.0	78.0	67.0	—	—	—	314
578	80.0	—	58.0	69.0	—	—	89.0	76.0	64.0	—	—	—	299
555	79.0	—	56.0	68.0	—	—	88.0	74.0	62.0	—	—	—	284
534	78.0	—	54.0	66.0	—	—	87.0	72.0	60.0	—	—	—	270
495	77.0	—	52.0	65.0	—	—	86.0	70.0	57.0	—	—	—	256
479	75.5	—	50.0	63.0	—	—	85.5	68.0	54.5	—	—	—	244
450	74.5	—	48.0	61.5	—	—	84.5	66.5	52.5	—	—	—	228
425	73.5	—	46.0	60.0	—	—	83.5	64.5	50.0	—	—	—	212
403	72.5	—	44.0	58.5	—	—	82.5	63.0	47.5	—	—	—	201
382	71.5	—	42.0	57.0	—	—	81.5	61.0	45.5	—	—	—	189
363	70.5	—	40.0	55.5	—	—	80.5	59.5	43.0	—	—	—	178
346	69.5	—	38.0	54.0	—	—	79.5	58.0	41.0	—	—	—	167
329	68.5	—	36.0	52.5	—	—	78.5	56.0	38.5	—	—	—	160
313	67.5	—	34.0	50.5	—	—	77.5	54.5	36.0	—	—	—	153
298	66.5	106	32.0	49.5	—	116.5	76.5	52.5	34.0	85.5	77.0	—	144
275	64.5	104	28.5	46.5	—	115.5	75.0	49.5	30.0	84.5	75.0	—	130
258	63.0	102	25.5	44.5	—	114.5	73.5	47.0	26.5	83.0	73.0	—	121
241	61.5	100	22.5	42.0	—	113.0	72.0	44.5	23.0	81.5	71.0	—	114
228	60.5	98	20.0	40.0	—	112.0	70.5	42.0	20.0	80.5	69.0	—	107
215	59.0	96	17.0	38.0	—	111.0	69.0	39.5	17.0	79.0	67.0	—	101
204	57.5	94	14.5	36.0	—	110.0	68.0	37.5	14.0	77.5	65.0	—	98
194	56.5	92	12.0	34.0	—	108.5	66.5	35.5	11.0	76.0	63.0	—	93
184	55.0	90	9.0	32.0	108.5	107.5	65.0	32.5	7.5	75.0	61.0	—	89
176	53.5	88	6.5	30.0	107.0	106.5	64.0	30.5	5.0	73.5	59.5	—	85

# Rockwell Hardness Tables

Brinell Hardness	Rockwell Hardness Number							Rockwell Superficial Hardness Number							Tensile Strength KSI
	A Scale	B Scale	C Scale	D Scale	E Scale	F Scale		15-N Scale	30-N Scale	45-N Scale	15-T Scale	30-T Scale	45-T Scale		
10-mm Std. Ball 3000-kgf load	Diamond Penetrator 60-kgf load	1.588-mm 1/16" Ball 100-kgf load	Diamond Penetrator 150-kgf load	Diamond Penetrator 100-kgf load	3.175-mm 1/8" Ball 100-kgf load	1.588-mm 1/16" Ball 60-kgf load		Superficial Diamond Penetrator 30-kgf load	Superficial Diamond Penetrator 30-kgf load	Superficial Diamond Penetrator 45-kgf load	1.588-mm 1/16" Ball 15-kgf load	1.588-mm 1/16" Ball 30-kgf load	1.588-mm 1/16" Ball 45-kgf load		
168	52.5	86	4.0	28.0	106.0	105.0		62.5	28.5	2.0	87.5	72.0	57.5	87	
161	51.5	84	2.0	26.5	104.5	104.0		61.5	26.5	-5	87.0	70.5	55.5	78	
155	50.0	82	—	24.5	103.0	103.0		—	—	—	86.0	69.5	53.5	75	
149	49.0	80	—	22.5	102.0	101.5		—	—	—	85.5	68.0	51.5	72	
144	47.5	78	—	21.0	100.5	100.5		—	—	—	84.5	66.5	49.5	69	
139	46.5	76	—	19.0	99.5	99.5		—	—	—	84.0	65.5	47.5	67	
134	45.5	74	—	17.5	98.0	98.5		—	—	—	83.0	64.0	45.5	65	
129	44.0	72	—	16.0	97.0	97.0		—	—	—	82.5	62.5	43.5	63	
125	43.0	70	—	14.5	95.5	96.0		—	—	—	82.0	61.0	41.5	61	
121	42.0	68	—	13.0	94.5	95.0		—	—	—	81.0	60.0	39.5	59	
118	41.0	66	—	11.5	93.0	93.5		—	—	—	80.5	58.5	37.5	57	
114	40.0	64	—	10.0	91.5	92.5		—	—	—	79.5	57.0	35.5	55	
111	39.0	62	—	8.0	90.5	91.5		—	—	—	79.0	56.0	33.5	53	
108	—	60	—	—	89.0	90.0		—	—	—	78.5	54.5	31.5	51	
108	—	58	—	—	88.0	89.0		—	—	—	77.5	53.0	29.5	—	
103	—	56	—	—	86.5	88.0		—	—	—	77.0	51.5	27.5	—	
100	—	54	—	—	85.5	87.0		—	—	—	76.0	50.5	25.5	—	
98	—	52	—	—	84.0	85.5		—	—	—	75.5	49.0	23.5	—	
95	—	50	—	—	83.0	84.5		—	—	—	74.5	47.5	21.5	—	
93	—	48	—	—	81.5	83.5		—	—	—	74.0	46.5	19.5	—	
91	—	46	—	—	80.5	82.0		—	—	—	73.5	45.0	17.0	—	

These tables show an approximate relationship between hardness values determined on Rockwell and Rockwell Superficial hardness testers and values determined on other testers.

Steel tensile strength relation to hardness is inexact depending upon specific material.

Relative values shown are average and could change with cold working and other properties. **This is not an exact conversion.**

## ASTM Specification Listing

Spec #	Book #	Description
A6	4	General requirements for rolled steel plates, shapes, sheet piling, & bars for structural use
A29	5	General requirements for Steel bars carbon & alloy, hot wrought & CF
A36	4	Structural steel
A109	3	Steel carbon, CR strip
A242	4	High strength low alloy (HSLA) structural steel
A283	4	Low & intermediate tensile strength carbon plates, shapes, & bars
A304	5	Steel bars, carbon & alloy, subject to end quench hardenability requirements
A322	5	Steel bars, alloy, standard grades
A366	3	Steel carbon, CR sheet, commercial quality
A505	3	General requirements for steel sheet & strip alloy, HR & CR
A506	3	Steel sheet & strip, alloy, HR & CR, regular quality
A507	3	Steel sheet & strip, alloy, HR & CR, drawing quality
A514	4	High yield strength, Quenched & Tempered alloy steel plate suitable for welding
A529	4	Structural steel with 42,000 psi min. yield point (1/2" max thickness)
A568	3	General requirements for steel, carbon & HSLA, HR strip and CR sheet
A569	3	Steel, carbon (.15% max), HR sheet & strip, commercial quality
A570	3	HR carbon steel sheet & strip, structural steel
A572	4	HSLA Columbium-Vanadium steels of structural quality
A575	5	Steel bars, carbon, merchant quality, m-grades
A576	5	Steel bars, carbon, Hot-wrought, special quality
A588	4	HSLA structural steel with 60,000 psi min yield point (up to 4" thick)
A606	3	Steel sheet & strip, HR & CR, HSLA, with improved corrosion resistance
A607	3	Steel sheet & strip, HR & CR, HSLA, Columbium and/or Vanadium
A611	4	Steel sheet, CR, structural quality
A619	3	Steel sheet, carbon, CR, drawing quality
A620	3	Steel sheet, carbon, CR, drawing quality, special killed
A621	3	Steel sheet & strip, carbon, HR, drawing quality
A622	3	Steel sheet & strip, carbon, HR, drawing quality, special killed
A635	3	Steel sheet & strip, carbon, HR, commercial quality, heavy thickness coils
A656	4	Steel, structural, HR, HSLA plate with improved formability
A659	3	Steel sheet & strip, HR, carbon (.16 to .25% max), commercial quality
A663	5	Steel bars, carbon, merchant properties, mechanical properties
A675	5	Steel bars, carbon, hot-wrought, special quality, mechanical properties
A678	4	Steel, HSLA plate, quenched & tempered
A682	3	General requirements for steel, high carbon strip, CR, spring quality
A684	3	Steel, strip, CR, high carbon
A689	5	Steel bars, carbon & alloy for springs
A715	3	Steel sheet & strip, HR, HSLA, with improved formability
A749	3	General requirements for steel carbon & HSLA, HR, strip
A794	3	Steel sheets, CR, carbon (.16-.25% max), commercial quality
A805	3	Steel flat wire, CR
A829	4	Steel plate, alloy, structural quality
A830	4	Steel plate, structural quality to chemical requirements

## ASTM Specification Cross Reference

Material Description	Spec #	Book #
Steel Bars	A29 A304 A322 A575 A576 A663	5 5 5 5 5 5
Spring Steel & Steel Springs	A680 A682 A684	5 5 5
Steel Sheet, Plate, & Strips	A109 A366 A505 A506 A507 A568 A569 A570 A606 A607 A619 A620 A621 A622 A635 A659 A682 A684 A715 A749 A794	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
Structural Steel	A6 A36 A242 A283 A514 A529 A572 A588 A611 A656 A678 A829 A830 A850	4 4 4 4 4 4 4 4 4 4 4 4 4 4

## AMS & QQS Specification List

Spec #	Description
AMS 5040	Sheet & strip, 0.15% max carbon, deep forming grade
AMS 5042	Sheet & strip, 0.15% max carbon, deep forming grade
AMS 5044	Sheet & strip, 0.15% max carbon, half hard temper
AMS 5045	Sheet & strip, 0.25% max carbon, hard temper
AMS 5047	Sheet & strip, 0.08-0.13% carbon, aluminum killed, deep forming grade
AMS 5062	Bars, forgings, tubing, sheet, strip, & plate, low carbon
AMS 5085	Sheet, strip, & plate, 0.47-0.55% carbon, annealed
AMS 5120	Strip, 0.68-0.80% carbon
AMS 5121	Sheet & Strip, 0.90-1.04% carbon
AMS 5122	Strip, 0.90-1.04% carbon, hard temper
AMS 5132	Bars, 0.90-1.30% carbon
AMS 6350	Sheet, strip, & plate, 0.95% Chromium, 0.20% Molybdenum, 0.28-0.33% carbon
AMS 6351	Sheet, strip, & plate, 0.95% Chromium, 0.20% Molybdenum, 0.28-0.33% car-
QQS 626	Steel plate, alloy (structural steel quality)
QQS 631	Steel bars, carbon, hot rolled (special quality)
QQS 633	Steel bars, carbon, cold finished, hot rolled
QQS 634	Steel bars, carbon, cold finished (standard quality)
QQS 635	Steel plate, carbon
QQS 636	Steel sheets & strips, carbon (low carbon)
QQS 637	Steel bars, carbon, cold finished (standard quality, free machining)
QQS 671	Steel bars, carbon & alloy
QQS 691	Steel plate, carbon silicon, carbon molybdenum, & manganese molybdenum alloys, hot rolled
QQS 693	Steel sheets, carbon, hot rolled
QQS 698	Steel sheets & strips, low carbon
QQS 700	Steel sheets & strips, medium & high carbon
QQS 741	Steel structural shapes, plates, & bars, carbon
QQS 751	Steel structural (including steel for cold flanging) and Steel rivets for ships other than naval vessels
QQS 775	Steel sheets, carbon, zinc coated by the hot dipped process

## International Cross Reference

USA	Germany		Great Britain	France	Italy	Japan
SAE/AISI	W.-Nr.	DIN	B.S.	AFNOR	UNI	JIS
1010	1.1121	Ck 10	045 M 10; 040 A 10	XC 10	C 10	S 10 C; S 9 CK
1015	1.0401	C 15	080 M; 040 A15; 1449 17 CS	AF 37 C12; XC 18	C15; C16	—
1015	1.1141	Ck 15	080 M 15	XC 18; XC 15	C15; C16	S 15 C; S 15 CK
1020	1.0402	C 22	050 A 20; 055 M 15	AF 42 C 20; XC 25	C20; C21; C25	—
1020; 1023	1.1151	Ck22	050 A 20 (055 M 15)	XC 25; XC 18	C20; C25	S 20 C; S 20 CK; S 22 C
1022; 1515	1.1133	20 Mn 5	120 M 19	20 M 5	G22 Mn 3	SMnC 420
1025	1.0406	C 25	070 M 26	AF 50 C30	C25	—
1025	1.1158	Ck 25	070 M 26	XC 25	C25	S 25 C
1035	1.1180	Cm 35	080 M 36	XC 32	—	—
1035	1.1181	Ck 35	080 M 36	XC 38 H1; XC 32	C35	S 35 C
1035	1.0501	C 35	060 A 35; 080 M 36; 1449 40 CS	AF 55 C35; XC 38	C35	—
1035	1.1183	Cf 35	060 A 35	XC 38 H 1 TS	C36; C38	S 35 C
1039	1.1157	40 Mn 4	150 M 36	35 M 5	—	—
1040	1.0511	C 40	—	AF 60 C 40	C40	—
1040	1.1186	Ck 40	080 A 4; 060 A 40 080 M 40	XC 42 H1	C40	S 40 C
1045	1.0503	C 45	080 M 46	AF 65 C 45	C45	—
1045	1.1191	CK 45	080 M 46; 060 A 47	XC 42 H 1; XC 45; XC 48	C45; C46	S 45 C
1045	1.1193	Ct 45	060 A 47; 080 M 46	XC 42 H 1 TS	C46; C43	S 45 C
1045	1.1201	Cm 45	080 M 46	XC 42 H 1; XC 48 H 1	—	S 50 C
1055	1.1203	Ck 55	070 M 55; 060 A 57	XC 55 H 1	C55	S 55 C
1050	1.1206	Ck 50	080 M 50	XC 48 H 1	—	—
1055	1.0535	C 55	070 M 55	—	C55	—
1055	1.1209	Cm 55	070 M 55	XC 55 H 1	—	—
1050	1.1213	Cf 53	060 A 52; 070 M 55	XC 48 H 1 TS	C53	S 50 C
1060	1.0601	C 60	080 A 62	AF 70 C 55	C60	—
1060	1.1221	Ck 60	080 A 62; 060 A 62	XC 60	C60	S 58 C
1070	1.1231	Ck 67	060 A 67	XC 68	C70	—
1078; 1080	1.1248	Ck 75	060 A 78	XC 75	C75	—
1086	1.1269	Ck 85	—	XC 90	C90	—
1095	1.1274	Ck 101	060 A 96	XC 100	C100	SUP 4
1108	1.0721	10 S 20	210 M 15	10 F 1	CF 10 S 20	—
1145	1.0726	35 S 20	212 M 36	35 MF 6	—	—
1215	1.0736	9 SMn 36	240 M 07	S 300	CF 9 Mn 36	—
	1.1165	30 Mn 5	120 M 36; 150 M 28	35 M 5	—	SMn 433 H; SCMn 2
1330						SCMn 1
1330	1.1170	28 Mn 6	150 M 28	20 M 5	C 28 Mn	—
	1.1167	36 Mn 5	150 M 36	40 M 5; 35 M 5	—	SMn 438 (H); SCMn 3
1335						SMn 433
1536	1.1166	34 Mn 5	—	—	—	SCM 420; SCM 430
4130	1.7218	25 CrMo 4	1717 CDS 110	25 CD 4	25 CrMo 4	SCM 432; CCrM3 SCM 435 H
4135; 4137	1.7220	35 CrMo 4	708 A 37	35 CD 4	35 CrMo 4	SCM 440 SCM 440 (H)
4140; 4142	1.7223	41 CrMo 4	708 M 40	42 CD 4 TS	41 CrMo 4	—
4140; 4142	1.7225	42 CrMo 4	708 M 48	42 CD 4	40 CrMo 4; 42 CrMo 4	—

This chart shows approximately equivalent standards and should be used as a reference only. All of our products are produced to meet the applicable ASTM, AMS, and/or QQS specifications. Copies of these specifications are available upon request.



## Gauge/Decimal Equivalents

*For accuracy, always order by decimal thickness not gauge number!!!*

SHEET STEEL		GAUGE NUMBER	STRIP STEEL	
DECIMAL	LBS/SQ. FT.		DECIMAL	LBS/SQ. FT.
-	-	-	.500	20.400
-	-	-	.454	15.520
-	-	-	.425	17.340
-	-	-	.380	15.300
-	-	0	.340	13.870
-	-	1	.300	12.240
-	-	2	.284	11.587
.2391	10.000	3	.259	10.567
.2242	9.375	4	.238	9.710
.2092	8.750	5	.220	8.976
.1943	8.155	6	.203	8.282
.1793	7.500	7	.180	7.344
.1644	6.875	8	.165	6.732
.1495	6.250	9	.148	6.038
.1345	5.625	10	.134	5.467
.1196	5.000	11	.120	4.896
.1046	4.375	12	.109	4.447
.0897	3.750	13	.095	3.876
.0747	3.125	14	.083	3.386
.0673	2.813	15	.072	2.938
.0598	2.500	16	.065	2.652
.0538	2.250	17	.058	2.366
.0478	2.000	18	.049	1.999
.0418	1.750	19	.042	1.714
.0359	1.500	20	.035	1.428
.0329	1.375	21	.032	1.306
.0299	1.250	22	.028	1.142
.0269	1.125	23	.025	1.020
.0239	1.000	24	.022	.989
.0209	.875	25	.020	.816
.0179	.750	26	.018	.734
.0164	.688	27	.016	.651
.0149	.625	28	.014	.571
.0135	.563	29	.013	.530
.0120	.500	30	.012	.490
.0105	.438	31	.010	.408
.0097	.406	32	.009	.367
.0090	.375	33	.008	.326
.0082	.344	34	.007	.286
.0075	.313	35	.005	.204
.0067	.281	36	.004	.163
.0064	.266	37	-	-

## Decimal & Metric Conversions

Fraction	Decimal	Millimeters	Fraction	Decimal	Millimeters
1/64"	.0156	0.3969	33/64"	.5156	13.0969
1/32"	.0312	0.7937	17/32"	.5312	13.4937
3/64"	.0468	1.1906	35/64"	.5468	13.8906
1/16"	.0625	1.5875	9/16"	.5625	14.2875
5/64"	.0781	1.9844	37/64"	.5781	14.6844
3/32"	.0937	2.3812	19/32"	.5937	15.0812
7/64"	.1093	2.7781	39/64"	.6093	15.4781
1/8"	.1250	3.1750	5/8"	.6250	15.8750
9/64"	.1406	3.5719	41/64"	.6406	16.2719
5/32"	.1562	3.9687	21/32"	.6562	16.6687
11/64"	.1718	4.3656	43/64"	.6718	17.0656
3/16"	.1875	4.7625	11/16"	.6875	17.4625
13/64"	.2031	5.1594	45/64"	.7031	17.8594
7/32"	.2187	5.5562	23/32"	.7187	18.2562
15/64"	.2343	5.9531	47/64"	.7343	18.6531
1/4"	.2500	6.3500	3/4"	.7500	19.0500
17/64"	.2656	6.7469	49/64"	.7656	19.4469
9/32"	.2812	7.1437	25/32"	.7812	19.8437
19/64"	.2968	7.5406	51/64"	.7968	20.2406
5/16"	.3125	7.9375	13/16"	.8125	20.6375
21/64"	.3281	8.3344	53/64"	.8281	21.0344
11/32"	.3437	8.7312	27/32"	.8437	21.4312
23/64"	.3593	9.1281	55/64"	.8593	21.8281
3/8"	.3750	9.5250	7/8"	.8750	22.2250
25/64"	.3906	9.9210	57/64"	.8906	22.6219
13/32"	.4062	10.3187	29/32"	.9062	23.0187
27/64"	.4218	10.7156	59/64"	.9218	23.4156
7/16"	.4375	11.1125	15/16"	.9375	23.8125
29/64"	.4531	11.5094	61/64"	.9531	24.2094
15/32"	.4687	11.9062	31/32"	.9687	24.6062
31/64"	.4843	12.3031	63/64"	.9843	25.0031
1/2"	.5000	12.7000	1"	1.0000	25.4001

## Decimal & Metric Conversions

### METRIC TO ENGLISH CONVERSIONS

- 1 millimeter = .03937 inches
- 1 meter = 3.281 feet
- 1 meter = 1.093 yards
- 1 kilometer = .621 mile
- 1 square millimeter = .00155 square inches
- 1 square meter = 10.764 square feet
- 1 square meter = 1.196 square yards
- 1 square kilometer = .386 square miles
- 1 kilogram = 35.27 ounces
- 1 kilogram = 2.204 pounds
- 1 metric ton = 2204 pounds

### ENGLISH TO METRIC CONVERSIONS

- 1 inch = 25.4 millimeters
- 1 foot = .3048 meters
- 1 yard = .9144 meters
- 1 mile = 1.6094 kilometers
- 1 square inch = 645.16 square millimeters
- 1 square foot = .0929 square meters
- 1 square yard = .8361 square meters
- 1 square mile = 2.590 square kilometers
- 1 ounce = .0283 kilograms
- 1 pound = .4536 kilograms
- 1 ton = 907.2 kilograms

## Glossary

**ABRASIVE** - A substance capable of grinding away another material.

**ACID-BRITTLINESS** - Brittleness resulting from pickling steel in acid; hydrogen, formed by the interaction between iron and acid, is partially absorbed by the metal, causing acid brittleness.

**AGE HARDENING** - The term as applied to soft, or low carbon steels, relates to a wide variety of commercially important, slow, gradual changes that take place in properties of steels after the final treatment. These changes, which bring about a condition of increased hardness, elastic limit, and tensile strength with a consequent loss in ductility, occur during the period in which the steel is at normal temperatures.

**AGING** - Spontaneous change in the physical properties of some metals, which occurs on standing, at atmospheric temperatures after final cold working or after a final heat treatment. Frequently synonymous with the term "Age-Hardening."

**AIR COOLING** - Cooling of the heated metal, intermediate in rapidity between slow furnace cooling and quenching, in which the metal is permitted to stand in the open air.

**AIR HARDENING STEEL** - Alloy steel that may be hardened by cooling in air from a temperature above the transformation range. Such steels attain their martensitic structure without going through the quenching process. Additions of chromium, nickel, molybdenum and manganese are effective toward this end.

**AISI STEELS** - Steels of the American Iron and Steel Institute. Common and alloy steels have been numbered in a system essentially the same as the SAE. The AISI system is more elaborate than the SAE in that all numbers are preceded by letters: "A" represents basic open-hearth alloy steel, "B" acid Bessemer carbon steel, "C" basic open-hearth carbon steel, "CB" either acid Bessemer or basic open-hearth carbon steel, "E" electric furnace alloy steel.

**ALLOY** - A substance having metallic properties and composed of two or more chemical elements of which at least one is a metal.

**ALLOY STEEL** - Steel containing significant quantities of alloying elements (other than carbon and the commonly accepted amounts of manganese, silicon, sulfur and phosphorus) added to effect changes in mechanical or physical properties. Those containing less than 5% total metallic alloying elements tend to be termed low-alloy steels, and those containing more than 5% tend to be termed high-alloy steels.

**ALLOYING ELEMENT** - An element added to a metal, and remaining in the metal, that effects changes in structure and properties.

**ALUMINUM** - (Chemical symbol Al) Element No.13 of the periodic system; Atomic weight 26.97; silvery white metal of valence 3; melting point 1220 F.; boiling point approximately 4116 F.; ductile and malleable; stable against normal atmospheric corrosion, but attacked by both acids and alkalis. Aluminum is used extensively in articles requiring lightness, corrosion resistance, electrical conductivity, etc. Its principal functions as an alloy in steel making: (1) Deoxidizes efficiently (See Aluminum killed) (2) Restricts grain growth (by forming dispersed oxides or nitrides) (3) Alloying element in nitriding steel.

**ALUMINUM KILLED STEEL** - A steel where aluminum has been used as a deoxidizing agent. (See Killed Steel.)

**ANNEALING** - A heating and cooling operation implying a relatively slow cooling. Annealing is a comprehensive term. The purpose of such a heat treatment may be to remove stresses; to induce softness; to alter ductility; toughness; electrical magnetic, or other physical properties; to reline the crystalline structure; to remove gases; to produce a definite microstructure. In annealing, the temperature of the operation and the rate of cooling depend upon the material being heat-treated and the purpose of the treatment.

**ARC WELDING** - A group of welding processes wherein the metal or metals being joined are coalesced by heating with an arc, with or without the application of pressure and with or without the use of filler metal.

## Glossary

A.S.T.M. - Abbreviation for American Society for Testing Material - An organization for Issuing standard specifications on materials, including metals and alloys.

AUSTEMPERING - Cooling an austenitized steel at a rate high enough to suppress formation of high-temperature transformation products, then holding the steel at a temperature below that for pearlite formation and above that for martensite formation until transformation to an essentially bainitic structure is complete.

AUSTENITE - Phase in certain steels, characterized as a solid solution, usually of carbon or iron carbide, in the gamma form of iron. Such steels are known as "austenitic." Austenite is stable only above 1333 F. in a plain carbon steel, but the presence of certain alloying elements, such as nickel and manganese, stabilizes the austenitic form, even at normal temperatures.

AUSTENITIC STEEL - Steel which, because of the presence of alloying elements, such as manganese, nickel, chromium, etc., shows stability of Austenite at normal temperatures.

BAINITE - A slender, needle-like (acicular) microstructure appearing in spring steel strip characterized by toughness and greater ductility than tempered Martensite. Bainite is a decomposition product of Austenite (see Austenite) best developed at interrupted holding temperatures below those forming fine pearlite and above those giving Martensite.

BASIC OXYGEN PROCESS - A steel-making process wherein oxygen of the highest purity is blown onto the surface of a bath of molten iron contained in a basic lined and ladle shaped vessel. The melting cycle duration is extremely short with quality comparable to Open Hearth Steel.

BASIC PROCESS - A steel making process either Bessemer, open hearth, or electric, in which the furnace is lined with a basic refractory. A slag, rich in lime, being formed and phosphorus removed.

BATH ANNEALING - Is immersion in a liquid bath (such as molten lead or fused salts) held at an assigned temperature-when a lead bath is used, the process is known as lead annealing.

BEADING - Raising a ridge on sheet metal.

BEND TEST - Various tests used to determine the toughness and ductility of flat rolled metal sheet, strip or plate, in which the material is bent around its axis or around an outside radius. A complete test might specify such a bend to be both with and against the direction of grain. For testing, samples should be edge filed to remove burrs and any edgewise cracks resulting from slitting or shearing. If a vice is to be used then line the jaws with some soft metal or brass, so as to permit a free flow of the metal in the sample being tested.

BESSEMER PROCESS - A steel making process in which air is blown through the molten iron so that the impurities are thus removed by oxidation.

BILLET - A solid, semi-finished steel round or square product that has been hot worked by forging, rolling or extrusion usually smaller than a bloom.

BLACK OIL TEMPERED SPRING STEEL STRIP - (Scaleless Blue) - A flat cold rolled usually .70/.80 medium high carbon spring steel strip, blue-black in color, which has been quenched in oil and drawn to desired hardness. While it looks and acts much like blue tempered spring steel and carries a Rockwell hardness of *C44/47*, it has not been polished and is lower in carbon content. Used for less exacting requirements than clock spring steel, such as snaps, lock springs, hold down springs, trap springs, etc. It will take a more severe bend before fracture than will clock spring, but it does not have the same degree of spring-back.

BLAST FURNACE - A vertical shaft type smelting furnace in which an air blast is used, usually hot, for producing pig iron. The furnace is continuous in operation using iron ore, coke, and limestone as raw materials that are charged at the top

## Glossary

while the molten iron and slag are collected at the bottom and are tapped out at intervals.

**BLISTER** - A defect in metal produced by gas bubbles either on the surface or formed beneath the surface while the metal is hot or plastic. Very fine blisters are called "pin-head" or "pepper" blisters.

**BLOOM** - (Slab, Billet, Sheet-Bar.) Semi-finished products, hot rolled from ingots. The chief differences are in their cross sectional areas in ratio of width to thickness, and in their intended use.

**BLOOMING MILL** - A mill used to reduce ingots to blooms, billets, slabs, sheet-bar etc., (See Semi-finished Steel).

**BLOWHOLE** - A cavity produced during the solidification of metal by evolved gas, which in failing to escape is held in pockets.

**BLUE TEMPERED SPRING STEEL STRIP** – (See Tempered Spring Steel Strip.)

**BLUING** – (1) Sheets – A method of coating sheets with a thin, even film of bluish-black oxide, obtained by exposure to an atmosphere of dry steam or air, at a temperature of about 1000° F., generally this is done during box-annealing. (2) Bluing of tempered spring steel strip; an oxide film blue in color produced by low temperature heating.

**BORON** – (Chemical Symbol B) Element N. 5 of the periodic system; (atomic weight 10.82.) It is gray in color, ignites at about 1112° F. and burns with a brilliant green flame, but its melting point in a non-oxidizing atmosphere is about 4000° F. Boron is used in steel in minute quantities for one purpose only – to increase the hardenability as in case hardening and to increase strength and hardness penetration.

**BOW** – (See Camber.)

**BOX ANNEALING** – A process of annealing a ferrous alloy in a suitable closed metal container, with or without packing materials, in order to minimize oxidation. The charge is usually heated slowly to a temperature below the transformation range, but sometimes above or within it, and is then cooled slowly.

**BRALE** – A diamond penetrator, conical in shape, used with a Rockwell hardness tester for hard metals.

**BRAZING** – Joining metals by fusion of nonferrous alloys that have melting points above 800° F., but lower than those of the metals being joined. This may be accomplished by means of a torch (torch brazing), in a furnace (furnace brazing) or by dipping in a molten flux bath (dip of flux brazing).

**BRIGHT ANNEALING** – A process of annealing usually carried out in a controlled furnace atmosphere so that surface oxidation is reduced to a minimum and the surface remains relatively bright.

**BRIGHT BASIC WIRE** – Bright steel wire, slightly softer than Bright Bessemer Wire. Used for round head wood screws, bolts and rivets, electric welded chain, etc.

**BRIGHT COMMERCIAL FINISH** – Refer to FINISHES.

**BRINELL HARDNESS (Test)** – A common standard method of measuring the hardness of certain metals. The smooth surface of the metal is subjected to indentation by a hardened steel ball under pressure or load. A special microscope measures the diameter of the resultant indentation in the metal surface, and the Brinell hardness value is read from a chart or calculated by formula.

**BRITTLENESS** - The tendency of a material to fracture without first undergoing significant plastic deformation.

**BROACHING** – Multiple shaving, accomplished by pushing a tool with stepped cutting edges along the work, particularly

## Glossary

through holes.

**BROWN & SHARPE GAGES (B&S)** – A standard series of sizes arbitrarily indicated, as by numbers, to which the diameter of wire or thickness of sheet metal is usually made and which is used in the manufacture of brass, bronze, copper, copper-base alloys and aluminum. These gage numbers have a definite relationship to each other. By this system the decimal thickness is reduced by 50% every six gage numbers – while temper is expressed by the number of B & S gage number in thickness reduction, there is assigned a hardness value of  $\frac{1}{4}$  hard. To illustrate: One number hard =  $\frac{1}{4}$  hard, two numbers hard =  $\frac{1}{2}$  hard, etc.

**BUCKLE** – Alternate bulges or hollows recurring along the length of the product with the edges remaining relatively flat.

**BURNING** – Heating a metal beyond the temperature limits allowable for the desired heat treatment, or beyond the point where serious oxidation or other detrimental action begins.

**BURR** – A thin ridge or roughness left by a cutting operation such as in metal slitting, shearing, blanking or sawing. This is common to a No. 3 slit edge in the case of steel.

**BUTT WELDING** – Joining two edges or ends by placing one against the other and welding them.

**CAMBER OR BOW** – Edgewise curvature. A lateral departure of a side edge of sheet or strip metal from a straight line.

**CARBIDE** - A compound of carbon with one or more metallic elements.

**CARBON** (Chemical symbol C) - Element No.6 of the periodic system; atomic weight 12.01; has three allotropic modifications, all non-metallic. Carbon is present in practically all ferrous alloys, and has tremendous effect on the properties of the resultant metal. Carbon is also an essential component of the cemented carbides. Its metallurgical use, in the form of coke, for reduction of oxides, is very extensive.

**CARBON RANGE** - In steel specifications, the carbon range is the difference between the minimum and maximum amount of carbon acceptable.

**CARBON STEEL** - Common or ordinary steel as contrasted with special or alloy steels, which contain other alloying metals in addition to the usual constituents of steel in their common percentages.

**CARBURIZING** - (Cementation.) Adding carbon to the surface of iron-base alloys by absorption through heating the metal at a temperature below its melting point in contact with carbonaceous solids, liquids or gases. The oldest method of case hardening.

**CASE** - In a ferrous alloy, the outer portion that has been made harder than the inner portion, or core (see *case hardening*).

**CASE HARDENING** - A generic term covering several processes applicable to steel that change the chemical composition of the surface layer by absorption of carbon or nitrogen, or a mixture of the two, and, by diffusion, create a concentration gradient.

**CHATTER MARKS** (Defect) - Parallel indentations or marks appearing at right angles to edge of strip forming a pattern at close and regular intervals, caused by roll vibrations.

**CHEMICAL POLISHING** - Improving the specular reflectivity of a metal surface by chemical treatment.

**CHROMIUM** (Chemical symbol Cr) - Element No.24 of the periodic system; atomic weight 52.01. It is of bright silvery color, relatively hard. It is strongly resistant to atmospheric and other oxidation. It is of great value in the manufacture of

## Glossary

Stainless Steel as an iron-base alloy Chromium plating has also become a large outlet for the metal. Its principal functions as an alloy in steel making, (1) increases resistance to corrosion and oxidation (2) increases hardenability (3) adds some strength at high temperatures (4) resists abrasion and wear (with high carbon)

CHROMIUM-NICKEL STEEL - Steel usually made by the electric furnace process in which chromium and nickel participate as alloying elements. The stainless steel of 18% chromium and 8% nickel are the better known of the chromium-nickel types.

CLAD METAL - A composite metal containing two or three layers that have been bonded together. The bonding may have been accomplished by co-rolling, welding, heavy chemical deposition or heavy electroplating.

CLOCK SPRING STEEL - (See Tempered and Polished Spring Steel Strip .90/.103 carbon range.)

COIL SET - A lengthwise curve or set found in coiled strip metals following its coil pattern. A departure from longitudinal flatness. Can be removed by roller or stretcher leveling from metals in the softer temper ranges.

COILS - Coiled flat sheet or strip metal-usually in one continuous piece or length.

COIL BREAKS - Creases or Ridges appearing in sheets as parallel lines transverse to the direction of rolling and generally extending across the width of the sheet.

COINING - A process of impressing images or characters of the die and punch onto a plane metal surface.

COLD REDUCED STRIP - Metal strip, made from hot-rolled strip, by rolling on cold-reduction mills.

COLD REDUCTION - Reduction of metal size, usually by rolling or drawing particularly thickness, while the metal is maintained at room temperature or below the recrystallization temperature of the metal.

COLD ROLLED FINISH - Finish obtained by cold rolling plain pickled sheet or strip with a lubricant resulting in a relatively smooth appearance.

COMMERCIAL QUALITY STEEL SHEET - Normally to a ladle analysis of carbon limit at 0.15 max. A Standard Quality Carbon Steel Sheet.

CONTINUOUS CASTING - A casting technique in which the ingot is continuously solidified while it is being poured, and the length is not determined by mold dimensions.

CONTINUOUS FURNACE - Furnace, in which the material being heated moves steadily through the furnace.

CONTINUOUS PICKLING - Passing sheet or strip metal continuously through a series of pickling and washing tanks.

CONTROLLED ATMOSPHERE FURNACES - A furnace used for bright annealing into which specially prepared gases are introduced for the purpose of maintaining a neutral atmosphere so that no oxidizing reaction between metal and atmosphere takes place.

CORROSION - Deterioration of a metal by chemical or electrochemical reaction with its environment.

CORROSION EMBRITTLEMENT - The embrittlement caused in certain alloys by exposure to a corrosive environment.

CROP - The defective ends of a rolled or forged product which are cut off and discarded.

CROSS BREAK - This term also applied to transverse ribs or ripple.



## Glossary

**CROSS ROLLING** - A (hot) rolling process in which rolling reduction is carried out in a direction perpendicular to, as well as a direction parallel to, the length of the original slab.

**CROWN** - Increased thickness in the center of metal sheet or strip as compared with thickness at the edge.

**CRYSTALLIZATION** - The formation of crystals by the atoms assuming definite positions in a crystal lattice. This is what happens when a liquid metal solidifies. (Fatigue, the failure of metals under repeated stresses, is sometimes falsely attributed to crystallization.)

**CYANIDING** - Surface hardening of an iron-base alloy article or portion of it by heating at a suitable temperature in contact with a cyanide salt, followed by quenching.

**DEAD FLAT** - Perfectly flat. As pertaining to sheet, strip or plate.

**DEAD SOFT STEEL** - Steel, normally made in the basic open-hearth furnace or by the basic oxygen process with carbon less than 0.10% and manganese in the 0.20-0.50% range, completely annealed.

**DEAD SOFT TEMPER (No.5 TEMPER)** - Condition of maximum softness commercially attainable in wire, strip, or sheet metal in the annealed state. Hardness of an R/B 55 max. Standard hardness range R/B 55 max.

**DEBURRING** - A method whereby the raw slit edge of metal is removed by rolling or filing.

**DECARBURIZATION** - Loss of carbon from the surface of a ferrous alloy as a result of heating in a medium that reacts with carbon.

**DEEP DRAWING** - The process of cold working or drawing sheet or strip metal blanks by means of dies on a press into shapes which are usually more or less cup-like in character involving considerable plastic deformation of the metal. Deep-drawing quality sheet or strip steel, ordered or sold on the basis of suitability for deep-drawing.

**DEGASSING** - Removing gases from the molten metal by means of a vacuum process in combination with mechanical action.

**DEOXIDATION** - (1) Removal of oxygen from molten metals by use of suitable chemical agents. (2) Sometimes refers to removal of undesirable elements other than oxygen by the introduction of elements or compounds that readily react with them.

**DISH** - A concave surface departing from a straight line edge to edge. Indicates transverse or across the width.

**DRAWING BACK** - Reheating after hardening to a temperature below the critical for the purpose of changing the hardness of the steel. (See Tempering.)

**DRILL ROD** - A term given to an annealed and polished high carbon tool steel rod usually round and centerless ground. The sizes range in round stock from .013 to 1-1/2" diameter. Commercial qualities embrace water and oil hardening grades. Drill Rods are used principally by machinists and tool and die makers for punches, drills, taps, dowel pins, screw machine parts, small tools, etc.

**DUCTILITY** - The capacity of a material to deform plastically without fracturing. Ductility is usually measured by elongation and reduction of area as determined in a tensile test.

**EARING** - Wavy projections formed at the open end of a cup or shell in the course of deep drawing because of differences in directional properties. Also termed scallop. See non-scalloping.

## Glossary

**EDGES** - Many types of edges can be produced in the manufacture of flat rolled metal products. Over the years the following types of edges have become recognized as standard in their respective fields.

### STRIP STEELS and STAINLESS STRIP

No.1 Edge-A smooth, uniform, round or square edge, either slit or filed or slit and edge rolled as specified. Width tolerance +/- .005".

No.2 Edge-A natural round mill edge carried through from the hot rolled band. Has not been slit, filed, or edge rolled. Tolerances not closer than hot-rolled strip limits.

No.3 Edge-Square, produced by slitting only. Not filed. Width tolerances close.

No.4 Edge-A round edge produced by edge rolling either from a natural mill edge or from slit edge strip. Not as perfect as No.1 edge Width tolerances liberal.

No.5 Edge-An approximately square edge produced by slitting and filing or slitting and rolling to remove burr.

No.6 Edge-A square edge produced by square edge rolling, generally from square edge hot-rolled occasionally from slit strip. Width tolerances and finish not as exacting as No.1 edge.

**EDGE FILING** - A method whereby the raw or slit edges of strip metal are passed or drawn one or more times against a series of files, mounted at various angles. This method may be used for deburring only or filing to a specific contour including a completely rounded edge.

**EDGING** - The dressing of metal strip edges by rolling, filing or drawing.

**ELASTIC LIMIT** - Maximum stress that a material will stand before permanent deformation occurs.

**ELECTRIC FURNACE STEEL** - Steel made in any furnace where heat is generated electrically, almost always by arc.

**ELONGATION** - Increase in length which occurs before a metal is fractured, when subjected to stress. This is usually expressed as a percentage of the original length and is a measure of the ductility of the metal.

**EMBOSSING** - Raising or indenting a design in relief on a sheet or strip of metal by passing between rolls of desired pattern.

**ENDURANCE LIMIT** - Maximum alternating stress which a given material will withstand for an indefinite number of times without causing fatigue failure.

**ETCHING** - Subjecting the surface of a metal to chemical or electrolytic attack to reveal structural details.

**EXTRUSION** - Shaping metal into a chosen continuous form by forcing it through a die of appropriate shape.

**FATIGUE** - The phenomenon leading to fracture under repeated or fluctuating stresses.

**FERROUS** - Related to iron. Ferrous alloys are, therefore, iron base alloys.

**FILED EDGES** - Finished edges, the final contours of which are produced by drawing the strip over a series of small steel files.

**FINISHED STEEL** - Steel that is ready for the market without further work or treatment. Blooms, billets, slabs, sheet bars, and wire rods are termed "semifinished."

# Glossary

**FINISHES** - The surface appearance of the various metals after final treatment such as rolling, etc. Over the years the following finishes have become recognized as standard in their respective fields.

## COLD ROLLED STRIP STEELS

No.1 Finish-A dull finish produced without luster by rolling on roughened rolls.

No.2 Finish-A regular bright finish produced by rolling on moderately bright rolls.

No.3 Finish-Best Bright Finish-A lustrous or high gloss finish produced by rolling on highly polished rolls – Also referred to as "Mirror Finish."

## TEMPERED CARBON SPRING STEEL STRIP

Classified by description as follows

(A) Black Oil Tempered.

(B) Scaleless Tempered

(C) Bright Tempered.

(D) Tempered and Polished.

(E) Tempered, Polished and Colored (Blue or straw).

**FINISHING TEMPERATURE** - Temperature of final hot-working of a metal.

**FLAT WIRE** - A flat Cold Rolled, prepared edge section, rectangular in shape. Generally produced from hot rolled rods or specially prepared round wire by one or more cold rolling operations. May also be produced by slitting cold rolled flat metal to desired width followed by edge dressing.

**FOIL** - Metal in any width but no more than about 0.005" thick.

**FORGING** - Plastically deforming metal, usually hot, into desired shapes with compressive force, with or without dies.

**FRACTURE** - Surface appearance of metals when broken.

**FRACTURE TEST** - Nicking and breaking a bar by means of sudden impact, to enable macroscopic study of the fractured surface.

**FULL HARD TEMPER** - (No.1 Temper.) In low carbon sheet or strip steel, stiff and springy, not suitable for bending in any direction. It is the hardest temper obtainable by hard cold rolling. Standard hardness range is R/B 90 min except .070" and heavier which has a hardness of R/B 84 min.

**GAGES** - Manufacturers standard numbering systems indicating decimal thicknesses or diameters.

**GRAIN** - An individual crystal in a polycrystalline metal or alloy, including twinned regions or subgrains if present.

**GRAIN DIRECTION** – Refers to grain fiber following the direction of rolling and parallel to edges of strip or steels.

**GRAIN GROWTH** - An increase in the average size of the grains in polycrystalline metal, usually a result of heating at elevated temperature.

**GRAIN SIZE** - A measure of the areas or volumes of grains in a polycrystalline metal or alloy, usually expressed as an average when the individual sizes are fairly uniform. In metals containing two or more phases, the grain size refers to that of the matrix unless otherwise specified. Grain size is reported in terms of number of grains per unit area or volume, average diameter, or as a number derived from area measurements.

**GROUND FLAT STOCK** - Annealed and pre-ground (to close tolerances) tool steel flats in standard sizes ready for tool room use. These are three common grades; water hardening, oil hardening, and air hardening quality.

## Glossary

**HALF HARD TEMPER** - (No.2 Temper.) In low carbon cold-rolled strip steel, produced by cold rolling to a hardness next to, but somewhat softer than full hard temper. Standard hardness range of R/B 70-85.

**HARDENABILITY** - In ferrous alloys, the property that determines the depth and distribution of hardness induced by quenching.

**HARDENED AND TEMPERED SPRING STEEL STRIP** - A medium or high carbon quality steel strip which has been subjected to the sequence of heating, quenching and tempering

**HARDENING** - Increasing hardness by suitable treatment, usually involving heating and cooling.

**HARDNESS (indentation)** - Resistance of a metal to plastic deformation by indentation. Various hardness tests such as Brinell, Rockwell and Vickers may be used.

**HEAT-AFFECTED ZONE** - That portion of the base metal which was not melted during brazing, cutting or welding, but within which microstructure and physical properties were altered by the treatment.

**HEAT OF STEEL** - The product of a single melting operation in a furnace, starting with the charging of raw materials and ending with the tapping of molten metal and consequently identical in its characteristics.

**HEAT TREATMENT** - Heating and cooling a solid metal or alloy in such a way that desired structures, conditions or properties are attained. Heating for the sole purpose of hot working is excluded from the meaning of this term.

**IMPACT TEST** - A test for determining the behavior of materials when subjected to high rates of loading under conditions designed to promote fracture, usually in bending, tension or torsion. The quantity measured is the energy absorbed when the specimen is broken by a single blow.

**IMPURITIES** - Elements or compounds whose presence in a material is undesired.

**INCLUSIONS** - Particles of impurities (usually oxides, sulfides, silicates, etc.) that are held mechanically or are formed during the solidification or by subsequent reaction within the solid metal.

**INDENTATION HARDNESS** - The resistance of a material to indentation. This is the usual type of hardness test, in which a pointed or rounded indenter is pressed into a surface under a substantially static load.

**INDUCTION HARDENING** - A process of hardening a ferrous alloy by heating it above the transformation range by means of electrical induction, and then cooling as required.

**INDUCTION HEATING** - A process of heating by electrical induction.

**INGOT** - A casting suitable for hot working or re-melting.

**INTERMEDIATE ANNEALING** - An annealing treatment given to wrought metals following cold work hardening for the purpose of softening prior to further cold working.

**IRON** - An element that has an average atomic number of 55.85 and that always, in engineering practice, contains small but significant amounts of carbon. Thus iron-carbon alloys containing less than about 0.1% C may be referred to as irons. Alloys with higher carbon contents are always, termed steels.

**KILLED STEEL** - Steel deoxidized with a strong deoxidizing agent, such as silicon or aluminum, to reduce the oxygen content to such a level that no reaction occurs between carbon and oxygen during solidification.

## Glossary

**LAMINATIONS** - A defect appearing in sheets or strips as a segregation or in layers. To become divided. caused by gas pockets in the ingot.

**LADLE ANALYSIS** - A term applied to the chemical analysis representative of a heat of steel as reported by the producer. It is determined by analyzing a test ingot sample obtained during the pouring of the steel from a ladle.

**MACHINABILITY** - The capacity of a material to be machined easily.

**MACROETCHING** - Etching of a metal surface with the objective of accentuating gross structural details, for observation by the unaided eye or at magnifications not exceeding ten diameters.

**MACROGRAPH** - A graphic reproduction of a prepared surface of a specimen at a magnification not exceeding ten diameters. When photographed, the reproduction is known as a photomacrograph (not a macrophotograph).

**MALLEABILITY** - The property that determines the ease of deforming a metal when the metal is subjected to rolling or hammering. The more malleable metals can be hammered or rolled into thin sheet more easily than others.

**MANGANESE** (Chemical symbol Mn) - Element No 25 of the periodic system. atomic weight 54.93 Lustrous, reddish-white metal of hard, brittle, and therefore non-malleable, character. The metal is used in large quantities in the form of Spiegel and Ferromanganese for steel manufacture as well as in manganese and many copper base alloys. Its principal function is as an alloy in steel making (1) It is a ferrite strengthening and carbide forming element. It increases hardenability inexpensively with a tendency toward embrittlement when too high carbon and too high manganese accompany each other (2) It counteracts brittleness from sulfur.

**MECHANICAL PROPERTIES** - Those properties of a material that reveal the elastic and inelastic reaction when force is applied, or that involve the relationship between stress and strain, for example elasticity, tensile strength and fatigue limit. These properties have often been designated as "physical properties."

**MECHANICAL WORKING** - Plastic deformation or other physical change to which metal is subjected, by rolling, hammering, drawing, etc. to change its shape, properties or structure.

**MELTING RANGE** - The range of temperature in which an alloy melts.

**METALLOGRAPH** - An optical instrument designed for both visual observation and photomicrography of prepared surfaces of opaque materials at magnifications ranging from about 25 to about 1500 diameters.

**MICROSTRUCTURE** - The structure of a prepared surface of a metal as revealed by a microscope at a magnification greater than ten diameters.

**MILL EDGE** - The edge of strip, sheet or plate in the as rolled state.

**MOLYBDENUM** - (Chemical symbol MO) - Element No. 42 of the periodic system; atomic weight 95.95. Hard, tough metal of grayish-white color, becoming very ductile and malleable when properly treated at high temperatures; melting point 4748 F.; boiling point about 6600 F. specific gravity 10.2. Its principal functions as an alloy in steel making' (1) Raises grain-coarsening temperature of austenite. (2) Deepens hardening (3) Forms abrasion-resisting particles.

**NICKEL** - (Chemical symbol Ni) - Element No. 28 of the periodic system; atomic weight 58.69 Silvery white, slightly magnetic metal, of medium hardness and high degree of ductility and malleability and resistance to chemical and atmospheric corrosion; melting point 2651 F.; boiling point about 5250 F., specific gravity 8.90.

**NITRIDING** - Process of surface hardening certain types of steel by heating in ammonia gas at about 935-1000 F., the increase in hardness being the result of surface nitride formation. Certain alloying constituents, principal among them being aluminum, greatly facilitate the hardening reaction. In general, the depth of the case is less than with carburizing

## Glossary

NON-FERROUS METALS - Metals or alloys that are free of iron or comparatively so.

NON-METALLIC INCLUSIONS - Impurities (commonly oxides), sulfides, silicates or similar substances held in metals mechanically during solidification or formed by reactions in the solid state.

NORMALIZING - A heat treatment applied to steel. Involves heating above the critical range followed by cooling in still air. Is performed to refine the crystal structure and eliminate internal stress.

NOTCH BRITTLENESS - A measure of the susceptibility of a material to brittle fracture at locations of stress concentration. For example, in a notch tensile test a material is said to be "notch brittle" if its notch strength is less than its tensile strength; otherwise, it is said to be "notch ductile".

NUCLEUS - (1) The first structurally stable particle capable of initiating recrystallization of a phase or the growth of a new phase, and separated from the matrix by an interface. (2) The heavy central core of an atom, in which most of the mass and the total positive electrical charge are concentrated.

OIL HARDENING - A process of hardening a ferrous alloy of suitable composition by heating within or above the transformation range and quenching in oil.

OIL-HARDENING STEEL - Steel adaptable to hardening by heat treatment and quenching in oil.

OLSEN (DUCTILITY) TEST - A method of measuring the ductility and drawing properties of strip or sheet metal which involves determination of the width and depth of impression. The test simulating a deep drawing operation is made by a standard steel ball under pressure. continuing until the cup formed from the metal sample fractures. Readings are in thousandths of an inch.

ORE - A mineral from which metal is (or may be) extracted.

OSCILLATE WOUND - A method of even winding metal strip or wire on to a reel or mandrel wherein the strands are uniformly over-lapped. The opposite of ribbon wound.

OXIDE - Compound of oxygen with another element.

PASS - A single transfer of metal through a stand of rolls.

PATTERNED OR EMBOSSED SHEET - A sheet product on which a raised or indented pattern has been impressed on either one or both surfaces by the use of rolls.

PEARLITE - A eutectoid transformation product of ferrite and cementite that ideally has a lamellar structure but that is always degenerate to some extent.

PERMANENT SET - Non-elastic or plastic, deformation of metal under stress, after passing the elastic limit.

PHOSPHORUS - (Chemical symbol P) - Element No.15 of the periodic system; atomic weight 30g. Non-metallic element occurring in at least three allotropic forms; melting point 111 F.; boiling point 5360 F.; specific gravity 1.82. In steels it is usually undesirable with limits set in most specifications.

PHOTOMICROGRAPH - A photographic reproduction of any object magnified more than ten diameters.

PHYSICAL PROPERTIES - Properties, other than mechanical properties, that pertain to the physical nature of a material; e.g., density, electrical conductivity, thermal expansion, reflectivity, magnetic susceptibility, etc.

## Glossary

**PICKLING** - The process of chemically removing oxides and scale from the surface of a metal by the action of water solutions of inorganic acids.

**PIPE** - Contraction cavity, essentially cone-like in shape, which occurs in the approximate center, at the top and reaching down into a casting; caused by the shrinkage of cast metal.

**PIT** - A sharp depression in the surface of the metal.

**PLATE** - A flat-rolled metal product of some minimum thickness and width arbitrarily dependent on the type of metal.

**PLATING** - A thin coating of metal laid on another metal.

**POLISHED SURFACE** - The finish obtained by buffing with rouge or similar fine abrasive, resulting in a high gloss or polish.

**POURING** - The transfer of molten metal from the ladle into ingot molds or other types of molds; for example, in castings.

**PREHEATING** - A general term used to describe heating applied as a preliminary to some further thermal or mechanical treatment.

**PROCESS ANNEALING** - A process by which a ferrous alloy is heated to a temperature close to, but below, the lower limit of the transformation range and is subsequently cooled. This process is applied in order to soften the alloy for further cold working.

**PYROMETER** - An instrument of any of various types used for measuring temperatures.

**QUARTER HARD (No. 3 TEMPER)** - In low carbon cold-rolled strip steel, a medium soft temper produced by a limited amount of cold rolling after annealing. Standard hardness range of R/B 60-75.

**QUENCHING** - In the heat treating of metals, the rapid cooling of the metal by immersing the metal in oil or water.

**QUENCH HARDENING** - Hardening by austenitizing and then cooling at a rate such that a substantial amount of austenite is transformed to martensite.

**RAGGED EDGES** - Edges of Sheet or Strip, which are torn, split, cracked, ragged or burred or otherwise disfigured.

**RECARBURIZING** - (1) Increasing the carbon content of molten cast iron or steel by adding carbonaceous material, high-carbon pig iron or a high-carbon alloy. (2) Carburizing a metal part to return surface carbon lost in processing.

**REFRACTORY** - A heat-resistant material, usually nonmetallic, which is used for furnace linings and such

**RESIDUAL ELEMENTS** - Small quantities of elements unintentionally present in an alloy.

**RESISTANCE WELDING** - A type of welding process in which the work pieces are heated by the passage of an electric current through the contact. Such processes include spot welding, seam or line welding and percussion welding. Flash and butt welding are sometimes considered as resistance welding processes.

**RESULFURIZED STEEL** - Steel to which sulfur has been added in controlled amounts after refining. The sulfur is added to improve machinability.

**RIBBON WOUND** - A term applied to a common method of winding strip steel layer upon layer around an arbor or mandrel.

**RIMMED STEEL** - Low-carbon steel containing sufficient iron oxide to produce continuous evolution of carbon monoxide

## Glossary

during ingot solidification, resulting in a case or rim of metal virtually free of voids.

**ROCKWELL HARDNESS (TEST)** - A standard method for measuring the hardness of metals. The hardness is expressed as a number related to the depth of residual penetration of a steel ball or diamond cone ("brale") after a minor load of 10 kilograms has been applied to hold the penetrator in position. This residual penetration is automatically registered on a dial when the major load is removed from the penetrator.

**ROLLED EDGES** - Finished edges, the final contours of which are produced by side or edging rolls. The edge contours most commonly used are square corners, rounded corners and rounded edge.

**ROLLED IN SCALE** - A surface defect consisting of scale partially rolled into the surface of the sheet.

**ROLLER LEVELING** - Passing sheet or strip metal through a series of staggered small rolls so as to flatten the metal.

**ROLLING** - Reducing the cross-sectional area of metal stock, or otherwise shaping metal products, through the use of rotating rolls.

**ROLLING DIRECTION** - The direction, in the plane of the sheet, perpendicular to the axes of the rolls during rolling.

**ROLLING MILLS** - Equipment used for rolling down metal to a smaller size or to a given shape employing sets of rolls the contours of which determine or fashion the product into numerous intermediate and final shapes, e.g., blooms, slabs, rails, bars, rods, sections, plates, sheets and strip.

**SAE** - Abbreviation for Society of Automotive Engineers - This organization has specified common and alloy steels and copper base alloys in accordance with a numerical index system allowing approximation of the composition of the metal. The last two digits always indicate the carbon content, usually within 0.05%.

**SCALE** - A layer of oxidation products formed on a metal at high temperature.

**SCARFING** - Cutting surface areas of metal objects, ordinarily by using a gas torch.

**SCRAP** - Material unsuitable for direct use but usable for reprocessing by remelting.

**SEAM** - On the surface of metal a crack that has been closed but not welded, usually produced by some defect either in casting or in working, such as blowholes that have become oxidized or folds and laps that have been formed during working. Similar to cold shut and laminations.

**SECONDS** - The designation given to sheet or strip that has imperfections in moderate degree or extent.

**SEGREGATION** - The non-uniform distribution of alloying elements, impurities or phases.

**SEMIFINISHED STEEL** - Steel in the form of billets, blooms, etc., requiring further working before completion into finished steel ready for marketing.

**SHEET** - A flat-rolled metal product of some maximum thickness and minimum width arbitrarily dependent on the type of metal. Sheet is thinner than plate.

**SILICON** - (Chemical Symbol Si) - Element No. 14 of the periodic system; atomic weight 28.06. Extremely common element, the major component of all rocks and sands; its chemical reactions, however, are those of a metalloid. Used in metallurgy as a deoxidizing scavenger. Silicon is present, to some extent, in all steels.

**SLAG** - A product resulting from the action of a flux on the nonmetallic constituents of a processed ore, or on the oxidized metallic constituents that are undesirable. Usually slags consist of combinations of acid oxides with basic oxides, and neutral oxides are added to aid fusibility.



## Glossary

**SLIT EDGES** - The edges of sheet or strip metal resulting from cutting to width by rotary Slitters.

**SLITTING** - Cutting sheet or strip metal to width by rotary slitters.

**SOAKING** - Prolonged heating of a metal at selected temperature.

**SOFT SKIN ROLLED TEMPER** - (No. 4 Temper.) - In low carbon-rolled strip steel, soft and ductile. Produced by subjecting annealed Strip to a pinch pass or skin rolling (a very light rolling). Standard hardness range of R/B 65 max.

**SOLDERING** - Joining metals by fusion of alloys that have relatively low melting points - most commonly, lead-base or tin-base alloys, which are the soft solders. Hard solders are alloys that have silver, copper, or nickel bases and use of these alloys with melting points higher than 800 F. is generally termed brazing.

**SPECTROGRAPH** - An optical instrument for determining the presence or concentration of minor metallic constituents in a material by indicating the presence and intensity of specific wave lengths of radiation when the material is thermally or electrically excited.

**SPHEROIDIZED STRUCTURE** - A microstructure consisting of a matrix containing spheroidal particles of another constituent

**SPHEROIDIZING** - Heating and cooling to produce a spheroidal or globular form of carbide in steel.

**SPHEROIDIZING ANNEALING** - A subcritical annealing treatment intended to produce spheroidization of cementite or other carbide phases.

**SPOT WELDING** - An electric-resistance welding process in which the fusion is limited to a small area. The pieces being welded are pressed together between a pair of water-cooled electrodes through which an electrical current is passed during a very short interval so that fusion occurs over a small area at the interface between the pieces.

**SPRING STEEL** - Steel, normally of the high-carbon or alloy type, used in the manufacture of springs, lending itself to appropriate heat treatment.

**STAINLESS STEEL** - Corrosion resistant steel of a wide variety, but always containing a high percentage of chromium. These are highly resistant to corrosion attack by organic acids, weak mineral acids, atmospheric oxidation, etc.

**STAMPING** - A term used to refer to various press forming operations in coining, embossing, blanking, and pressing.

**STEEL** - Iron, malleable in at least one range of temperature below its melting point without special heat treatment, substantially free from slag, and containing carbon more than about 0.05% and less than about 2.00%. Other alloying elements may be present in significant quantities, but all steels contain at least small amounts of manganese and silicon, and usually as undesirable constituents, also sulfur and phosphorus.

**STRESS** - Deforming force to which a body is subjected, or, the resistance which the body offers to deformation by the force.

**STRESS RELIEVING** - Heating to a suitable temperature, holding long enough to reduce residual stresses and then cooling slowly enough to minimize the development of new residual stresses.

**STRETCHER LEVELING** - A method of making metal sheet or strip dead flat by stretching.

**STRIP STEEL (Cold rolled)** - A flat cold rolled steel product (Other than Flat Wire) 23-15/16" and narrower; under .250" in thickness, which has been cold reduced to desired decimal thickness and temper on single stand, single stand reversing,

# Glossary

or tandem cold mills in coil form from coiled hot rolled pickled strip steel.

**SULFUR** (Chemical Symbol S.) - Element No.16 of the periodic system; atomic weight 32.06. Non-metal occurring in a number of allotropic modifications, the most common being a pale-yellow brittle solid. In steel most commonly encountered as an undesired contaminant. However, it is frequently deliberately added to cutting stock, to increase machinability.

**SURFACE HARDENING** - A generic term covering several processes applicable to a suitable ferrous alloy that produce, by quench hardening only, a surface layer that is harder or more wear resistant than the core. There is no significant alteration of the chemical composition of the surface layer. The processes commonly used are induction hardening, flame hardening and shell hardening. Use of the applicable specific process name is preferred.

**TANDEM MILL** - Arrangement of rolling mills, in direct line, allowing the metal to pass from one set of rolls into the next.

**TELESCOPING** - Transverse slipping of successive layers of a coil so that the edge of the coil is conical rather than flat.

**TEMPER** - The state or condition of a metal as to its hardness or toughness produced by either thermal treatment or heat treatment and quench or cold working or a combination of same in order to bring the metal to its specified consistency.

**SHEET STEEL (Low Carbon Cold Rolled)-Temper Classifications.**

Temper	Rockwell
Full Hard (.070 & Thicker)	B 84 min.
Full Hard (.069 & Thinner)	B 90 min.
Half Hard	Approx R/B 70/85
Quarter Hard	Approx R/B 60/75
Soft (Commercial Quality)	Approx R/B 65 max.
Drawing Quality	Approx R/B 55 max.

**STRIP STEEL (Low Carbon Cold Rolled)-Temper Classifications.**

Temper	Rockwell	Mean Tensile
#1 Full Hard (.070 & thicker)	B 84 min.	80,000
#1 Full Hard (.069 & thinner)	B 90 min.	80,000
#2 Half Hard	B 70-85	64,000
#3 Quarter Hard	B 60-70	54,000
#4 Skin Rolled	B 65 max.	48,000
#5 Dead Soft	B 55 max.	

**TEMPERED and POLISHED SPRING STEEL STRIP** - .90/1.03 carbon range (Also known as clock spring steel.) - This product, while similar to general description under heading of Tempered Spring Steel Strip, is manufactured and processed with great and extreme care exercised in each step of its production. Manufactured from carbon range of .90/1.03 with Rockwell range C 48/51.

**TEMPERED SPRING STEEL STRIP** - Any medium or high carbon (excluding clock spring) strip steel of spring quality, which has been hardened and tempered to meet specifications. Where specification calls for blue or straw color, same is accomplished by passing through heat prepared at proper temperature depending on color required. Blue is developed at approximately 600 F.

**TEMPERING** - A process of re-heating quench-hardened or normalized steel to a temperature below the transformation range and then cooling at any rate desired. The primary purpose of tempering is to impart a degree of plasticity or toughness to the steel to alleviate the brittleness of its martensite.

## Glossary

**TEMPER ROLLING** – Light cold rolling of sheet steel. The operation is performed to improve flatness, to minimize the formation of stretcher strains, and to obtain a specified hardness or temper.

**TENSILE STRENGTH** - Breaking strength of a material when subjected to a tensile (stretching) force. Usually measured by placing a standard test piece in the jaws of a tensile machine, gradually separating the jaws, and measuring the stretching force necessary to break the test piece. Tensile strength is commonly expressed as pounds (or tons) per square inch of original cross section.

**THICKNESS GAGE OR FEELER STOCK** - A hardened and tempered, edged, ground, and polished thin section, high carbon strip steel. Usually 1/2" in width and in thicknesses from .001" to .050" manufactured to extremely close tolerances. It is used primarily for determining the measurement of openings by tool and die makers, machinists, and automobile technicians.

**TOLERANCE LIMIT** - The permissible deviation from the desired value.

**TOOL STEEL** - Any high carbon or alloy steel capable of being suitably tempered for use in the manufacture of tools.

**TOUGHNESS** - Capacity of a metal to absorb energy and deform plastically before fracturing.

**TRACE** - Extremely small quantity of an element, usually too small to determine quantitatively.

**TUMBLING** - Cleaning articles by rotating them in a cylinder with cleaning materials.

**VICKERS HARDNESS** - Standard method for measuring the hardness of metals, particularly those with extremely hard surfaces; the surface is subjected to a standard pressure for a standard length of time by means of a pyramid-shaped diamond. The diagonal of the resulting indentation is measured under a microscope and the Vickers Hardness value read from a conversion table.

**WATER HARDENING** - Process of hardening high carbon steels by quenching in water or brine, after heating.

**WAVY** - Not flat. A slight wave following the direction of rolling and beyond the standard limitation for flatness.

**WELDING** - Joining two or more pieces of material by applying heat or pressure, or both, with or without filler metal, to produce a localized union through fusion or recrystallization across the interface.

**WORK HARDENING** – Hardness produced by cold working.

**WORKABILITY** - The characteristic or group of characteristics that determines the ease of forming a metal into desired shapes.

**WROUGHT IRON** - An iron produced by direct reduction of ore or by refining molten cast iron under conditions where a pasty mass of solid iron with included slag is produced. The iron has a low carbon content.

**YIELD POINT**-The load per unit of original cross section at which, in soft steel, a marked increase in deformation occurs without increase in load.

## Trade Customs

- Quotations are subject to change without notice. All sales are made subject to strikes, accidents, or other unavoidable delays. Special material may not be canceled without our written consent.
- Confirming orders should be plainly marked “CONFIRMATION”. Confirming orders not so marked may be treated as an original order and cause duplication of shipment. In such cases we are not responsible for the extra shipping and handling expenses.
- Local deliveries are made as agreed. We will confirm all deliveries the day before the delivery is scheduled. We do not guarantee specific delivery times as delays are often unavoidable. The customer or a designated representative must be present to unload the truck – our drivers can not unload the truck. All COD amounts must be paid prior to unloading the truck.
- Phone orders are accepted at the risk of the customer, as shipments made prior to receipt of written confirmation are made for the benefit of the customer.
- Claims for damaged material should be made immediately with the carrier. Bills of lading and receiving tickets should be marked as being received damaged. Responsibility for material lies with the carrier.
- Claims for defective or wrong material should be made immediately upon discovery. All materials are carefully inspected before shipment, but it is impossible to detect all imperfections.
- We guarantee to replace, with new material, such goods as proved defective within a reasonable period of time. Under no circumstances are we responsible for any damages beyond the replacement of steel. All material claimed defective must be held for our inspection and disposition.
- In any instance where the product is unsatisfactory, the buyer will immediately discontinue use and advise the seller of the facts. The seller will make all decisions on disposition so that loss to either party will be minimized. We will not make allowance for labor or expenses to repair defective goods. We do not accept any responsibility for liability of product guarantees or failure of goods manufactured by customers.