METAL REFERENCE GUIDE

THE WORLD'S LARGEST SUPPLIER OF SMALL-QUANTITY METALS

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The Convenience Stores For Metal®

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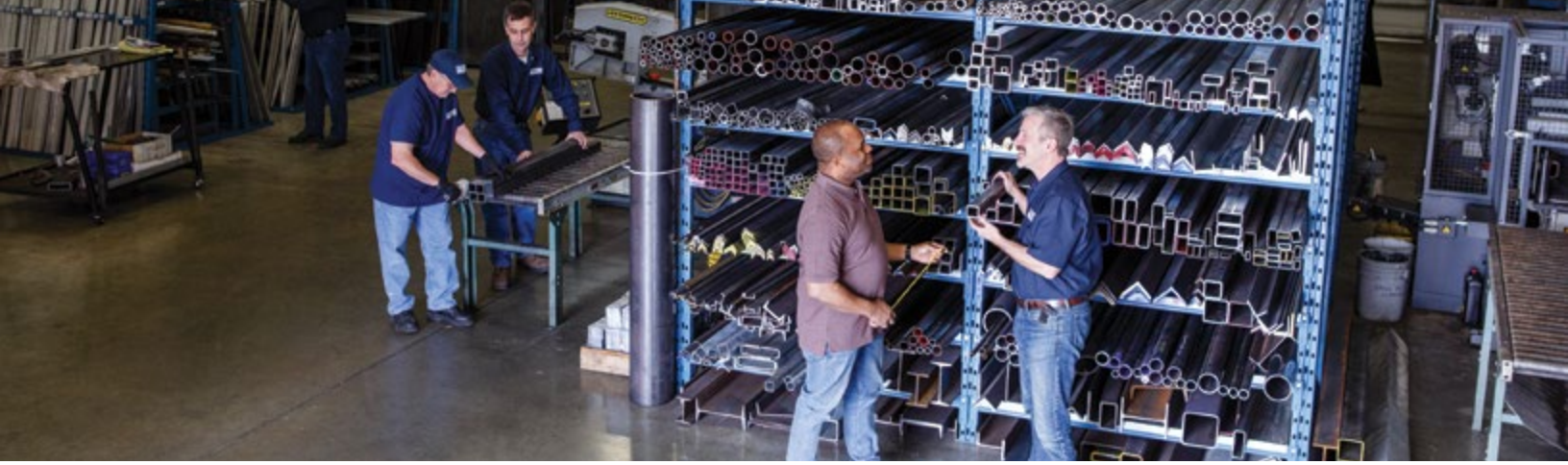

ABOUT US

Founded in 1985, **Metal Supermarkets** is the world's largest supplier of small quantity metals.

Our **100+** locations in Canada, the United States and United Kingdom are dedicated to providing **just in time delivery of any type of metal** custom cut, with no minimum quantities. Small and large manufacturers, machine shops, tool & die shops, hospitals, hotels, universities, schools, contractors, homeowners, artists, hobbyists and many others use our services on a daily basis. They appreciate the rapid service and our **buy only what you need policy.**

Our customers have come to realize that having **Metal Supermarkets** handle their small quantity metal requirements is so much more cost efficient than stockpiling inventory. There is no need to buy full lengths when you use our services. You simply purchase exactly the size and shape that you need.

Hard-to-find items are a specialty of **Metal Supermarkets.** With over 3,000 suppliers worldwide, we can usually find what our customers need and find it fast! We also bring value-added services to you – need holes punched, metal sheared and bent? These services can be done in-house or we will outsource them. **We are your one stop shop for your metal needs.**

We invite you to learn and experience what over 60,000 repeat customers worldwide already know; that **Metal Supermarkets** is the very best at servicing the small quantity metal buyer!

This **Metal Reference Guide** is designed to give you a catalog of metals that we stock or can source and supply to you. **If you don't see what you are looking for, call your nearest Metal Supermarkets location and we'll do our best to get it for you.** In addition, we have included technical information* that may be of assistance when you are determining what type of material is best suited for the job at hand.

Service is not an old-fashioned word at our stores. **We are dedicated to exceeding your service expectations each and every time.**

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* The information enclosed has been compiled from credible sources such as trade associations, metal producers and technical societies. That said, we make no representation or warrant that the information is accurate. Individual mill practices, manufacturing processes and technological changes may result in variances in the properties and characteristics of materials and should be considered and evaluated accordingly. Also, with technological and material evolution, material specifications may change. Our intention is to update such specifications; however, as updates may not be current, the data included should be used only as a guide. MSKS IP Inc. is the sole and exclusive owner of the compilation of content in this reference guide, and this content is protected by international copyrights laws, None of the material contained herein may be copied, reproduced, distributed, displayed, posted or transmitted in any form or by any means without the prior written permission of MSKS IP Inc. Warning: Products may contain one or more chemicals known to the State of California to cause cancer, birth defects or reproductive harm.

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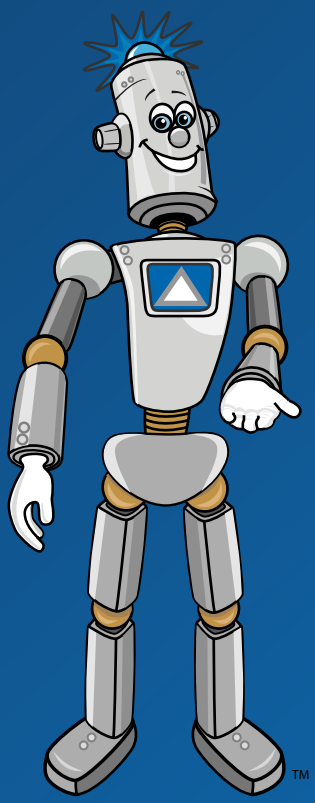

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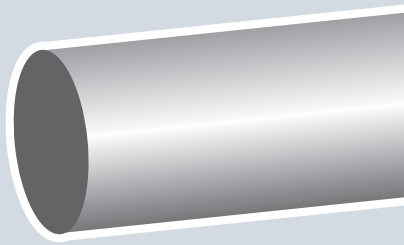

DATA AND SPECIFICATIONS

4140 CHROMIUM-MOLYBDENUM STEEL

Oil-hardening chromium-molybdenum steel has good strength and wear resistance, excellent toughness and ductility with the ability to resist stress and creep at prolonged high temperatures (up to 1000° F). Also available in leaded grades that have greatly improved machinability, but should not be used in applications over 400° F. Elevated temperatures cause lower ductility in leaded grades.

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

Analysis:		
C – 38/.43 Max.	Mn – .75/1.00	P – .035 Max.
S – .04 Max.	Si – .15/.35	Cr – .80/1.10
Mo – .15/.25		

Mechanical Properties	
	Annealed
Tensile Strength (psi)	140,000
Yield Point (psi)	90,000
Elongation (% in 2”)	20
Reduction of Area (%)	45
Brinell Hardness	285

Weldability: Difficult but can be welded by any of the common welding processes providing section is preheated and stress relieved after welding. Grade of welding rod used depends on welding conditions such as thickness of section, design, service requirements, etc. When welding leaded material, adequate ventilation should be provided to prevent accumulation of fumes. **Forging:** Excellent forge stock due to self-scaling characteristics. Forge at 2100° F - 2200° F.

4340 NICKEL-CHROMIUM-MOLYBDENUM STEEL

This steel can obtain much deeper hardenability than 4100 series steel. High strength in heavy sections is possible with maximum toughness and ductility. This material has a high fatigue/tensile ratio and maintains strength, ductility, and toughness at relatively high temperatures. Also has excellent non-distorting properties for an alloy steel.

Applications: Crank shafts, axle shafts, dies, subs, gear shafts, gears, mine drilling parts, oil well fishing tools and parts, etc.

Analysis:		
C – .38/.43	Mn – .60/.80	P – .035 Max.
S – .04 Max.	Si – .15/.35	Cr – .70–.90
Ni – 1.65/2.00	Mo – .20/.30	

Mechanical Properties	
	Annealed
Tensile Strength (psi)	110,000
Yield Point (psi)	66,000
Elongation (% in 2”)	23
Reduction of Area (%)	49
Brinell Hardness	197

Machinability: Rating in the annealed condition of approximately 57% of 1212. **Weldability:** Easily welded by all welding processes, and the resultant welds and joints are of extremely high quality. Grade of welding rod used depends on welding conditions such as thickness of section, design, service requirements, etc. **Surface Cutting Speed:** 95 ft/Min. **Forging:** Heat to 2200° - 2300° F. **Normalizing:** Heat to 1600° - 1700° F. Cool in air. Average Brinell Hardness: 197. **Annealing:** Heat to 1500° - 1600° F. Cool slowly in furnace. **Hardening:** Standard hardening range is between 1475° F - 1575° F. Quench in oil. A wide range of mechanical properties can be obtained by tempering between 400° F and 1200° F.

8620 CHROMIUM-NICKEL-MOLYBDENUM STEEL

Nickel imparts good toughness and ductility, chromium and molybdenum contribute increased hardness penetration and wear. They are readily carburized and the well-balanced alloy content permits hardening to produce a strong, tough core and high case hardness.

Applications: Because of the fine combination of properties that may be developed, as well as the ease with which it may be processed, this material is ideal for a wide variety of applications. Gears, pinions, oil pump piston rods and liners, spline shafts, piston pins, cams, jigs, plastic molds, oil tool slips, jaws, gauges,etc.

Analysis:		
C – .18/.23	Mn – .70/.90	P – .035 Max.
S – .04 Max.	Si –. 15/.35	
Ni – .40/.70	Mo –. 15/.25	

Mechanical Properties		
The following values are average values and are representative		
	As-Rolled	**Annealed**
Tensile Strength (psi)	97,000	78,000
Yield Point (psi)	57,000	56,000
Elongation (% in 2")	25	31
Reduction of Area (%)	58	62
Brinell Hardness	201	156

Machinability: 66%; **Surface Cutting Speed:** 127 ft/min. **Weldability:** Easily welded by any of the common welding procedures. Grade of welding rod used depends on welding conditions such as thickness of section, design, service requirements, etc. Preheating and stress relieving is recommended. When welding leaded material, adequate ventilation should be provided to prevent accumulation of fumes. Forging: Heat to 2150° - 2250° F. Normalizing: Heat to 1650° - 1750° F. Cool in air.

6150 CHROMIUM-VANADIUM STEEL

High carbon, chromium-vanadium, commercial quality alloy steel with higher strength and hardness than 4142. When heat treated, the material has excellent toughness, shock resistance, and water/abrasion resistance.

Applications: Gears, pinions, shafting, axles, machinery parts, springs, heavy duty pins, bolting, hand tools.

Analysis:		
C – .48/.53	Mn – .70/.90	P – .035 Max.
S – .04 Max.	Si – .15/35	Cr –.80/1.10
V – .15 Min.		

Mechanical Properties		
The following values are average values and are representative		
	As-Rolled	**Annealed**
Tensile Strength (psi)	130,000	96,000
Yield Point (psi)	75,000	59,000
Elongation (% in 2")	20.5	23
Reduction of Area (%)	56	48
Brinell Hardness	269	197

Machinability: Medium. **Weldability:** Difficult to weld, but possible. **Forging:** Start at 1750° - 2150° F, Do not forge below 1600° F. **Normalizing:** Heat to 1650° - 1750° F. Average Brinell: 179-217. **Annealing:** Heat to 1525° - 1575° F. **Surface Cutting Speed:** 110 ft/min.|

20FT. RANDOMS†

Size (inches)	Lbs/Ft.	4140 CF&HR ANN	4140 CF&HR HT	4340 HR ANN	4340 CF&HR HT
1/4	.167	×†			
5/16	.261	×†	×		
3/8	.376	×†	×		
7/16	.511	×†	×		
1/2	.668	×	×		
9/16	.845	×			
5/8	1.043	×	×		
11/16	1.262	×			
3/4	1.502	×	×		
13/16	1.763	×			
7/8	2.045	×	×		
15/16	2.347		×		
1	2.670	×	×	×	×
1-1/16	3.015	×	×		
1-1/8	3.380	×	×		
1-3/16	3.766		×	×	
1-1/4	4.172	×	×	×	×
1-5/16	4.600	×			
1-3/8	5.049	×	×		
1-7/16	5.518		×		
1-1/2	6.008	×	×	×	×
1-9/16	6.519	×			
1-5/8	7.051	×	×	×	
1-3/4	8.178	×	×	×	
1-7/8	9.388	×	×	×	
1-15/16	10.020		×		
2	10.680	×	×	×	
2-1/8	12.060	×	×	×	

Size (inches)	Lbs/Ft.	4140 CF&HR ANN	4140 CF&HR HT	4340 HR ANN	4340 CF&HR HT
2-1/4	13.520	×	×	×	×
2-3/8	15.060	×	×		
2-7/16	15.870		×		
2-1/2	16.690	×	×	×	×
2-5/8	18.400	×	×	×	
2-3/4	21.130	×	×	×	×
2-7/8	22.070	×	×	×	
3	25.050	×	×	×	×
3-1/8	26.080	×	×		
3-1/4	29.300	×	×	×	×
3-3/8	30.833		×		
3-7/16	31.399		×		
3-1/2	33.890	×	×	×	×
3-5/8	35.090	×	×		×
3-3/4	38.810	×	×	×	×
3-7/8	40.100	×			
3-15/16	41.400		×		
4	44.070	×	×	×	×
4-1/8	45.440	×	×		
4-1/4	48.230	×	×	×	×
4-1/2	55.590	×	×	×	×
4-5/8	57.120		×		
4-3/4	61.850	×	×	×	×
5	66.760	×	×	×	×
5-1/4	73.600	×	×	×	×
5-1/2	83.520	×	×	×	×
5-3/4	88.290	×	×	×	×
6	96.130	×	×	×	×
6-1/4	104.300	×	×	×	×
6-1/2	116.100	×	×	×	×
6-3/4	121.600	×	×		
7	134.300	×	×	×	×
7-1/4	140.400	×	×	×	×
7-1/2	150.200	×	×	×	×
7-3/4	160.400	×		×	
8	174.900	×	×	×	×
8-1/4	181.800	×	×		×
8-1/2	192.900	×	×	×	×
9	216.300	×	×	×	×
9-1/2	241.000	×	×	×	×
10	267.000	×	×	×	×
10-1/2	294.400	×		×	×
11	323.100	×		×	×
11-1/2	353.200	×			
12	384.500	×		×	

†(Smaller diameters may be cold drawn only) 12' randoms)

20FT. ROUNDERS† — FORGED AND ROUGH TURNED

Size (inches)	Lbs/Ft.	4140CF&HR ANN	4140CF&HR HT	4340 HR ANN	8620 HR
10	273.800		×		
10-1/4	281.000		×		
10-1/2	301.500	×		×	×
11	330.500	×	×	×	×
11-1/2	360.900		×		×
12	392.600	×	×	×	×
12-1/2	425.600		×		×
13	460.000	×	×	×	×
14	532.800	×	×	×	×
15	610.900	×			×
16	694.300	×			×
18	877.200	×			×
19	976.700	×			×
20	1081.000	×			×
22	1307.000				×

20FT. RANDOMS†

Size (inches)	Lbs/Ft.	8620 HR	8620 CF	6150 HR	8620 HR
1/4	0.167		×		
3/8	0.376		×		
7/16	0.511		×		
1/2	0.668	×	×	×	
9/16	0.845		×		
5/8	1.043	×	×		
11/16	1.262		×		
3/4	1.502	×	×	×	
13/16	1.763		×		
7/8	2.045	×	×		
15/16	2.347		×		
1	2.670	×	×	×	
1-1/16	3.015		×		
1-1/8	3.380	×	×	×	
1-3/16	3.766	×	×		
1-1/4	4.172	×	×		
1-5/16	4.600	×	×		
1-3/8	5.049	×	×		
1-1/2	6.008	×	×	×	
1-9/16	6.519		×		
1-5/8	7.051	×	×		
1-3/4	8.178	×	×	×	
1-7/8	9.388	×	×		
1-15/16	10.020		×		

†(Smaller diameters may be cold drawn only) 12'randoms

20FT. RANDOMS†

Size (inches)	Lbs/Ft.	8620 HR	8620 CF	6150 HR 1
2	10.680	×	×	×
2-1/8	12.060	×	×	
2-1/4	13.520	×	×	×
2-3/8	15.060	×	×	
2-1/2	16.690	×	×	×
2-5/8	18.400	×	×	
2-3/4	20.190	×	×	×
2-7/8	22.070	×	×	
3	24.030	×	×	×
3-1/8	26.080	×		
3-1/4	28.210	×	×	
3-3/8	30.420	×		
3-1/2	32.710	×	×	×
3-5/8	35.090	×		
3-3/4	37.550	×		×
3-7/8	40.100	×		
4	42.730	×	×	×
4-1/16	44.070	×		
4-1/4	48.230	×		×
4-3/8	51.110	×		
4-1/2	54.080	×	×	×
4-5/8	57.120	×		
4-3/4	60.250	×	×	×
5	66.760	×		×
5-1/8	70.140	×		
5-1/4	73.600	×		
5-1/2	80.780	×		×
5-3/4	88.290	×		×
6	96.130	×		×
6-1/4	104.300	×		
6-1/2	112.800	×		×
6-3/4	121.700	×		
7	130.900	×		×
7-1/4	140.400	×		
7-1/2	150.200	×		
7-3/4	160.400	×		

†(Smaller diameters may be cold drawn only) 12'randoms

20FT. RANDOMS†

Size (inches)	Lbs/Ft.	8620 HR	8620 CF	6150 HR
8	170.900	×		×
8-1/4	181.800	×		
8-1/2	192.900	×		
9	216.300	×		×
9-1/2	241.000	×		
10	267.000	×		×
10-1/2	294.400	×		
11	323.100	×		
12	384.500	×		

†(Smaller diameters may be cold drawn only) 12'randoms

NOTES

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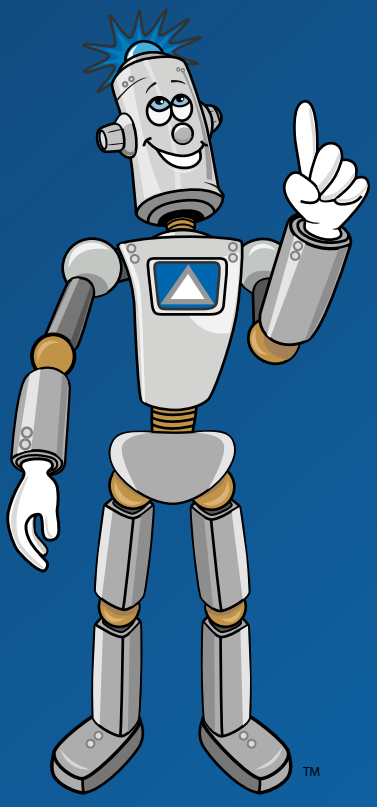
ALUMINUM



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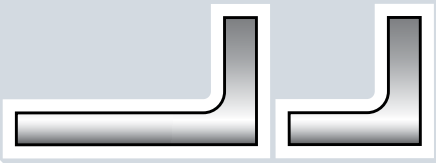
ALUMINUM ANGLES



DATA AND SPECIFICATIONS

6061 ALUMINUM ANGLES

(Typically Rounded Corners)

This is the most versatile of the heat treatable aluminum alloys. This alloy offers a wide range of mechanical properties and corrosion resistance. It is easily fabricated and has good formability.

Applications: Screw machine parts, structural components, truck bodies and frames. Alclad 6061 is used where appearance and better corrosion resistance with good strength are required.

Analysis:		
Cu – .15/.40	Si – .40/.80	Fe – .70 Max.
Mn – .15 Max.	Mg – .80/1.2	Zn – .25 Max.
Cr – .04/.35	Ti – .15 Max.	

Mechanical Properties:	
(T6-T651 bare)	
Tensile Strength (psi)	45,000
Yield Point (psi)	40,000
Elongation (in 2" for 1/2" dia.)	17
Brinell Hardness	95

Machinability: Rated between 70% and 80% of 2011 in the T4 and T6 conditions, and 50% in the T4 and T6 conditions. **Weldability:** All methods including furnace brazing. **Forming:** In T4 conditions, fairly severe forming operations may be accomplished. **Heat Treating:** Treatable.

6063 – T52 ALUMINUM ANGLES

(Typically Square Corners)

This grade is commonly referred to as the architectural alloy. Developed as an extrusion alloy with relatively high tensile properties, excellent finish characteristics and high corrosion resistance.

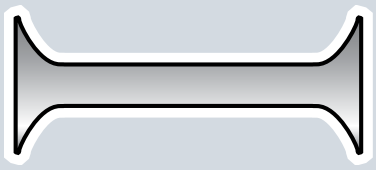
Applications: Moldings and extruded trim for stores and homes both interior and exterior. Used extensively for anodized parts.

Analysis:		
Cu – .10 Max.	Si – .20/.60	Fe – .35 Max.
Mn – .10 Max.	Mg – .45/.90	Zn – .10 Max.
Cr – .10 Max.	Ti – .10 Max.	

Mechanical Properties:	
(T52)	
Tensile Strength (psi)	27,000
Yield Point (psi)	21,000
Elongation (in 2" for 1/2" dia.)	12
Brinell Hardness	60

Machinability: For automatic screw machine operations rated between 75% and 85% of 2011 in the T5 condition. It is 60% of 2011 in the O condition, and 50% in the T42 condition.

ALUMINUM BEAM



DATA AND SPECIFICATIONS

6061 ALUMINUM BEAMS

This is the most versatile of the heat treatable aluminum alloys. This alloy offers a wide range of mechanical properties and corrosion resistance. It is easily fabricated and has good formability.

Applications: Screw machine parts, structural components, truck bodies and frames. Alclad 6061 is used where appearance and better corrosion resistance with good strength are required.

Analysis:		
Cu – .15/.40	Si – .40/.80	Fe – .70 Max.
Mn – .15 Max.	Mg – .80/1.2	Zn – .25 Max.
Cr – .04/.35	Ti – .15 Max.	

Mechanical Properties:	
(T6-T651 bare)	
Tensile Strength (psi)	45,000
Yield Point (psi)	40,000
Elongation (in 2" for 1/2" dia.)	17
Brinell Hardness	95

Machinability: Rated between 70% and 80% of 2011 in the T4 and T6 conditions, and 50% in the T4 and T6 conditions. **Weldability:** All methods including furnace brazing. **Forming:** In T4 condition, fairly severe forming operations may be accomplished. **Heat Treating:** Treatable.

ALUMINUM CHANNELS

DATA AND SPECIFICATIONS

6061 ALUMINUM CHANNELS

This is the most versatile of the heat treatable aluminum alloys. This alloy offers a wide range of mechanical properties and corrosion resistance. It is easily fabricated and has good formability.

Applications: Screw machine parts, structural components, truck bodies and frames. Alclad 6061 is used where appearance and better corrosion resistance with good strength are required.

Analysis:		
Cu – .15/.40	Si – .40/.80	Fe – .70 Max.
Mn – .15 Max.	Mg – .80/1.2	Zn – .25 Max.
Cr – .04/.35	Ti – .15 Max.	

Mechanical Properties:	
(T6-T651 bare)	
Tensile Strength (psi)	45,000
Yield Point (psi)	40,000
Elongation (in 2" for 1⁄2" dia.)	17
Brinell Hardness	95

Machinability: Rated between 70% and 80% of 2011 in the T4 and T6 conditions, and 50% in the T4 and T6 conditions. **Weldability:** All methods including furnace brazing. **Forming:** In T4 condition, fairly severe forming operations may be accomplished. **Heat Treating:** Treatable.

6063 – T52 ALUMINUM CHANNELS

This grade is commonly referred to as the architectural alloy. Developed as an extrusion alloy with relatively high tensile properties, excellent finish characteristics and high corrosion resistance.

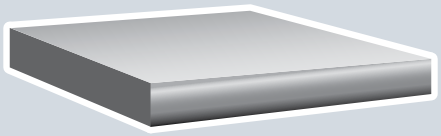
Applications: Moldings and extruded trim for stores and homes both interior and exterior. Used extensively for anodized parts.

Analysis:		
Cu – .10 Max.	Si – .20/.60	Fe – .35 Max.
Mn – .10 Max.	Mg – .45/.90	Zn – .10 Max.
Cr – .10 Max.	Ti – .10 Max.	

Mechanical Properties:	
(T52)	
Tensile Strength (psi)	27,000
Yield Point (psi)	21,000
Elongation (in 2"for l/2" dia.)	12
Brinell Hardness	60

Machinability: For automatic screw machine operations rated between 75% and 85% of 2011 in theT5 condition. It is 60% of 2011 in the O condition, and 50% in theT42 condition.

ALUMINUM TREAD PLATE



DATA AND SPECIFICATIONS

2024-T351 ALUMINUM PLATE

This is one of the best known of high strength aluminum alloys. With excellent strength and fatigue resistance it is used to advantage on structures and parts where a good strength-to-weight ratio is desired. It can be subsequently hardened by artificial aging.

Applications: Aircraft structural components and parts for the transportation industry.

Analysis:		
Cu – 3.80/4.90	Si – .50 Max.	Fe – .50 Max.
Mn – .30/.90 Max.	Mg – 1.20/1.80 Max	Zn – .25
Cr – .10 Max.	Ti – .15 Max.	Other – .15 Max.

Mechanical Properties:	
(typical):	
Tensile Strength (psi)	68,000
Yield Point (psi)	47,000
Elongation (% in 2”)	20
Brinell Hardness	120

Machinability: Good. **Weldability:** May be spot, seam, or flash welded. Arc or Gas is not recommended. **Annealing:** Can be softened to ”O” temper by thermal treatment. **Forming:** It is recommended that any forming be performed after being fully annealed. **Corrosion Resistance:** Relatively poor but to improve corrosion resistance parts should be anodized or clad.

6061 – T651 WROUGHT ALUMINUM PLATE

This is the most versatile of the heat treatable aluminum alloys. It offers good mechanical properties and excellent corrosion resistance and can be fabricated by many of the commonly used techniques.

Applications: Wide variety of applications from tooling to truck frames and bodies and various structural components.

Analysis:		
Cu – .15/.40 Max.	Si – .40/.80 Max.	Fe – .70 Max.
Mil – .15 Max.	Mg – .80/1.20 Max.	Zn – .25 Max.
Cr – .04/.35	Ti – .15 Max.	Other – .15 Max.

Mechanical Properties:	
(typical)	
Tensile Strength (psi)	45,000
Yield Point (psi)	40,000
Elongation (% in 2”)	12
Brinell Hardness	95

Machinability: Fair. **Weldability:** Excellent. **Annealing:** Can be softened to “O” temper by thermal treatment. **Hardening:** Can be hardened by artificial aging thermal treatment processes. **Forming:** Good by most forming methods.

7075-T651 WROUGHT ALUMINUM PLATE

This is one of the highest strength aluminum alloys available. Its strength-to-weight ratio is excellent. It is ideally suited for highly stressed aircraft parts.

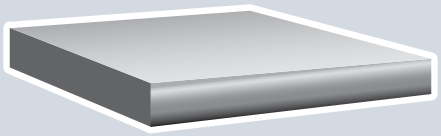
Applications: Used mostly in aircraft and transportation industries where strength is critical. Has been used as mold material in the plastics industry.

Analysis:		
Cu – 1.20/2.20 Max.	Si – .40 Max.	Fe – .50 Max.
Mn – .30 Max.	Mg – 2.10/2.90 Max	Zn – 5.10/6.10 Max.
Cr – .18/.28	Ti – .20 Max.	Other – .15 Max.

Mechanical Properties:	
(typical):	
Tensile Strength (psi)	83,000
Yield Point (psi)	73,000
Elongation (% in 2”)	11
Brinell Hardness	150

Machinability: Good. **Weldability:** Spot and seam welding can be used. Arc and gas not recommended. **Annealing:** Can be softened to “O” temper by thermal treatment. **Hardening:** Can be hardened by artificial aging thermal treatment processes. **Forming:** May be formed in the annealed condition and subsequently hardened by artificial aging. **Corrosion Resistance:** Average but may be improved by cladding parts.

ALUMINUM TREAD PLATE



DATA AND SPECIFICATIONS

6061–T6 ALUMINUM TREAD PLATE

Used in aluminum structural applications where strength and skid resistance is critical. Produced at the mill with a raised diamond pattern on the surface for skid resistance.

Applications: Running boards, steps, floors, walkways, platforms, cover plates, trench covers, truck runways.

Analysis:		
Cu – .15/.40 Max.	Si – .40/.80 Max.	Fe – .70 Max.
Mn – .15 Max.	Mg – .80/1.20 Max	Zn – .25 Max.
Cr – .04/35	Ti – .15 Max.	Other – .15 Max.

Mechanical Properties:	
(typical)	
Tensile Strength (psi)	45,000
Yield Point (psi)	40,000
Elongation (% in 2")	12
Brinell Hardness	95

Machinability: Fair. **Weldability:** Excellent. **Forming:** Good by most forming methods.

3003 BRIGHT TREAD ALUMINUM PLATE

This is the highest strength alloy of the more common non-heat-treatable grades. Fatigue strength is higher than most aluminum alloys. Particularly good resistance to marine atmosphere and salt water corrosion. Excellent workability. It may be drawn or formed into intricate shapes and its slightly greater strength in the annealed condition minimizes tearing that occurs in 1100 or 3003. Excellent finishing characteristics with bright, clear anodic coatings.

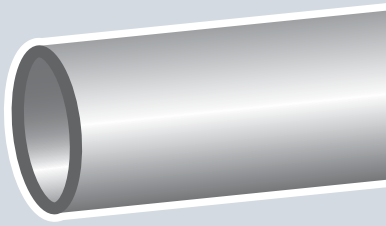
Applications: Wide variety from aircraft components to home appliances, marine and transportation industry parts, heavy duty cooking utensils, and equipment for bulk processing food.

Analysis:		
Cu – .10 Max.	Si – .25 Max.	Fe – .40 Max.
Mn – .10 Max.	Mg – 2.20/2.80 Max.	Zn – .10
Cr – .15/.35		

Mechanical Properties:	
(typical):	
Tensile Strength (psi)	33,000
Yield Point (psi)	28,000
Elongation (in 2"for .064"sheet)	12

Weldability: Yes. **Forming:** Yes.

ALUMINUM ROD & BAR



DATA AND SPECIFICATIONS

5086 – H34 MILL FINISH TREAD PLATE

Sister alloy to 5083 with comparable characteristics (excellent corrosion resistance, weldability, and high strength) but slightly less strength.

Applications: Primarily for marine applications.

Weldability: Weldable with high strength. **Corrosion Resistance:** High. **Forming:** Yes.

2011 – T3 ALUMINUM (ROD & BAR) (FREE MACHINING SCREW STOCK)

The most free machining of the common aluminum alloys with excellent mechanical properties. It is widely used for automatic screw machine products in parts requiring extensive machining. It may be machined at high speeds with relatively heavy feeds. Its corrosion resistance is good with excellent hardness and strength.

Applications: High speed automatic screw machine parts.

Analysis:		
34" and under:		
Cu – 5.0/6.0	Si – 0.4 Max.	Fe – 0.7 Max.
Zn – 0.3 Max.	Bi – 0.2/0.6	Pb – 0.2/0.6

Mechanical Properties:	
Tensile Strength (psi)	55,000
Yield Point (psi)	43,000
Elongation (in 2" 1/2" Round)	15
Brinell Hardness	95

Machinability: 100%. **Weldability:** Resistance. **Surface Cutting Speed:** 120 ft/Min.

2024 – T4/T351 ALUMINUM (ROD & BAR)

One of the best known of high strength aluminum alloys. With its high strength and excellent fatigue resistance it is used to advantage on structures and parts where a good strength-to-weight ratio is desired. 2024 in the annealed condition is easily formed and may be subsequently heat treated. Since corrosion resistance is relatively low, 2024 is commonly used with an anodized finish or in clad form (Alclad) with a thin surface layer of high purity aluminum.

Applications: Aircraft fittings, structural components, hardware, truck wheels and parts for the transportation industry.

Analysis:		
Cu – 3.80/4.90	Si – .50 Max.	Fe – .50 Max.
Mn – .30/.90	Mg – 1.20/1.80	Zn – .25Max.\
Cr – .10 Max.	Ti – .15 Max.	

Mechanical Properties:	
(T4-T351 bare)	
Tensile Strength (psi)	68,000
Yield Point (psi)	47,000
Elongation (in 2" 1/2" Round)	19
Brinell Hardness	120

Machinability: 90% forT4 condition. Machines to high finish. **Weldability:** Spot, seam or flash welded. Arc and gas welding not recommended. **Forming:** Easily formed in the annealed condition. **Heat Treating:** Treatable.

6061 – T6/T651 ALUMINUM (ROD & BAR)

This is the most versatile of the heat treatable aluminum alloys. This alloy offers a wide range of mechanical properties and corrosion resistance. It is easily fabricated and has good formability.

Applications: Screw machine parts, structural components, truck bodies and frames. Alclad 6061 is used where appearance and better corrosion resistance with good strength are required.

Analysis:		
Cu – .15/.40	Si – .40/.80	Fe – .70 Max.
Mn – .15 Max.	Mg – .80/1.2	Zn – .25 Max.
Cr – .04/.35	Ti – .15 Max.	

Mechanical Properties:	
(T6-T651 bare)	
Tensile Strength (psi)	45,000
Yield Point (psi)	40,000
Elongation (in 2" 1/2" Round)	17
Brinell Hardness	95

Machinability: Rated between 70% and 80% of 2011 in the T4 and T6 conditions, and 50% in the) condition. **Weldability:** All methods including furnace brazing. **Forming:** In T4 condition, fairly severe forming operations may be accomplished. **Heat Treating:** Treatable.

7075 – T651 ALUMINUM (ROD & BAR)

This is one of the highest strength aluminum alloys available. This material has high strength-to-weight ratio and is used for highly stressed parts.

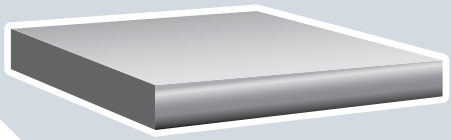
Applications: Used where highest strength is needed.

Analysis:		
Cu – 1.20/2.00	Si – .40 Max.	Fe – .50 Max.
Mn – .30 Max.	Mg – 2.10/2.90	Zn – 5.10/6.10
Cr – .18/.28	Ti – .20 Max.	

Mechanical Properties:	
(T6-T651 bare)	
Tensile Strength (psi)	83,000
Yield Point (psi)	73,000
Elongation (in 2" 1/2" Round)	11
Brinell Hardness	150

Machinability: For automatic screw machine operations rated between 75% and 85% of 2011 in the T6 condition, and 65% in the O condition. **Weldability:** Spot or flash welded, arc and gas welding not recommended. **Forming:** Easily formed in the annealed condition. **Heat Treating:** Treatable.

ALUMINUM SHEET



DATA AND SPECIFICATIONS

1100-H14 ALUMINUM SHEET

This grade is commercially pure aluminum. It is soft and ductile with excellent workability. Ideal for applications involving intricate forming because it work-hardens more slowly than other alloys. It has the highest thermal conductivity of any aluminum alloy and its electrical conductivity is second only to the electrical conductor grade.

Applications: Kitchenware, giftware, decorative trim, intricate formed parts, chemical and food processing industries.

Analysis:		
Cu – .05/.02	Si + Fe – .95 Max.	Mn – .05 Max.
Zn – .10 Max.		

Mechanical Properties:	
(typical)	
Tensile Strength (psi)	18,000
Yield Point (psi)	17,000
Elongation (in 2" for .064" sheet)	9

Weldability: Yes. **Forming:** Yes. **Heat Treatable:** No.
Corrosion Resistance: Excellent.

3003-H14 ALUMINUM SHEET

This is the most widely used of all aluminum alloys. It is essentially commercially pure aluminum with the addition of Manganese which increases strength some 20% over 1100. With excellent corrosion resistance and workability it can be deep drawn or spun, welded or brazed.

Applications: Cooking utensils, kitchen equipment, decorative trim, awnings, siding, storage tanks, chemical equipment.

Analysis:		
Cu – .20 Max.	Si – .60 Max.	Fe–.70
Zn – .10		

Mechanical Properties:	
(typical):	
Tensile Strength (psi)	22,000
Yield Point (psi)	21,000
Elongation (in 2"for .064"sheet)	8

Weldability: Yes. **Forming:** Yes. **Heat Treatable:** No.

5052-H32 ALUMINUM SHEET

This is the highest strength alloy of the more common non-heat-treatable grades. Fatigue strength is higher than most aluminum alloys. Particularly good resistance to marine atmosphere and salt water corrosion. Excellent workability. It may be drawn or formed into intricate shapes and its slightly greater strength in the annealed condition minimizes tearing that occurs in 1100 or 3003. Excellent finishing characteristics with bright, clear anodic coatings.

Applications: Wide variety from aircraft components to home appliances, marine and transportation industry parts, heavy duty cooking utensils, and equipment for bulk processing food.

Analysis:		
Cu – .10 Max.	Si – .25 Max.	Fe – .40 Max.
Mn – .10 Max.	Mg – 2.20/2.80 Max.	Zn – .10
Cr – .15/.35		

Mechanical Properties:	
(typical)	
Tensile Strength (psi)	33,000
Yield Point (psi)	28,000
Elongation (in 2"for .064"sheet)	12

Weldability: Yes. **Forming:** Yes.

6061 ALUMINUM SHEET

This is the most versatile of the heat treatable aluminum alloys. It has most of the good qualities of aluminum and offers a wide range of mechanical properties and corrosion resistance. It can be fabricated by many of the commonly used techniques. In the annealed condition it has good formability. In the T4 condition, fairly severe forming operations may be accomplished. The T6 properties may be obtained by artificial aging.

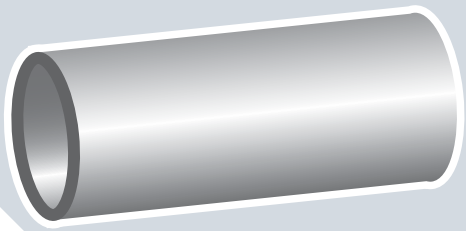
Applications: Used for a wide variety of products and applications from truck bodies and frames to screw machine parts and structural components. Alclad 6061 is used where appearance and better corrosion resistance with good strength are required.

Analysis:		
Cu – .15/.40	Si – .40/.80	Fe – .70 Max.
Mn – .15 Max.	Mg – .80/1.2	Zn – .25 Max.
Cr – .04/.35	Ti – .15 Max.	

Mechanical Properties:				
	T4 Bare	**T6 Bare**	**Alclad T4**	**Alclad T6**
Tensile Strength (psi)	35,000	45,000	33,000	42,000
Yield Point (psi)	21,000	40,000	19,000	37,000

Machinability: Rated between 70% and 80% of 2011 in the T4 and T6 conditions, and 50% in the T4 andT6 conditions. **Weldability:** All methods including furnace brazing. **Heat Treating:** Treatable.

ALUMINUM TUBES



DATA AND SPECIFICATIONS

6063 DRAWN AND EXTRUDED ALUMINUM TUBES

This grade is similar to 6061 except that it has slightly lesser strength. Commonly referred to as an architectural alloy, it is the best suited alloy for anodizing applications including hard coat anodizing for air cylinder tube.

Applications: Construction tube, lawn furniture, luggage racks, air cylinders.

Analysis:		
Cu – .10 Max.	Si – .20/.60	Fe – .35 Max.
Mn – .10 Max.	Mg – .45/.90	Zn – .10 Max.
Cr – .10 Max.	Ti – .10 Max.	

Mechanical Properties:	
(typical)	
Tensile Strength (psi)	35,000
Yield Point (psi)	31,000
Elongation (% in 2”)	12

Machinability: Fair. **Weldability:** Excellent.

“When our assembly line went down, we needed a piece of cold rolled steel cut to size. Within minutes, Metal Supermarkets delivered it to our back door.”

6061 – T6 EXTRUDED ALUMINUM ANGLES EQUAL LEG

Size (inches)					Lbs/Ft.	Size (inches)					Lbs/Ft.
3/4	×	3/4	×	1/8	.201	3	×	3	×	3/16	1.247
1	×	1	×	1/8	.275	3	×	3	×	1/4	1.684
1	×	1	×	3/16	.400	3	×	3	×	5/16	2.082
1	×	1	×	1/4	.514	3	×	3	×	3/8	2.474
1-1/4	×	1-1/4	×	1/8	.343	3	×	3	×	1/2	3.227
1-1/4	×	1-1/4	×	3/16	.510	3-1/2	×	3-1/2	×	1/4	1.989
1-1/4	×	1-1/4	×	1/4	.656	3-1/2	×	3-1/2	×	3/8	2.926
1-1/2	×	1-1/2	×	1/8	.423	3-1/2	×	3-1/2	×	1/2	3.826
1-1/2	×	1-1/2	×	3/16	.619	4	×	4	×	1/4	2.283
1-1/2	×	1-1/2	×	1/4	.809	4	×	4	×	3/8	3.366
1-3/4	×	1-3/4	×	1/8	.497	4	×	4	×	1/2	4.414
1-3/4	×	1-3/4	×	3/16	.731	5	×	5	×	3/8	4.237
1-3/4	×	1-3/4	×	1/4	.956	5	×	5	×	1/2	5.578
2	×	2	×	1/8	.577	6	×	6	×	3/8	5.119
2	×	2	×	3/16	.850	6	×	6	×	1/2	6.754
2	×	2	×	1/4	1.110	6	×	6	×	5/8	8.353
2	×	2	×	5/16	1.364	6	×	6	×	3/4	9.915
2	×	2	×	3/8	1.606	8	×	8	×	1/2	9.141
2-1/2	×	2-1/2	×	3/16	1.070	8	×	8	×	5/8	11.328
2-1/2	×	2-1/2	×	1/4	1.404	8	×	8	×	3/4	13.478
2-1/2	×	2-1/2	×	5/16	1.729	8	×	8	×	1	17.667
2-1/2	×	2-1/2	×	3/8	2.047						

6061 – T6 EXTRUDED ALUMINUM ANGLES UNEQUAL LEG

Size (inches)					Lbs/Ft.	Size (inches)					Lbs/Ft.
1	×	3/4	×	1/8	.238	3	×	2	×	3/8	2.046
1-1/2	×	1	×	1/4	.662	3	×	2	×	1/2	2.653
1-1/2	×	1-1/4	×	3/16	.338	3	×	2-1/2	×	1/4	1.537
1-1/2	×	1-1/4	×	1/4	.741	3	×	2-1/2	×	3/8	2.258
2	×	1	×	3/16	.613	3-1/2	×	2-1/2	×	3/16	1.285
2	×	1-1/2	×	1/8	.494	3-1/2	×	2-1/2	×	1/4	1.684
2	×	1-1/2	×	3/16	.729	3-1/2	×	2-1/2	×	3/8	2.474
2	×	1-1/2	×	1/4	.953	4	×	3	×	1/4	1.988
2	×	1-1/2	×	3/8	1.379	4	×	3	×	3/8	2.926
2-1/2	×	1-1/4	×	1/8	.536	5	×	3	×	3/8	3.349
2-1/2	×	1-1/2	×	3/16	.850	5	×	3	×	1/2	4.396
2-1/2	×	1-1/2	×	1/4	1.105	6	×	3	×	3/8	3.768
2-1/2	×	2	×	3/16	.964	6	×	4	×	3/8	4.237
2-1/2	×	2	×	1/4	1.258	6	×	4	×	1/2	5.578
3	×	2	×	3/16	1.068	8	×	6	×	5/8	9.844
3	×	2	×	1/4	1.399	8	×	6	×	3/4	11.679

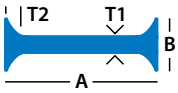
6063 – T52 ALUMINUM ANGLES EQUAL LEG

Size (inches)					Lbs/Ft.	Size (inches)					Lbs/Ft.
1/2	×	1/2	×	1/16	.069	1-1/2	×	1-1/2	×	1/8	.422
1/2	×	1/2	×	1/8	.128	1-1/2	×	1-1/2	×	3/16	.622
5/8	×	5/8	×	1/8	.166	1-1/2	×	1-1/2	×	1/4	.808
3/4	×	3/4	×	1/16	.105	2	×	2	×	1/8	.569
3/4	×	3/4	×	1/8	.202	2	×	2	×	3/16	.843
1	×	1	×	1/16	.141	2	×	2	×	1/4	1.103
1	×	1	×	1/8	.275	2-1/2	×	2-1/2	×	1/8	.724
1	×	1	×	3/16	.401	3	×	3	×	3/16	1.275
1-1/4	×	1-1/4	×	1/8	.349	3	×	3	×	1/4	1.684
1-1/4	×	1-1/4	×	3/16	.511						

6063 – T52 ALUMINUM ANGLES UNEQUAL LEG

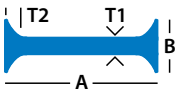
Size (inches)					Lbs/Ft.	Size (inches)					Lbs/Ft.
1	×	1/2	×	1/8	.202	3	×	1	×	1/8	.569
1	×	3/4	×	1/8	.239	3	×	2	×	1/8	.716
1-1/4	×	1/2	×	1/8	.239	3	×	2	×	1/4	1.397
1-1/2	×	3/4	×	1/8	.349	3	×	2	×	3/8	2.039
1-1/2	×	1	×	1/8	.422	4	×	2	×	1/8	.863
2	×	1	×	1/8	.496	4	×	2	×	1/4	1.691
2	×	1-1/2	×	1/8	.496	4	×	3	×	1/8	1.010
2-1/2	×	1	×	1/8	.569	5	×	3	×	1/8	1.157
2-1/2	×	1-1/2	×	1/8	.643	5	×	4	×	1/8	1.304

I 6061 – T6 EXTRUDED I-BEAM AMERICAN STANDARD



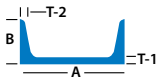
A	B	T1	T2	Lbs/Ft.
3.000	2.330	.170	.170	1.964
3.000	2.509	.349	.170	2.599
4.000	2.600	.190	.190	2.646
4.000	2.796	.326	.190	3.281
5.000	3.000	.210	.210	3.434
5.000	3.137	.347	.210	4.234
5.000	3.284	.494	.210	5.104
6.000	3.330	.230	.230	4.304
6.000	3.443	.343	.230	5.104
6.000	3.565	.465	.230	5.962
7.000	3.755	.345	.250	6.056
8.000	4.000	.270	.270	6.350
8.000	4.262	.532	.270	8.808
9.000	4.330	.290	.290	7.503
10.000	4.660	.310	.310	8.761
10.000	4.797	.447	.310	10.372
12.000	5.000	.350	.350	10.996
12.000	5.078	.428	.350	12.089
12.000	5.250	.460	.460	14.077
12.000	5.355	.565	.460	15.558
12.000	5.477	.687	.460	17.287

I 6061 – T6 EXTRUDED I-BEAM AMERICAN ASSOCIATION



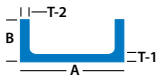
A	B	T1	T2	Lbs/Ft.
3.000	2.500	.130	.200	1.637
3.000	2.500	.150	.260	2.030
4.000	3.000	.150	.230	2.311
4.000	3.000	.170	.290	2.793
5.000	3.500	.190	.320	3.700
6.000	4.000	.190	.290	4.030
6.000	4.000	.210	.350	4.692
7.000	4.500	.230	.380	5.799
8.000	5.000	.230	.350	6.181
8.000	5.000	.250	.410	7.023
9.000	5.500	.270	.440	8.361
10.000	6.000	.250	.410	8.647
10.000	6.000	.290	.500	10.286
12.000	7.000	.290	.470	11.671
12.000	7.000	.310	.620	14.292

6061 – T6 EXTRUDED CHANNELS AMERICAN STANDARD



A	B	T1	T2	Lbs/Ft.
3.00	1.410	.170	.170	1.417
3.00	1.498	.258	.170	1.729
3.00	1.596	.356	.170	2.074
4.00	1.580	.180	.180	1.846
4.00	1.647	.247	.180	2.161
4.00	1.720	.320	.180	2.504
5.00	1.750	.190	.190	2.316
5.00	1.885	.325	.190	3.108
6.00	1.920	.200	.200	2.826
6.00	1.945	.225	.200	3.002
6.00	2.034	.314	.200	3.631
6.00	2.157	.437	.200	4.498
7.00	2.110	.230	.210	3.541
8.00	2.290	.250	.220	4.252
8.00	2.257	.488	.220	6.484
9.00	2.648	.448	.230	6.911
10.00	2.600	.240	.240	5.278
10.00	2.886	.526	.240	8.641
12.00	2.960	.300	.280	7.411
12.00	3.047	.387	.280	8.639
12.00	3.170	.510	.280	10.374

6061 – T6 EXTRUDED CHANNELS ALUMINUM ASSOCIATION



A	B	T1	T2	Lbs/Ft.
2.00	1.000	.130	.130	.557
2.00	1.250	.170	.260	1.071
3.00	1.500	.130	.200	1.135
3.00	1.750	.170	.260	1.597
4.00	2.000	.150	.230	1.738
4.00	2.250	.190	.290	2.331
5.00	2.250	.150	.260	2.212
6.00	2.500	.170	.290	2.834
6.00	3.250	.210	.350	4.030
8.00	3.000	.190	.350	4.147
9.00	3.250	.230	.350	4.983
9.00	4.000	.290	.440	6.970
10.00	3.500	.250	.410	6.136
10.00	4.250	.310	.500	8.360
12.00	4.000	.290	.470	8.274
12.00	5.000	.350	.620	11.822

6063 – T52 EXTRUDED ALUMINUM CHANNELS (Typically Sharp Corners) QQA 200/9 and ASTM B221

Size (inches)					Lbs/Ft.	Size (inches)					Lbs/Ft.
A		B		C		A		B		C	
1/2	×	3/8	×	1/8	.147	1-3/4	×	3/4	×	1/8	.441
1/2	×	1/2	×	3/32	.145	1-3/4	×	1	×	1/8	.516
1/2	×	3/4	×	1/8	.258	2	×	1/2	×	1/8	.405
5/8	×	5/8	×	1/8	.239	2	×	1	×	1/8	.562
3/4	×	3/8	×	1/8	.183	2	×	2	×	1/8	.846
3/4	×	3/4	×	1/8	.294	2	×	2	×	1/8	1.634
1	×	1/2	×	1/8	.258	2-1/4	×	7/8	×	1/8	.552
1	×	1	×	1/8	.405	2-1/2	×	1-1/2	×	1/8	.771
1-1/8	×	1/2	×	1/8	.294	3	×	1/2	×	1/8	.552
1-1/4	×	1-1/4	×	1/8	.516	3	×	1	×	1/8	.699
1-1/2	×	1/2	×	1/8	.330	3	×	1-1/2	×	3/16	1.243
1-1/2	×	1	×	1/8	.447	5	×	2	×	3/16	1.906

2011 – T3 ALUMINUM HEXAGONS

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
3/16	.037	13/16	.671
15/64	.058	7/8	.810
1/4	.065	15/16	.893
5/16	.103	1	1.057
3/8	.148	1-1/8	1.338
25/64	.162	1-3/16	1.490
7/16	.202	1-1/4	1.651
1/2	.264	1-3/8	1.998
9/16	.334	1-1/2	2.378
5/8	.413	1-3/4	3.116
11/16	.481	2	4.232
3/4	.595		

2024 – T351 ALUMINUM HEXAGONS

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
5/8	.403	1-1/4	1.619
11/16	.490	1-3/8	1.960
3/4	.583	1-1/2	2.332
13/16	.685	1-5/8	2.740
7/8	.794	1-3/4	3.178
15/16	.910	1-7/8	3.648
1	1.037	2	4.151
1-1/8	1.312	2-1/2	6.486

6061 – T6 ALUMINUM HEXAGONS

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
1/4	.063	1-1/8	1.289
3/8	.143	1-1/4	1.591
1/2	.254	1-3/8	1.925
5/8	.397	1-1/2	2.291
3/4	.572	1-3/4	3.119
1	1.018	2	4.074

6061 – T6 and 6063-T6 SEAMLESS PIPE EXTRUDED

Nom.	Sched.	O.D./In.	Wall/In.	I.D./In.	Wt./Ft	Alloy 6061	ALLOY 6063
1/8"	40	.405	.068	.269	.085	×	
1/4"	40	.540	.088	.364	.147	×	
3/8"	40	.675	.091	.493	.196	×	
1/2"	40	.840	.109	.622	.294	×	
1/2"	80	.840	.147	.543	.376	×	
3/4"	40	1.050	.113	.824	.391	×	
3/4"	80	1.050	.154	.742	.510	×	
1"	40	1.315	.133	1.049	.581	×	×
1"	80	1.315	.179	.957	.751	×	
1-1/4"	10	1.660	.109	1.442	.625		×
1-1/4"	40	1.660	.140	1.380	.786	×	×
1-1/4"	80	1.660	.191	1.278	1.037	×	
1-1/2"	10	1.900	.109	1.682	.721		×
1-1/2"	40	1.900	.145	1.610	.940	×	×
1-1/2"	80	1.900	.200	1.500	1.256	×	
2"	5	2.375	.065	2.245	.555		×
2"	10	2.375	.109	2.157	.913		×
2"	40	2.375	.154	2.067	1.264	×	×
2"	80	2.375	.218	1.939	1.737	×	×
2-1/2"	10	2.875	.120	2.635	1.221		×
2-1/2"	40	2.875	.203	2.469	2.004	×	×
2-1/2"	80	2.875	.276	2.323	2.650	×	
3"	5	3.500	.083	3.334	1.047		×
3"	10	3.500	.120	3.260	1.498		×
3"	40	3.500	.216	3.068	2.621	×	×
3"	80	3.500	.300	2.900	3.547	×	
3-1/2"	40	4.000	.226	3.548	3.151	×	
3-1/2"	80	4.000	.318	3.364	4.326	×	
4"	5	4.500	.083	4.334	1.354		×
4"	10	4.500	.120	4.260	1.942	×	×
4"	40	4.500	.237	4.026	3.733	×	×
4"	80	4.500	.337	3.826	5.183	×	
5"	10	5.563	.134	5.295	2.688		×
5"	40	5.563	.258	5.047	5.057	×	×
5"	80	5.563	.375	4.813	7.188	×	
6"	10	6.625	.134	6.357	3.213		×
6"	40	6.625	.280	6.065	6.564	×	×
6"	80	6.625	.432	5.761	9.884	×	
8"	10	8.625	.148	8.329	4.635		×
8"	40	8.625	.322	7.981	9.878	×	×
8"	80	8.625	.500	7.625	15.010	×	
10"	40	10.750	.365	10.020	14.004	×	×
12"	STD	12.750	.375	12.000	17.146	×	
12"	80	12.750	.688	11.375	30.620	×	

2024 – T351 ALUMINUM PLATE MILL FINISH – HEAT TREATABLE

Thickness (Inches)	Width (In)		Length (In)	Lbs/ Sq/ Ft	Lbs/ Plate
.250	36	×	96	3.600	88.060
.250	48	×	144	3.600	175.210
.313	48	×	144	4.510	219.490
.375	48	×	144	5.400	262.810
.500	36	×	144	7.200	262.800
.500	48	×	144	7.200	350.410
.625	48	×	144	9.000	438.020
.750	48	×	144	10.800	525.620
.875	36	×	96	12.600	308.200
1.000	48	×	144	14.400	700.820
1.250	48	×	144	18.000	876.030
1.500	48	×	144	21.600	1051.240
1.750	48	×	144	25.200	1226.440
2.000	48	×	144	28.800	1401.650
2.500	48	×	144	36.000	1752.060
3.000	48	×	144	43.200	2102.470
3.500	48	×	144	50.400	2452.890
4.000	48	×	144	57.600	2803.300
4.500	48	×	144	64.800	2153.710
5.000	48	×	144	72.000	3504.120
6.000	48	×	144	86.400	4204.950

6061 – T651 ALUMINUM PLATE MILL FINISH – HEAT TREATABLE

Thickness (Inches)	Width (In)		Length (In)	Lbs/ Sq/Ft	Lbs/ Plate
1/4	36	×	96	3.660	89.520
	48	×	96	3.660	118.960
	48	×	144	3.660	178.960
	60	×	120	3.660	185.290
	60	×	144	3.660	222.200
	72	×	144	3.660	266.270
	96	×	240	3.660	585.600
5/16	36	×	96	4.520	110.560
	48	×	144	4.520	219.980
	96	×	240	4.520	723.200
3/8	36	×	96	5.440	133.060
	48	×	144	5.440	264.760
	60	×	144	5.440	330.260
	72	×	144	5.440	395.770
	96	×	240	5.440	870.400
1/2	36	×	96	7.250	177.340
	48	×	144	7.250	352.850
	60	×	144	7.250	440.150

6061 – T651 ALUMINUM PLATE MILL FINISH – HEAT TREATABLE

Thickness (Inches)	Width (In)		Length (In)	Lbs/ Sq. Ft	Lbs/ Plate
1/2	72	×	144	7.250	522.000
5/8	36	×	96	9.020	216.480
	48	×	144	9.020	438.990
	60	×	120	9.020	456.650
3/4	36	×	96	10.840	265.650
	48	×	144	10.840	527.570
	60	×	144	10.840	658.100
	72	×	240	10.580	1269.600
	72	×	144	10.580	769.710
7/8	48	×	144	12.550	610.790
1	36	×	96	14.440	353.200
	48	×	144	14.440	702.770
	60	×	144	14.440	876.650
1-1/4	48	×	144	17.960	874.080
1-1/2	36	×	96	21.490	525.650
	48	×	144	21.490	1045.880
	60	×	144	21.490	1304.660
1-3/4	36	×	96	25.070	613.210
	48	×	144	25.070	1220.120
	48	×	144	28.640	1393.860
	60	×	144	28.640	1738.740
	72	×	144	28.640	2083.610
2	48	×	144	28.220	1373.420
	60	×	144	28.220	1713.240
2-1/4	48	×	144	32.130	1563.720
2-1/2	48	×	144	35.800	1742.330
3	48	×	144	42.850	2085.440
	60	×	144	42.850	2601.430
3-1/2	48	×	144	50.090	2437.800
4	48	×	144	57.360	2791.620
	60	×	144	57.360	3482.330
4-1/2	48	×	144	64.210	3135.220
5	48	×	144	71.470	3478.330
5-1/2	48	×	144	77.620	3777.640
6	48	×	144	85.580	4165.040
7	48	×	144	98.720	4804.99
8	48	×	144	112.900	5495.18
9	48	×	144	129.600	6308.02
10	48	×	144	141.100	6867.76
12	48	×	144	169.300	8240.34

Also available in 1100,3003, 5052,5083, 5086, etc

7075 – T651 ALUMINUM PLATE MILL FINISH – HEAT TREATABLE

Thickness (Inches)	Width (In)		Length (In)	Lbs/ Sq/ Ft	Lbs/ Plate
0.250	48	×	144	3.636	176.96
0.375	48	×	144	5.454	265.44
0.500	48	×	144	7.292	353.92
0.625	48	×	144	9.090	442.40
0.750	48	×	144	10.91	530.97
1.000	48	×	144	14.54	707.64
1.250	48	×	144	18.18	884.79
1.500	48	×	144	21.82	1061.94
1.750	48	×	144	25.45	1238.61
2.000	48	×	144	29.09	1415.76
2.250	48	×	144	32.73	1592.92
2.500	48	×	144	36.36	1769.58
3.000	48	×	144	43.64	2123.40
4.000	48	×	144	58.18	2831.53
5.000	48	×	144	72.72	3539.17
6.000	48	×	144	87.26	4246.80
8.000	48	×	133	116.40	5214.15

5086 – H34 ALUMINUM MILL FINISH TREAD PLATE

Thickness (Inches)	Width (In)		Length (In)	Lbs/ Sq/ Ft	Lbs/ Plate
.125	48	×	192	1.83	117.12
.125	60	×	192	1.83	146.40
.188	48	×	192	2.60	166.53
.188	60	×	192	2.60	208.16
.250	48	×	192	3.66	234.24
.250	50	×	192	3.66	292.80
.250	96	×	192	3.66	468.48

6061 – T6 ALUMINUM MILL FINISH TREAD PLATE

Thickness (Inches)	Width (In)		Length (In)	Lbs/ Sq/ Ft	Lbs/ Plate
.100	48	×	192	1.57	100.48
.125	48	×	120	1.90	76.00
.125	48	×	144	1.90	91.20
.125	48	×	192	1.90	121.60
.125	60	×	144	1.90	114.00
.125	60	×	192	1.90	152.00
.188	48	×	144	2.82	135.36
.188	48	×	192	2.82	180.48
.188	60	×	192	2.82	225.60
.250	36	×	144	3.70	133.20
.250	48	×	120	3.70	148.00
.250	48	×	144	3.70	177.60

Continued

Thickness (Inches)	Width (In)		Length (In)	Lbs/ Sq/ Ft	Lbs/ Plate
.250	48	×	192	3.70	236.80
.250	60	×	192	3.70	296.00
.375	48	×	144	5.49	263.52
.375	48	×	192	5.49	351.36
.375	60	×	192	5.49	439.20
.375	72	×	192	5.49	527.04
.500	48	×	192	7.27	465.28
.500	60	×	192	7.27	581.60
.500	72	×	192	7.27	697.92

3003 BRIGHT TREAD ALUMINUM PLATE

Thickness (Inches)	Width (In)		Length (In)	Lbs/ Sq. Ft	Lbs/ Plate
.063	48	×	192	.96	61.44
.063	60	×	192	.96	76.80
.100	48	×	96	1.57	50.24
.100	48	×	120	1.57	62.80
.100	48	×	144	1.57	75.36
.100	48	×	192	1.57	100.48
.100	60	×	96	1.57	62.80
.100	60	×	120	1.57	78.50
.100	60	×	144	1.57	94.20
.100	60	×	192	1.57	125.60
.125	48	×	96	1.92	61.44
.125	48	×	120	1.92	76.80
.125	48	×	144	1.92	92.16
.125	48	×	180	1.92	115.20
.125	48	×	192	1.92	122.88
.125	60	×	120	1.92	96.00
.125	60	×	144	1.92	115.20
.125	60	×	192	1.92	153.60
.125	72	×	144	1.92	138.24
.188	48	×	120	2.82	112.80
.188	48	×	144	2.82	135.36
.188	48	×	192	2.82	180.48
.188	60	×	144	2.82	169.20
.250	48	×	144	3.63	176.96
.375	48	×	144	5.45	265.44
.500	48	×	144	7.27	353.92

ORDER IN PERSON, BY TELEPHONE, FAX OR EMAIL.

6061 – T6 EXTRUDED ALUMINUM RECTANGLES

Size (inches)		Lbs/Ft.	Size (inches)		Lbs/Ft.
1/8 ×	1/2	.074	1/4 ×	9	2.646
	3/4	.110		10	2.940
	1	.147		11	3.300
	1-1/4	.184		12	3.528
	1-1/2	.220	5/16 ×	1/2	.183
	1-3/4	.257		3/4	.275
	2	.294		1	.367
	2-1/2	.368		1-1/4	.459
	3	.441		1-1/2	.550
	3-1/2	.514		2	.734
	4	.588		2-1/2	.917
	5	.735		3	1.101
	6	.880		4	1.468
3/16 ×	1/2	.111		5	1.835
	3/4	.166		6	2.201
	1	.221	3/8 ×	1/2	.220
	1-1/4	.276		3/4	.331
	1-1/2	.332		1	.441
	1-3/4	.387		1-1/4	.551
	2	.442		1-1/2	.662
	2-1/4	.497		1-3/4	.772
	2-1/2	.553		2	.882
	3	.663		2-1/4	.992
	3-1/2	.774		2-1/2	1.102
	4	.884		2-3/4	1.213
	5	1.105		3	1.323
	6	1.327		3-1/2	1.544
1/4 ×	1/2	.147		4	1.764
	3/4	.220		4-1/2	1.984
	1	.294		5	2.205
	1-1/4	.368		5-1/2	2.426
	1-1/2	.441		6	2.646
	1-3/4	.514		7	3.087
	2	.588		8	3.528
	2-1/4	.662		10	4.410
	2-1/2	.735		11	4.851
	3	.882		12	5.292
	3-1/2	1.029	1/2 ×	3/4	.441
	4	1.176		1	.588
	4-1/2	1.323		1-1/4	.735
	5	1.470		1-1/2	.882
	6	1.764		1-3/4	1.029
	7	2.058		2	1.176
	8	2.352		2-1/4	1.323

6061 – T6 EXTRUDED ALUMINUM RECTANGLES

Size (inches)		Lbs/Ft.	Size (inches)		Lbs/Ft.
1/2 ×	2-1/2	1.470	3/4 ×	10	8.820
	2-3/4	1.617		12	10.584
	3	1.764	1 ×	1-1/4	1.470
	3-1/4	1.911		1-1/2	1.764
	3-1/2	2.058		2	2.352
	4	2.352		2-1/4	2.646
	4-1/2	2.646		2-1/2	2.940
	5	2.940		2-3/4	3.234
	6	3.528		3	3.528
	6-1/2	3.822		4	4.704
	7	4.116		5	5.880
	8	4.704		6	7.056
	8-1/2	4.998		7	8.232
	9	5.292		8	9.408
	10	5.880		9	10.584
	12	7.056		10	11.760
5/8 ×	1	.735		12	14.112
	1-1/4	.919	1-1/4 ×	1-1/2	2.205
	1-1/2	1.102		1-5/8	2.389
	2	1.470		1-3/4	2.572
	2-1/2	1.838		2	2.940
	3	2.205		2-1/4	3.307
	4	2.940		2-1/2	3.675
	5	3.675		3	4.410
	6	4.410		3-1/2	5.145
	8	5.880		3-3/4	5.512
	9	6.615		4	5.880
	10	7.350		4-1/2	6.615
	12	8.820		5	7.350
3/4 ×	1	.882		6	8.820
	1-1/4	1.102		7	10.290
	1-1/2	1.323		8	11.760
	2	1.764		9	13.230
	2-1/4	1.984		10	14.700
	2-1/2	2.205		12	17.640
	2-3/4	2.426	1-1/2 ×	2	3.528
	3	2.646		2-1/4	3.969
	3-1/2	3.087		2-1/2	4.410
	4	3.578		2-3/4	4.851
	5	4.410		3	5.292
	6	5.292		3-1/4	5.733
	7	6.174		3-1/2	6.174
	8	7.056		4	7.056
	9	7.938		5	8.820

6061 – T6 EXTRUDED ALUMINUM RECTANGLES

Size (inches)		Lbs/Ft.	Size (inches)		Lbs/Ft.
1-1/2 ×	6	10.584	2-1/4 ×	4	10.584
	7	12.348		4-1/2	11.907
	8	14.112		5	13.230
	9	15.876	2-1/2 ×	2-3/4	8.085
	10	17.640		3	8.820
	12	21.168		3-1/4	9.555
1-3/4 ×	2	4.116		3-1/2	10.290
	2-1/2	5.145		4	11.760
	3	6.174		5	14.700
	4	8.232		6	17.640
	4-1/2	9.261	2-3/4 ×	3	9.702
	5	10.290		3-1/2	11.319
	6	12.348		4	12.936
2 ×	2-1/2	5.880	3 ×	3-1/2	12.348
	3	7.056		4	14.112
	3-1/2	8.232		4-1/2	15.876
	4	9.408		5	17.640
	4-1/2	10.584		6	21.168
	5	11.760	3-1/2 ×	4	14.464
	6	14.112		4-1/2	18.522
	7	16.464		6	24.696
	8	18.816		8	32.928
	9	21.168		10	41.160
	10	23.520	4 ×	4-1/2	21.168
	12	28.224		5	23.520
2-1/4 ×	2-3/4	7.277		6	28.224
	3	7.938	4-1/2 ×	5	26.460
	3-1/2	9.261		6	32.400

2011 – T3 ALUMINUM ROUNDS

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
1/8	.015	1-5/16	1.653
5/32	.023	1-3/8	1.814
3/16	.033	1-7/16	1.983
7/32	.046	1-1/2	2.159
15/64	.052	1-9/16	2.343
1/4	.060	1-5/8	2.534
17/64	.067	1-3/4	2.939
9/32	.075	1-13/16	3.152
5/16	.093	1-7/8	3.373
11/32	.113	1-15/16	3.602
3/8	.134	2	3.838
25/64	.141	2-1/16	4.082
7/16	.183	2-1/8	4.333
15/32	.210	2-3/16	4.592
1/2	.239	2-1/4	4.858
17/32	.270	2-5/16	5.132
9/16	.303	2-3/8	5.413
19/32	.338	2-1/2	5.997
5/8	.374	2-5/8	6.612
21/32	.413	2-3/4	7.257
11/16	.453	2-7/8	7.932
3/44	.539	3	8.636
25/32	.585	3-1/8	9.371
13/16	.633	3-1/4	10.140
7/8	.734	3-1/2	11.760
15/16	.843	3-3/4	13.490
1	.959	4	15.350
1-1/32	1.020	4-1/4	17.330
1-1/16	1.083	4-1/2	19.430
1-1/8	1.210	4-3/4	21.650
1-3/16	1.353	5	23.990
1-1/4	1.499	5-1/8	25.200
1-9/32	1.575	5-1/4	26.450

2024 – T4/T351 ALUMINUM ROUNDS

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
1/8	.014	**2-3/8**	5.369
3/16	.033	**2-1/2**	5.949
1/4	.059	**2-9/16**	6.251
5/16	.093	**2-5/8**	6.559
3/8	.133	**2-3/4**	7.199
7/16	.182	**2-7/8**	7.868
1/2	.238	**3**	8.567
9/16	.301	**3-1/6**	8.928
5/8	.371	**3-1/8**	9.296
11/16	.449	**3-1/4**	10.050
3/4	.535	**3-3/8**	10.840
13/16	.628	**3-1/2**	11.660
7/8	.728	**3-9/16**	12.080
15/16	.836	**3-3/4**	13.390
1	.951	**4**	15.230
1-1/16	1.075	**4-1/16**	15.710
1-1/8	1.205	**4-1/4**	17.190
1-3/16	1.328	**4-1/2**	19.280
1-1/4	1.487	**4-5/8**	20.360
1-5/16	1.640	**4-3/4**	21.480
1-3/8	1.800	**5**	23.800
1-7/16	1.967	**5-1/8**	25.000
1-1/2	2.142	**5-1/4**	26.240
1-9/16	2.324	**5-1/2**	28.800
1-5/8	2.514	**6**	34.270
1-3/4	2.915	**6-1/4**	37.180
1-7/8	3.347	**6-1/2**	40.220
1-15/16	3.570	**7**	46.640
2	3.808	**7-1/4**	50.030
2-1/16	4.049	**7-1/2**	53.540
2-1/8	4.298	**8**	60.920
2-1/4	4.819		

6061 – T6/T651 EXTRUDED ALUMINUM ROUNDS

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
1/8	.014	**2-5/8**	6.364
3/16	.032	**2-3/4**	6.985
1/4	.057	**2-7/8**	7.635
5/16	.090	**3**	8.312
3/8	.129	**3-1/8**	9.019
1/2	.230	**3-1/4**	9.756
9/16	.292	**3-3/8**	10.520
5/8	.360	**3-1/2**	11.310
11/16	.436	**3-5/8**	12.140
3/4	.519	**3-3/4**	12.990
13/16	.609	**4**	14.780
7/8	.707	**4-1/8**	15.720
15/16	.811	**4-1/4**	16.680
1	.923	**4-1/3**	18.700
1-1/16	1.043	**4-3/4**	20.840
1-1/8	1.169	**5**	23.090
1-3/16	1.302	**5-1/4**	25.460
1-1/4	1.443	**5-1/2**	27.940
1-5/16	1.591	**5-3/4**	30.540
1-3/8	1.746	**6**	33.250
1-7/16	1.909	**6-1/4**	36.080
1-1/2	2.073	**6-1/2**	39.020
1-5/8	2.439	**6-3/4**	42.080
1-3/4	2.829	**7**	45.260
1-7/8	3.247	**7-1/2**	51.960
2	3.694	**8**	59.110
2-1/8	4.171	**8-1/2**	66.730
2-1/4	4.676	**9**	74.810
2-3/8	5.210	**11**	111.800
2-1/2	5.773	**12**	133.000

7075 – T651 ALUMINUM ROUNDS

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
3/8	.133	**2-1/4**	4.811
7/16	.181	**2-3/8**	5.361
1/2	.237	**2-1/2**	5.940
5/8	.371	**2-3/4**	7.187
3/4	.534	**3**	8.553
7/8	.727	**3-1/4**	10.040
1	.950	**3-1/2**	11.640
1-1/8	1.203	**4**	15.210
1-1/4	1.485	**4-1/2**	19.240
1-3/8	1.797	**4-3/4**	21.440
1-1/2	2.138	**5**	23.760
1-5/8	2.509	**5-1/4**	26.190
1-3/4	2.910	**6**	34.210
1-7/8	3.341	**6-1/2**	40.150
2	3.802	**7**	46.570
2-1/8	4.291		

1100 – H14 ALUMINUM SHEET MILL FINISH – NON HEAT-TREATABLE

Thickness	Size (inches)	Lbs/Ft.	Thickness	Size (inches)	Lbs/Ft.
.020 (.282 Lbs./Sq. Ft.)	36 × 96	6.77	**.080 (1.127 Lbs./Sq. Ft.)**	48 × 96	36.07
.025 (.353 Lbs./Sq. Ft.)	36 × 96	8.48		48 × 120	45.08
.032 (.452 Lbs./Sq. Ft.)	36 × 96	10.85		48 × 144	54.10
	48 × 96	14.74	**.090 (1.274 Lbs./Sq. Ft.)**	36 × 96	30.58
.040 (.565 Lbs./Sq. Ft.)	36 × 96	13.56		36 × 120	38.22
	36 × 120	16.95		48 × 96	40.77
	48 × 96	18.08		48 × 120	50.96
	48 × 120	22.60		48 × 144	61.16
	48 × 144	27.12	**.125 (1.764 LBS./Sq. Ft.)**	36 × 96	42.34
.050 (.706 Lbs./Sq. Ft.)	36× 96	16.94		36 × 120	52.92
	36 × 120	21.18		48 × 96	56.45
	48 × 96	22.59		48 × 120	70.56
	48 × 120	28.24		48 × 144	84.68
	48 × 144	33.89	**.160 (2.254 LBS./Sq. Ft.)**	48 × 144	108.19
.063 (.889 Lbs./Sq. Ft.)	36 × 96	13.56	**.190 (2.68 LBS./Sq. Ft.)**	36 × 96	64.32
	36 × 120	26.67		36 × 120	80.40
	48 × 96	28.45		48 × 96	85.76
	48 × 120	35.56		48 × 120	107.20
	48 × 144	42.68		48 × 144	128.64

3003 – H14 ALUMINUM SHEET MILL FINISH – NON HEAT-TREATABLE

Size (inches)	Size (inches)	Lbs/Ft.		Size (inches)	Lbs/Ft.
.016	36 × 96	5.47	**.063**	48 × 120	35.92
	36 × 120	6.84		48 × 144	43.11
.020	36 × 96	6.84		60 × 120	44.91
	36 × 120	8.55		60 × 144	53.89
.025	36 × 96	8.55	**.080**	36 × 96	27.38
	48 × 96	11.40		48 × 120	45.64
	48 × 120	14.26		48 × 144	54.77
	48 × 144	17.11		60 × 120	57.05
.032	36 × 96	10.95		60 × 144	68.46
	36 × 120	13.69	**.090**	36 × 96	30.79
	48 × 96	14.60		48 × 120	51.32
	48 × 120	18.25		48 × 144	61.58
	48 × 144	21.90		60 × 144	76.98
.040	36×96	13.68	**.100**	36 × 96	34.22
	36 × 120	17.11		48 × 120	57.04
	48×96	18.25		48 × 144	68.45
	48 × 120	22.81		60 × 144	85.56
	48 × 144	27.37	**.125**	36 × 96	42.77
	60 × 144	34.21		36 × 120	53.46
.050	36 × 96	17.11		48 × 96	57.02
	36 × 120	21.38		48 × 120	71.28
	48×96	22.81		48 × 144	85.54
	48 × 120	28.51		60 × 144	106.90
	48 × 144	34.21		72 × 144	128.30
	60 × 120	35.64	**.160**	48 × 144	108.19
	60 × 144	42.77	**.190**	36 × 96	65.02
.063	36 × 96	21.55		48 × 120	108.40
	36 × 120	26.94		48 × 144	130.00
	48 × 96	28.74		60 × 144	162.50
				72 × 144	195.00

5052 – H32 ALUMINUM SHEET MILL FINISH – NON HEAT-TREATABLE

THICKNESS	Size (inches)	Lbs/Ft.	THICKNESS	Size (inches)	Lbs/Ft.
.020	36 × 96	6.706	.090	36 × 96	30.170
.025	36 × 96	8.381		48 × 96	40.220
	48×96	11.170		48 × 120	50.280
.032	36 × 96	10.730		48 × 144	60.340
	48× 120	17.880		60 × 144	75.420
	48× 144	21.460	.100	36 × 120	41.910
.040	36 × 96	13.410		48 × 120	55.880
	48× 96	17.880		48 × 144	67.060
	48 × 120	22.350	.125	36 × 96	41.900
	48 × 144	26.820		36 × 120	52.380
.050	36 × 96	16.760		48 × 96	55.870
	48 × 96	22.350		48 × 120	69.840
	48 × 120	27.940		48 × 144	83.810
	48 × 144	33.520		60 × 120	87.300
	60 × 144	41.900		60 × 144	104.800
.063	36 × 96	21.120		72 × 96	83.810
	48 × 96	28.160		72 × 120	104.800
	48 × 120	35.200		72 × 144	125.700
	48 × 144	42.240	.160	48 × 144	107.300
	60 × 144	52.800	.190	36 × 96	63.700
.080	36 × 96	26.810		48 × 96	84.930
	48 × 96	35.740		48 × 120	106.200
	48 × 120	44.680		48 × 144	127.400
	48 × 144	53.620		60 × 120	132.700
				72 × 96	127.400
				72 × 144	191.100

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6061 – T6 ALUMINUM SHEET MILL FINISH – HEAT TREATABLE

THICKNESS	Size (inches)	Lbs./SQ. Ft.	Lbs./SHt.	THICKNESS	Size (inches)	Lbs./SQ. Ft.	Lbs./SHt.
.032	48 × 144	.45	21.70	**.125**	36 × 96	1.76	42.34
.040	48 × 144	.56	27.12		48 × 96	1.76	56.45
.050	48 × 120	.70	28.24		48 × 120	1.76	70.56
	48 × 144	.70	33.89		48 × 144	1.76	84.67
	60 × 144	.70	42.36		60 × 144	1.76	105.84
.063	48 × 96	.88	28.45		72 × 144	1.76	127.01
	48 × 120	.88	35.56	**.160**	48 × 144	2.25	108.19
	48 × 144	.88	42.67	**.190**	36 × 96	2.68	64.44
	60 × 144	.88	53.34		48 × 96	2.68	85.92
.080	48 × 120	1.12	45.08		48 × 120	2.68	107.40
	48 × 144	1.12	54.10		48 × 144	2.68	128.88
	60 × 144	1.12	67.62		60 × 120	2.68	134.25
.090	48 × 144	1.27	61.15		60 × 144	2.68	161.10
	60 × 144	1.27	76.44		72 × 96	2.68	50.69
.100	48 × 120	1.41	56.44		72 × 120	2.68	161.10
	48 × 144	1.41	67.73		72 × 144	2.68	193.32

2024 – T351/T4 ALUMINUM SQUARES

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
3/8	.168	**1-3/4**	3.670
1/2	.299	**2**	4.793
5/8	.468	**2-1/4**	6.075
3/4	.674	**2-1/2**	7.500
7/8	.917	**2-3/4**	9.062
1	1.198	**3**	10.800
1-1/8	1.517	**3-1/4**	12.660
1-1/4	1.872	**3-1/2**	14.700
1-1/2	2.696	**4**	19.170

6061 – T6 EXTRUDED ALUMINUM SQUARES

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
1/2	.294	**2-1/4**	5.953
5/8	.459	**2-1/2**	7.350
3/4	.661	**2-3/4**	8.893
7/8	.901	**3**	10.580
1	1.176	**3-1/2**	14.410
1-1/4	1.838	**4**	18.820
1-1/2	2.646	**4-1/2**	23.810
1-5/8	3.108	**5**	29.400
1-3/4	3.600	**5-1/2**	35.570
2	4.704	**6**	42.340

7075 – T651 EXTRUDED ALUMINUM SQUARES

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
3/4	.681	**1-3/4**	3.712
1	1.212	**2**	4.848
1-1/2	2.727		

6061 – T6 DRAWN SEAMLESS TUBING

O.D.	WALL	I.D.	LBS/FT.	O.D.	WALL	I.D.	LBS/FT.
3/16	.035	.118	.019	**1**	.058	.884	.201
	.049	.090	.025		.065	.870	.224
1/4	.035	.180	.027		.083	.834	.281
	.049	.152	.036		.125	.750	.404
	.058	.134	.041	**1-1/8**	.035	1.055	.140
5/16	.035	.243	.035		.058	1.009	.228
	.049	.215	.047	**1-1/4**	.035	1.180	.157
	.058	.197	.054		.049	1.152	.217
3/8	.035	.305	.044		.058	1.134	.255
	.049	.277	.059		.065	1.120	.284
	.058	.259	.067		.083	1.084	.357
	.065	.245	.074	**1-3/8**	.035	1.305	.173
7/16	.035	.368	.052		.049	1.277	.240
	.049	.340	.070		.058	1.259	.282
	.065	.308	.089	**1-1/2**	.035	1.430	.189
1/2	.028	.444	.048		.049	1.402	.262
	.035	.430	.060		.058	1.384	.309
	.049	.402	.081		.065	1.370	.344
	.058	.384	.094		.083	1.334	.434
	.065	.370	.104	**1-5/8**	.035	1.555	.205
	.120	.260	.168		.058	1.509	.335
5/8	.028	.569	.061	**1-3/4**	.058	1.634	.362
	.035	.555	.076		.083	1.584	.511
	.049	.527	.104	**1-7/8**	.058	1.759	.389
	.058	.509	.121	**2**	.049	1.902	.353
	.065	.495	.134		.058	1.884	.416
3/4	.035	.680	.092		.065	1.870	.464
	.049	.652	.126		.083	1.834	.587
	.058	.634	.148	**2-1/4**	.049	2.152	.398
	.065	.620	.164		.065	2.120	.524
	.083	.584	.204		.083	2.084	.664
7/8	.035	.805	.108	**2-1/2**	.065	2.370	.584
	.049	.777	.149		.083	2.334	.741
	.058	.759	.175	**3**	.065	2.870	.704
	.065	.745	.194		.083	2.834	.894
1	.035	.930	.124	**4**	.065	3.870	.945
	.049	.902	.172				

Q 6061 – 6511 EXTRUDED SEAMLESS ROUND TUBING

O.D. (Inch)	WALL	I.D. (Inch)	LBS/FT.	O.D. (Inch)	WALL	I.D. (Inch)	LBS/FT.
1-1/2 ×	1/8	1.250	.635	**4 ×**	1/4	3.500	3.464
	1/4	1.000	1.155		1/2	3.000	6.465
2 ×	1/8	1.750	.866		3/4	2.500	9.005
	1/4	1.500	1.616	**4-1/2 ×**	1/2	3.500	7.389
2-1/2 ×	1/8	2.250	1.097		3/4	3.000	10.390
	1/4	2.000	2.078	**5 ×**	1/2	4.000	8.313
	1/2	1.500	3.695		3/4	3.500	11.780
2-3/4 ×	1/2	1.750	4.152		1	3.000	14.780
	5/8	1.500	4.907	**5-1/2 ×**	1/2	4.500	9.236
3 ×	1/8	2.750	1.328		3/4	4.000	13.160
	1/4	2.500	2.540		1	3.500	16.630
	1/2	2.000	4.618	**6 ×**	1/2	5.000	10.160
	3/4	1.500	6.234		3/4	4.500	14.550
3-1/4 ×	3/8	2.500	3.983	**6-1/2 ×**	1	4.500	20.320
	1/2	2.250	5.080	**7 ×**	1/2	6.000	12.010
3-1/2 ×	1/2	2.500	5.542		3/4	5.500	17.320
	3/4	2.000	7.620		1	5.000	22.170
3-3/4 ×	1/2	2.750	6.004	**8 ×**	1/4	7.500	7.158
4 ×	1/8	3.750	1.788		1/2	7.000	13.850
					1	6.000	25.860

6063 – T5 EXTRUDED RECTANGULAR TUBING (Typically Sharp Corners)

Size (inches)			NOMINAL WALL THICKNESS	Lbs/ Ft.	Size (inches)			NOMINAL WALL THICKNESS	Lbs/ Ft.
1/2	×	1	.125	.368	1-3/4	×	5	.125	1.911
1/2	×	1-1/4	.125	.441	2	×	3	.125	1.396
3/4	×	1-1/2	.125	.588	2	×	3	.250	1.646
3/4	×	2-1/2	.125	.882	2	×	4	.125	1.690
1	×	1-1/2	.125	.662	2	×	4	.188	2.487
1	×	2	.125	.808	2	×	5	.125	1.984
1	×	2-1/2	.125	.956	2	×	6	.125	2.278
1	×	3	.125	1.102	2	×	6	.188	3.348
1-1/4	×	2	.125	.882	3	×	4	.125	1.984
1-1/4	×	2-1/2	.125	1.029	3	×	4	.188	2.989
1-1/4	×	3	.125	1.176	3	×	5	.188	3.371
1-1/2	×	2	.125	.956	3	×	5	.250	4.410
1-1/2	×	2	.250	1.755	3	×	6	.188	3.813
1-1/2	×	3	.125	1.250	4	×	6	.250	5.586
1-1/2	×	4	.125	1.574	4	×	6	.500	10.584
1-3/4	×	2	.125	1.029	4	×	8	.250	6.762
1-3/4	×	3	.125	1.323	5	×	8	.375	10.805
1-3/4	×	4	.125	1.617					

6063 – T5 EXTRUDED SQUARE TUBING (Typically Sharp Corners)

Size O.D. (Inches)	NOMINAL WALL THICKNESS	Lbs/ Ft.	Size O.D. (Inches)	NOMINAL WALL THICKNESS	Lbs/ Ft.
3/4	.065	.184	2-3/4	.188	2.266
3/4	.125	.368	3	.125	1.690
1	.065	.274	3	.188	2.487
1	.125	.514	3	.250	3.234
1-1/4	.125	.662	3-1/2	.125	1.984
1-1/2	.125	.808	4	.125	2.278
1-1/2	.188	1.160	4	.188	3.371
2	.125	1.102	4	.250	4.410
2	.188	1.602	4	.500	8.232
2	.250	2.058	5	.188	4.245
2-1/2	.125	1.396	5	.250	5.588
2-1/2	.250	2.646	6	.250	6.762
2-3/4	.125	1.544	6	.500	12.936

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Normally only available in tubing products, it has a good balance of workability and, because of the presence of lead, machinability.

Applications: Industrial: Power and Pump Cylinder Liners, Power and Pump Cylinders;

Ordnance: Primers. Plumbing: plumbing accessories, pump lines, trap lines, j bends, plumbing brass goods.

Analysis:		
Cu – 66%	Zn – 33.5%	Fe – .07%
Pb – .5%		

Common Fabrication Processes: Forming and bending, machining, piercing and punching.

Mechanical Properties:	
Room temperature, 68° F (20°C	
Ultimate Tensile Strength (psi)	65,300
Yield Strength (psi)	50,000
Elongation (%)	32
Rockwell Hardness	B80

Machinability: Machinability rating is 60. **Hot Forming:** Poor. **Cold Working:** Excellent. **Joining Techniques:** Excellent for: Soldering. Good for: Brazing; Fair for: Oxyacetylene, gas shield arc, spot and butt welding.; Not Recommended for: Coated metal arc and seam welding.

C360 BRASS

The most commonly used of the brass rod and bar items. The presence of lead creates a highly machinable material that can be cut, drilled and shaped easily.

Applications: Architecture: Terrazzo strip; Automotive: Sensor bodies, thermostat parts, fluid connectors, threaded inserts for plastic; Builders Hardware: Lock bodies, fittings, hardware; Consumer: hot combs (to straighten hair); Fasteners: screws, nuts, bolts; Industrial: faucet components, pinions, automatic screw machine parts, pneumatic fittings, gears, nozzles, valve stems, valve trim, valve seats, gauges, fluid connectors, screw machine products, adapters, unions; Plumbing: faucet stems, plumbers' brass goods, faucet seats, plumbing fittings.

Analysis:		
Cu – 60/63%	Zn – 35.5%	Fe – .35% Min.
Pb – 2.5–3.7%		

Common Fabrication Processes: Machining, roll threading and knurling;

Mechanical Properties:	
Room temperature, 68° F (20°C	
Ultimate Tensile Strength (psi)	58,000
Yield Strength (psi)	45,000
Elongation (%)	25
Rockwell Hardness	B78

Machinability: Machinability rating is 100. No material of comparable strength machines faster and produces better surface finishes than C360. **Hot Forming:** Fair. **Cold Working:** Fair. **Corrosion Resistance:** Excellent. **Joining Techniques:** Excellent for: Soldering. Good for: Brazing; Fair for: Butt weld; Not Recommended for: Oxyacetylene, gas shield arc welding, coated metal arc, spot, and seam welding.

BRONZE

DATA AND SPECIFICATIONS

Bronze is an alloy of metal that is copper based with tin as the main additive. Some tins, though, can have phosphorus, manganese, aluminum, or silicon as the main alloying ingredient. Bronze is typically strong, tough, and corrosion resistant with high electrical and thermal conductivity.

SAE 660

The most commonly used bronze in bushing and bearing applications, it is easy to machine and provides long life in applications where wear is an issue.

Applications: Automotive: Automotive fittings; Fasteners: washers; Industrial: pump impellers, diesel engine wrist pin bushings, forging press toggle lever bearings, hydraulic press stuffing box, hydraulic press main lining, main spindle bearings, machine tool bearings, bearings for cranes, trunnion bearings, roll neck bearings, rolling mill bearings, linkage bushings for presses, fuel pump bushings, water pump bushings, pump fixtures, fittings, insert bearings, bearings, thrust washers, pumps, bushings, machine parts, general purpose bushings.

Analysis:		
Cu – 83%	Sn – 7%	Pb – 7%
Zn – 3%		

Mechanical Properties:	
Minimal	
	Continuous Cast
Ultimate Tensile Strength (psi)	35,000
Yield Strength (psi)	20,000
Elongation (%)	10

Machinability: Rated at 70% of free machining brass. **Joining Techniques:** Excellent for: Soldering; Good for: Brazing. Not Recommended for: Oxyacetylene, gas shielded arc, and coated metal arc welding.

COPPER

DATA AND SPECIFICATIONS

Known for its malleability and ductility, heat conductivity, and electrical conductivity. Copper alloys are generally red or pinkish in colour.

110 COPPER

Copper, ETP, Electrolytic Tough Pitch. Has conductivity of 101% IACS. Ductile, anneal resistant.

Applications: Architecture: Skylight frames, roofing, building fronts, flashing, gutters, spouting, downspouts; Automotive: gaskets, radiators; Builders Hardware: butts, tacks, nails, soldering copper, rivets, cotter pins, ball floats; Building: screening, wire screening; Consumer: Christmas ornaments; Fasteners: fasteners; Industrial: printing rolls, chimney cap screens, heat exchangers, anodes, kettles, chlorine cells, rotating bands, road bed expansion plates, vats, pressure vessels, chemical process equipment, pan; Electrical: terminals, switches, radio parts, contacts, trolley wire, magnet wire, busbars, terminal connectors, conductors, electrical, stranded conductors, wire, electrical;

Analysis:
Cu – 99.9%

Common Fabrication Processes: Blanking, coining, coppersmithing, drawing, etching, forming and bending, heading and upsetting, hot forging and pressing, piercing and punching, roll threading and knurling, shearing, spinning, squeezing and swaging, stamping.

Mechanical Properties:			
Room temperature, 68° F (20°C) HO4 Full Hard Temper			
	Flats (ETP)	**Rounds (ETP)**	**Squares (ETP)**
Ultimate Tensile Strength (psi)	50,000	50,000	50,000
Yield Strength (psi)	45,000	45,000	45,000
Hardness	B50	B50	B50

Machinability: The machinability rating of this alloy is 20. (Where Alloy 360 FC Brass is 100). **Corrosion Resistance:** Excellent. **Forging:** The hot forgeability rating of this

alloy is 65. (Forging brass = 100). The recommended hot working temperature for this alloy is between 1400° and 1600° F. **Hot Working:** Excellent. **Cold Working:** Excellent. **Annealing:** Between 700° F and 1200° F. **Joining Techniques:** Excellent for: Soldering; Good for: Brazing and butt weld; Fair for: Gas shield arc welding; Not Recommended for: Oxyacetylene, coated metal arc, spot, and seam welding.

122 COPPER

Applications: Architecture: roofing, flashing, downspouts, gutters. Automotive: oil lines, air lines, hydraulic lines. Building: heater lines, gas lines, air conditioner tubes and condenser sheets, heater units, oil burner tubes. Consumer: refrigerators, air conditioners. Electrical: wire connectors, heater elements. Industrial: gage lines, rotating bands, oil lines in airplanes, hydraulic lines in airplanes, gasoline lines in airplanes, air lines in airplanes, oil coolers in airplanes, tanks, water lines, steam lines, paper lines, pulp lines, distiller tubes, dairy tubes, heat exchanger tubes, evaporator tubes, condenser tubes, brewery tubes, sugar house refinery lines, print rolls, paper rolls, expansion joint tubes, plating hangers, plumbing tube, plating anodes, plating racks, plating anodes, casting molds, tubing, lp gas service, tubing, medical gas-oxygen, kettles, anodes for electroplating, heat exchanger shells. Marine: gasoline lines, oil coolers. Plumbing: plumbing pipe, plumbing fittings.

Analysis:	
Cu – 99.9%	P – .02% Max.

Common Fabrication Processes: Blanking, coining, coppersmithing, drawing, etching, forming and bending, heading and upsetting, hot forging and pressing, piercing and punching, roll threading and knurling, shearing, spinning, squeezing and swaging, stamping.

Mechanical Properties:	
Room temperature, 68° F (20°C)	
	Squares (ETP)
Ultimate Tensile Strength (psi)	50,000
Yield Strength (psi)	45,000

Machinability: 20. **Hot Formed:** Excellent. **Cold Worked:** Excellent. **Forgeability:** 65. **Joining Techniques:** Excellent for: Soldering, brazing, gas shield arc welding. Good for: Oxyacetylene welding and butt weld; Not Recommended for: Coated metal arc, spot, and seam welding.

ALLOY 360 FREE-CUTTING BRASS FLATS

SIZE (IN)		LBS/FT.	LBS/144" LENGTH	SIZE (IN)		LBS/FT.	LBS/144" LENGTH
1/8 ×	1/4	.1151	1.381		1-3/4	2.4180	29.020
	3/8	.1727	2.072		2	2.7630	33.160
	1/2	.2303	2.764		2-1/2	3.4540	41.450
	3/4	.3454	4.145		3	4.1450	49.740
	1	.4605	5.526		4	5.5260	66.310
	1-1/4	.5756	6.907	1/2 ×	5/8	1.1510	13.810
	1-1/2	.6908	8.290		3/4	1.3820	16.580
	2	.9210	11.050		1	1.8420	22.100
	2-1/2	1.1510	13.810		1-1/4	2.3030	27.640
	3	1.3820	16.580		1-1/2	2.7630	33.160
3/16 ×	1/2	.3454	4.145		1-3/4	3.2240	38.690
	3/4	.5181	6.217	1/2 ×	2	3.684	44.210
	1	.6908	8.290		2-1/2	4.605	5.260
	1-1/4	.8634	10.360		3	5.526	66.310
	1-1/2	1.0360	12.430		3-1/2	6.447	77.360
	2	1.3820	16.580		4	7.368	88.420
	2-1/2	1.7270	20.720		5	9.210	110.500
	3	2.0720	24.860	3/4 ×	1	2.763	33.160
1/4 ×	3/8	.3454	4.145		1-1/4	3.454	1.450
	1/2	.4605	5.526		1-1/2	4.145	49.740
	3/4	.6908	8.290		2	5.526	66.310
	1	.9210	11.050		2-1/2	6.908	82.900
	1-1/4	1.1510	13.810		3	8.289	99.470
	1-1/2	1.3820	16.580		4	11.050	132.600
	1-3/4	1.6120	19.340	1 ×	1-1/4	4.605	55.260
	2	1.8420	22.100		1-1/2	5.526	66.310
	2-1/2	2.3030	27.640		2	7.368	88.42
	3	2.7630	33.160		2-1/4	8.289	99.47
	4	3.6840	44.210		2-1/2	9.210	110.50
	5	4.6050	55.260		3	11.050	132.60
3/8 ×	1/2	.6908	8.290		3-1/2	12.890	154.70
	3/4	1.0360	12.430		4	14.740	176.90
	1	1.3820	16.580		5	18.420	221.00
	1-1/4	1.7270	20.720		6	22.100	265.20
	1-1/2	2.0720	24.860				

ALLOY 360 FREE-CUTTING BRASS HEXAGONS

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
1/8	.0498	**1**	3.190
3/16	.1122	**1-1/8**	4.038
1/4	.1994	**1-3/16**	4.499
5/16	.3116	**1-1/4**	4.985
3/8	.4486	**1-3/8**	6.032
7/16	.6106	**1-1/2**	7.178
1/2	.7976	**1-5/8**	8.424
9/16	1.009	**1-3/4**	9.770
5/8	1.246	**2**	12.760
11/16	1.508	**2-1/4**	16.150
3/4	1.795	**2-1/2**	19.940
13/16	2.106	**2-3/4**	24.130
7/8	2.443	**3**	28.710

ALLOY 360 FREE-CUTTING BRASS ROUNDS

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
3/32	.0255	**1-3/4**	8.861
1/8	.0452	**1-7/8**	10.170
5/32	.0707	**2**	11.570
3/16	.1017	**2-1/8**	13.070
7/32	.1385	**2-1/4**	14.650
1/4	.1808	**2-3/8**	16.320
9/32	.2290	**2-1/2**	18.080
5/16	.2826	**2-5/8**	19.940
3/8	.4069	**2-3/4**	21.880
7/16	.5538	**3**	26.040
1/2	.7234	**3-1/4**	30.560
9/16	.9155	**3-1/2**	35.440
5/8	1.130	**3-3/4**	40.690
3/4	1.628	**4**	46.290
7/8	2.215	**4-1/4**	52.260
1	2.893	**4-1/2**	58.590
1-1/8	3.662	**4-3/4**	65.280
1-3/16	4.080	**5**	72.340
1-1/4	4.521	**5-1/2**	87.530
1-1/2	6.510	**6**	104.200

ALLOY 360 FREE-CUTTING BRASS SQUARES

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
1/8	.058	**1**	3.684
3/16	.130	**1-1/4**	5.756
1/4	.230	**1-3/8**	6.965
9/32	.291	**1-1/2**	8.289
5/16	.360	**1-5/8**	9.728
3/8	.518	**1-3/4**	11.280
7/16	.705	**2**	14.740
1/2	.921	**2-1/4**	18.650
9/16	1.166	**2-1/2**	23.030
5/8	1.439	**3**	33.160
3/4	2.072	**4**	58.940
7/8	2.821		

ALLOY 330 SEAMLESS BRASS TUBING

O.D.	WALL	I.D.	LBS/FT.	O.D.	WALL	I.D.	LBS/FT.
3/16	.032	.123	.0576	**1-1/4**	.032	1.186	.4511
1/4	.032	.186	.0807		.065	1.120	.8915
	.065	.120	.1392	**1-3/8**	.032	1.311	.4974
5/16	.032	.248	.1039		.065	1.245	.9855
	.065	.182	.1862	**1-1/2**	.032	1.436	.5437
3/8	.032	.311	.1270		.065	1.370	1.080
	.065	.245	.2332		.091	1.318	1.484
7/16	.032	.373	.1502	**1-5/8**	.065	1.495	1.174
	.065	.307	.2802	**1-3/4**	.032	1.686	.6363
1/2	.032	.436	.1733		.065	1.620	1.268
	.065	.370	.3272	**2**	.032	1.936	.7289
9/16	.032	.498	.1965		.065	1.870	1.456
	.065	.432	.3743	**2-1/4**	.065	2.120	1.644
5/8	.032	.561	.2196		.128	1.994	3.144
	.035	.555	.2390	**2-1/2**	.065	2.370	1.832
	.065	.495	.4213		.128	2.244	3.514
3/4	.032	.686	.2659	**3**	.065	2.870	2.208
	.065	.620	.5153		.128	2.744	4.255
7/8	.032	.811	.3122	**3-1/4**	.065	3.120	2.396
	.065	.745	.6094		.128	2.994	4.625
1	.032	.936	.3585	**3-1/2**	.065	3.370	2.584
	.065	.870	.7034		.128	3.244	4.995
1-1/8	.032	1.061	.4048	**3-3/4**	.065	3.620	2.772
	.065	.995	.7974		.128	3.494	5.366
1-3/16	.032	1.123	.4279	**4**	.065	3.870	2.960
	.065	1.057	.8444		.128	3.744	5.736
	.128	.931	1.5700				

660 CONTINUOUS CAST BEARING BRONZE

BRONZE HOLLOW BAR and ROUND BAR

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ALLOY 110 COPPER BUS BAR FLATS – SQUARE EDGE ELECTROLYTIC TOUGH PITCH

SIZE (IN)		LBS/FT.	LBS/144" LENGTH	SIZE (IN)		LBS/FT.	LBS/144" LENGTH
1/8 ×	3/8	.1817	2.180	3/8 ×	1/2	.727	8.722
	1/2	.2423	2.908		3/4	1.090	13.080
	5/8	.3028	3.634		1	1.454	17.450
	3/4	.3634	4.361		1-1/4	1.817	21.800
	1	.4845	5.814		1-1/2	2.180	26.160
	1-1/4	.6056	7.267		2	2.907	34.880
	1-1/2	.7268	8.722		2-1/2	3.634	43.610
	2	.9690	11.630		3	4.361	52.330
	3	1.4540	17.450		4	5.814	69.770
3/16 ×	1/2	.3634	4.361	1/2 ×	3/4	1.454	17.450
	3/4	.5451	6.541		1	1.938	23.260
	1	.7268	8.722		1-1/4	2.423	29.080
	1-1/4	.9084	10.900		1-1/2	2.907	34.880
	1-1/2	1.0900	13.080		2	3.876	46.510
	2	1.4540	17.450		3	5.814	69.770
	3	2.1800	26.160		4	7.752	93.020
1/4 ×	1/2	.4845	5.814	3/4 ×	1	2.907	34.880
	5/8	.6056	7.267		1-1/4	3.634	43.610
	3/4	.7268	8.722		1-1/2	4.361	52.330
	1	.9690	11.630		2	5.814	69.770
	1-1/4	1.2110	14.530		3	8.721	104.700
	1-1/2	1.4540	17.450		4	11.630	139.600
	2	1.9380	23.260	1 ×	1-1/4	4.845	58.140
	2-1/2	2.4230	29.080		1-1/2	5.814	69.770
	3	2.9070	34.880		2	7.752	93.020
	4	3.8760	46.510		3	11.630	139.600
	6	5.8140	69.770		4	15.500	186.000

.

ALLOY 122 COPPER PIPE

NOM. Size	O.D.	WALL	I.D.	LBS/FT.
1/8	.405	.062	.281	.2590
1/4	.540	.082	.375	.4573
3/8	.675	.090	.494	.6411
1/2	.840	.107	.625	.9550
3/4	1.050	.114	.822	1.2990
1	1.315	.126	1.062	1.8240
1-1/4	1.660	.146	1.368	2.6920
1-1/2	1.900	.150	1.600	3.1960
2	2.375	.156	2.062	4.2150
2-1/2	2.875	.187	2.500	6.1210

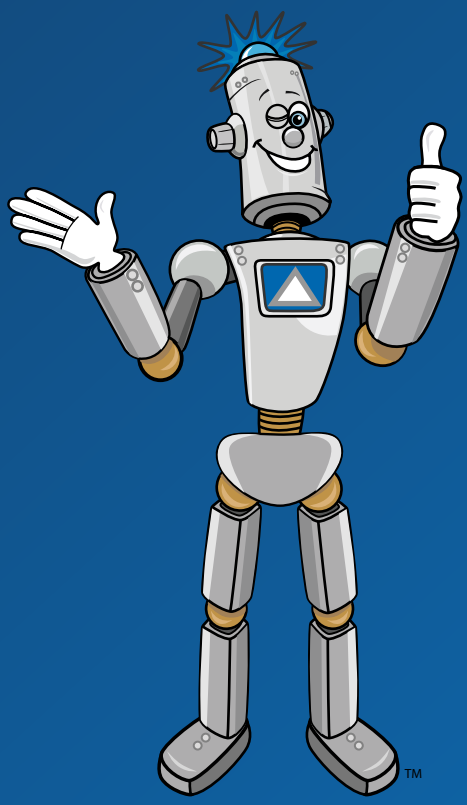
ALLOY 110 COPPER ROUNDS ELECTROLYTIC TOUGH PITCH

Size (inches)	Lbs/Ft.	Size (inches)	Lbs/Ft.
1/8	.0476	1-1/4	4.757
3/16	.1070	1-3/8	5.755
1/4	.1903	1-1/2	6.849
5/16	.2973	1-3/4	9.323
3/8	.4281	2	12.180
1/2	.7611	2-1/4	15.410
9/16	.9632	2-1/2	19.030
5/8	1.1890	2-3/4	23.020
3/4	1.7120	3	27.400
7/8	2.3310	3-1/2	37.290
1	3.0440	4	48.710
1-1/8	3.8530		

ALLOY 110 COPPER SQUARES – HARD PITCH ELECTROLYTIC TOUGH PITCH

Size (inches)	LBS/FT.	Lbs/144" LENGTH	Size (inches)	LBS/FT.	Lbs/144" LENGTH
1/4	.2423	2.908	1	3.876	46.510
3/8	.5451	6.541	1-1/4	6.056	72.670
1/2	.9690	11.630	1-1/2	8.721	104.700
5/8	1.514	18.170	2	15.500	186.000
3/4	2.180	26.160			

CARBON STEEL PLATE



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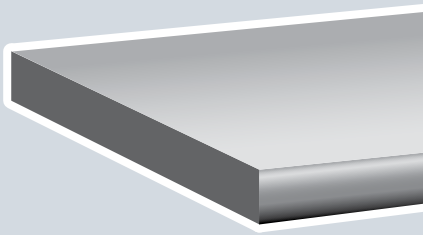
CARBON STEEL PLATE



DATA AND SPECIFICATIONS

HOT ROLLED – COMMERCIAL QUALITY CARBON STEEL PLATE

Applications: Storage tanks, storage bins, welded pipe, bridge construction, freight and passenger cars, barges, tankers, machinery construction, mining cars and equipment, bearing plates for buildings, other structural applications and various parts obtained by flame cutting.

Analysis:					
3/4" and under:	C – .25 Max.	Mn – .60/1.15	P – .04	S – .05	
Over 3/4"to 11/2":	C – .25 Max.	Mn – .80/1.20	P – .04	S – .05	
Over 1 1/2"to 2 1/2":	C – .26 Max.	Mn – .80/1.20	P – .04	S – .05	Si – .15/.40
Over 2 1/2" to 4":	C – .27 Max.	Mn – .85/1.20	P – .04	S – .05	Si – .15/.40
Over 4":	C – .29 Max.	Mn – .85/1.20	P –.04	S – .05	Si – .15/.40

Mechanical Properties:	
Following values are average and are representative	
Tensile Strength (psi)	58/80,000
Yield Point (psi)	36,000 Min.
Elongation in 8"* (%)	18 Min.

* Subject to reduction for thickness under 5/16"

Machinability: 72% based on 1212 as 100%. **Surface Cutting Speed:** 120 ft/Min. **Weldability:** Excellent. Easily welded by all welding processes and the resultant welds and joints are of extremely high quality. Grade of welding rod used depends on welding conditions such as thickness of section, design, service requirements, etc.

CARBON STEEL FLOOR PLATES

Provides maximum skid resistance regardless of how the plate is laid or the angle from which it is approached.

Applications: Running board steps, floors, walkways, platforms, cover plates, stair treads, hatch covers, trench covers, truck runways, conveyors, etc.

Analysis:		
C – .10/.25	Mn – .30/.70	P – .05 Approx.
S – .05 Approx.		

Mechanical Properties:	
Floor plates are not normally used as stress-carrying members and are seldom specified to tensile requirement. However, properties are approximately as follows:	
Tensile Strength (psi)	60,000
Yield Strength (psi)	33,000
Elongation in 2" (%)	22

Machinability: Can be machined or drilled readily.

Weldability: Easily welded by all welding processes and the resultant welds and joints are of extremely high quality. Grade of welding rod used depends on welding conditions such as thickness of section, design, service requirements, etc.

CARBON STEEL TREAD PLATE

STOCK SIZE (inch)	ESTIMATED WEIGHT LBS. /SQ. FT.	/PLATE
0.060"		
48 × 120	**3.00**	120.00
× 144		144.00
0.075"		
30 × 168	**3.75**	131.30
36 × 96		90.00
× 120		112.50
× 144		135.00
48 × 96		120.00
× 120		150.00
× 144		180.00
0.104"		
30 × 120	**5.25**	131.30
× 180		196.90
36 × 96		126.00
× 120		157.50
× 144		189.00
× 180		236.30
48 × 96		168.00
× 120		210.00
× 144		252.00
× 240		420.00
0.104"		
60 × 96	**5.25**	210.00
× 120		262.50
× 144		315.00
× 240		525.00
1/8		
42 × 96	**6.15**	172.20
48 × 96		196.80
× 120		246.00
× 144		295.20
× 168		344.40
× 192		393.60
× 240		492.00
× 288		590.40
60 × 96		246.00
× 120		307.50
× 144		369.00
× 240		615.00
× 288		738.00
72 × 240		738.00
× 288		885.60

STOCK SIZE (inch)	ESTIMATED WEIGHT LBS. /SQ. FT.	/PLATE
3/16		
× 24	**8.71**	17.42
× 30		21.78
× 36		26.13
× 42		30.49
× 48		34.84
× 60		43.55
× 72		52.26
× 84		60.97
× 96		69.68
1/4		
× 48	**11.26**	45.04
× 60		56.30
× 72		67.56
× 84		78.82
× 96		90.08
5/16		
× 48	**13.81**	55.24
× 60		69.05
× 72		82.86
× 84		96.67
× 96		110.50
3/8		
× 48	**16.37**	65.48
× 60		81.85
× 72		98.22
× 84		114.60
× 96		131.00
1/2		
× 48	**21.47**	85.88
× 60		107.40
× 72		128.80
× 84		150.30
× 96		171.80
5/8		
× 60	**25.58**	132.90
× 72		159.50
3/4		
× 60	**31.68**	158.40
× 96		253.40

CARBON STEEL PLATE

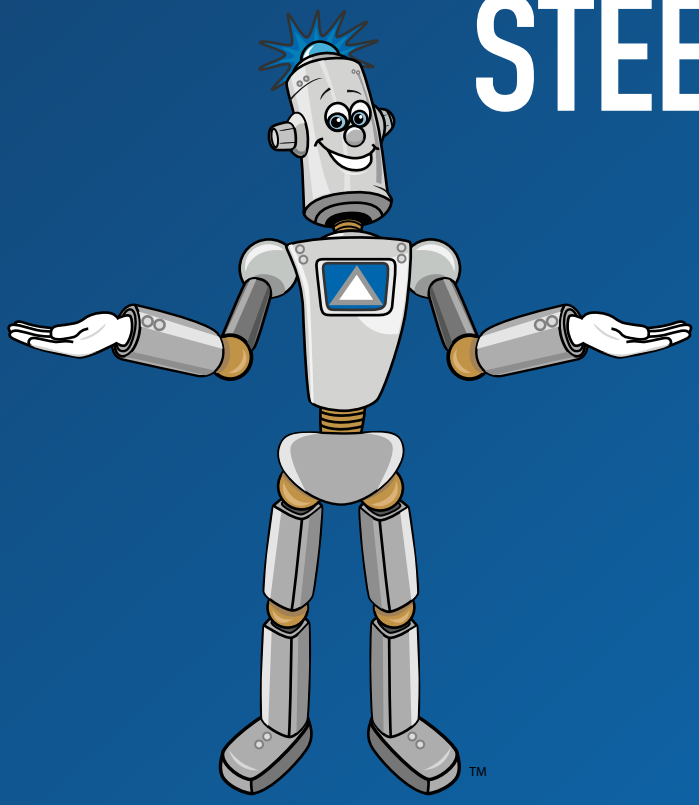
THICKNESS	WT./ SQ. IN.	WT./ SQ. FT.	WEIGHT PER LINEAL FOOT 48" WIDE	60" WIDE	72" WIDE	84" WIDE	96" WIDE	120" WIDE
3/16	.0532	7.66	30.64	38.30	45.96	53.62	61.28	76.60
1/4	.0709	10.21	40.84	51.05	61.26	71.47	81.68	102.10
5/16	.0886	12.76	51.04	63.80	76.56	89.32	102.08	127.60
3/8	.1064	15.31	61.24	76.55	91.86	107.17	122.48	153.10
7/16	.1241	17.87	72.48	89.35	107.22	125.09	142.96	178.70
1/2	.1418	20.42	81.68	102.10	122.52	142.94	163.36	204.20
9/16	.1595	22.97	91.88	114.85	137.82	160.79	183.76	229.70
5/8	.1773	25.52	102.08	127.60	153.12	178.64	204.16	255.20
11/16	.1950	28.08	112.32	140.40	168.48	196.56	224.61	280.80
3/4	.2127	30.63	122.52	153.15	183.78	214.41	245.04	306.30
7/8	.2481	35.73	142.92	175.65	214.38	250.11	285.84	357.30
1	.2836	40.84	163.36	204.20	245.04	285.88	326.72	408.40
1-1/8	.3191	45.94	183.76	229.70	275.64	321.58	367.51	459.40
1-1/4	.3545	51.05	204.20	255.25	306.30	357.35	408.40	510.50
1-3/8	.3900	56.16	224.64	280.80	336.96	393.12	449.28	561.60
1-1/2	.4254	61.26	245.04	306.30	367.56	428.82	490.08	612.60
1-5/8	.4609	66.36	265.44	331.80	398.16	464.52	530.88	663.60
1-3/4	.4963	71.47	285.88	357.35	428.82	500.29	571.76	714.70
1-7/8	.5318	76.57	306.28	382.85	459.42	535.99	612.56	765.70
2	.5672	81.68	326.72	408.40	490.08	571.76	653.44	816.80
2-1/8	.6027	86.78	347.12	433.90	520.68	607.46	694.24	867.80
2-1/4	.6381	91.89	367.56	459.45	551.34	643.23	735.12	918.90
2-1/2	.7090	102.10	408.40	510.50	612.60	714.70	816.80	1021.00
2-3/4	.7799	112.31	449.24	561.55	673.86	786.17	898.48	1123.10
3	.8508	122.52	490.08	612.60	735.12	857.64	980.16	1225.20
3-1/4	.9217	132.72	530.88	663.60	796.32	929.04	1061.76	1327.20
3-1/2	.9926	142.93	571.72	714.65	857.58	1000.51	1143.44	1429.30
3-3/4	1.0635	153.14	612.56	765.70	918.84	1071.98	1225.12	1531.40
4	1.1344	163.35	653.40	816.75	980.10	1143.45	1306.80	1633.50
4-1/4	1.2053	173.56	694.24	867.80	1041.36	1214.92	1388.48	1735.60
4-1/2	1.2762	183.77	735.08	918.85	1102.62	1286.39	1470.16	1837.70
5	1.4180	204.19	816.76	1020.95	1225.14	1429.33	1633.52	2041.90
5-1/2	1.5598	224.61	898.44	1123.05	1347.66	1572.27	1796.88	2246.10
6	1.7016	245.06	980.12	1225.15	1470.18	1715.21	1960.24	2450.30
6-1/2	1.8434	265.45	1061.80	1327.25	1592.70	1858.15	2123.60	2654.50
7	1.9852	285.87	1143.48	1429.35	1715.22	2001.09	2286.96	2858.70
7-1/2	2.1270	306.29	1225.16	1531.45	1837.74	2144.03	2450.32	3062.90
8	2.2688	326.71	1306.84	1633.55	1960.26	2286.97	2613.68	3267.10
8-1/2	2.4106	347.13	1388.52	1735.65	2082.78	2429.91	2777.04	3471.30
9	2.5524	267.55	1470.20	1837.75	2205.30	2572.85	2940.40	3675.50
10	2.8360	408.38	1633.52	2041.90	2450.28	2858.66	3267.04	4083.80
12	3.4032	490.06	1960.24	2450.30	2940.36	3430.42	3920.48	4900.60
12-1/2	3.5450	510.48	2041.92	2552.40	3062.88	3573.36	4083.84	5104.80

Continued

CARBON STEEL PLATE

THICKNESS	WT./ SQ. IN.	WT./ SQ. FT.	WEIGHT PER LINEAL FOOT 48" WIDE	60" WIDE	72" WIDE	84" WIDE	96" WIDE	120" WIDE
13	3.6868	530.90	2123.60	2654.50	3185.40	3716.29	4247.19	5309.00
13-1/2	3.8286	551.32	2205.28	2756.60	3307.92	3859.23	4410.56	5513.20
14	3.9704	571.74	2286.96	2858.70	3430.44	4002.16	4573.90	5717.38
14-1/2	4.1122	592.16	2368.64	2960.78	3552.94	4145.10	4737.25	5921.57
15	4.2540	612.58	2450.30	3062.88	3675.46	4288.03	4900.61	6125.76
15-1/2	4.3958	633.00	2532.00	3164.98	3797.97	4430.99	5063.96	6329.95
16	4.5376	653.41	2613.66	3267.07	3920.49	4573.90	5227.32	6534.14
17	4.8212	694.25	2777.01	3471.26	4165.52	4859.77	5554.02	6942.53
18	5.1048	735.09	2940.36	3675.46	4410.55	5145.64	5880.73	7350.91
20	5.6720	816.77	3267.07	4083.84	4900.61	5717.38	6534.14	8167.68

CARBON STEEL SHEET



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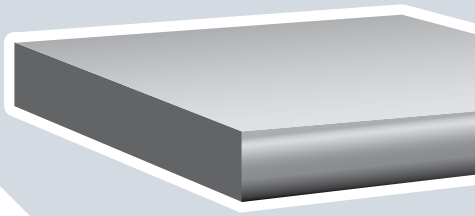
CARBON STEEL SHEET



DATA AND SPECIFICATIONS

HOT ROLLED PICKLED AND OILED COMMERCIAL QUALITY CARBON STEEL SHEET

Pickled and Oiled Sheets should be used when the tight oxide scale present on Hot Rolled Sheets is objectionable.

Applications: The superior smooth, clean surface is especially suited for stamping and ordinary drawing applications.

Hot Rolled Sheets may also be used for structural purposes where mechanical property test values are required, in which case ASTM A570 should be specified.

Analysis		
C – .15	Mn – .60 Max.	P – .04 Max.
S – .040 Max.		

Mechanical Properties:		
Following minimum properties apply to Grades 30 and 33		
	Grade 30	**Grade 33**
Tensile Strength (psi)	49,000	52,000
Yield Point (psi)	30,000	33,000
Elongation(% in 2")	35-42	38-43
(.0255" - .0635")	21	18
(.0636" - .0971")	24	22
(.0972" - .2299")	25	23

Weldability: Yes. **Forming:** Yes.

GALVANIZED STEEL SHEET

Steel sheets are hot dip coated with a durable protective coating of zinc. This material is intended for uses where corrosion is a consideration and where simple bending or moderate forming is involved. They may be bent flat upon themselves in any direction at room temperature without cracking.

Applications: For general utility uses such as corrugated siding and roofing, culverts, window frames, heating and ventilating ducting, cornices, eaves troughs, etc. Galvanized sheets are sometimes painted, but when a superior paint retaining surface is desired the use of Electrolytic Zinc Coated Sheets are recommended.

Analysis		
C – .15 Max.	Mn – .60 Max.	P – .035 Max.
S – .04 Max.		

COLD ROLLED COMMERCIAL QUALITY CARBON STEEL SHEET – OILED

Cold Rolled Commercial Quality Sheets are produced from rimmed, capped and semi-killed steel and are intended for exposed or unexposed parts involving bending, moderate drawing or forming and welding. They may be bent flat on themselves in any direction without cracking.

Applications: Practical experience is usually sufficient to determine whether Commercial Quality or Drawing Quality is required, otherwise, the Scribed Square Test (ASTM A 568) can be helpful. A grid of 1" squares is marked on the section representing the most severe draw. The squares are measured for percent increase in area after drawing. Experience has shown that Commercial Quality is usually satisfactory if the increase in the area is less than 25%.If more than 25%, Drawing Quality is recommended.

Analysis:		
C – .15 Max.	Mn – .60 Max.	P – .035 Max.
S – .04 Max.		

Mechanical Properties:		
Following values are average and are representative		
	Commercial	**Drawing**
Tensile Strength (psi)	38-50,000	36-46,000
Yield Point (psi)	25-35.000	23-30,000
Elongation (% in 2")	35-42	38-43

Weldability: Yes. **Forming:** Yes.

HOT ROLLED – COMMERCIAL QUALITY CARBON STEEL SHEET

Hot Rolled Commercial Quality Sheets are produced from low carbon rimmed, capped or semi-killed steel, and are intended for uses involving simple bending or moderate drawing and welding. They can be bent flat on themselves in any direction at room temperature without cracking on the outside of the bent portion.

Applications: From agricultural implements to automotive equipment, blower and ventilating systems, hot air registers, stub barrels and drums to bins and partitions. Hot Rolled Sheets may also be used for structural purposes where mechanical property test values are required, in which case ASTM A570 should be specified.

Analysis:		
C – .15 Max.	Mn – .60 Max.	P – .035 Max.
S – .04 Max.		

Weldability: Yes. **Forming:** Yes.

CARBON STEEL SHEET COLD ROLLED COMMERCIAL QUALITY – OILED

GAUGE AND SIZE (INCHES)	Lbs/ SHEET	GAUGE AND SIZE (INCHES)	Lbs/ SHEET
26 Ga. (.0179) .750 # Sq. Ft.		**16 Ga. (.0598) 2.500 # Sq. Ft.**	
36 × 120	22.50	**36 × 144**	90.00
48 × 120	30.00	**48 × 96**	80.00
24 Ga. (0.239) 1.000 # Sq. Ft.		**48 × 120**	100.00
30 × 96	20.00	**48 × 144**	120.00
36 × 96	24.00	**60 × 120**	125.00
42 × 120	35.00	**60 × 144**	150.00
48 × 96	32.00	**72 × 120**	150.00
48 × 120	40.00	**72 × 144**	180.00
22 Ga. (.0299) 1.250 # Sq. Ft.		**14 Ga. (.0747) 3.125 # Sq. Ft.**	
30 × 96	25.00	**36 × 96**	75.00
36 × 96	30.00	**36 × 120**	93.75
48 × 96	40.00	**48 × 96**	100.00
48 × 120	50.00	**48 × 120**	125.00
48 × 144	60.00	**48 ×144**	150.00
20 Ga. (.0359) 1.500 # Sq. Ft.		**60 X 120**	156.30
30 × 96	30.00	**60 X 144**	187.50
36 ×96	36.00	**72 X 120**	181.50
36 × 120	45.00	**72 × 144**	225.00
36 × 144	54.00	**13 Ga. (.0897) 3.750 # Sq. Ft.**	
48 ×96	48.00	**36 × 96**	90.00
78 × 120	60.00	**36 × 120**	112.50
48 × 144	72.00	**48 × 96**	120.00
60 × 120	75.00	**48 × 120**	150.00
60 × 144	90.00	**48 × 144**	180.00
19 Ga. (.0418) 1.750 # Sq. Ft.		**12 Ga. (.1046) 4.375 # Sq. Ft.**	
36 × 96	42.00	**36 × 96**	105.00
36 × 120	52.50	**36 × 120**	131.30
48 × 96	56.00	**48 × 96**	140.00
48 × 120	70.00	**48 × 120**	175.00
60 × 120	87.50	**48 × 144**	210.00
18 Ga. (.0478) 2.000 # Sq. Ft.		**60 × 120**	218.80
30 × 96	40.00	**60 × 144**	262.50
36 × 96	48.00	**11 Ga. (.1196) 5.000 # Sq. Ft.**	
36 × 120	60.00	**36 × 96**	120.00
36 × 144	72.00	**36 × 120**	150.00
48 × 96	64.00	**48 × 96**	160.00
48 × 120	80.00	**48 × 120**	200.00
48 × 144	96.00	**48 × 144**	240.00
60 × 120	100.00	**60 × 120**	250.00
16 Ga. (.0598) 2.500 # Sq. Ft.		**10 Ga. (.1345) 5.625 # Sq. Ft.**	
30 × 96	50.00	**36 × 96**	135.00
36 × 96	60.00	**36 × 120**	168.80
36 × 120	75.00	**48 × 96**	180.00
		48 × 120	225.00

CARBON STEEL SHEET HOT ROLLED (BLACK) COMMERCIAL QUALITY

GAUGE AND SIZE (INCHES)	Lbs/ SHEET	GAUGE AND SIZE (INCHES)	Lbs/ SHEET
16 Ga. (.0598) 2.500 # Sq. Ft.		**10 Ga. (.1345) 5.625 # Sq. Ft.**	
36 × 96	60.00	**30 × 96**	112.50
36 × 120	75.00	**36 × 96**	135.00
36 × 144	90.00	**36 × 120**	168.80
48 × 96	80.00	**36 × 144**	202.50
48 × 120	100.00	**48 × 96**	180.00
48 × 144	120.00	**48 × 120**	225.00
14 Ga. (.0747) 3.125 # Sq. Ft.		**48 × 144**	270.00
36 × 96	75.00	**60 × 120**	281.30
36 × 120	93.75	**60 × 144**	337.50
36 × 144	112.50	**72 × 120**	337.50
48 × 96	100.00	**72 × 144**	405.00
48 × 120	125.00	**72 × 240**	675.00
48 × 144	150.00	**96 × 240**	939.40
60 × 120	156.30	**9 Ga. (.1495) 6.25 # Sq. Ft.**	
60 × 144	187.50	**48 × 120**	250.00
12 Ga. (.1046) 4.375 # Sq. Ft.		**8 Ga. (.1644) 6.875 # Sq. Ft.**	
36 × 96	105.00	**36 × 96**	165.00
36 × 120	131.30	**36 × 120**	206.30
36 × 144	157.50	**48 × 96**	220.00
42 × 120	153.10	**48 × 120**	275.00
48 × 96	140.00	**60 × 96**	275.00
48 × 120	175.00	**60 × 120**	343.80
48 × 144	210.00	**7 Ga. (.1793) 7.500 # Sq. Ft.**	
60 × 120	218.80	**36 × 96**	180.00
60 × 144	262.50	**36 × 120**	225.00
72 × 120	262.50	**36 × 144**	270.00
72 × 144	315.00	**48 × 96**	240.00
11 Ga. (.1196) 5.000 # Sq. Ft.		**48 × 120**	300.00
36 × 96	120.00	**48 × 144**	360.00
36 × 120	150.00	**60 × 120**	375.00
48 × 96	160.00	**60 × 144**	450.00
48 × 120	200.00	**72 × 96**	360.00
48 × 144	240.00	**72 × 120**	450.00
60 × 120	250.00	**72 × 144**	540.00
60 × 144	300.00	**6 Ga. (.1943) 8.125 # Sq. Ft.**	
72 × 120	300.00	**36 × 120**	243.80
72 × 144	360.00	**48 × 96**	260.00
96 × 240	835.30	**48 × 120**	325.00

CARBON STEEL SHEET HOT ROLLED COMMERCIAL QUALITY – PICKLED AND OILED

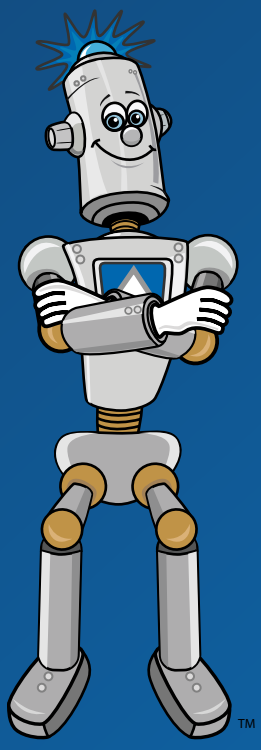
GAUGE AND SIZE (INCHES)	Lbs/ SHEET	GAUGE AND SIZE (INCHES)	Lbs/ SHEET
16 Ga. (0.598) 2.500 # Sq. Ft.		**11 Ga. (.1196) 5.000 # Sq. Ft.**	
36 × 120	75.00	**60 × 144**	300.00
48 × 120	100.00	**72 × 120**	300.00
60 × 120	125.00	**72 × 144**	360.00
14 Ga. (.0747) 3.125 # Sq. Ft.		**72 × 160**	400.00
36 × 96	75.00	**10 Ga. (.1345) 5.625 # Sq. Ft.**	
36 × 120	93.75	**36 × 96**	135.00
36 × 144	112.50	**36 × 120**	168.80
48 × 96	100.00	**48 × 96**	180.00
48 × 120	125.00	**48 × 120**	225.00
48 × 144	150.00	**48 × 144**	270.00
60 × 120	156.30	**60 × 120**	281.30
60 × 144	187.50	**60 × 144**	337.50
13 Ga. (.0897) 3.750 # Sq. Ft.		**72 × 96**	270.00
36 × 96	90.00	**72 × 120**	337.50
36 × 120	112.50	**72 × 144**	405.00
48 × 96	120.00	**9 Ga. (.1495) 6.25 # Sq. Ft.**	
48 × 120	150.00	**78 × 96**	200.00
60 × 120	187.50	**78 × 120**	250.00
12 Ga. (.1046) 4.375 # Sq. Ft.		**8 Ga. (.1644) 6.875 # Sq. Ft.**	
36 × 96	105.00	**48 × 96**	220.00
36 × 120	131.30	**48 × 120**	275.00
48 × 96	140.00	**7 Ga. (.1793) 7.500 # Sq. Ft.**	
48 × 120	175.00	**36 × 96**	180.00
48 × 144	210.00	**36 × 120**	225.00
60 × 120	218.80	**48 × 96**	240.00
60 × 144	262.50	**48 × 120**	300.00
72 × 96	210.00	**48 × 144**	360.00
72 × 120	262.50	**60 × 120**	375.00
72 × 144	315.00	**60 × 144**	450.00
11 Ga. (.1196) 5.000 # Sq. Ft.		**72 × 120**	450.00
36×96	120.00	**72 × 144**	540.00
36 × 120	150.00	**6 Ga. (.1943) 8.125 # Sq. Ft.**	
48 × 96	160.00	**36 × 120**	243.80
48 × 120	200.00	**48 × 96**	260.00
48 × 144	240.00	**48 × 120**	325.00
60 × 120	250.00		

GALVANIZED – CARBON STEEL SHEET

GAUGE AND SIZE (INCHES)	Lbs/ SHEET	GAUGE AND SIZE (INCHES)	Lbs/ SHEET
28 Ga. (.018) 0.781 # Sq. Ft.		**16 Ga. (.0635) 2.656 # Sq. Ft.**	
36 × 96	18.79	**36 × 120**	79.68
48 × 96	25.05	**36 × 144**	95.60
48 × 120	31.32	**48 × 96**	84.99
26 Ga. (.0217) .906 # Sq. Ft.		**48 × 120**	106.20
36 × 120	27.18	**48 × 144**	127.50
48 × 96	28.99	**60 × 120**	132.80
48 × 120	36.24	**14 Ga. (.0785) 3.281 # Sq. Ft.**	
60 × 120	45.30	**36 × 96**	78.740
24 Ga. (.0276) 1.156 # Sq. Ft.		**36 × 120**	98.430
36 × 96	27.74	**36 × 144**	118.10
36 × 120	34.68	**48 × 96**	105.00
48 × 96	36.99	**48 × 120**	131.20
48 × 120	46.24	**48 × 144**	157.50
48 × 144	55.49	**60 × 120**	164.10
60 × 120	57.80	**12 Ga. (.1084) 4.531 # Sq. Ft.**	
22 Ga. (.0336) 1.406 # Sq. Ft.		**36 × 96**	108.70
36 × 96	33.74	**36 × 120**	135.90
36 × 120	42.18	**48 × 96**	145.00
48 × 96	44.99	**48 × 120**	181.20
48 × 120	56.24	**48 × 144**	217.50
60 × 120	70.30	**60 × 120**	226.60
20 Ga. (.0396) 1.656 # Sq. Ft.		**60 × 144**	271.90
36 × 96	39.74	**11 Ga (.1233) 5.1S6 # Sq. Ft.**	
36 × 120	49.68	**48 × 96**	165.00
48 × 96	52.99	**48 × 120**	206.20
48 × 120	66.24	**48 × 144**	247.50
48 × 144	79.49	**10 Ga. (.1382) S.781 # Sq. Ft.**	
60 × 120	82.80	**36 × 96**	138.70
18 Ga (.0516) 2.156 # Sq. Ft.		**36 × 120**	173.40
36 × 96	51.74	**48 × 96**	185.00
36 × 120	64.68	**48 × 120**	231.20
48 × 96	68.99	**48 × 144**	277.50
48 × 120	86.24	**60 × 120**	289.10
48 × 144	103.50	**8 Ga (.1681) 7.031 # Sq. Ft.**	
60 × 120	107.80	**48 × 120**	281.20
16 Ga (.0635) 2.656 # Sq. Ft.		**48 × 144**	337.50
36 × 96	63.74		

Typically coated with a G.90 (Z275) coating, however in certain cases a G.60 (Z180) coating can be found.

COLD FINISHED STEEL BARS



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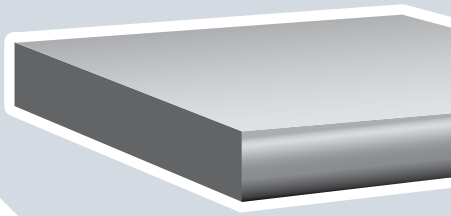
COLD FINISHED STEEL BARS



DATA AND SPECIFICATIONS

C1018 COLD FINISHED BAR

A low carbon steel with medium manganese content.

Applications: Cold forming and bending operations (for severe bends stress relieving may be needed to prevent cracking); carburized parts requiring soft core and high surface hardness such as king pins, gears, dogs, etc. Also suitable for parts requiring cold forming such as crimping, swaging or bending.

Analysis:		
C – .15/.20	Mn – .60/.90	P – .04 Max.
S – .05 Max.		

Mechanical Properties:		
Following are minimum properties based on typical 1”bar). Conforms to ASTM A108.		
	1” rd Cold	**1” rd Hot**
Tensile Strength (psi)	64,000	58,000
Yield Point (psi)	54,000	36,000
Elongation (% in 2”)	15	25
Reduction of Area (%)	55	
Brinell Hardness	125	120

Machinability: 78% based on 1212 as 100%. **Surface Cutting Speed:** 130 ft/min. **Weldability:** Excellent by all processes forming extremely high quality joints and welds. **Hardening:** Standard carburizing methods. Hard case and tough core carburize at 1650° F - 1700° F for approx. 8 hrs. Oven cool. Reheat to 1400° F - 1450° F. Water quench and draw at 300° F - 350° F.

C1045 COLD FINISHED BAR

A medium carbon steel allowing higher strength properties than 1018. A wide range of properties can be obtained.

Applications: Shafts, machinery parts, bolts, pinions, gears.

Analysis:		
C – .43/.50	Mn – .60/.90	P – .04 Max.
S – .05 Max.		

Mechanical Properties:	
Following are minimum properties based on typical 1” bar	
	1”rd
Tensile Strength (psi)	82,000
Yield Point (psi)	45,000
Elongation (% in 2”)	16
Reduction of Area (%)	32
Brinell Hardness	162

Machinability: 64% based on 1212 as 100%. **Surface Cutting Speed:** 95-105 ft/min. **Weldability:** Fair. With thin sections and flexible design, gas or arc welding may be used without preheating except in joints over 1/2” to 3/4”thick where preheating is necessary. For equivalent strength in a weld a low alloy filler is recommended. Stress relieving after is recommended. Grade of welding rod to be used depends on thickness of section, design, service requirement, etc. **Hardening:** Essentially water hardened (1550° F) although can be quenched in oil (1575° F). Wide range of mechanical properties obtained by tempering between 700° F to 1300° F. Avoid tempering between 500° F and 700° F.

C1144 STRESSPROOF™ COLD FINISHED BAR

Medium carbon-free machining steel severely cold reduced to improve mechanical properties. Its inherent strength without heat treatment is comparable to heat treated steels of equal hardness.

Applications: Arbors, keyed shafts, spindles, gears, pinions, piston rods, sleeves, lead screws, racks, motor shafts, pump shafts, link pins, mandrels, boring bars, collets, bushings, drive shafts, armature shafts, king pins.

Analysis:		
C – .40/.48	Mn – 1.35/1.65	P – .04 Max.
S – .24/.33		

Mechanical Properties:	
Following are minimum properties based on typical 1" bar	
	Thru 2"
Tensile Strength (psi)	115,000
Yield Point (psi)	100,000
Elongation(% in 2")	8
Reduction of Area (%)	25
Brinell Hardness	26

Machinability: 83% of B1112. **Surface Cutting Speed:** 140 ft/min. **Weldability:** None.

StressProof™ is a registered trademark of the LaSalle Steel Co.

C12L14 COLD FINISHED BAR – SCREW MACHINE STOCK

The fastest machining steels available, this is essentially a resulfurized, rephosphorized screw stock with lead added.

Applications: Bushings, inserts, couplings, hydraulic hose fittings.

Analysis:		
C – .15 Max.	Mn – .85/1.15	P – .04/.09
S – .26/.35	Pb – .15/.35	

Mechanical Properties:	
Following are minimum properties based on typical 1" bar	
	1"rd
Tensile Strength (psi)	78,000
Yield Point (psi)	60,000
Elongation(% in 2")	15
Reduction of Area (%)	50
Brinell Hardness	163

Machinability: 193%. **Surface Cutting Speed:** 325 ft/min. **Weldability:** None due to high sulphur content. **Hardening:** Not considered a case hardening grade.

COLD FINISHED BARS: MECHANICAL PROPERTIES COMPARISON

Following are minimum properties based on typical 1" bar.
Larger bars will typically have lower values.
Cold rolled 1018 steel products conforms to ASTM A108.

	1018		1045	1144	12L14	4140H
	Hot	Cold				
Tensile, ksi	58,000	64,000	82,000	115,000	78,000	135,000
Yield, ksi	36,000	54,000	45,000	100,000	60,000	125,000
Elongation, %	25	15	16	8	15	16
Reduction of Area (%)		55	32	25	50	
Brinell Hardness	120	125	162	250	163	26

C1018 COLD FINISHED STEEL FLATS

SIZE (INCHES)	Lbs./ FT.	SIZE (INCHES)	Lbs./ FT.
1/8 ×		**3/16 ×**	
1/4	.1063	6	3.8250
3/8	.1594	7	4.4780
1/2	.2125	8	5.1000
5/8	.2656	9	5.7580
3/4	.3188	10	6.3750
7/8	.3719	**1/4 ×**	
1	.4250	3/8	.3188
1-1/4	.5313	7/16	.3719
1-1/2	.6375	1/2	.4250
1-3/4	.7438	9/16	.4781
2	.8500	5/8	.5313
2-1/4	.9563	11/16	.5844
2-1/2	1.0630	3/4	.6375
2-3/4	1.1690	7/8	.7438
3	1.2750	1	.8500
3-1/2	1.4880	1-1/8	.9563
4	1.7000	1-1/4	1.063
5	2.1250	1-3/8	1.169
6	2.5500	1-1/2	1.275
3/16×		1-3/4	1.488
1/4	.1594	2	1.700
3/8	.2391	2-1/2	2.125
1/2	.3188	3	2.550
5/8	.3984	3-1/2	2.975
3/4	.4781	4	3.400
7/8	.5578	4-1/2	3.825
1	.6375	5	4.250
1-1/4	.7969	5-1/2	4.675
1-1/2	.9563	6	5.100
1-3/4	1.1160	7	5.950
2	1.2750	8	6.800
2-1/2	1.5940	9	7.650
3	1.9130	10	8.500
3-1/2	2.2310	11	9.350
4	2.5500	12	10.200
5	3.1880		

C1018 COLD FINISHED STEEL FLATS

SIZE (INCHES)	Lbs./ FT.	SIZE (INCHES)	Lbs./ FT.
5/16 X		**3/8 X**	
3/8	.3984	3-1/2	4.4630
7/16	.4648	4	5.1000
1/2	.5313	4-1/2	5.7380
9/16	.5977	5	6.3750
5/8	.6641	5-1/2	7.0130
3/4	.7969	6	7.6500
7/8	.9297	7	8.9250
1	1.0630	8	10.2000
1-1/8	1.1950	9	11.4800
1-1/4	1.3280	10	12.7500
1-3/8	1.4610	12	15.3000
1-1/2	1.5940	**7/16X**	
1-3/4	1.8590	1/2	.7438
2	2.125	5/8	.9297
2-1/4	2.3910	3/4	1.1160
2-1/2	2.6560	1	1.4880
2-3/4	2.9220	1-1/4	1.8590
3	3.1880	1-1/2	2.2310
3-1/4	3.4530	2	2.9750
3-1/2	3.7190	2-1/2	3.7190
4	4.2500	3	4.4630
4-1/2	4.7810	4	5.9500
5	5.3130	**1/2 X**	
6	6.3750	9/16	.9563
7	7.4380	5/8	1.0630
8	8.5000	3/4	1.2750
9	9.5560	7/8	1.4880
10	10.6300	1	1.7000
12	12.7500	1-1/4	2.1250
3/8 X		1-1/2	2.5500
7/16	.5578	1-3/4	2.9750
1/2	.6375	2	3.4000
5/8	.7969	2-1/2	4.2500
3/4	.9563	3	5.1000
7/8	1.1160	3-1/2	5.9500
1	1.2750	4	6.8000
1-1/4	1.5940	4-1/2	7.6500
1-1/2	1.9130	5	8.5000
1-5/8	2.0720	5-1/2	9.3500
1-3/4	2.2310	6	10.2000
2	2.5500	7	11.9000
2-1/2	3.1880	8	13.6000
3	3.8250	9	15.3000

C1018 COLD FINISHED STEEL FLATS

SIZE (INCHES)	Lbs./ FT.	SIZE (INCHES)	Lbs./ FT.
1/2 ×		**3/4 ×**	
10	17.000	3	7.650
12	20.400	3-1/2	8.925
9/16 ×		4	10.200
5/8	1.195	4-1/2	11.480
3/4	1.434	5	12.750
1	1.913	6	15.300
1-1/2	2.869	7	17.850
2	3.825	8	20.400
5/8 ×		9	22.950
11/16	1.461	10	25.500
3/4	1.594	12	30.600
7/8	1.859	**7/8 ×**	
1	2.125	1-1/2	4.463
1-1/4	2.656	2	5.950
1-1/2	3.188	2-1/2	7.438
1-3/4	3.719	3	8.925
2	4.250	**1 ×**	
2-1/4	4.781	1-1/8	3.825
2-1/2	5.313	1-1/4	4.250
2-3/4	5.844	1-3/8	4.675
3	6.375	1-1/2	5.100
3-1/2	7.438	1-5/8	5.525
4	8.500	1-3/4	5.950
4-1/2	9.563	2	6.800
5	10.630	2-1/4	7.650
5-1/2	11.690	2-1/2	8.500
6	12.750	2-3/4	9.350
7	14.880	3	10.200
8	17.000	3-1/4	11.050
10	21.250	3-1/2	11.900
12	25.500	4	13.600
3/4×		4-1/2	15.300
7/8	2.231	5	17.000
1	2.550	5-1/2	18.700
1-1/4	3.188	6	20.400
1-1/2	3.825	7	23.800
1-3/4	4.463	8	27.200
2	5.100	9	30.600
2-1/4	5.738	10	34.000
2-1/2	6.375	12	40.800
2-3/4	7.013		

C1018 COLD FINISHED STEEL FLATS

SIZE (INCHES)	Lbs./ FT.	SIZE (INCHES)	Lbs./ FT.
1-1/4 ×		**2 ×**	
1-1/2	6.375	2-1/4	15.300
1-3/4	7.438	2-1/2	17.000
2	8.500	2-3/4	18.700
2-1/4	9.563	3	20.400
2-1/2	10.630	3-1/2	23.800
2-3/4	11.690	4	27.200
3	12.750	4-1/2	30.600
3-1/2	14.880	5	34.000
4	17.000	6	40.800
4-1/2	19.130	8	54.400
5	21.250	10	68.000
6	25.500	12	81.600
8	34.000	**2-1/4 ×**	
10	42.500	2-1/2	19.130
12	51.000	2-3/4	21.040
1-1/2 ×		3	22.950
1-3/4	8.925	3-1/2	26.780
2	10.200	4	30.600
2-1/2	12.750	4-1/2	34.430
3	15.300	5	38.250
3-1/2	17.850	6	45.900
4	20.400	**2-1/2 ×**	
4-1/2	22.950	3	25.500
5	25.500	3-1/2	29.750
6	30.600	4	34.000
8	40.800	4-1/2	38.250
10	51.000	5	42.500
12	61.200	6	51.000
1-3/4 ×		8	68.000
2	11.900	10	85.000
2-1/2	14.880	**3 ×**	
3	17.850	3-1/2	35.700
3-1/2	20.830	4	40.800
3-3/4	22.310	5	51.000
4	23.800	6	61.200
4-1/2	26.780	8	81.600
5	29.750	10	102.000
5-1/2	32.730	12	122.400
6	35.700		

COLD FINISHED STEEL HEXAGONS

SIZE (INCHES)	Lbs./FT.	C1018	C12L14
3/16	.104	X	X
7/32	.140		X
1/4	.184	X	X
9/32	.233		X
5/16	.288	X	X
11/32	.348		X
3/8	.414	X	X
13/32	.486		X
7/16	.564	X	X
1/2	.736	X	X
9/16	.932		X
5/8	1.150	X	X
11/16	1.390	X	X
3/4	1.660	X	X
13/16	1.940	X	X
7/8	2.250	X	X
15/16	2.590	X	X
1	2.940	X	X
1-1/16	3.320		X
1-1/8	3.730	X	X
1-3/16	4.150	X	
1-1/4	4.600	X	X
1-5/16	5.070		X
1-3/8	5.570	X	X
1-7/16	6.090		X
1-1/2	6.630	X	X
1-9/16	7.190		X
1-5/8	7.780		X
1-11/16	8.390		X
1-3/4	9.020	X	X
1-13/16	9.670		X
1-7/8	10.350		X
1-15/16	11.050		X
2	11.780	X	X
2-1/8	13.300		X
2-3/16	14.090		X
2-1/4	14.910	X	X
2-1/2	18.400	X	X
2-5/8	20.290		X
2-3/4	22.270		X
2-7/8	24.340		X
3	26.500	X	X

COLD FINISHED STEEL ROUNDS

DIAMETER (INCH)	Lbs./FT.	C1018	C1045	C12L14	C1144
1/8	.042	X		X	
5/32	.065	X		X	
3/16	.094	X		X	
7/32	.128	X		X	
1/4	.167	X		X	X
5/16	.261	X		X	X
3/8	.375	X	X	X	X
7/16	.511	X		X	X
1/2	.668	X	X	X	X
9/16	.845	X	X	X	X
5/8	1.043	X	X	X	X
11/16	1.262	X	X		
3/4	1.502	X	X	X	X
13/16	1.763	X	X	X	X
7/8	2.044	X	X	X	X
15/16	2.347	X	X	X	X
1	2.670	X	X	X	X
1-1/16	3.014	X		X	
1-1/8	3.379	X	X	X	X
1-3/16	3.765	X	X	X	X
1-1/4	4.172	X	X	X	X
1-5/16	4.599	X	X	X	X
1-3/8	5.048	X	X	X	X
1-7/16	5.517	X	X	X	X
1-1/2	6.008	X	X	X	X
1-9/16	6.519	X	X	X	
1-5/8	7.050	X	X	X	
1-11/16	7.603	X	X	X	X
1-3/4	8.177	X	X	X	X
1-13/16	8.771	X	X	X	
1-7/8	9.387	X	X	X	X
1-15/16	10.020	X	X	X	
2	10.680	X	X	X	X
2-1 /16	11.360	X	X		
2-1/8	12.060	X	X	X	X
2-3/16	12.780	X	X	X	
2-1/4	13.520	X	X	X	X
2-5/16	14.280	X	X	X	
2-3/8	15.060	X	X	X	X
2-7/16	15.860	X	X		
2-1/2	16.690	X	X	X	X
2-9/16	17.530	X	X		
2-5/8	18.400	X	X	X	X

Continued

DIAMETER (INCH)	Lbs./FT.	C1018	C1045	C12L14	C1144
2-11/16	19.280	X	X		
2-3/4	20.190	X	X	X	X
2-13/16	21.120	X	X	X	
2-7/8	22.070	X	X	X	X
2-15/16	23.040	X	X		
3	24.030	X	X	X	X
3-1/16	25.030	X			
3-1/8	26.070	X		X	
3-3/16	27.130	X			
3-1/4	28.200	X	X	X	X
3-3/8	30.410	X		X	X
3-7/16	31.550	X			
3-1/2	32.710	X	X	X	X
3-5/8	35.090	X			X
3-3/4	37.550	X	X	X	X
3-7/8	40.090	X			
3-15/16	41.410	X			
4	42.720	X	X	X	X
4-1/8	45.430	X			
4-1/4	48.230	X		X	X
4-3/8	51.110	X			
4-1/2	54.070	X	X	X	X
4-5/8	57.110	X			
4-3/4	60.240	X		X	X
4-7/8	63.450	X			
4-15/16	65.080	X			
5	66.750	X	X	X	X
5-1/4	73.590	X			
5-1/2	80.770	X	X	X	
5-3/4	88.280	X			
6	96.120	X	X	X	
6-1/4	104.300	X			
6-1/2	112.810	X		X	
7	130.830	X		X	
7-1/2	150.190	X			
8	170.880	X		X	
8-1/2	192.910	X			
9	216.270	X		X	
9-1/2	240.970	X			
10	267.000	X			
11	323.070	X			
12	384.480	X			

COLD FINISHED TURNED, GROUND AND POLISHED STEEL SHAFTING

SIZE (INCHES)	LBS/FT.	1018	1045	SIZE (INCHES)	LBS/FT.	1018	1045
5/8	1.043		X	2-3/4	20.190		X
3/4	1.502	X	X	2-7/8	22.070		X
1	2.670	X	X	2-15/16	23.040	X	X
1-1/8	3.380	X	X	3	24.030	X	X
1-3/16	3.766	X	X	3-3/16	27.130		X
1-1/4	4.173	X	X	3-1/4	28.210		X
1-5/16	4.600		X	3-7/16	31.550		X
1-3/8	5.049	X	X	3-1/2	32.710	X	X
1-7/16	5.518	X	X	3-11/16	36.310		X
1-1/2	6.008	X	X	3-3/4	37.550		X
1-9/16	6.520		X	3-15/16	41.400		X
1-5/8	7.052		X	4	42.730		X
1-11/16	7.604		X	4-1/4	48.230		X
1-3/4	8.178	X	X	4-7/16	52.580		X
1-7/8	9.388		X	4-1/2	54.080		X
1-15/16	10.020	X	X	4-3/4	60.250		X
2	10.680	X	X	4-15/16	65.100		X
2-1/8	12.060		X	5	66.760		X
2-3/16	12.780	X	X	5-1/4	73.600		X
2-1/4	13.520	X		5-7/16	78.950		X
2-5/16	14.280		X	5-1/2	80.780		X
2-3/8	15.060		X	5-3/4	88.290		X
2-7/16	15.870		X	5-15/16	94.140		X
2-1/2	16.690	X	X	6	96.130		X
2-5/8	18.400		X	7	130.800		X
2-11/16	19.290		X	8	170.900		X

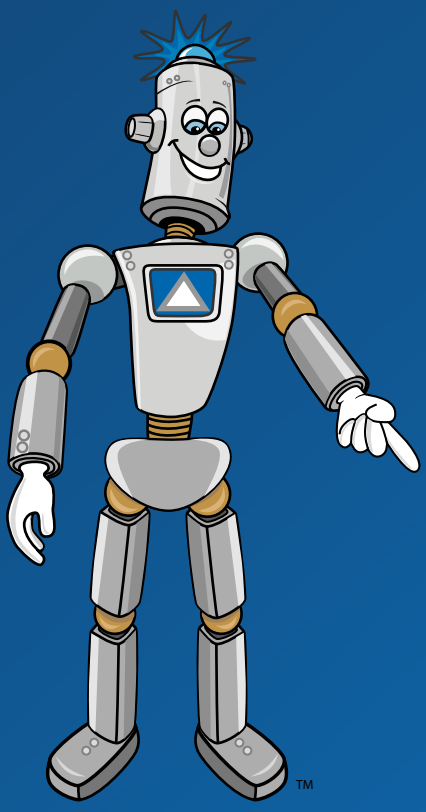
TOLERANCES – 1018, 1045

5/8" to 1" incl.	-.001 to +.000
1-1/8" to 1-1 /2" incl.	-.0005 to -.0015
1-9/16" to 2-7/16" incl.	-.0005 to -.002
2-1/2" to 3" incl.	-.0005 to -.0025
3-1/16" to 4" incl.	-.0005 to -.0035
4-1/16" to 6" incl.	-.0005 to -.0055
6-1/16" to 8" incl.	-.0005 to -.0065

COLD FINISHED STEEL SQUARES

SIZE (INCHES)	Lbs/FT.	C1018	C12L14	C1215
1/8	.053	X	X	
3/16	.120	X	X	X
1/4	.213	X	X	X
5/16	.332	X	X	
3/8	.478	X	X	X
7/16	.651	X	X	
1/2	.850	X	X	X
9/16	1.080	X	X	
5/8	1.330	X	X	X
11/16	1.610	X	X	
3/4	1.910	X	X	X
7/8	2.600	X	X	X
15/16	2.990		X	
1	3.400	X	X	X
1-1/8	4.300	X	X	X
1-3/16	4.800	X	X	X
1-1/4	5.310	X	X	X
1-5/16	5.860			X
1-3/8	6.430	X	X	X
1-7/16	7.030	X		
1-1/2	7.650	X	X	X
1-5/8	8.890	X		
1-3/4	10.410	X	X	X
1-7/8	11.950	X		
2	13.600	X	X	X
2-1/8	15.350	X		
2-1/4	17.210	X		
2-3/8	19.180	X		
2-1/2	21.250	X	X	X
2-5/8	32.430	X		
2-3/4	25.710	X		
3	30.600	X		X
3-1/4	35.910	X		
3-1/2	41.650	X		
3-3/4	47.810	X		
4	54.400	X		
4-1/2	68.850	X		
5	65.040	X		
5-1/2	102.800	X		
6	122.400	X		

HOT ROLLED STEEL BARS



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NOTES

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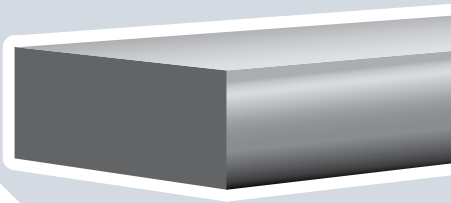
HOT ROLLED STEEL BARS



DATA AND SPECIFICATIONS

A36 HOT ROLLED MILD STEEL BAR

A hot rolled mild carbon steel which has good overall mechanical properties, is easily fabricated and may be formed hot or cold.

Applications: Structural, agricultural instruments, transportation equipment, and miscellaneous non-critical applications that involve mild cold bending, hot forming, punching and welding. Used where seams and other surface imperfections may be tolerated.

Analysis:				
3/4 and Under:	C – .26 Max.	Mn – .80/1.20	P – .04 Max.	S – .05 Max.
Over 3/4 to 1/2" Incl.:	C – .27 Max.	Mn – .60/.90	P – .04 Max.	5 – .05 Max.
Over 1/2":	C – .28 Max.	Mn – .60/.90	P – .04 Max.	S – .05 Max.

Mechanical Properties:	
Following values are average and are representative	
	1"rd
Tensile Strength (psi)	58-80,000
Yield Point (psi)	36,000 Min.
Elongation (% in 2")	23 Min.

Weldability: Easily welded by all welding processes, and the resultant welds and joints are of extremely high quality. Grade of welding rod used depends on welding conditions such as thickness of section, design, service requirements, etc.

1018 / 1020 HOT ROLLED MILD STEEL BAR

A low carbon steel having a higher manganese content than mild steel and various other low carbon steels. Higher manganese makes this a better steel for carburized parts since it produces a harder and more uniform case. It also has higher mechanical properties, including Brinell Hardness, and better machining characteristics. Special manufacturing controls result in a quality product suitable for applications involving forging, heat treating, cold drawing, machining, etc.

Applications: Gears, pinions, worms, king pins, chain pins, ratchets, dogs, oil tool slips and liners, studs, anchor pins, special bolts, tie rods. Any carburized parts requiring hard surface and soft core

Analysis:		
C – .15/.20	Mn – .60/.90	P – .04 Max.
S – .05 Max.		

Mechanical Properties:			
Following values are average and are representative			
	As Rolled	**Normalized**	**Annealed**
Tensile Strength (psi)	67,000	66,000	60,000
Yield Point (psi)	45,000	43,000	40,000
Elongation (% in 2")	36	37	38
Reduction of Area (%)	58	60	62
Brinell Hardness	137	137	121

Machinability: 78% of B1112. **Weldability:** Easily welded by all welding processes, and the resultant welds and joints are of extremely high quality. Grade of welding rod used depends on welding conditions such as thickness of section, design, service requirements, etc. **Forging:** Heat to 2150°- 2250° F. **Normalizing:** Heat to 1650° - 1750° F. **Annealing:** Heat to 1550° - 1650° F. Cool in furnace. **Hardening:** This grade will respond to any of the standard carburizing methods and subsequent heat treatments. For a hard case and a tough core, carburize at 1650° - 1700° F for approximately 8hrs, cool in box, reheat to 1400° - 1450° F, quench in water and draw at 300° - 350° F.

1045 HOT ROLLED STEEL BAR

Medium carbon steels suitable for machining, forging, heat treating, cold drawing, etc. When heat treated, 1045 provides greater strength than can be obtained from lower carbon steels.

Applications: Axles, machinery parts, stud bolts, ordinary shafts, pinions, gears, rock screens, forming dies, tool shanks.

Analysis:		
C – .43/.50	Mn – .60/.90	P – .04 Max.
S – .05 Max.		

Mechanical Properties:

Following values are average values for 1”round and are representative

	As Rolled	Normalized	Annealed
Tensile Strength (psi)	90,000	87,000	80,000
Yield Point (psi)	59,000	58,000	48,000
Elongation (% in 2”)	26	28	30
Reduction of Area (%)	50	52	54
Brinell Hardness	201	192	159

Weldability: Not readily welded due to higher carbon content. With thin sections and flexible design, gas or arc welding may be used without preheating, but in joints over 1/2” to 3/4”thick preheating is necessary. To develop equivalent strength in a weld, a low alloy filler is recommended. Stress relieving is also recommended. Grade of welding rod used depends on welding conditions such as thickness of section, design, service requirements, etc. **Forging:** Heat to 2100° - 2200° F. **Normalizing:** Heat to 1600° - 1750° F. Cool in air. **Annealing:** Heat to 1450° - 1550° F. Cool in furnace. **Hardening:** Essentially water hardened steel but may be quenched in oil. The recommended quenching temperatures are 1550° F for water and 1575° F for oil. A wide range of mechanical properties can be obtained by tempering at different temperatures between 700° F and 1300° F. Tempering in the range of 500° F - 700° F should be avoided.

1141 HOT ROLLED MILD STEEL BAR

Medium carbon and manganese steel. Excellent machinability, fine-grain structure, high consistency and uniformity, and is high strength as-rolled.

Applications: Axles, studs, bolts, shafts, tie rods.

Analysis:		
C – .37/.45	Mn – 1.35/1.65	P – .04 Max.
S – .08-.13		

Mechanical Properties:

Following values are average values for 1”round and are representative

	As Rolled	Normalized	Annealed
Tensile Strength (psi)	95,000	97,000	85,000
Yield Point (psi)	56,000	58,000	50,000
Elongation (% in 2”)	25	23	26
Reduction of Area (%)	50	49	53
Brinell Hardness	197	201	174

Weldability: This grade is not readily welded due to high carbon, manganese and sulphur content. Gas or arc welding may be used provided area to be welded is preheated. Stress relieve after welding. **Forging:** Heat to 2100° - 2200° F. **Normalizing:** Heat to 1600° - 1700° F. Cool in air. **Annealing:** Heat to 1400°- 1500° F. Cool in furnace. **Hardening:** This grade is essentially an oil hardening steel. It can be water quenched, but care should be exercised when this is done. Oil quenching temperature is between 1475° F and 1550° F. A wide range of mechanical properties can be obtained by tempering at different temperatures between 400° F and 1200° F.

A36 HOT ROLLED STEEL FLATS

SIZE (INCHES)	Lbs./ FT.	SIZE (INCHES)	Lbs./ FT.
1/8 ×		**3/16 ×**	
1/2	.213	4	2.55
5/8	.266	4-1/2	2.865
3/4	.319	5	3.188
7/8	.372	5-1/2	3.508
1	.425	6	3.826
1-1/8	.478	7	4.463
1-1/4	.531	8	5.10
1-3/8	.584	10	6.375
1-1/2	.638	12	7.65
1-3/4	.744	**1/4 ×**	
2	.850	3/8	.319
2-1/4	.956	1/2	.425
2-1/2	1.063	5/8	.532
2-3/4	1.152	3/4	.638
3	1.275	7/8	.744
3-1/2	1.488	1	.850
4	1.70	1-1/8	.9563
4-1/2	1.913	1-1/4	1.063
5	2.125	1-3/8	1.169
5-1/2	2.338	1-1/2	1.275
6	2.55	1-5/8	1.38
7	2.975	1-3/4	1.488
8	3.40	2	1.70
10	4.25	2-1/4	1.913
12	5.10	2-1/2	2.125
3/16 ×		2-3/4	2.338
1/2	.319	3	2.55
5/8	.398	3-1/4	2.76
3/4	.478	3-1/2	2.976
7/8	.558	3-3/4	3.19
1	.638	4	3.40
1-1/8	.72	4-1/4	3.613
1-1/4	.797	4-1/2	3.826
1-3/8	.8766	5	4.25
1-1/2	.956	5-1/2	4.675
1-3/4	1.116	6	5.10
2	1.275	6-1/2	5.525
2-1/4	1.434	7	5.95
2-1/2	1.594	8	6.80
2-3/4	1.753	9	7.65
3	1.913	10	8.50
3-1/4	2.072	11	9.36
3-1/2	2.231	12	10.20

A36 HOT ROLLED STEEL FLATS

SIZE (INCHES)	Lbs./ FT.	SIZE (INCHES)	Lbs./ FT.
5/16 ×		**3/8 ×**	
1/2	.5313	3	3.825
5/8	.6641	3-1/4	4.144
3/4	.7969	3-1/2	4.463
7/8	.930	3-5/8	4.622
1	1.063	4	5.10
1-1/8	1.195	4-1/2	5.738
1-1/4	1.328	5	6.375
1-3/8	1.461	5-1/2	7.013
1-1/2	1.594	6	7.650
1-3/4	1.859	6-1/2	8.288
2	2.125	7	8.925
2-1/4	2.391	8	10.20
2-1/2	2.656	9	11.48
2-3/4	2.922	10	12.75
3	3.188	11	14.03
3-1/4	3.453	12	15.30
3-1/2	3.719	**7/16 ×**	
4	4.250	1	1.488
4-1/2	4.781	1-1/4	1.859
5	5.313	1-1/2	2.231
5-1/2	5.844	1-3/4	2.603
6	6.375	2	2.975
7	7.438	2-1/4	3.347
8	8.50	2-1/	3.719
10	10.63	3	4.463
3/8 ×		3-1/2	5.206
1/2	.638	4	5.950
5/8	.7969	5	7.438
3/4	.9563	**1/2 ×**	
7/8	1.116	5/8	1.063
1	1.275	3/4	1.275
1-1/8	1.434	7/8	1.488
1-1/4	1.594	1	1.700
1-3/8	1.753	1-1/8	1.913
1-1/2	1.913	1-1/4	2.125
1-5/8	2.072	1-3/8	2.338
1-3/4	2.231	1-1/2	2.550
2	2.55	1-5/8	2.763
2-1/4	2.869	1/3/4	2.975
2-1/2	3.188	2	3.400
2-3/4	3.506	2-1/4	3.826

A36 HOT ROLLED STEEL FLATS

SIZE (INCHES)	Lbs./ FT.	SIZE (INCHES)	Lbs./ FT.
1/2 ×		**5/8 ×**	
2-1/2	4.250	9	19.150
2-3/4	4.677	10	21.280
3	5.105	11	23.570
3-1/4	5.525	12	25.530
3-1/2	5.950	14	29.760
4	6.800	**3/4 ×**	
4-1/2	7.650	7/8	2.231
5	8.500	1	2.550
5-1/2	9.350	1-1/8	2.869
6	10.200	1-1/4	3.188
7	11.900	1-1/2	3.825
8	13.600	1-3/4	4.463
9	15.310	2	5.100
10	17.020	2-1/4	5.738
11	18.720	2-1/2	6.375
12	20.420	2-3/4	7.013
5/8 ×		3	7.650
3/4	1.590	3-1/4	8.288
7/8	1.859	3-1/2	8.925
1	2.125	4	10.200
1-1/8	2.393	4-1/2	11.480
1-1/4	2.656	5	12.750
1-3/8	2.922	5-1/2	14.030
1-1/2	3.188	6	15.300
1-5/8	3.453	7	17.850
1-3/4	3.719	8	20.400
2	4.250	9	22.970
2-1/4	4.781	10	25.53
2-1/2	5.313	12	30.63
2-3/4	5.844	**7/8 ×**	
3	6.375	1	2.975
3-1/4	6.906	1-1/4	3.722
3-1/2	7.438	1-1/2	4.467
3-3/4	7.968	1-3/4	5.211
4	8.500	2	5.956
4-1/2	9.563	2-1/4	6.70
5	10.625	2-1/2	7.445
5-1/2	11.690	2-3/4	8.189
6	12.750	3	8.933
7	14.880	3-1/2	10.41
8	17.000		

A36 HOT ROLLED STEEL FLATS

SIZE (INCHES)	Lbs./ FT.	SIZE (INCHES)	Lbs./ FT.
7/8 ×		**1-1/4 ×**	
4	11.9	2-3/4	11.70
4-1/2	13.39	3	12.76
5	14.88	3-1/4	13.82
5-1/2	16.38	3-1/2	14.89
6	17.85	4	17.02
7	20.83	4-1/2	19.14
8	23.82	5	21.27
1 ×		5-1/2	23.40
1-1/4	4.25	6	25.52
1-1/2	5.105	7	29.78
1-3/4	5.956	8	34.03
2	6.806	10	42.54
2-1/4	7.657	**1-1/2 ×**	
2-1/2	8.508	1-3/4	8.933
2-3/4	9.359	2	10.21
3	10.21	2-1/4	11.49
3-1/4	11.06	2-1/2	12.76
3-1/2	11.91	2-3/4	14.04
4	13.61	3	15.31
4-1/2	15.31	3-1/2	17.87
5	17.02	4	20.42
5-1/2	18.72	4-1/2	22.97
6	20.42	5	25.52
7	23.82	5-1/2	28.08
8	27.23	6	30.63
9	30.63	7	35.73
10	34.03	8	40.84
12	40.84	10	51.05
1-1/8 ×		12	61.26
2	7.657	**1-3/4 ×**	
3	11.49	2	11.91
4	15.31	2-1/2	14.89
5	19.14	3	17.87
6	22.97	3-1/2	20.84
1-1/4 ×		4	23.82
1-1/2	6.381	4-1/2	26.80
1-3/4	7.445	5	29.78
2	8.508	5-1/2	32.76
2-1/4	9.572	6	35.73
2-1/2	10.64	8	47.64

A36 HOT ROLLED STEEL FLATS

SIZE (INCHES)	Lbs./ FT.	SIZE (INCHES)	Lbs./ FT.
2 ×		**2-1/2 ×**	
2-1/4	15.31	3	25.52
2-1/2	17.02	3-1/2	29.78
3	20.42	4	34.03
3-1/2	23.82	4-1/2	38.29
4	27.23	5	42.54
4-1/2	30.63	6	51.05
5	34.03	**3×**	
6	40.84	4	40.84
7	47.64	4-1/2	45.94
8	54.45	5	51.05
2-1/4 ×		6	61.26
4	30.63		

REINFORCING BARS (US: Grades 40, 60) (CAN: CSA G30.12 – M1977)

BAR DESIGNATION NUMBER	NOM. DIAMETER {IN} (EXCLUDING DEFORMATIONS)	METRIC DESIGNATION Number	WEIGHT Lbs./FT.
3	.375	10	.376
4	.500	13	.668
5	.625	16	1.043
6	.750	19	1.502
7	.875	22	2.044
8	1.00	25	2.670
9	1.128	29	3.400
10	1.270	32	4.303
11	1.410	36	5.313
14	1.693	43	7.650
18	2.257	57	13.60

	GRADE 40	GRADE 60
Tensile Strenght (Min. Psi)	70,000	90,000
Yield Strength (Min. Psi)	40,000	60,000

HOT ROLLED STEEL ROUNDS

SIZES (INCHES)	Lbs/FT.	A36	1018/1020	1045	1141
3/16	.094		X		
1/4	.167		X		
5/16	.261		X		
3/8	.376		X		
7/16	.511	X			
1/2	.668	X		X	
9/16	.845	X			
5/8	1.043	X		X	
11/16	1.26	X			
3/4	1.502	X		X	
7/8	2.045	X		X	
1	2.670	X		X	
1-1/8	3.380	X		X	
1-1/4	4.172	X		X	
1-5/16	4.600			X	
1-3/8	5.049	X		X	
1-7/16	5.518			X	
1-1/2	6.014	X		X	
1-5/8	7.051	X	X	X	
1-3/4	8.186	X		X	
1-7/8	9.397	X		X	
2	10.69	X		X	X
2-1/8	12.07	X		X	X
2-1/4	13.53	X		X	X
2-3/8	15.08	X		X	X
2-1/2	16.71	X	X	X	X
2-1/8	12.06	X		X	X
2-1/4	13.52	X	X	X	X
2-3/8	15.06	X		X	X
2-1/2	16.69	X	X	X	X
2-5/8	18.40	X		X	X
2-3/4	20.19	X	X	X	X
2-7/8	22.07	X		X	X
3	24.03	X	X	X	X
3-1/8	26.08		X	X	X
3-1/4	28.21		X	X	X
3-3/8	30.42		X	X	X
3-1/2	32.71		X	X	X
3-5/8	35.09		X	X	X
3-3/4	37.55		X	X	X
3-7/8	40.14		X		
4	42.73		X	X	X
4-1/8	45.44		X	X	

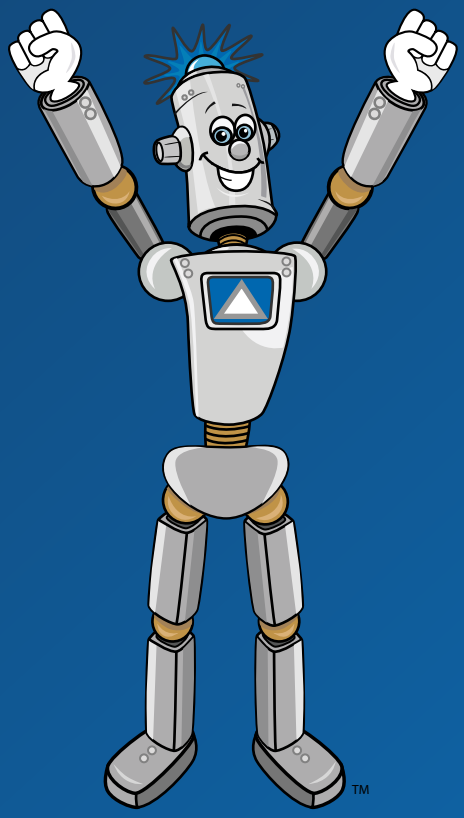
Continued

SIZES (INCHES)	Lbs/FT.	A36	1018/1020	1045	1141
4-1/4	48.23		X	X	X
4-3/8	51.11		X		
4-1/2	54.08		X	X	X
4-5/8	57.12		X	X	
4-3/4	60.25		X	X	X
5	66.76		X	X	X
5-1/4	73.60		X	X	X
5-1/2	80.78		X	X	X
5-3/4	88.29		X	X	X
6	96.13		X	X	X
6-1/4	104.30		X	X	X
6-1/2	112.80		X	X	X
6-3/4	121.70		X	X	X
7	130.90		X	X	X
7-1/4	140.40		X	X	X
7-1/2	150.20		X	X	X
7-3/4	160.50		X	X	X
8	171.10		X	X	X
8-1/4	181.90		X	X	X
8-1/2	193.10		X	X	X
8-3/4	204.50		X	X	X
9	216.50		X	X	X
9-1/4	228.70		X		
9-1/2	241.20		X	X	X
9-3/4	254.10		X	X	
10	267.30		X	X	X
10-1/4	280.82		X	X	
10-1/2	294.20		X	X	
11	323.10		X	X	
11-1/2	353.49		X	X	
12	384.50		X	X	
12-1/2	417.60		X	X	
13	451.70		X	X	
13-1/2	487.10		X	X	

HOT ROLLED STEEL SQUARES – A36

SIZE (INCHES)	#/ FT.	SIZE (INCHES)	#/ FT.
3/8	.4781	1-3/4	10.410
7/16	.6508	2	13.600
1/2	.8500	2-1/4	17.210
9/16	1.076	2-1/2	21.250
5/8	1.328	2-3/4	25.710
3/4	1.913	3	30.600
7/8	2.603	3-1/2	41.650
1	3.400	4	54.400
1-1/8	4.303	4-1/2	68.850
1-1/4	5.313	5	85.000
1-1/2	7.650	6	122.400

STAINLESS STEEL



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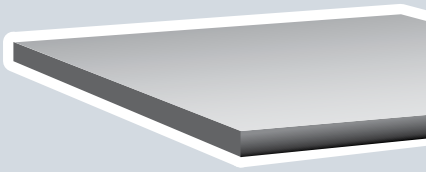


DATA AND SPECIFICATIONS

303

Chromium-nickel stainless steel with added sulfur or selenium and phosphorus to improve machinability and non-seizing properties. It is the most free machining of the chromium-nickel grades. Non-magnetic in the annealed condition.

Applications: Aircraft parts and parts requiring machining, grinding or polishing with good corrosion resistance. Excellent for moving parts and where low magnetic permeability is required.

Analysis:		
	303S	303Se
C	.15 Max.	.15 Max.
Mn	2.00 Max.	2.00 Max.
P	.15 Max.	.17 Max.
S	.15 Max.	.04 Max.
Se	—	.15/.40
Si	1.00 Max.	1.00 Max.
Cr	17.00/19.00	17.00/19.00
Ni	8.00/10.00	8.00/10.00
Cu	.75 Max.	.75 Max.
Mo	.75 Max.	.75 Max.

Mechanical Properties:	
Following values are average and are representative	
	(1/2" and under)
Tensile Strength (psi)	100,000
Brinell Hardness	228

Surface Cutting Speed: 130 ft/min. **Weldability:** Fair. **Hardening:** Not hardenable by heat treatment. Cold working increases tensile strength and hardness. **Corrosion Resistance:** Maximum corrosion resistance in the annealed condition. Free machining elements reduce overall corrosion resistance. **Resistance to Scaling:** Excellent up to 1600° F in continuous service. In design, beware of high coefficient of expansion.

304

Excellent mechanical properties, resistance to many corrosive agents. Useful where sanitation and cleanliness are important. Non magnetic in the annealed condition. Hardness and tensile strength can be increased by cold working, but modified by lowered carbon content providing good resistance to corrosion in welded construction where subsequent heat treatment is not practical.

Applications: Dairy, beverage and food product handling/processing equipment. Used for handling acetic, nitric, and citric acids; organic and inorganic chemicals, dye stuff, crude and refined oils; instruments; hospital equipment; applications requiring welding.

Analysis:		
C – .08 Max.	Mn – 2.00 Max.	P – .04 Max.
S – .03 Max.	Si – 1.0 Max.	Cr – 18.00/20.00
Ni – 8.00/10.50	Cu – .75 Max.	Mo – .75 Max.

Mechanical Properties:	
Following values are average and are representative	
Tensile Strength (psi)	90,000
Yield Point (psi)	40,000
Elongation(% in 2")	50
Brinell Hardness	163

Weldability: Excellent. **Surface Cutting Speed:** 75 ft/Min. **Corrosion Resistance:** Maximum resistance in annealed condition shows good resistance to strong oxidizing acids such as nitric acid, and resists attack by a wide variety of organic and inorganic chemicals. Intergranular corrosion may occur if heated within or cooled through the range of 800° F - 1500° F. **Resistance to Scaling:** Excellent at temperatures up to 1600° F in continuous service. In design, beware of high coefficient of expansion.

304L

As per above except: 304L is an extra-low-carbon analysis, the advantage of which is that it precludes any harmful precipitation in the 800° F - 1500° F range, such as might otherwise occur in welding heavier sections.

309

This alloy is known for good strength and oxidation resistance in continuous service temperatures up to 2000° F (1093° C). It is superior to 304 stainless in both strength and corrosion resistance.

Applications: Oven linings, boiler baffles, fire box sheets, furnace components and other high temperature containers.

Analysis:		
C – .2 Max.	Cr – 22.00/24.00	Fe – Balance
Mn – 2.00 Max.	Ni – 12.00/15.00	P – .045 Max.
S – .03 Max.	Si – 1.0 Max.	

Mechanical Properties:	
Following values are average and are representative	
Ultimate Tensile Strength	75 KSI min (620 MPa min)
Yield Strength (0.2% Offset)	30 KSI min (205 MPa min)
Elongation	40% min
Hardness	Rb 95 max

Machinability: This alloy machines similarly to type 304 stainless. Its chips are stringy and it will work-harden rapidly. It is necessary to keep the tool cutting at all times and use chip breakers. **Weldability:** Most of the austenitic stainless steels can be readily welded using fusion or resistance methods. Oxyacetylene welding is not recommended. **Hot Working:** Working temperatures are 2150° F (1177° C), with reheating necessary at 1800° F (982° C). Rapid quenching is recommended. Full post-work annealing is required to reattain maximum corrosion resistance. **Cold Working:** Although this alloy has a high work hardening rate, it can be drawn, headed, upset, and stamped. Full annealing is required after cold work to remove internai stress. Cold work will cause an increase in both hardness and strength. **Annealing:** 1900° - 2050° F (1038° - 1121° C), water quench. **Hardening:** This alloy does not respond to heat treatment.

310

Relatively high chromium-nickel content makes this a superior steel in most environments over 304 and 309.

Applications: Oven linings, boiler baffles, kilns, lead pots, radiant tubes, annealing covers, saggers, burners, combustion tubes, refractory anchor bolts, fire box sheets, furnace components and other high temperature containers.

Analysis:		
C – .25 Max.	Cr – 24.00/26.00	Fe: Balance
Mn – 2.00 Max.	Ni – .19/.22	P – .045 Max.
S – .03 Max.	Si – 1.50 Max.	

Mechanical Properties:	
Following values are average and are representative	
	Annealed
Tensile Strength (psi)	100 Max.
Yield Point (psi)	35,000-55,000
Elongation (% in 2")	35
Rockwell Hardness	95 Max.

Machinability: This alloy machines similarly to type 304 stainless. Its chips are stringy and it will work harden rapidly. It is necessary to keep the tool cutting at all times and use chip breakers. **Weldability:** Most austentitic stainless steels can be welded using fusion or resistance welding. Oxyacetylene not recommended. **Hot working:** Most hot work methods can be successfully performed after uniform heating to 2150° F (1177° C). Do not forge below 1800° F (982° C). Rapid cooling is required to maximize corrosion resistance. **Cold Working:** Can be drawn, heated, upset, and stamped. Full annealing is required after cold working to remove internal stress. **Hardening:** Does not respond to heat treatment. To increase hardness and strength cold working is recommended.

316

Low-carbon "18-8" chromium-nickel stainless steel with molybdenum added to increase corrosion resistance and mechanical properties at elevated temperatures. Non-magnetic in the annealed condition and not hardenable by heat treatment.

Applications: Pump shafts and parts in machinery used to process paper, textiles, chemicals and pharmaceuticals. In aircraft applications, used for parts requiring low magnetic permeability and good corrosion resistance.

Analysis:		
C – .08 Max.	Mn – 2.00 Max.	P – .04 Max.
S – .03 Max.	Si – 1.0 Max.	Cr – 16.00/18.00
Ni – 10.00 - 14.00	Cu – .75 Max.	Mo – 2.00/3.00 Max.
N – .10 Max.	Si – 1.50 Max.	

Mechanical Properties:

Maintains highest creep and tensile strength at elevated temperatures of any of the commonly used stainless steels.

	CF (under 1/2" dia)	CF (over 1/2" dia)	HR
Tensile Strength (psi)	90-125,000	75,000 Min.	75-115,000
Yield Point (psi)	45,000 Min.	30,000 Min.	30,000 Min
Elongation (% in 2")	35 Min.	35 Min.	40Min
Reduction of Area (%)	45	50	50

Weldability: Excellent. Annealing after welding recommended for maximum corrosion resistance. **Surface Cutting Speed:** 75 ft/Min. **Corrosion Resistance:** Type 316 is more resistant to atmospheric and general corrosive conditions than any of the other standard stainless steels. Good resistance to sulfates, phosphates and other salts as well as reducing acids such as sulfuric, sulfurous and phosphoric. This grade is less susceptible to pitting in applications where acetic acid vapors or solutions of chlorides, bromides, or iodides are encountered. **Resistance to Scaling:** Excellent up to temperatures of 1650° F in continuous service.

316L

The 316L grade (low carbon) precludes any harmful precipitation in the 800° F - 1500° F range that might result from welding heavier sections. This grade is available in precision ground pump shafting.

416

Chromium grade of stainless steel with phosphorous and sulfur added to improve machinability. Most readily machinable of the stainless grades. It is magnetic in all conditions and capable of a wide range of mechanical properties by heat treating. This grade is available in precision-ground pump shafting.

Applications: Pump shafts and parts in machinery used in or around fresh water, food acids, and neutral and basic salts.

Analysis:		
C – .15 Max.	Mn – 1.25 Max.	P – .06 Max.
S – .15/.40 Max.	Si – 1.0 Max.	Cr – 12.00/13.50
Ni – .75	Cu – .50 Max.	Mo – .60 Max.

Mechanical Properties:

Maintains highest creep and tensile strength at elevated temperatures of any of the commonly used stainless steels.

	CF (under 1/2" dia)	CF (over 1/2" dia)	HR
Tensile Strength (psi)	90-125,000	75,000 Min.	75-115,000
Yield Point (psi)	45,000 Min.	30,000 Min.	30,000 Min.
Elongation (% in 2")	35 Min.	35 Min.	40 Min.
Reduction of Area (%)	45	50	50

Weldability: Good. Large sections should be preheated prior to welding. Due to air hardening properties, annealing after welding is recommended to obtain maximum ductility and toughness. **Surface Cutting Speed:** 90 ft/Min. **Corrosion Resistance:** Resistant to corrosion from the atmosphere, fresh water, iron-bearing mine waters, food acids, neutral and basic salts, mild acids and alkalis. Maximum corrosion resistance of this grade is obtained by hardening and polishing. Resists oxidation up to 1000° F.

STAINLESS STEEL ANGLES – HR ANNEALED and PICKLED

A		B		C	LBS./FT.	304	304L	316	316L
3/4	×	3/4	×	1/8	.590	X			X
1	×	1	×	1/8	.800	X	X		X
1	×	1	×	3/16	1.160	X			X
				1/4	1.490	X			
1-1/4	×	1-1/4	×	1/8	1.010	X			X
				3/16	1.480	X			
				1/4	1.920	X			
1-1/2	×	1-1/2	×	1/8	1.230	X	X		X
				3/16	1.800	X	X	X	X
				1/4	2.340	X	X		X
2	×	2	×	1/8	1.650	X			
				3/16	2.440	X	X	X	X
				1/4	3.190	X	X		X
				3/8	4.700	X	X		
2-1/2	×	2-1/2	×	3/16	3.070	X			
				1/4	4.100	X		X	X
				3/8	5.900	X			
3	×	1-1/2	×	1/4	3.510	X			
3	×	2	×	3/16	3.070	X			
				1/4	4.100	X			
3	×	3	×	1/4	4.900	X	X		X
				5/16	6.100	X			
				3/8	7.200	X	X		X
3-1/2	×	3-1/2	×	1/4	5.800	X			
4	×	3	×	1/4	5.800	X			
				3/8	8.500	X			
4	×	4	×	1/4	6.600	X			X
				3/8	9.800	X			
5	×	3	×	3/8	9.850	X			
5	×	5	×	3/8	12.300	X			
6	×	3	×	3/8	11.020	X			
6	×	4	×	1/4	9.210	X			
				3/8	12.300	X			
6	×	6	×	3/8	14.900	X			

304 and 316 STAINLESS STEEL FLATS – HOT ROLLED, ANNEALED and PICKLED

Size	LBS/FT	304	316	Size	LBS./FT.	304	316
1/8 × 1/2	.213	X		**3/8 ×** 5	6.380	X	
3/4	.319	X		6	7.650	X	
1	.425	X	X	**1/2 ×** 3/4	1.275	X	
1-1/4	.531	X	X		1.700	X	
1-1/2	.638	X	X	1-1/4	2.125	X	
1-3/4	.744	X		1-1/2	2.550	X	
2	.850	X	X	2	3.400	X	X
2-1/2	1.063	X		2-1/2	4.250	X	X
3	1.275	X		3	5.100	X	X
4	1.700	X		4	6.800	X	X
3/16 × 1/2	.319	X		6	10.200	X	X
5/8	.398	X		7	11.900	X	
3/4	.478	X		**5/8 ×** 3/4	1.594	X	
1	.638	X	X		2.125	X	
1-1/4	.797	X		1-1/4	2.656	X	
1-1/2	.956	X	X	1-1/2	3.188	X	X
1-3/4	1.116	X		1-3/4	3.719	X	
2	1.275	X	X	2	4.250	X	
2-1/2	1.594	X		2-1/2	5.313	X	
3	1.913	X		3	6.375	X	
4	2.550	X		3-1/2	7.438	X	
6	3.825	X		4	8.500	X	
1/4 × 1/2	.425	X		5	10.630	X	
5/8	.531	X		6	12.750	X	
3/4	.638	X		**3/4 ×** 1	2.550	X	X
1	.850	X	X	1-1/4	3.188	X	
1-1/4	1.063	X	X	1-1/2	3.830	X	X
1-1/2	1.275	X	X	1-3/4	4.460	X	
1-3/4	1.488	X	X	2	5.100	X	X
2	1.700	X	X	2-1/4	5.738	X	
2-1/2	2.125	X	X	2-1/2	6.375	X	X
3	2.550	X	X	3	7.650	X	X
3-1/2	2.967	X		3-1/2	8.925	X	
4	3.400	X	X	4	10.200	X	X
5	4.250	X		5	12.750	X	
6	5.100	X		6	15.300	X	
5/16 × 1	1.060	X		**1 ×** 1-1/4	4.250	X	X
3/8 × 1/2	.638	X		1-1/2	5.100	X	X
3/4	.956	X		1-3/4	5.950	X	
1	1.275	X		2	6.800	X	X
1-1/4	1.594	X		2-1/4	7.650	X	
1-1/2	1.913	X		2-1/2	8.500	X	X
2	2.550	X	X	3	10.200	X	X
2-1/2	3.188	X		3-1/2	11.900	X	
3	3.825	X	X	4	13.600	X	X
4	5.100	X	X	5	17.000	X	
				6	20.400	X	

STAINLESS STEEL HEXAGONS

Size (inches)	Lbs/Ft.	303	304	316	416
1/8	.046	X			
3/16	.104	X			
1/4	.184	X			X
5/16	.288	X	X		
3/8	.414	X	X		
7/16	.564	X		X	X
1/2	.736	X		X	X
9/16	.932	X			
5/8	1.150	X		X	X
11/16	1.390	X		X	X
3/4	1.666	X		X	X
13/16	1.940	X			
7/8	2.254	X	X	X	X
15/16	2.590			X	
1	2.950	X	X	X	X
1-1/16	3.320	X	X		
1-1/8	3.727	X	X	X	X
1-3/16	4.152				
1-1/4	4.601	X		X	X
1-5/16	5.073	X	X	X	X
1-3/8	5.570	X		X	X
1-1/2	6.625	X		X	X
1-5/8	7.780	X	X	X	X
1-3/4	9.020	X		X	X
1-13/16	9.673	X			
1-7/8	10.400	X	X		
2	11.780	X		X	
2-1/4	14.910	X		X	
2-1/2	18.400	X		X	X
3	26.500				X

STAINLESS STEEL PIPE – SEAMLESS and WELDED TYPES 304, 304L, 316, 316L, 309, and 310

NOM. SIZE (IN)	LBS/FT.	O.D. (INCHES)	I.D.	WALL THICKNESS
SCHEDULE 10				
1/2	.540	.840	.710	.065
3/4	.690	1.050	.920	.065
1	.880	1.315	1.185	.065
1-1/4	1.120	1.660	1.530	.065
1-1/2	1.290	1.900	1.770	.065
2	1.620	2.375	2.245	.065
3	3.060	3.500	3.334	.083
3-1/2	3.510	4.000	3.834	.083
SCHEDULE 10				
1	1.420	1.315	1.097	.109
1-1/2	2.100	1.900	1.682	.109
2	2.660	2.375	2.157	.109
3	4.370	3.500	3.260	.120
3-1/2	5.020	4.000	3.760	.120
4	5.670	4.500	4.260	.120
5	7.840	5.563	5.295	.134
6	9.380	6.625	6.357	.134
8	13.400	8.625	8.329	.148
10	18.650	10.750	10.420	.165
12	24.160	12.750	12.390	.180
SCHEDULE 40				
1/8	.250	.405	.269	.068
1/4	.430	.540	.364	.088
3/8	.570	.675	.493	.091
1/2	.860	.840	.622	.109
3/4	1.140	1.050	.824	.113
1	1.700	1.315	1.049	.133
1-1/4	2.290	1.660	1.380	.140
1-1/2	2.740	1.900	1.610	.145
2	3.700	2.375	2.067	.154
2-1/2	5.850	2.875	2.469	.203
3	7.650	3.500	3.068	.216
3-1/2	9.190	4.000	3.548	.226
4	10.890	4.500	4.026	.237
5	14.750	5.563	5.047	.258
6	19.150	6.625	6.065	.280
8	28.820	8.625	7.981	.322
10	40.860	10.750	10.020	.365
12	50.030	12.750	12.000	.375

Continued

NOM. SIZE (IN)	LBS/FT.	O.D. (INCHES)	I.D.	WALL THICKNESS
SCHEDULE 80				
1/8	.320	.405	.215	.095
1/4	.540	.540	.302	.119
3/8	.750	.675	.423	.126
1/2	1.100	.840	.546	.147
3/4	1.490	1.050	.742	.154
1	2.190	1.315	.957	.179
1-1/4	3.030	1.660	1.278	.191
1-1/2	3.670	1.900	1.500	.200
2	5.070	2.375	1.939	.218
2-1/2	7.660	2.875	2.323	.276
3	10.250	3.500	2.900	.300
3-1/2	12.500	4.000	3.364	.318
4	14.980	4.500	3.826	.337
5	20.780	5.563	4.813	.375
6	28.570	6.625	5.761	.432

STAINLESS STEEL PLATE

Thickness (inches)	Width	Lbs./SQ. Ft.	304	304L	316	316
3/16	48	7.713	X	X	X	X
	60	7.713	X	X	X	X
	72	7.713	X	X	X	X
	96	7.713	X	X	X	X
1/4	36	10.311	X			
	48	10.311	X	X	X	X
	60	10.311	X	X	X	X
	72	10.311	X	X	X	X
	96	10.311	X	X	X	X
5/16	48	12.910	X			X
	60	12.910	X			
	72	12.910	X			X
	96	12.910	X	X	X	X
3/8	48	15.467	X	X	X	X
	60	15.467	X		X	X
	72	15.467	X	X	X	X
	96	15.467	X	X	X	X
	120	15.467	X			X
1/2	48	20.623	X	X	X	X
	60	20.623	X		X	X
	72	20.623	X	X	X	X
	84	20.623			X	
	96	20.623	X	X	X	X
5/8	72	25.779	X	X		X
	96	25.779	X	X	X	X
3/4	48	30.935			X	X
	72	30.935	X			X
	96	30.935	X	X	X	X
7/8	72	36.090	X			X
	96	36.090	X	X		X
1	48	41.246	X	X		
	72	41.246	X			X
	96	41.246	X	X	X	X
1-1/4	72	51.558				X
	96	51.558	X	X	X	X
1-1/2	72	61.870				X
	96	61.870	X	X	X	X
1-3/4	72	72.181				X
	96	72.181	X	X	X	X
2	48	82.493				X
	96	82.493	X	X	X	X
2-1/4	96	92.805			X	X
2-1/2	96	103.117	X	X	X	X
3	96	123.740	X	X	X	X
3-1/2	96	144.363	X			
4	96	164.987	X			

STAINLESS STEEL ROUNDS – ANNEALED and CENTERLESS GROUND

Size (inches)	Lbs./Ft.	303	304	316	416
1/8	.042	X	X	X	X
9/64	.053	X			X
5/32	.065	X			X
11/64	.079	X			X
3/16	.094	X	X	X	X
13/64	.111	X			X
7/32	.129	X			X
1/4	.168	X	X	X	X
17/64	.190	X			X
9/32	.213	X	X		X
5/16	.263	X	X	X	X
21/64	.290	X			X
11/32	.318	X			X
3/8	.379	X	X	X	X
25/64	.411	X			
13/32	.445	X			X
7/16	.516	X	X	X	X
29/64	.554	X			
15/32	.593	X			X
31/64	.633	X			
1/2	.674	X	X	X	X
33/64	.717	X			X
17/32	.761	X			X
9/16	.854	X	X	X	X
19/32	.951	X			X
5/8	1.054	X	X	X	X
41/64	1.107	X			
21/32	1.162	X			
11/16	1.276	X	X		X
3/4	1.518	X	X	X	X
13/16	1.782	X	X		
7/8	2.066	X	X	X	X
29/32	2.216	X			
15/16	2.372	X	X	X	
1	2.699	X	X	X	X
1-1/16	3.062	X			X
1-1/8	3.416	X	X	X	X
1-3/16	3.803	X	X	X	
1-1/4	4.218	X	X	X	X
1-5/16	4.650	X	X	X	
1-3/8	5.104	X	X	X	X
1-7/16	5.578	X	X		X
1-1/2	6.074	X	X	X	X

Continued

Size (inches)	Lbs./Ft.	303	304	316	416
1-9/16	6.590	X	X		
1-5/8	7.128	X	X	X	
1-11/16	7.687	X			
1-3/4	8.267	X	X	X	X
1-13/16	8.868	X			
1-7/8	9.490	X	X		X
1-15/16	10.134	X	X		
2	10.798	X	X	X	X
2-1/8	12.190	X	X		
2-1/4	13.666	X	X	X	X
2-3/8	15.227	X	X	X	
2-7/16	16.039	X	X		
2-1/2	16.872	X	X	X	X
2-5/8	18.602	X	X		X
2-3/4	20.415	X	X	X	X
2-7/8	22.314	X			
3	24.296	X	X	X	X
3-1/8	26.363	X	X		
3-1/4	28.514	X	X	X	X
3-1/2	33.070	X	X	X	X
3-3/4	37.963	X	X	X	
4	43.194	X	X	X	X
4-1/4	48.762	X	X	X	X
4-1/2	54.667	X	X		X
4-3/4	60.810	X	X		X
5	67.480	X	X	X	X
5-1/2	81.663	X	X	X	
6	97.186	X	X	X	

STAINLESS STEEL ROUNDS - HOT ROLLED ANNEALED and ROUGH TURNED

SIZE (inches)	Lbs/Ft.	303	304	316	416
6-1/4	105.454	X	X	X	
6-1/2	114.059	X	X	X	
6-3/4	123.001	X	X		
7	132.281	X	X	X	
7-1/4	141.899			X	
7-1/2	151.854	X	X	X	
7-3/4	162.146			X	
8	172.776	X	X	X	
8-1/2	195.011	X	X	X	
9	218.669	X	X	X	
9-1/2	243.641			X	
10	269.962	X	X	X	
11	326.655	X	X	X	
12	388.746	X	X	X	

TYPE 304 STAINLESS STEEL SHEET – No. 2B FINISH or with No. 4 POLISH ONE SIDE

GAUGE AND SIZE (INCHES)	Lbs./ Sq. Ft.	Est. Lbs./ Sheet
28 Ga. (.015)		
36 × 96	.6300	15.120
36 × 120	.6300	18.900
26 Ga. (.019)		
36 × 96	.7560	18.140
38 × 96	.7560	22.680
48 × 96	.7560	24.190
48 × 120	.7560	30.240
24 Ga. (.025)		
30 ×96	1.050	20.160
30 × 120	1.050	25.200
36 × 96	1.050	24.190
36 × 120	1.050	30.240
48 × 96	1.050	32.260
48 × 120	1.050	40.320
22 Ga. (.031)		
30 × 96	1.313	25.200
30 × 120	1.313	31.500
36 × 96	1.313	30.240
36 × 120	1.313	37.800
48 × 96	1.313	40.320
48 × 120	1.313	50.400
48 × 144	1.313	60.480
20 Ga. (.038)		
30 × 96	1.580	30.240
30 × 120	1.580	37.800
36 × 96	1.580	36.290
36 × 120	1.580	45.360
42 × 120	1.580	52.920
48 × 96	1.580	48.380
48 × 120	1.580	60.480
48 × 144	1.580	72.580
60 × 120	1.580	75.600
19 Ga. (.042)		
36 × 120	1.764	52.920
18 Ga. (.050)		
30 × 96	2.100	40.320
30 × 120	2.100	50.400
36 × 96	2.100	48.380
36 × 120	2.100	60.480
36 × 144	2.100	72.580
18 Ga. (.050)		
42 × 120	2.100	70.560
48 × 96	2.100	64.510
48 × 120	2.100	80.640
48 × 144	2.100	96.770
60 × 120	2.100	100.800
60 × 144	2.100	121.000
16 Ga. (.063)		
30 × 96	2.625	50.400
30 × 120	2.625	63.000
36 × 96	2.625	60.480
36 × 120	2.625	75.600
36 × 144	2.625	90.720
42 × 96	2.625	70.560
42 × 120	2.625	88.200
48 × 96	2.625	80.640
48 × 120	2.625	100.800
48 × 144	2.625	121.000
60 × 90	2.625	100.800
60 × 120	2.625	126.000
60 × 144	2.625	151.200
72 × 144	2.625	181.400
14 Ga. (.078)		
30 × 120	3.281	78.750
36 × 96	3.281	75.600
36 × 120	3.281	94.500
36 × 144	3.281	113.400
42 × 120	3.281	110.300
42 × 144	3.281	132.300
48 × 96	3.281	100.800
48 × 12	3.281	126.000
48 × 144	3.281	151.200
60 × 120	3.281	157.500
60 × 144	3.281	189.000
72 × 120	3.281	189.000
72 × 144	3.281	226.800
13 Ga. (.090)		
36 × 96	3.780	90.720
36 × 120	3.780	113.400
48 × 96	3.780	121.000
48 × 120	3.780	151.200

Continued

GAUGE AND SIZE (INCHES)	Lbs./ Sq. Ft.	Est. Lbs./ Sheet	GAUGE AND SIZE (INCHES)	Lbs./ Sq. Ft.	Est. Lbs./ Sheet
12 Ga. (.109)			**10 Ga. (.141)**		
36 × 96	4.594	105.80	36 × 120	5.9050	170.10
36 × 120	4.594	132.30	48 × 96	5.9050	181.40
36 × 144	4.594	158.80	48 × 120	5.9050	226.80
48 × 96	4.594	141.10	48 × 144	5.9050	272.20
48 × 120	4.594	176.40	60 × 120	5.9050	283.50
48 × 144	4.594	211.70	60 × 144	5.9050	340.20
60 × 96	4.594	176.40	72 × 120	5.9050	340.20
60 × 120	4.594	220.50	72 × 144	5.9050	408.20
60 × 144	4.594	264.60	**8 Ga.(.172)**		
72 × 120	4.594	264.60	36 × 120	6.8057	207.90
72 × 144	4.594	317.50	48 × 96	6.8057	221.80
11 Ga. (.125)			48 × 120	6.8057	277.20
36×96	5.250	121.00	48 × 144	6.8057	332.60
36 × 120	5.250	151.20	60 × 120	6.8057	346.50
36 × 144	5.250	181.40	**7 Ga. (.187)**		
48 × 96	5.250	161.30	48 × 96	7.7296	251.90
48 × 12	5.250	201.60	48 × 120	7.7296	314.80
48 × 144	5.250	241.90	48 × 144	7.7296	377.80
60 × 120	5.250	252.00	60 × 120	7.7296	393.60
60 × 144	5.250	302.40	72 × 120	7.7296	472.30
72 × 120	5.250	302.40			
72 × 144	5.250	362.90			

Common Stainless Sheet Finishes

No. 2B Finish – The Material is given a subsequent light skin pass cold rolling operation between polished rolls resulting in a uniform dull matt finish

No. 4 Finish – This is a ground unidirectional finish obtained with 150 grit abrasive. It is not highly reflective, but is a good general purpose finish on components which will suffer from fairly rough handling in service (eg restaurant equipment).

No. 7 Finish – This is a buffed finish having a high degree of reflectivity.

No. 8 Finish – This is produced in an equivalent manner to a No. 7 Finish, the final operations being done with extremely fine buffing compounds. The final surface is blemish free with a high degree of image clarity, and is the true mirror finish.

Note – The finer polished finishes (No. 4, No. 6, No. 7 and No. 8) are generally only produced one side of the sheet, the reverse side being either a 2B or No. 3 Finish.

TYPE 316 and 316L STAINLESS STEEL SHEET – No. 2B FINISH

GAUGE AND SIZE (INCHES)	Lbs./ Sq. Ft.	Est. Lbs./ Sheet	GAUGE AND SIZE (INCHES)	Lbs./ Sq. Ft.	Est. Lbs./ Sheet
26 Ga.(.019)			**14 Ga. (.078)**		
36 × 96	.7424	18.140	36 × 120	3.0935	94.500
24 Ga. (.02S)			48 × 96	3.0935	98.992
36 × 120	.9899	30.240	60 × 120	3.0935	154.675
48 × 96	.9899	32.260	60 × 144	3.0935	189.0
48 × 120	.9899	40.320	**12 Ga. (.109)**		
22 Ga. (.031)			36 × 96	4.3309	105.8
36 × 96	1.2374	30.240	36 × 120	4.3309	132.3
36 × 120	1.2374	37.800	48 × 96	4.3309	141.1
48 × 120	1.2374	50.400	48 × 120	4.3309	176.4
20 Ga. (.038)			60 × 120	4.3309	220.5
36 × 96	1.4949	36.290	60 × 144	4.3309	264.6
36 × 120	1.4949	45.360	**11 Ga. (.125)**		
48 × 96	1.4949	48.380	36 × 96	4.9496	121.0
48 × 120	1.4949	60.480	36 × 120	4.9496	151.2
18 Ga. (.050)			48 × 120	4.9496	201.6
36 × 96	1.979	48.380	60 × 120	4.9496	252.0
36 × 120	1.979	60.480	60 × 144	4.9496	302.4
48 × 96	1.979	64.510	**10 Ga. (.141)**		
48 × 120	1.979	80.640	48 × 120	5.5683	226.8
16 Ga. (.063)			48 × 144	5.5683	272.2
36 × 96	8.4749	60.480	60 × 120	5.5683	283.5
36 × 120	8.4749	75.600	60 × 144	5.5683	340.2
48 × 96	8.4749	80.640	**8 Ga. (.172)**		
48 × 120	8.4749	100.800	48 × 120	6.9057	277.2
60 × 120	8.4749	126.000	60 × 120	6.9057	346.5
60 × 144	8.4749	151.200	**7 Ga. (.187)**		
14 Ga. (.078)			48 × 120	7.7296	314.8
36 × 96	3.0935	75.600			

STAINLESS STEEL SQUARES

SIZE (inches)	Lbs/Ft.	303	304	316	416
1/8	.053	X		X	X
3/16	.120	X	X	X	X
1/4	.213	X	X	X	X
5/16	.332	X	X	X	X
3/8	.478	X	X	X	X
7/16	.651	X			X
1/2	.850	X	X	X	X
9/16	.932	X			
5/8	1.330	X	X	X	X
3/4	1.910	X	X	X	X
7/8	2.600	X	X	X	X
1	3.400	X	X	X	X
1-1/8	3.730				X
1-1/4	5.313	X	X	X	X
1-1/2	7.650	X	X	X	X
1-3/4	10.410	X			X
2	13.600	X	X	X	X
2-1/2	21.250	X			
2-3/4	25.710	X			
3-1/2	41.650	X			
4	54.400	X			

180 GRIT STAINLESS STEEL ROUND TUBING – ORNAMENTAL POLISH

Size (inches)	WALL THICKNESS DECIMAL	Lbs/Ft.
5/8"	.049	.301
3/4"	.049	.367
7/8"	.049	.432
1"	.049	.498
	.065	.650
1-1/8"	.049	.563
1-1/4"	.049	.629
	.065	.830
1-3/8"	.065	.909
1-1/2"	.065	.996
1-5/8"	.065	1.080
1-3/4"	.065	1.170
2"	.065	1.343
	.049	1.021

☐ 180 GRIT STAINLESS STEEL SQUARE TUBING – ORNAMENTAL POLISH

Size (inches)	WALL THICKNESS DECIMAL	Lbs/Ft.
1/2"	.062	.390
5/8"	.062	.490
3/4"	.062	.605
1"	.049	.630
	.065	.827
1-1/4"	.065	1.050
1-1/2"	.065	1.270
	.120	2.255
1-3/4"	.083	1.920
2"	.065	1.710
	.120	3.068

◯ TYPE 304 STAINLESS STEEL WELDED ROUND TUBING – MILL FINISH, STRUCTURAL GRADE

Size (inches)	WALL THICKNESS DECIMAL	Lbs/Ft.
1"	.0494	.630
	.0650	.827
	.1200	1.436
1-1/4"	.0650	1.050
	.0830	1.317
	.1200	1.844
1-1/2"	.0650	1.270
	.0830	1.610
	.1200	2.255
	.1800	3.320
1-3/4"	.0830	1.920
2"	.0650	1.710
	.0830	2.164
	.1200	3.068
	.1800	4.455
	.1880	4.460
	.2500	6.010
2-1/2"	.1800	5.680
3"	.0830	3.293
	.1200	4.700
	.1800	6.903
	.1880	6.900
	.2500	8.950
4"	.1200	6.260
	.1800	9.270
	.1880	9.270
	.2500	12.680
6"	.2500	18.199
8"	.3750	39.293

TYPE 304 STAINLESS STEEL WELDED SQUARE TUBING – MILL FINISH, STRUCTURAL GRADE

Size (inches)	WALL THICKNESS DECIMAL	Lbs/Ft.
2 × 1″	.0650	1.270
2 × 1″	.1200	2.252
3 × 2″	.1200	3.884
3 × 2″	.1800	5.679
4 × 2″	.1200	4.700
4 × 2″	.1800	6.903
4 × 2″	.2500	8.930
4 × 3″	.1800	8.127
4 × 3″	.2500	11.250
5 × 3″	.1800	9.270
5 × 3″	.2500	12.680
6 × 2″	.1800	9.270
6 × 2″	.2500	12.680
6 × 3″	.1800	10.520
6 × 4″	.1800	11.900
6 × 4″	.2500	16.350
8 × 4″	.2500	18.770
8 × 4″	.3750	28.690

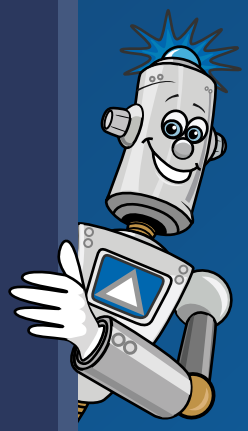
TYPE 304/304L STAINLESS STEEL WELDED & SMLS ROUND TUBING ANNEALED and PICKLED, BRIGHT ANNEALED OR COLD FINISHED

O.D. (Inches)	WALL DECIMAL	I.D.	LBS./FT.	WELDED 304	SEAMLESS 304
1/8"	.028	.069	.029	X	
	.035	.055	.034	X	
3/16"	.028	.132	.048	X	
	.035	.118	.057	X	
1/4"	.028	.194	.066	X	
	.035	.180	.080	X	X
	.049	.152	.105	X	X
	.065	.120	.128	X	X
5/16"	.028	.257	.085	X	
	.035	.243	.104	X	
	.049	.215	.138	X	
	.065	.183	.172	X	X
3/8"	.028	.319	.104	X	
	.035	.305	.127	X	X
	.049	.277	.171	X	
	.065	.245	.215	X	X
7/16"	.035	.368	.151	X	
	.049	.340	.204	X	
	.065	.308	.259	X	
1/2"	.028	.444	.141	X	
	.035	.430	.174	X	X
	.049	.402	.236	X	X
	.065	.370	.302	X	X
	.095	.310	.411	X	X
5/8"	.028	.569	.179	X	
	.035	.555	.221	X	
	.049	.527	.301	X	X
	.065	.495	.389	X	X
	.083	.459	.481	X	
	.120	.385	.647	X	X
3/4"	.035	.680	.267	X	X
	.049	.652	.367	X	
	.065	.620	.476	X	X
	.095	.560	.665	X	X
	.120	.510	.807	X	
7/8"	.035	.805	.314	X	
	.049	.777	.432	X	
	.065	.745	.562	X	
	.120	.635	.968	X	X
1"	.035	.930	.361	X	X
	.049	.902	.498	X	X
	.065	.870	.649	X	X

Continued

O.D. (Inches)	WALL DECIMAL	I.D.	LBS./FT.	WELDED 304	SEAMLESS 304
	.083	.834	.813	X	X
	.095	.810	.918	X	X
	.120	.760	1.128	X	X
	.188	.625	1.630	X	
	.250	.500	2.003		X
1-1/4"	.035	1.180	.454	X	
	.049	1.152	.629	X	
	.065	1.120	.823	X	X
	.083	1.084	1.034	X	
	.120	1.010	1.448	X	X
	.188	.874	2.132		X
	.250	.750	2.670		X
1-1/2"	.035	1.430	.548	X	
	.049	1.402	.759	X	
	.065	1.370	.996	X	X
	.083	1.334	1.256	X	
	.120	1.260	1.769	X	X
	.188	1.124	2.634	X	
	.250	1.000	3.338		X
1-3/4"	.035	1.680	.641	X	
	.049	1.652	.890	X	
	.065	1.620	1.170	X	
	.120	1.510	2.089	X	X
	.188	1.375	3.136	X	

STEEL STRUCTURAL



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NOTES

STEEL STRUCTURAL

DATA AND SPECIFICATIONS

A36 CARBON STEEL

A hot rolled mild carbon steel which has good overall mechanical properties, is easily fabricated and may be formed hot or cold.

Applications: Structural, agricultural instruments, transportation equipment, and miscellaneous non-critical applications that involve mild cold bending, hot forming, punching and welding. Used where seams and other surface imperfections may be tolerated.

Analysis:				
3/4 and Under:	C - .26 Max.	Mn - ---	P - .04 Max.	S - .05 Max.
Over 3/4 to 1/2" Incl.:	C - .27 Max.	Mn - .60/.90	P - .04 Max.	S - .05 Max.
Over 1/2":	C - .28 Max.	Mn - .60/.90	P - .04 Max.	S - .05 Max.

Mechanical Properties:	
Following values are average and are representative	
	l"rd
Tensile Strength (psi)	58-80,000
Yield Point (psi)	36,000 Min.
Elongation (% in 2")	23 min.

Weldability: Easily welded by all welding processes with the resultant welds and joints being extremely high quality. Grade of welding rod used depends on welding conditions such as thickness of section, design, service requirements, etc.

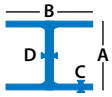
L A36 CARBON STEEL ANGLES – BAR MILL SIZES

Size (inches)					Lbs/Ft.	Size (inches)					Lbs/Ft.
A		B		C		A		B		C	
1/2	×	1/2	×	1/8	.380	1-3/4	×	1-3/4	×	3/16	2.120
5/8	×	5/8	×	1/8	.480					1/4	.770
3/4	×	3/4	×	1/8	.590	2	×	1-1/4	×	3/16	1.960
7/8	×	7/8	×	1/8	.700					1/4	2.550
1	×	5/8	×	1/8	.640	2	×	1-1/2	×	1/8	1.440
1	×	3/4	×	1/8	.700					3/16	2.120
1	×	1	×	1/8	.800					1/4	2.770
				3/16	1.160	2	×	2	×	1/8	1.650
				1/4	1.490					3/16	2.440
1-1/8	×	1-1/8	×	1/8	.900					1/4	3.190
1-1/4	×	1-1/4	×	1/8	1.010					5/16	3.920
				3/16	1.480					3/8	4.700
				1/4	1.920	2-1/2	×	1-1/2	×	3/16	2.440
1-3/8	×	7/8	×	1/8	.910					1/4	3.190
				3/16	1.320					5/16	3.920
1-1/2	×	1-1/4	×	3/16	1.640	2-1/2	×	2	×	3/16	2.750
1-1/2	×	1-1/2	×	1/8	1.230					1/4	3.620
				3/16	1.800					5/16	4.500
				1/4	2.340					3/8	5.300
				3/8	3.350	2-1/2	×	2-1/2	×	3/16	3.070
1-3/4	×	1-1/4	×	1/8	1.230					1/4	4.100
				3/16	1.800					5/16	5.000
				1/4	2.340					3/8	5.900
1-3/4	×	1-3/4	×	1/8	1.440					1/2	7.700

Size (inches)					Lbs/Ft.	Size (inches)					Lbs/Ft.
3	×	2	×	3/16	3.070	5	×	3	×	1/4	6.600
				1/4	4.100					5/16	8.200
				5/16	5.000					3/8	9.800
				3/8	5.900					1/2	12.800
				1/2	7.700	5	×	3-1/2	×	1/4	7.000
3	×	2-1/2	×	3/16	3.350					5/16	8.700
				1/4	4.500					3/8	10.400
				5/16	5.600					1/2	13.600
				3/8	6.600					5/8	16.800
				1/2	8.500					3/4	19.800
3	×	3	×	3/16	3.710	5	×	5	×	5/16	10.300
				1/4	4.900					3/8	12.300
				5/16	6.100					1/2	16.200
				3/8	7.200					5/8	20.000
				1/2	9.400					3/4	23.600
3-1/2	×	2-1/2	×	1/4	4.900	6	×	3-1/2	×	1/4	7.900
				5/16	6.100					5/16	9.800
				3/8	7.200					3/8	11.700
				1/2	9.400					1/2	15.300
3-1/2	×	3-1/2	×	1/4	5.400	6	×	4	×	5/16	10.300
				5/16	6.600					3/8	12.300
				3/8	7.900					1/2	16.200
				1/2	10.200	6	×	4	×	5/8	20.000
3-1/2	×	3-1/2	×	1/4	5.800					3/4	23.600
				5/16	7.200	6	×	6	×	5/16	12.500
				3/8	8.500					3/8	14.900
				1/2	11.100					1/2	19.600
4	×	3	×	1/4	5.800					5/8	24.200
				5/16	7.200					3/4	28.700
				3/8	8.500					1	37.400
				1/2	11.100	7	×	4	×	3/8	13.600
4	×	3-1/2	×	1/4	6.200					1/2	17.900
				5/16	7.700					3/4	26.200
				3/8	9.100	8	×	4	×	1/2	19.600
				1/2	11.900					3/4	28.700
4	×	4	×	1/4	6.600	8	×	6	×	1/2	23.000
				5/16	8.200					3/4	33.800
				3/8	9.800					1	44.200
				1/2	12.800	8	×	8	×	1/2	26.400
				5/8	15.700					5/8	32.700
				3/4	18.500					3/4	38.900
										1	51.000
						9	×	4	×	1/2	21.30*

*Not rolled section, cut from channel.

H-BEAMS/WIDE FLANGE CARBON STEEL STRUCTURAL



Depth		LBS./FT.	Depth (A) In.	Width (B) In.	Thick (C) In.	Web (D) In.
W4	X	13	4.160	4.060	.345	.280
W5	X	16	5.010	5.000	.360	.240
		19	5.010	5.030	.430	.270
W6	X	9	5.900	3.940	.215	.170
		12	6.030	4.000	.280	.230
		15	5.990	5.990	.260	.230
		16	6.280	4.030	.405	.260
		20	6.200	6.020	.365	.260
		25	6.380	6.080	.455	.320
W8	X	10	7.890	3.940	.205	.170
		13	7.990	4.000	.255	.230
		15	8.110	4.015	.315	.245
		18	8.140	5.250	.330	.230
		21	8.280	5.270	.400	.250
		24	7.930	6.495	.400	.245
		28	8.060	6.535	.465	.285
		31	8.000	7.995	.435	.285
		35	8.120	8.020	.495	.310
		40	8.250	8.070	.560	.360
		48	8.500	8.110	.685	.400
		58	8.750	8.220	.810	.510
		67	9.000	8.280	.935	.570
W10	X	12	9.870	3.960	.210	.190
		15	9.990	4.000	.270	.230
		17	10.110	4.010	.330	.240
		19	10.240	4.020	.395	.250
		22	10.170	5.750	.360	.240
		26	10.330	5.770	.440	.260
		30	10.470	5.810	.510	.300
		33	9.730	7.960	.435	.290
		39	9.920	7.985	.530	.315
		45	10.100	8.020	.620	.350
		49	9.980	10.000	.560	.340
		54	10.090	10.030	.615	.370
		60	10.220	10.080	.680	.420
		68	10.400	10.130	.770	.470
		77	10.600	10.190	.870	.530
		88	10.840	10.265	.990	.605
		100	11.100	10.340	1.120	.680
		112	11.360	10.415	1.250	.755
W12	X	14	11.910	3.970	.225	.200
		16	11.990	3.990	.265	.220

Continued

Depth		LBS./FT.	Depth (A) In.	Width (B) In.	Thick (C) In.	Web (D) In.
		19	12.160	4.005	.350	.235
		22	12.310	4.030	.425	.260
		26	12.220	6.490	.380	.230
		30	12.340	6.520	.440	.260
		35	12.500	6.560	.520	.300
		40	11.940	8.005	.515	.295
		45	12.060	8.045	.575	.335
		50	12.190	8.080	.640	.370
		53	12.060	9.995	.575	.345
		58	12.190	10.010	.640	.360
		65	12.120	12.000	.605	.390
		72	12.250	12.040	.670	.430
		79	12.380	12.080	.735	.470
		87	12.530	12.125	.810	.515
		96	12.710	12.160	.900	.550
		106	12.890	12.220	.990	.610
		120	13.120	12.320	1.105	.710
		136	13.410	12.400	1.250	.790
W14	X	22	13.740	5.000	.335	.230
		26	13.910	5.025	.420	.255
		30	13.840	6.730	.385	.270
		34	13.980	6.745	.455	.285
		38	14.100	6.770	.515	.310
		43	13.660	7.995	.530	.305
		48	13.790	8.030	.595	.340
		53	13.920	8.060	.660	.370
		61	13.890	9.995	.645	.375
		68	14.040	10.035	.720	.415
		74	14.170	10.070	.785	.450
		82	14.310	10.130	.855	.510
		90	14.020	14.520	.710	.440
		99	14.160	14.565	.780	.485
		109	14.320	14.605	.860	.525
W16	X	26	15.690	5.500	.345	.250
		31	15.880	5.525	.440	.275
		36	15.860	6.985	.430	.295
		40	16.010	6.995	.505	.305
		45	16.130	7.035	.565	.345
		50	16.260	7.070	.630	.380
		57	16.430	7.120	.715	.430
		67	16.330	10.235	.665	.395
		77	16.520	10.295	.760	.455
		89	16.750	10.365	.875	.525
		100	26.970	10.425	.985	.585
W18	X	35	17.700	6.000	.425	.300

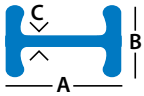
Continued

Depth		LBS./FT.	Depth (A) In.	Width (B) In.	Thick (C) In.	Web (D) In.
		40	17.900	6.015	.525	.315
		46	18.060	6.060	.605	.360
		50	17.990	7.495	.570	.355
W18	X	55	18.110	7.530	.630	.390
		60	18.240	7.555	.695	.415
		65	18.350	7.590	.750	.450
		71	18.470	7.635	.810	.495
		76	18.210	11.035	.680	.425
		86	18.390	11.090	.770	.480
		97	18.590	11.145	.870	.535
		106	18.730	11.200	.940	.590
		119	18.970	11.265	1.060	.655
W21	X	44	20.660	6.500	.450	.350
		50	20.830	6.530	.535	.380
		57	21.060	6.555	.650	.405
		62	20.990	8.240	.615	.400
		68	21.130	8.270	.685	.430
		73	21.240	8.295	.740	.455
		83	21.430	8.355	.835	.515
		101	21.360	12.290	.800	.500
		111	21.510	12.340	.875	.550
		132	21.830	12.440	1.035	.650
W21	X	147	22.060	12.510	1.150	.720
W24	X	55	23.570	7.005	.505	.395
		62	23.740	7.040	.590	.430
		68	23.730	8.965	.585	.415
		76	23.920	8.990	.680	.440
		84	24.100	9.020	.770	.470
		94	24.310	9.065	.875	.515
		104	24.060	12.750	.750	.500
		117	24.260	12.800	.850	.550
		131	24.480	12.855	.960	.605
		146	24.740	12.900	1.090	.650
W27	X	84	26.710	9.960	.640	.460
		94	26.920	9.990	.745	.490
		102	27.090	10.015	.830	.515
		114	27.290	10.070	.930	.570
		146	27.380	13.965	.975	.605
W30	X	108	29.830	10.475	.760	.545
		116	30.010	10.495	.850	.565
		124	30.170	10.515	.930	.585
		132	30.310	10.545	1.000	.615
		173	30.440	14.985	1.065	.655
		211	30.940	15.105	1.315	.775
W33	X	118	32.860	11.480	.740	.550

Continued

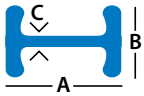
Depth		LBS./FT.	Depth (A) In.	Width (B) In.	Thick (C) In.	Web (D) In.
		130	33.090	11.510	.855	.580
		201	33.680	15.745	1.150	.715
W36	**X**	**135**	35.550	11.950	.790	.600
		150	35.850	11.975	.940	.625

I A36 JUNIOR BEAMS CARBON STEEL STRUCTURAL



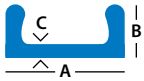
A Depth	Lbs./Ft.	C THICKNESS OF WEB	B Width of Flange
6”	4.40	.114	1.840
8”	6.50	.135	2.280
10”	9.00	.155	2.690
12”	11.80	.175	3.060

I A36 STANDARD S-BEAMS CARBON STEEL STRUCTURAL



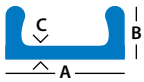
A Depth	Lbs./Ft.	C THICKNESS OF WEB	B Width of Flange
3”	5.70	.170	2.330
	7.50	.349	2.509
4”	7.70	.190	2.660
	9.50	.326	2.796
5”	10.00	.210	3.000
	14.75	.494	3.284
6”	12.50	.230	3.330
	17.25	.465	3.565
7”	15.30	.250	3.660
8”	18.40	.270	4.000
	23.00	.441	4.171
10”	25.40	.310	4.660
	35.00	.594	4.944
12”	31.80	.350	5.000
	35.00	.428	5.078
	40.80	.460	5.250
	50.00	.687	5.477
15”	42.90	.410	5.500
	50.00	.550	5.640
18”	54.70	.460	6.000
	70.00	.711	6.251
20”	66.00	.505	6.255
	75.00	.635	6.385
	86.00	.660	7.060
	96.00	.800	7.200
24”	80.00	.500	7.000
	90.00	.625	7.125
	100.00	.745	7.245
	106.00	.620	7.870
	121.00	.800	8.050

A36 CHANNELS BAR MILL SIZES – CARBON STEEL STRUCTURAL



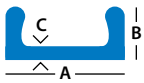
A DEPTH	B FLange	C WEB Thick-ness	LBS. /FT.	A Depth	B Flange	C Web Thick-ness	Lbs./ Ft.
3/4	3/8	1/8	.560	**1-1 /2**	3/4	1/8	1.170
1	3/8	1/8	.680	**2**	1/2	1/8	1.430
1	1/2	1/8	.840	**2**	9/16	3/16	1.860
1-1/8	9/16	3/16	1.160	**2**	5/8	1/4	2.280
1-1/4	1/2	1/8	.990	**2**	1	1/8	1.590
1-1/2	1/2	1/8	1.120	**2**	1	3/16	2.320
1-1/2	9/16	3/16	1.440	**2-1/2**	5/8	3/16	2.270

A36 CHANNELS SHIP and CAR SIZES – CARBON STEEL STRUCTURAL



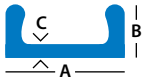
A DEPTH	LBS. /FT.	C WEB Thick-ness	B Flange.	A Depth	LBS. /FT	C Web Thick-ness	B Flange
3”	7.10	.313	1.938	**10”**	33.60	.575	4.100
4”	13.80	.500	2.500		41.10	.796	4.321
6”	12.00	.313	2.500	**12”**	32.90	.500	3.500
	15.30	.340	3.500		35.00	.467	3.767
	16.30	.375	3.000		45.00	.712	4.012
	18.00	.375	3.500		50.00	.835	4.135
7”	19.10	.350	3.450	**13”**	31.80	.375	4.000
	22.70	.500	3.600		35.00	.447	4.072
8”	18.70	.350	2.975		40.00	.560	4.185
	20.00	.400	3.025		50.00	.787	4.412
	21.40	.375	3.450	**18”**	42.70	.450	3.950
	22.80	.425	3.500		45.80	.500	4.000
9”	25.40	.450	3.500		51.90	.600	4.100
10”	21.90	.325	3.450		58.00	.700	4.200
	28.50	.425	3.950				

A36 CHANNELS STAIR STRINGERS (JUNIOR) CARBON STEEL STRUCTURAL



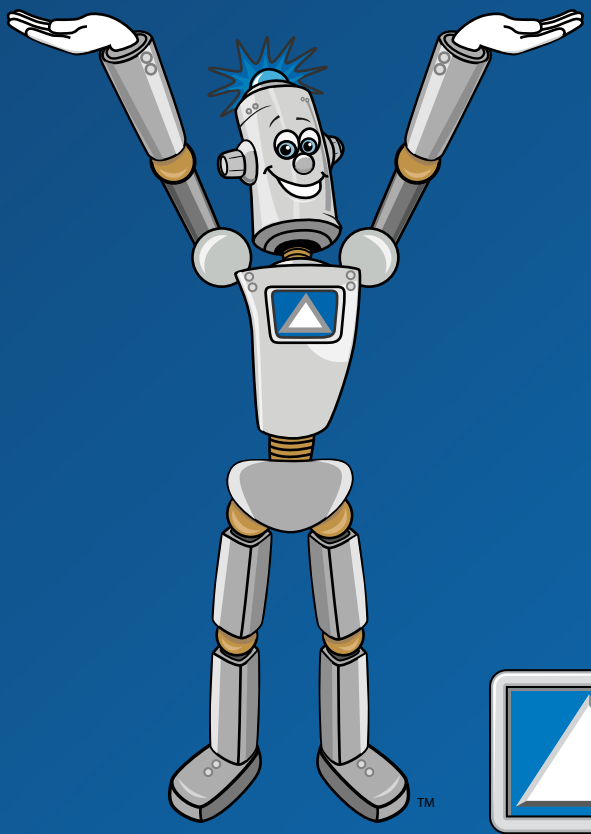
A	LBS./FT.	C	B	A	LBS./FT.	C	B
8”	8.50	.180	1.875	**10”**	8.40	.170	1.500
10”	6.50	.150	1.125	**12”**	10.6	.190	1.500

A36 CHANNELS STRUCTURAL SIZES CARBON STEEL STRUCTURAL



A	LBS./FT.	C	B	A	LBS./FT.	C	B
3"	4.100	.170	1.410	**8"**	13.750	.303	2.343
	5.000	.258	1.498		18.750	.487	2.527
	6.000	.356	1.596	**9"**	13.400	.230	2.430
4"	5.400	.180	1.580		15.000	.285	2.485
	6.250	.247	1.647		20.000	.448	2.648
	7.250	.320	1.720	**10"**	15.300	.240	2.600
5"	6.700	.190	1.750		20.000	.379	2.739
	9.000	.325	1.885		25.000	.526	2.886
6"	8.200	.200	1.920		30.000	.673	3.033
	10.500	.314	2.034	**12"**	20.700	.280	2.940
	13.000	.437	2.157		25.000	.387	3.047
7"	9.800	.210	2.090		30.000	.510	3.170
	12.250	.314	2.194	**15"**	33.900	.400	3.400
	14.750	.419	2.299		40.000	.520	3.520
8"	11.500	.220	2.260		50.000	.716	3.716

STEEL TUBING AND PIPE



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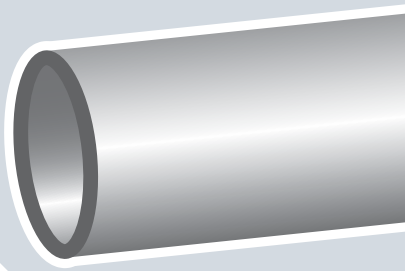
STEEL TUBING AND PIPE



DATA AND SPECIFICATIONS

Included in the following data and specifications are Mechanical Properties covering tubes of various types of steel after normal cold drawn passes and annealing. These figures represent values of tubing of usual sizes and wall thickness. They do not apply to unusual sizes, gauges or specifications - for several reasons.

1. Physical properties of cold drawn tubes will vary according to varying degrees of cold work performed in producing the tubes.
2. Annealing of cold drawn tubes changes the physical properties. The amount of these changes will vary with the degree of cold work the tube has received.
3. Greater proportion of change, with increased proportionate strength, will be found in light wall tubes than in tubes with heavy walls, due to the fact that the latter cannot be given the same degree of cold work as the light wall tubes. For the same reason, large tubes with relatively heavy walls will not show the same increase in strength as small tubes.

1010 ELECTRIC WELD CARBON STEEL TUBE

Normally used in the manufacturing of electric-resistance welded tube. Typically available in cold rolled strip (16 gauge and lighter), and hot rolled strip (.083"wall and heavier). This product can be obtained in the as-welded condition (flash-in) or in the flash-controlled condition.

Applications: Machinery stands, exhaust tubes, handles, hand rails, display stands, conveyor rollers.

Analysis:		
C - .08/.13	Mn - .30/.60	P - .035 Max.
S - .035 Max.		

Mechanical Properties:

Minimum Values

	Hot Rolled	Cold Drawn	S-R Anneal	Soft Annealed
Yield Strength (psi)	24,000	60,000	45,000	28,000
Ultimate Strength (psi)	43,000	72,000	58,000	57,000
Elongation (% in 2")	28	15	28	50

Machinability: Good. **Surface Cutting Speed:** 110 ft/min. **Weldability:** Easily welded by all welding processes, and the resultant welds and joints are of extremely high quality. Grade of welding rod used depends on welding conditions such as thickness of section, design, service requirements, etc.

1015 CARBON STEEL TUBE

General purpose low carbon with predictable qualities.

Applications: Structural.

Analysis:		
C- .13/.18	Mn -.30/.60	P- .04 Max.
S- .05 Max.		

Mechanical Properties:

Minimum Values

	H.R.	Norm.	Soft Annealed	As-Drawn	CD-Stress Relief Annealed	CD-Med. Annealed
Yield Strength (psi)	33,000	35,000	30,000	65,000	55,000	40,000
Ultimate Strength (psi)	55,000	50,000	48,000	80,000	75,000	65,000
Elongation(% in 2")	40	40	40	15	20	30

Weldability: Excellent.

1026 CARBON STEEL TUBE

Normally used in the manufacturing of DOM, cold drawn and hot finished seamless and furnished over 2" O.D. with walls heavier than .156". A variety of thermal treatments can be applied, depending on the type and size of material.

Applications: Mechanical, hydraulic cylinders, shaft, tight tolerance requirements.

Analysis:		
C - .22/.28	Mn - .60/.90	P - .040 Max.
S - .050 Max.		

Mechanical Properties:

Minimum Values

	H.R.	Norm.	Soft Annealed	As-Drawn	CD-Stress Relief Annealed	CD-Med. Annealed
Yield Strength (psi)	47,000	50,000	36,000	72,000	65,000	52,000
Ultimate Strength (psi)	70,000	67,000	60,000	87,000	82,000	72,000
Elongation(% in 2")	28	33	35	10	15	22

Machinability: Good. **Weldability:** Excellent. **Surface Cutting Speed:** 120 ft/min. **Corrosion Resistance:** Poor.

1045 CARBON STEEL TUBE

For greater strength and hardness in the as-rolled condition. Good for hammer forge processes.

Applications: Gears, shafts, axles, bolts and studs.

Analysis:		
C – .43/.50	Mn –- .60/.90	P – .040 Max.
S – .050 Max.		

Mechanical Properties:						
Minimum Values						
	H.R.	**Norm.**	**Soft Annealed**	**As-Drawn**	**CD-Stress Relief Annealed**	**CD-Med. Annealed**
Yield Strength (psi)	50,000	55,000	45,000	85,000	78,000	55,000
Ultimate Strength (psi)	80,000	78,000	73,000	95,000	92,000	80,000
Elongation (% in 2")	20	20	25	7	10	15

4130 ALLOY STEEL TUBE

A low alloy steel containing molybdenum and chromium as strengthening agents.

Applications: Structural such as aircraft engine mounts and welded tubing.

Analysis:		
C – .28/.33	Mn – .40/.60	P – .035 Max.
S – .040 Max.	Si – .20/.35	Cr – .80/1.10
Mo – .15/.25		

Mechanical Properties:						
Minimum Values						
	H.R.	**Norm.**	**Soft Annealed**	**As-Drawn**	**CD-Stress Relief Annealed**	**CD-Med. Annealed**
Yield Strength (psi)	70,000	60,000	50,000	90,000	5,000	80,000
Ultimate Strength (psi)	90,000	90,000	75,000	100,000	105,000	100,000
Elongation (%in 2")	20	20	30	10	10	10

Machinability: Readily machined by conventional methods. **Weldability:** Excellent by all commercial methods. **Heat Treatable:** Heating at 1600° F followed by oil quenching. **Forging:** Forge at 2200° F - 1750° F.

4140 ALLOY STEEL TUBE

Low cost, general purpose alloys. Variations in heat treatments provides a wide range of strength and toughness.

Applications: Numerous including forgings, tubing and fittings.

Analysis:		
C – .38/.43	Mn – .75/1.00	P – .035 Max.
S – .040 Max.	Si – .20/.35	Cr – .80/1.10
Mo – .15/.25		

Mechanical Properties:				
Minimum Values				
	H.R.	**Normalized**	**Soft Annealed**	**As-Drawn**
Yield Strength (psi)	**90,000**	**90,000**	**60,000**	**100,000**
Ultimate Strength (psi)	120,000	120,000	80,000	120,000
Elongation (% in 2")	15	20	25	10

Machinability: Good in the annealed condition. In the heat treated and quenched condition machining is best limited to finished grinding. **Welding:** Good by all commercial methods. **Heat Treatable:** Heat to 1550° F. Oil quench. **Forging:** Forge at 2200° F - 1700° F.

8620 ALLOY STEEL TUBE

The most widely used of all case hardening alloys. A hardenable chromium, molybdenum, nickel low alloy steel often used for carburizing to develop a case-hardened part. This case-hardening will result in good wear characteristics.

Applications: Gears, ring gears, shafts and crankshafts.

Analysis:		
C –.18/.23	Mn – .70/.90	P – .035 Max.
S – .040 Max.	Ni – .40/.70	Cr – .40/.60
Mo – .15/.25	Si – .15/.30	

Mechanical Properties:			
Minimum Values			
	H.R.	**Normalized**	**As-Drawn**
Yield Strength (psi)	**50,000**	**50,000**	**90,000**
Ultimate Strength (psi)	85,000	80,000	100,000
Elongation (% in 2")	25	25	10

Machinability: Prior to carburizing to within as close a tolerance as possible. **Weldability:** Good by all conventional methods, typically gas or arc. **Heat Treatable:** Heating to 1500° F followed by water quenching. **Forging:** Forge at 2200° F - 1800° F.

STANDARD PIPE SIZES and WEIGHT

Nominal Pipe Size	O.D. INCHES	SCH. 5S	WALL THICKNESS AND WEIGHT PER FOOT				
			SCH. 10S	SCH. 40	SCH. 80	SCH. 160	XXS
1/8 Lb/Foot	.405		.049 .1863	.068 .2447	.095 .3145		
1/4 Lb/Foot	.540		.065 .3297	.088 .4248	.119 .5351		
3/8 Lb/Foot	.675		.065 .4225	.091 .5650	.126 .7388		
1/2 Lb/Foot	.840	.065 .5380	.083 .6710	.109 .8510	.147 1.0880	.187 1.304	.294 1.714
3/4 Lb/Foot	1.050	.065 .6838	.083 .8572	.113 1.1310	.154 1.4740	.218 1.937	.308 2.441
1 Lb/Foot	1.315	.065 .8678	.109 1.4040	.133 1.6790	.179 2.1720	.250 2.844	.358 3.659
1-1/4 Lb/Foot	1.660	.065 1.1070	.109 1.1070	.140 2.2730	.191 2.9970	.250 3.765	.382 5.214
1-1/2 Lb/Foot	1.900	.065 1.2740	.109 1.8060	.145 2.7180	.200 3.6310	.281 4.859	.400 6.408
2 Lb/Foot	2.375	.065 1.6040	.109 2.6380	.145 3.6530	.218 5.0220	.343 7.444	.436 9.029
2-1/2 Lb/Foot	2.875	.083 2.4750	.120 3.5310	.203 5.7930	.276 7.6610	.375 10.010	.552 13.700
3 Lb/Foot	3.500	.083 3.0290	.120 4.3320	.216 7.7560	.300 10.2500	.438 14.320	.600 18.580
3-1/2 Lb/Foot	4.000	.083 3.4720	.120 4.9730	.226 9.1090	.318 12.5100		

STANDARD PIPE SIZES and WEIGHT

Nominal Pipe Size	O.D. INCHES	WALL THICKNESS AND WEIGHT PER FOOT		
		SCH. 5	SCH. 10	SCH. 40
4 Lb/Foot	4.500	.083 3.9150	.120 5.630	.237 10.790
5 Lb/Foot	5.563	.109 6.3490	.134 7.770	.258 14.620
6 Lb/Foot	6.625	.109 7.5850	.134 9.289	.280 18.97
8 Lb/Foot	8.625	.109 9.1750	.148 13.400	.322 28.550
10 Lb/Foot	10.750	.134 15.190	.165 18.650	.365 40.480
12 Lb/Foot	12.750	.156 20.980	.180 24.160	.406 53.520
14 Lb/Foot	14.000		.250 36.710	.438 63.440
16 Lb/Foot	16.000		.250 42.050	.500 82.770
18 Lb/Foot	18.000		.250 47.390	.562 104.70
20 Lb/Foot	20.000		.250 52.730	.593 122.900
24 Lb/Foot	24.000		.250 63.410	.687 171.100
30 Lb/Foot	30.000		.312 98.930	

INQUIRE ABOUT SCHEDULE 20, 30, 100, 120, 140 availability.

STANDARD PIPE SIZES and WEIGHT

Nominal Pipe Size	WALL THICKNESS AND WEIGHT PER FOOT				
	SCH. 40	XS (Extra Strong)	SCH. 80	SCH. 160	XXS (DBL. EXTRA STRONG
4 Lb/Foot	.237 10.79	.337 14.98	.337 14.98	.531 22.51	.674 27.54
5 Lb/Foot	.258 14.62	.375 20.78	.375 20.78	.625 32.96	.750 38.55
6 Lb/Foot	.280 18.97	.432 28.57	.432 28.57	.718 45.35	.864 53.16
8 Lb/Foot	.322 28.55	.500 43.39	.500 43.39	.906 74.69	.875 72.42
10 Lb/Foot	.365 40.48	.500 54.74	.593 65.33	1.125 115.60	1.000 104.10
12 Lb/Foot	.375 49.56	.500 65.42	.687 88.51	1.312 160.30	1.000 125.50
14 Lb/Foot		.500 72.09	.750 106.10	1.406 189.10	
16 Lb/Foot		.500 82.77	.843 136.50	1.593 245.1	
18 Lb/Foot			.937 170.80	1.781 308.50	
20 Lb/Foot			1.031 208.9	1.968 379.00	
24 Lb/Foot			1.218 295.90	2.343 541.90	

CARBON STEEL TUBING – RECTANGULAR
ERW SIZES – LOW CARBON
STRUCTURAL SIZES – ASTM A500 GRADE B

SIZE (INCHES)	WALL THICKNESS	LBS./ FT.	SIZE (INCHES)	WALL THICKNESS	LBS./ FT.
1 × 1/2	0.065	0.606	5 × 2-1/2	0.188	8.780
1-1/2 × 1/2	0.065	0.827	5 × 3	0.188	9.420
1-1/2 × 3/4	0.083	1.176		0.250	02.210
	0.120	1.601		0.375	17.270
1-1/2 × 1	0.065	1.048		0.500	21.630
	0.083	1.317	6 × 2	0.120	6.460
	0.120	1.844		0.188	9.420
2 × 1	0.065	1.269		0.250	12.210
	0.083	1.600		0.375	17.270
	0.120	2.252	6 × 3	0.120	7.300
2 × 1-1/4	0.083	1.741		0.188	10.700
2 × 1-1/2	0.083	1.882		0.250	13.910
	0.120	2.660		0.375	19.820
2-1/2 × 1	0.083	1.882	6 × 4	0.188	11.970
	0.148	2.950		0.250	15.620
2-1/2 × 1-1/2	0.083	2.160		0.313	19.080
	0.120	3.070	6 × 5	0.375	26.1068
	0.188	4.320		0.500	33.960
	0.250	5.400	7 × 4	0.188	13.250
3 × 1	0.065	1.710		0.250	17.320
	0.083	2.160		0.375	24.930
	0.120	3.070	7 × 5	0.250	19.020
3 × 1-1/2	0.083	2.390		0.375	27.480
	0.120	3.480		0.500	35.240
	0.188	4.960	8 × 3	0.188	13.250
3 × 2	0.083	2.670		0.250	17.320
	0.120	3.900		0.313	21.210
	0.188	5.590		0.375	24.930
	0.250	7.110	8 × 4	0.188	14.530
3-1/2 × 2-1/2	0.188	6.870		0.250	19.020
4 × 2	0.083	3.240		0.313	23.340
	0.120	4.750		0.375	27.480
	0.088	6.870		0.500	35.240
	0.250	8.810	8 × 6	0.188	17.080
4 × 3	0.120	5.610		0.250	22.420
	0.188	8.150		0.313	27.590
	0.250	10.510		0.375	32.580
	0.313	12.700		0.500	42.050
5 × 2	0.120	5.610	10 × 3	0.188	15.840
	0.250	10.510		0.250	20.720

CARBON STEEL TUBING – RECTANGULAR
ERW SIZES – LOW CARBON
STRUCTURAL SIZES – ASTM A500 GRADE B

SIZE (INCHES)	WALL THICKNESS	LBS./ FT.	SIZE (INCHES)	WALL THICKNESS	LBS./ FT.
10 × 4	0.188	17.080	**12 × 8**	0.250	32.630
	0.250	22.420		0.313	40.350
	0.375	32.580		0.375	47.900
	0.500	42.050		0.500	62.460
10 × 6	0.250	25.820		0.625	76.330
	0.313	31.840	**14 × 6**	0.250	32.630
	0.375	37.690		0.313	40.350
	0.500	48.850		0.375	47.900
10 × 8	0.250	29.230		0.500	62.460
	0.375	42.790	**14 × 10**	0.313	48.860
	0.500	55.660		0.375	58.100
12 × 3	0.188	18.400		0.500	76.070
	0.250	22.420	**16 × 4**	0.313	40.350
12 × 4	0.188	19.630		0.375	47.900
	0.250	25.820		0.500	62.900
	0.313	31.840	**16 × 8**	0.313	48.860
	0.375	37.690		.0375	58.100
	0.500	48.850		0.500	76.070
12 × 6	0.188	22.180	**16 × 12**	0.313	57.360
	0.250	29.230		0.375	68.310
	0.313	36.100		0.500	89.680
	0.375	42.790			
	0.500	55.660			

CARBON STEEL TUBING ROUND, SEAMLESS and WELDED

4130 – COLD DRAWN SEAMLESS DOM – DRAWN OVER MANDREL
ERW – ELECTRIC RESISTANCE WELDED SMLS HF – HOT FINISHED SEAMLESS

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
1/8"	0.022	0.081	0.0242		X		
	0.028	0.069	0.0290	X	X		
5/32"	0.028	0.100	0.0385	X	X		
3/16"	0.035	0.118	0.0567	X	X		
	0.042	0.104	0.0650	X	X		
	0.049	0.090	0.0722	X	X		
	0.065	0.058	0.0849	X	X		
0.250	0.028	0.194	0.066	X	X		
	0.035	0.180	0.080	X	X		
	0.049	0.152	0.105	X	X		
0.313	0.028	0.257	0.085	X	X		
	0.035	0.243	0.104	X	X		
	0.049	0.215	0.138	X	X		
	0.065	0.184	0.172	X	X		
0.375	0.028	0.319	0.104	X	X		
	0.035	0.305	0.127	X	X		
	0.049	0.277	0.171	X	X	X	
	0.065	0.245	0.215	X	X	X	
	0.083	0.209	0.259	X	X		
	0.120	0.135	0.327	X	X		
0.438	0.035	0.367	0.151	X			
	0.049	0.340	0.204	X			
	0.065	0.307	0.259	X			
	0.083	0.272	0.315	X			
	0.095	0.247	0.348	X			
	0.120	0.197	0.408	X			
0.500	0.028	0.444	0.141	X	X		
	0.035	0.430	0.174	X	X	X	
	0.049	0.402	0.236	X	X	X	
	0.058	0.384	0.274	X	X		
	0.065	0.370	0.302	X	X	X	
	0.083	0.334	0.370	X	X		
	0.109	0.282	0.455	X	X		
	0.120	0.260	0.487	X	X		
0.563	0.035	0.493	0.197	X	X		
	0.049	0.464	0.269	X			
	0.065	0.433	0.345	X	X		
	0.083	0.397	0.425	X	X		
	0.095	0.341	0.442	X			
	0.120	0.323	0.568	X	X		
0.625	0.035	0.555	0.221	X	X	X	
	0.049	0.527	0.301	X	X	X	

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
0.625	0.058	0.509	0.351	X	X		
	0.065	0.495	0.389	X	X	X	
	0.083	0.459	0.480	X	X	X	
	0.109	0.407	0.601	X	X		
	0.120	0.385	0.647	X	X		
	0.134	0.357	0.703	X	X		
	0.156	0.313	0.781	X	X		
	0.188	0.249	0.877	X	X		
0.688	0.065	0.558	0.432	X	X		
	0.083	0.522	0.535		X		
	0.095	0.498	0.602		X		
	0.109	0.470	0.674		X		
	0.156	0.375	0.886	X			
	0.120	0.448	0.728	X	X		
	0.188	0.312	1.004	X			
0.750	0.028	0.694	0.216	X			
	0.035	0.680	0.267	X	X	X	
	0.049	0.652	0.367	X	X	X	
	0.065	0.620	0.476	X	X	X	
	0.083	0.584	0.591	X	X	X	
	0.095	0.560	0.665	X	X	X	
	0.109	0.532	0.746	X	X		
	0.120	0.510	0.807	X	X	X	
	0.134	0.482	0.882	X	X		
	0.156	0.438	0.990	X	X		
	0.188	0.374	1.128	X	X		
	0.219	0.312	1.242	X	X		
	0.250	0.250	1.335	X	X		
0.813	0.065	0.683	0.519	X	X		
	0.083	0.647	0.647	X	X		
	0.095	0.623	0.728	X	X		
	0.120	0.573	0.888	X	X		
	0.109	0.545	0.972	X	X		
0.875	0.035	0.805	0.314	X	X		
	0.049	0.777	0.432	X	X	X	
	0.058	0.759	0.506	X	X		
	0.065	0.745	0.562	X	X	X	
	0.083	0.709	0.702	X	X	X	
	0.095	0.685	0.791	X	X	X	
	0.109	0.657	0.892	X	X		
	0.120	0.635	0.968	X	X		
	0.134	0.607	1.060		X		
	0.156	0.563	1.198	X	X		
	0.188	0.499	1.379	X	X		
	0.250	0.375	1.669	X	X		
	0.313	0.249	1.879	X			

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
1.000	0.028	0.944	0.291	X			
	0.035	0.930	0.361	X	X	X	
	0.049	0.902	0.498	X	X	X	
	0.065	0.870	0.649	X	X	X	
	0.083	0.834	0.813	X	X	X	
	0.095	0.810	0.918	X	X	X	
	0.109	0.782	1.037	X	X	X	
	0.120	0.760	1.128	X	X	X	
	0.134	0.732	1.239	X	X		
	0.156	0.688	1.406	X	X		
	0.188	0.624	1.630	X	X		
	0.219	0.562	1.827	X	X		
	0.250	0.500	2.003	X	X		
1.065	0.083	0.899	0.870	X	X		
	0.095	0.875	0.984	X	X		
	0.109	0.847	1.113		X		
	0.120	0.825	1.211	X	X		
	0.156	0.753	1.514		X		
	0.188	0.689	1.761	X	X		
	0.250	0.565	2.176	X	X		
1.125	0.035	1.055	0.407	X	X	X	
	0.049	1.027	0.563	X	X	X	
	0.058	1.009	0.661	X			
	0.065	0.995	0.736	X	X	X	
	0.083	0.959	0.924	X	X	X	
	0.095	0.935	1.045	X	X		
	0.109	0.907	1.183	X	X		
	0.120	0.885	1.288	X	X		
	0.134	0.857	1.418		X		
	0.156	0.813	1.614	X	X		
	0.188	0.749	1.881	X	X		
	0.219	0.687	2.119	X	X		
	0.250	0.625	2.336	X	X		
	0.281	0.563	2.533		X		
	0.313	0.499	2.714	X	X		
1.188	0.065	1.058	0.780		X	X	
	0.083	1.022	0.980	X			
	0.120	0.948	1.369		X		
	0.156	0.876	1.719		X		
	0.188	0.812	2.008	X	X		
	0.219	0.750	2.266		X		
	0.250	0.688	2.504		X		
1.250	0.035	1.180	0.454	X		X	
	0.049	1.152	0.629	X	X	X	
	0.058	1.134	0.738	X			
	0.065	1.120	0.823	X	X	X	

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
1.250	0.083	1.084	1.034	X	X	X	
	0.095	1.060	1.172	X	X	X	
	0.109	1.032	1.328	X	X	X	
	0.120	1.010	1.448	X	X	X	
	0.134	0.982	1.597		X		
	0.156	0.938	1.823	X	X		
	0.188	0.874	2.132	X	X		
	0.219	0.812	2.411		X		
	0.250	0.750	2.670	X	X		
	0.313	0.624	3.132	X	X		
	0.375	0.500	3.504	X	X		
1.313	0.095	1.122	1.236	X			
	0.120	1.073	1.529		X		
	0.134	1.045	1.687		X		
	0.156	1.001	1.928		X		
	0.188	0.937	2.259	X	X		
	0.219	0.875	2.559	X	X		
	0.250	0.813	2.838		X		
	0.313	0.687	3.343		X		
	0.375	0.563	3.757		X		
1.375	0.035	1.305	0.501	X			
	0.049	1.277	0.694	X	X	X	
	0.058	1.259	0.816	X			
	0.065	1.245	0.909	X	X	X	
	0.083	1.209	1.145	X	X	X	
	0.095	1.185	1.299	X	X	X	
	0.109	1.157	1.474		X		
	0.120	1.137	1.608	X	X	X	
	0.134	1.107	1.776		X		
	0.156	1.063	2.031	X	X		
	0.188	0.999	2.383	X	X		
	0.219	0.937	2.704	X	X		
	0.250	0.875	3.004	X	X		
	0.281	0.813	3.283		X		
	0.313	0.749	3.550	X	X		
	0.175	0.625	4.005		X		
1.438	0.156	1.126	2.136		X		
	0.188	1.062	2.510		X		
	0.219	1.000	2.851		X		
	0.250	0.938	3.172		X		
1.500	0.028	1.444	0.440	X			
	0.035	1.430	0.548	X	X	X	
	0.049	1.402	0.759	X	X	X	
	0.058	1.384	0.893	X			
	0.065	1.370	0.996	X	X	X	
	0.083	1.334	1.256	X	X	X	

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
1.500	0.095	1.310	1.426	X	X	X	
	0.209	2.282	1.619		X	X	
	0.120	1.260	1.769	X	X	X	
	0.134	1.232	1.955		X		
	0.156	1.888	2.239	X	X		
	0.188	1.124	2.634	X	X		
	0.219	1.062	2.996		X		
	0.250	1.000	3.338	X	X		
	0.281	0.938	3.658		X		
	0.313	0.874	3.968	X	X		
	0.375	0.750	4.506		X		
	0.438	0.624	4.968		X		
	0.500	0.500	5.340		X		
1.563	0.120	1.323	1.849		X		
	0.156	1.251	2.344	X	X		
	0.188	1.187	2.761	X			
	0.250	1.063	3.506		X		
	0.375	0.813	4.758		X		
1.625	0.049	1.527	0.825	X	X	X	
	0.058	1.509	0.971	X			
	0.065	1.495	1.083	X	X	X	
	0.083	1.459	1.367	X	X	X	
	0.095	1.435	1.552	X	X	X	
	0.109	1.407	1.765		X	X	
	0.120	1.385	1.929	X	X	X	
	0.134	1.357	2.134		X		
	0.156	1.313	2.447	X	X		
	0.188	1.249	2.885	X	X		
	0.219	1.187	3.289	X	X		
	0.250	1.125	3.671	X	X		
	0.281	1.063	4.033		X		
	0.313	0.999	4.386	X	X		
	0.375	0.875	5.006	X	X		
	0.500	0.625	6.008		X		
1.750	0.049	1.652	0.890	X	X	X	
	0.058	1.634	1.048	X			
	0.065	1.620	1.170	X	X	X	
	0.083	1.584	1.478	X	X	X	
	0.095	1.560	1.679	X	X	X	
	0.109	1.532	1.910		X		
	0.120	1.510	2.089	X	X	X	
	0.134	1.482	2.313		X		
	0.156	1.438	2.656	X	X		
	0.188	1.374	3.136	X	X		
	0.219	1.312	5.581	X	X		
	0.250	1.250	4.005	X	X		

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
1.750	0.313	1.124	4.804		X		
	0.375	1.000	5.507		X		
	0.500	0.750	6.675		X		
1.875	0.035	1.805	0.688	X			
	0.049	1.777	0.956		X	X	
	0.058	1.759	1.126	X			
	0.065	1.745	1.257	X	X	X	
	0.083	1.709	1.589	X	X	X	
	0.095	1.685	1.806	X	X	X	
	0.109	1.657	2.056		X		
	0.120	1.635	2.249	X	X		
	0.134	1.607	2.492	X			
	0.156	1.563	2.864	X	X		
	0.188	1.499	3.387	X	X		
	0.219	1.437	3.873		X		
	0.250	1.375	4.339	X	X		
	0.281	1.313	4.784	X	X		
	0.313	1.249	5.222	X	X		
	0.375	1.125	6.008		X		
	0.500	0.875	7.343	X			
2.000	0.035	1.930	0.735		X	X	
	0.049	1.902	1.021	X	X	X	
	0.065	1.870	1.343	X	X	X	
	0.083	1.834	1.699	X	X	X	
	0.095	1.810	1.933	X	X	X	
	0.109	1.782	2.201		X	X	
	0.120	1.760	2.409	X	X	X	
	0.134	1/732	2.670		X		
	0.156	1.688	3.072		X		
	0.188	1.624	3.638		X		
	0.219	1.562	4.166		X		
	0.250	1.500	4.673	X	X		
	0.281	1.438	5.159		X		
	0.313	1.374	5.639	X	X		
	0.375	1.250	6.508		X		
	0.438	1.124	7.307		X		
	0.500	1.000	8.010		X		
	0.563	0.874	8.640				
	0.625	0.750	9.178	X			
	0.750	0.500	10.013				
2.125	0.049	2.027	1.086		X	X	
	0.065	1.995	1.430	X	X	X	
	0.083	1.959	1.810		X		
	0.095	1.935	2.060		X		
	0.120	1.885	2.570		X		
	0.156	1.813	3.281	X	X		

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
2.125	0.188	1.749	3.889	X	X		
	0.219	1.687	4.458		X		
	0.250	1.625	5.006	X	X		
	0.281	1.563	5.534		X		
	0.313	1.499	6.057	X	X		
	0.375	1.375	7.009	X	X		
	0.500	1.125	8.678	X	X		
2.250	0.049	2.152	1.152		X		
	0.065	2.120	1.517	X	X	X	
	0.083	2.084	2.921		X	X	
	0.095	2.060	2.186	X	X		
	0.120	2.010	2.730	X	X	X	
	0.134	1.982	3.028	X	X		
	0.156	1.938	3.489	X	X		
	0.188	1.874	4.140	X	X		
	0.219	1.812	4.750	X	X		
	0.250	1.750	5.340	X	X		
	0.281	1.688	5.909		X		
	0.313	1.624	6.475		X		
	0.375	1.500	7.509	X	X		
	0.438	1.374	8.476		X		
	0.500	1.250	9.345	X			
	0.625	1.000	10.847	X			
	0.750	0.750	12.015		X		
2.375	0.065	2.245	1.604			X	
	0.083	2.209	2.032			X	
	0.109	2.157	2.638			X	
	0.120	2.135	2.890		X	X	
	0.156	2.063	3.697	X	X		
	0.188	1.999	4.391	X	X		
	0.219	1.937	5.043	X	X		
	0.250	1.875	5.674	X	X		
	0.313	1.749	6.893		X		
	0.375	1.625	8.010	X	X		
	0.438	1.500	9.061	X			
	0.500	1.375	10.013		X		
2.500	0.065	2.370	1.690	X	X	X	
	0.083	2.334	2.143	X	X	X	
	0.095	2.310	2.440	X	X	X	
	0.109	2.282	2.783		X		
	1.120	2.260	3.050	X	X	X	
	0.156	2.188	3.905	X	X		
	0.188	2.124	4.642	X	X		
	0.219	2.062	5.335		X		
	0.250	2.000	6.008	X	X		
	0.281	1.938	6.659		X		

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
2.500	0.313	1.874	7.311	X	X		
	0.375	1.750	8.511	X	X		
	0.438	1.624	9.646		X		
	0.500	1.500	10.680	X	X		
	0.563	1.374	11.647	X	X		
2.625	0.065	2.495	1.777		X	X	
	0.095	2.435	2.561		X		
	0.120	2.385	3.210		X		
	0.188	2.249	4.893		X		
	0.250	2.125	6.341		X		
	0.313	1.999	7.729		X		
	0.375	1.875	9.011		X		
	0.438	1.749	10.230	X	X		
	0.500	1.625	11.348		X		
	0.625	1.375	13.350	X			
	0.750	1.125	15.019	X			
2.750	0.065	2.620	1.864		X	X	
	0.083	2.584	2.364		X	X	
	0.095	2.560	2.694		X		
	0.120	2.510	3.371		X	X	
	0.156	2.438	4.322		X		
	0.188	2.374	5.144		X		
	0.219	2.312	5.920		X		
	0.250	2.250	6.675		X		
	0.281	2.188	7.410		X		
	0.313	2.124	8.147		X		
	0.375	2.000	9.512		X		
	0.438	1.874	10.815	X	X		
	0.500	1.750	12.015		X		
	0.563	1.624	13.150		X		
	0.625	1.500	14.184		X		
	0.750	1.250	16.020	X			
	0.875	1.000	17.522	X			
2.875	0.065	2.745	1.951			X	
	0.120	2.635	3.531		X	X	
	0.188	2.499	5.395		X		
	0.219	2.437	6.212		X		
	0.250	2.375	7.009		X		
	0.313	2.249	8,564		X		
	0.375	2.125	10.013		X		
2.875	0.438	1.999	11.400		X		
	0.500	1.875	12.683		X		
	0.563	1.749	13.902		X		
	0.625	1.625	15.019		X		
3.000	0.049	2.902	1.544			X	
	0.065	2.870	2.037		X	X	

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
3.000	0.083	2.834	2.586		X	X	
	0.095	2.810	2.947		X	X	
	0.120	2.760	3.691		X	X	
	0.156	2.688	4.738		X		
	.0188	2.624	5.646		X		
	0.219	2.562	6.505		X		
	0.250	2.500	7.343		X		
	0.281	2.438	8.160		X		
	0.313	2.374	8.982		X		
	0.375	2.250	10.513		X		
	0.438	2.124	11.985		X		
	0.500	2.000	13.350		X		X
	0.563	1.874	14.653		X		
	0.625	1.750	15.853		X		
	0.750	1.500	18.023	X			X
	0.875	1.250	19.858	X			X
	1.000	1.000	21.360	X			X
3.125	0.120	2.885	3.851		X		
	0.188	2.749	5.897		X		
	0.250	2.625	7.676		X		
	0.313	2.499	9.400		X		
	0.375	2.375	11.014		X		
	0.438	2.249	12.569		X		
	0.500	2.125	14.018		X		
	0.563	1.999	15.405		X		
	0.625	1.875	16.888		X		
	0.750	1.625	9.024		X		
	0.875	1.375	21.026	X			
3.250	0.065	3.120	2.211		X	X	
	0.083	3.084	2.807		X	X	
	0.095	3.060	3.201		X	X	
	0.120	3.010	4.011		X	X	
	0.156	2.938	5.155		X		
	0.188	2.874	6.148		X		
	0.250	2.750	8.010		X		
	0.281	2.688	8.910		X		
	0.313	2.624	99.818		X		
	0.375	2.500	11.514		X		
	0.438	2.374	13.154		X		
	0.500	2.250	14.685		X		
3.250	0.563	2.124	16.157		X		
	0.625	2.000	17.522		X		
	0.750	1.750	20.025	X			X
	0.875	1.500	22.194	X			X
	1.000	1.250	24.030	X			X
3.500	0.065	3.370	2.385		X	X	

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
3.500	0.083	3.334	3.029		X	X	
	0.095	3.310	3.455		X	X	
	0.120	3.260	4.332		X	X	
	0.156	3.188	5.571		X		
	0.188	3.124	6.650		X		
	0.219	3.062	7.674		X		
	0.250	3.000	7.678		X		
	0.281	2.938	9.660		X		
	0.313	2.874	10.654		X		
	0.375	2.750	12.516		X		
	0.438	2.624	14.324		X		
	0.500	2.500	16.020		X		X
	0.563	2.374	17.660		X		
	0.625	2.250	19.191		X		
	0.750	2.000	22.028		X		X
	0.875	1.750	24.531		X		X
	1.000	1.500	26.700		X		X
3.625	0.120	3.385	4.492		X		
	0.188	3.249	6.901		X		
	0.250	3.125	9.011		X		
	0.313	2.999	11.071		X		
	0.375	2.875	13.016		X		
	0.438	2.749	14.908		X		
	0.500	2.625	16.688		X		
	0.625	2.375	20.025		X		
	0.750	2.125	23.029	X			
3.750	0.120	3.510	4.652		X	X	
	0.188	3.374	7.152		X		
	0.250	3.250	9.345		X		
	0.313	3.124	11.489		X		
	0.375	3.000	13.517		X		
	0.438	2.874	15.493		X		
	0.500	2.750	17.355		X		X
	0.563	2.624	19.163		X		
	0.625	2.500	2.859		X		
	0.750	2.250	24.030	X			
	0.875	2.000	23.867	X			X
	1.000	1.750	29.370	X			X
3.875	0.120	3.635	4.812		X		
	0.188	3.499	7.403		X		
3.875	0.250	3.375	9.679		X		
	0.375	3.125	14.018		X		
	0.500	2.875	18.023		X		
	0.625	2.625	21.694		X		
	0.750	2.375	25.031	X			
4.000	0.065	3.870	2.732		X	X	

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
4.000	0.083	3.834	3.472		X	X	
	0.095	3.810	3.962		X	X	
	0.120	3.760	4.973		X	X	
	0.188	3.624	7.654		X		
	0.219	3.562	8.843		X		
	0.250	3.500	10.013		X		
	0.313	3.374	12.325		X		
	0.375	3.250	14.518		X		
	0.438	3.124	16.662		X		
	0.500	3.000	18.690		X		X
	0.563	2.874	20.666		X		
	0.625	2.750	22.528		X		
	0.750	2.500	26.033	X			X
	0.875	2.250	29.203	X			X
	1.000	2.000	32.040	X			X
	1.125	1.750	34.543				X
	1.250	1.500	36.713	X			X
4.125	0.250	3.625	10.346		X		
	0.313	3.499	12.743		X		
	0.375	3.375	15.019		X		
	0.500	3.125	19.358		X		
4.250	0.625	2.875	23.363		X		
	0.065	4.120	2.905		X	X	
	0.095	4.060	4.216		X	X	
	0.120	4.010	5.293		X	X	
	0.188	3.874	8.156		X		
	0.250	3.750	10.680		X		
	0.313	3.624	13.161		X		
	.0375	3.500	15.519		X		
	0.438	3.374	17.832		X		
	0.500	3.250	20.025		X		
	0.625	3.000	24.197		X		
	0.750	2.750	28.035	X			X
	0.875	2.500	31.539	X			X
	1.000	2.250	34.710	X			X
	1.125	2.000	37.547	X			X
	1.250	17.50	40.050				X
4.500	0.065	4.370	3.079		X	X	
	0.083	4.334	3.915		X	X	
	0.095	4.310	4.469		X	X	
4.500	0.120	4.260	5.613		X	X	
	0.134	4.232	6.248		X		
	0.188	4.124	8.658		X		
	0.219	4.062	10.013		X		
	0.250	4.000	11.348		X		
	0.313	3.874	13.996		X		

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
4.500	0.375	3.750	16.521		X		
	0.438	3.624	19.001		X		
	0.500	3.500	21.360		X		X
	0.625	3.250	25.866	X	X		
	0.750	3.000	30.038	X			X
	0.875	2.750	33.876	X			X
	1.000	2.500	37.380	X			X
	1.125	2.250	40.551	X			X
	1.250	2.000	43.388	X			X
	1.500	1.500	48.060				X
4.625	0.250	4.125	11.681		X		
	0.313	3.999	14.414		X		
	0.375	3.875	17.021		X		
	0.500	3.625	22.028		X		
4.750	0.120	4.510	5.934		X		
	0.188	4.374	9.160		X		
	0.250	4.250	12.015		X		
	0.313	4.124	14.832		X		
	0.375	4.000	17.522		X		
	0.500	3.750	22.695		X		X
	0.625	3.500	27.534		X		
	0.750	3.250	32.040	X			X
	0.875	3.000	36.212	X			X
	1.000	2.750	40.050	X			X
	1.250	2.250	46.725				X
	1.500	1.750	52.065				X
5.000	0.065	4.870	3.426		X	X	
	0.083	4.834	4.359		X	X	
	0.120	4.760	6.254		X	X	
	0.188	4.624	9.662		X		
	0.250	4.500	12.683		X		
	0.313	4.374	15668		X		
	0.375	4.250	18.523		X		
	0.438	4.124	21.340		X		
	0.500	4.000	24.030		X		X
	0.625	3.750	29.203		X		X
	0.750	3.500	34.043	X			X
	0.875	3.250	38.548	X			X
	1.000	3.000	42.720	X			X
	1.125	2.750	46.558				X
5.000	1.250	2.500	50.063	X			X
	1.500	2.000	56.070	X			X
5.250	0.120	5.010	6.575		X		
	0.188	4.874	10.164		X		
	0.250	4.750	13.350		X		
	0.313	4.624	16.504		X		

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
5.250	0.375	4.500	19.524		X		
	0.500	4.250	23.365		X		X
	0.625	4.000	30.872		X		
	0.750	3.750	36.045	X			X
	0.875	3.500	40.884	X			X
	1.000	3.250	45.390	X			X
	1.125	3.000	49.562				X
	1.250	2.750	53.400				X
	1.500	2.250	60.075				X
5.500	0.083	5.334	4.802			X	
	0.120	5.260	6.895		X	X	
	0.188	5.124	10.666		X		
	0.250	5.000	14.018		X		
	0.313	4.874	17.339		X		
	0.375	4.750	20.526		X		
	0.438	4.624	23.679		X		
	0.500	4.500	26.700		X		X
	0.625	4.250	32.541		X		
	0.750	4.000	38.048	X			X
	0.875	3.750	43.221	X			X
	1.000	3.500	48.060	X			X
	1.125	3.250	52.566				X
	1.250	3.000	56.738	X			X
	1.500	2.500	64.080				X
5.750	0.188	5.374	11.168		X		
	0.250	5.250	14.685		X		
	0.313	5.124	18.175		X		
	0.375	5.000	21.527		X		
	0.500	4.750	28.035		X		X
	0.625	4.500	34.209		X		
	0.750	4.250	40.050	X			X
	0.875	4.000	45.557	X			
	1.000	3.750	50.730	X			X
	1.250	3.250	60.075	X			X
	1.500	2.750	68.085				X
6.000	0.065	5.870	4.120		X	X	
	0.083	5.834	5.245		X	X	
	0.109	5.782	6.858			X	
	0.120	5.760	7.536		X	X	
	0.134	5.732	8.395			X	
	0.188	5.624	11.670		X		
	1.250	5.500	15.353		X		
	0.313	5.374	19.011		X		
	0.375	5.250	22.528		X		
	0.500	5.000	29.370		X		X
	0.625	4.750	35.878		X		X

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
6.000	0.750	4.500	42.053	X			X
	0.875	4.250	47.893	X			X
	1.000	4.000	53.400	X			X
	1.125	3.750	58.573				X
	1.250	3.500	63.413	X			X
	1.500	3.000	72.090				X
	1.750	2.500	79.433				X
	2.000	2.000	85.440				X
6.250	0.120	6.010	7.856		X		
	0.188	5.874	12.172		X		
	0.250	5.750	16.020		X		
	0.375	5.500	23.529		X		
	0.500	5.250	30.705		X		X
	0.625	5.000	37.547		X		X
	0.750	4.750	44.055	X			X
	0.875	4.500	50.229	X			X
	1.000	4.250	56.070	X			X
	1.125	4.000	61.577				X
	1.250	3.750	66.750				X
	1.500	3.250	76.095				X
6.500	0.188	3.124	12.673		X		
	0.250	6.000	16.688		X		
	0.375	5.750	24.531		X		
	0.500	5.500	32.040		X		X
	0.625	5.250	39.216		X		X
	0.750	5.000	46.058	X			X
	0.875	4.750	52.566	X			
	1.000	4.500	58.740	X			X
	1.250	4.000	70.088				X
	1.500	3.500	80.100				X
	1.750	3.000	88.778				X
	2.000	2.500	96.120				X
6.625	0.109	6.407	7.585			X	
	0.120	6.385	8.337			X	
	0.134	6.357	9.289			X	
	0.313	5.999	21.100		X		
6.750	0.250	6.250	17.355		X		
	0.375	6.000	25.532		X		
	0.500	5.750	33.375		X		X
	0.625	5.500	40.884		X		
6.750	0.750	5.250	48.060	X			X
	0.875	5.000	54.902				X
	1.000	4.750	61.410	X			X
	1.250	4.250	73.425				X
	1.500	3.750	84.105				X
7.000	0.065	6.870	4.814		X	X	

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
7.000	0.083	6.834	6.132			X	
	0.109	6.782	8.022			X	
	0.120	6.760	8.817			X	
	0.188	6.624	13.677		X		
	0.250	6.500	18.023		X		
	0.375	6.250	25.533		X		
	0.500	6.000	34.710		X		X
	0.625	5.750	42.553		X		X
	0.750	5.500	5.063		X		X
	0.875	5.250	57.238				X
	1.000	5.000	64.080	X			X
	1.125	4.750	70.588				X
	1.250	4.500	76.763				X
	1.500	4.000	88.110				X
	1.750	3.500	98.123				X
	2.000	3.000	106.800				X
7.250	0.250	6.750	18.690		X		
	0.375	6.500	27.534		X		
	0.500	6.250	36.045		X		
	0.625	6.000	44.222		X		X
	0.750	5.750	52.065		X		X
	1.000	5.250	66.750		X		X
	0.125	5.000	73.592				X
	1.250	4.750	80.100				X
	1.500	4.250	92.115				X
7.500	0.188	7.124	14.681		X		
	0.250	7.000	19.358		X		
	0.375	6.750	28.536		X		
	0.500	6.500	37.380		X		X
	0.625	6.250	45.891		X		X
	0.750	6.000	54.068		X		X
	1.000	5.500	69.420		X		X
	1.250	5.000	83.438				X
	1.500	4.500	96.120				X
	1.750	4.000	107.468				X
	2.000	3.500	117.480				X
7.750	0.188	7.374	15.183		X		
	0.250	7.250	20.025		X		
	0.375	7.000	29.537		X		
7.750	0.500	6.750	37.715		X		X
	0.625	6.500	47.559		X		
	0.750	6.250	56.070	X			X
	1.000	5.750	72.090	X			X
	1.250	5.250	86.775				X
	1.500	4.750	100.125				X
8.000	0.065	7.870	5.508			X	

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
8.00	0.083	7.834	7.018			X	
	0.109	7.782	9.186			X	
	0.120	7.760	10.099			X	
	0.134	7.732	11.257			X	
	0.188	7.624	15.685		X		
	0.250	7.500	20.693		X		
	0.375	7.250	30.538		X		
	0.500	7.000	40.050		X		X
	0.625	6.750	49.228		X		X
	0.750	6.500	58.073	X			X
	0.875	6.250	66.583				X
	1.000	6.000	74.760	X			X
	1.125	5.750	82.603				X
	1.250	5.500	90.113				X
	1.500	5.000	104.130				X
	1.750	4.500	116.813				X
	2.000	4.000	128.160				X
	2.250	3.500	138.173				X
	2.500	3.000	146.850				X
8.250	0.250	7.750	21.360		X		
	0.375	7.500	31.539		X		
	0.500	7.250	41.385		X		X
	0.625	7.000	50.897	X	X		
	0.750	6.750	60.075		X		X
	1.000	6.250	77.430		X		X
	1.125	6.000	85.607				X
	1.250	5.750	94.450				X
	1.500	5.250	108.135				X
8.500	0.250	8.000	22.028		X		
	0.375	7.750	35.541		X		
	0.500	7.500	42.720		X		X
	0.625	7.250	52.566		X		
	0.750	7.000	62.078	X			X
	1.000	6.500	80.100	X			X
	1.250	6.000	96.788				X
	1.500	5.500	112.140				X
	1.750	5.000	126.158				X
	2.000	4.500	138.840				X
	2.500	3.500	160.200				X
8.750	0.375	8.000	33.542		X		
	0.500	7.750	44.055		X		X
	0.750	7.250	64.080		X		X
	1.000	6.750	82.770				X
	1.250	6.250	100.125				X
	1.500	5.750	116.145				X
	2.000	4.750	144.180				X

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
9.000	0.250	8.500	23.363		X		
	0.375	8.250	34.543		X		
	0.500	8.000	45.390		X		
	0.625	7.750	55.903				X
	0.750	7.500	66.083	X			X
	1.000	7.000	85.440	X			X
	1.250	6.500	103.463				X
	1.500	6.000	120.150				X
	1.750	5.500	135.503				X
	2.000	5.000	149.520				X
	2.250	4.500	162.203				X
	2.500	4.000	173.550				X
	3.000	3.000	192.240				X
9.250	0.250	8.750	24.030		X		
	0.375	8.500	35.544		X		
	0.200	8.250	46.725		X		
	0.625	8.000	57.572		X		X
	0.750	7.750	68.085				X
	1.000	7.250	88.110				X
9.500	0.250	6.750	106.800				X
	1.200	6.250	124.155				X
	0.250	9.000	24.698		X		
	0.375	8.750	36.546		X		
	0.500	8.500	48.060		X		X
	0.750	8.000	70.088	X			X
	1.000	7.500	90.780	X			X
	1.250	7.000	110.138				X
10.250	1.000	8.250	98.790				X
	1.250	7.750	120.150				X
	1.500	7.250	140.175				X
10.500	0.250	10.000	27.368		X		
	0.375	9.750	40.551		X		
	0.500	9.500	53.400		X		X
	0.750	9.000	78.098	X			X
	1.000	8.500	101.460	X			X
	1.250	8.000	123.488				X
	1.500	7.500	144.180				X
	1.750	7.000	163.538				X
	2.000	6.500	181.560				X
10.500	2.500	5.500	213.600				X
	3.000	4.500	240.300				X
10.750	0.250	10.250	28.035	X			
	0.375	10.000	41.552		X		
	0.500	9.750	54.735		X		
	0.750	9.250	80.100	X			
	1.000	8.750	104.130				X

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
	1.250	8.250	126.825				X
	1.500	7.750	148.185				X
	1.750	7.250	168.210				X
	2.000	6.750	46.900				X
	2.250	6.250	204.255				X
	2.500	5.750	220.275				X
11.000	0.500	10.000	56.070		X		X
	0.750	9.500	82.103				X
	1.000	9.000	106.800				X
	1.250	8.500	130.163				X
	1.500	8.000	152.190				X
	1.750	7.500	172.883				X
	2.000	7.000	192.240				X
	2.500	6.000	226.950				X
	3.000	5.000	256.320				X
11.250	0.500	10.250	57.405				X
	0.750	9.750	84.105				X
	1.000	9.250	109.480				X
	1.250	8.750	133.500				X
	1.500	8.250	156.195				X
	2.000	7.250	197.580				X
11.500	0.500	10.500	58.750				X
	0.750	10.000	86.108				X
	1.000	9.500	112.140				X
	1.250	9.000	135.838				X
	1.500	8.500	160.200				X
	1.750	8.000	182.228				X
	2.000	7.500	202.920				X
	2.500	6.500	240.300				X
12.000	0.250	11.500	31.373		X		
	0.375	11.250	46.558		X		
	0.500	11.000	61.410		X		X
	0.625	10.750	75.928				X
	0.750	10.500	90.113		X		X
	1.000	10.000	117.480		X		X
	1.250	9.500	143.513				X
	1.500	9.000	168.210				X
	1.750	8.500	191.573				X
	2.000	8.000	213.600				X
12.000	2.250	7.500	234.293				X
	2.500	7.000	253.650				X
	3.000	6.000	288.360				X
12.500	1.000	10.500	122.800				X
	2.500	7.500	267.000				X
13.000	1.000	11.000	128.200				X
	1.500	10.000	184.200				X

O.D. (IN)	WALL THICKNESS	I.D. DECIMAL	LBS. /FT.	4130	DOM	ERW	SMLS HF
14.000	1.000	12.000	138.800				X
	1.250	11.500	170.200				X
	1.500	11.000	200.300				X
	2.000	10.000	256.300				X
16.000	1.000	14.000	160.200				X
	1.500	13.000	232.300				X
16.500	0.500	15.500	85.440				X
	0.750	15.000	126.158				X
	1.000	14.500	165540				X
	1.500	13.500	240.300				X
	2.000	12.500	309.720				X

CARBON STEEL TUBING
ROUND STRUCTURAL
ASTM A500 GRADE B / CSA G40.21 50W

O.D. (INCHES)	WALL THICKNESS	LBS./ FT.	O.D. (INCHES)	WALL THICKNESS	LBS./ FT.
1.050	.100	1.020	**4.000**	.150	6.170
	.125	1.240		.188	7.670
	.134	1.600		.210	8.510
1.315	.100	1.300		.250	10.020
	.125	1.590		.313	12.340
1.660	.100	1.670	**4.500**	.188	8.680
	.125	2.050		.210	9.630
1.690	.100	1.700		.250	11.360
	.125	2.090		.313	14.010
1.900	.110	2.100		.375	16.540
	.125	2.380	**5.000**	.134	6.970
	.150	2.810		.150	7.780
	.188	3.450		.188	9.670
2.000	.100	2.030		.250	12.690
	.125	2.500		.313	15.690
	.150	2.960		.375	18.540
	.188	3.640	**5.562**	.188	10.80
2.375	.100	2.430		.250	14.20
	.125	3.010		.313	17.60
	.150	3.570	**6.000**	.134	8.41
	.188	4.400		.150	9.38
	.250	5.680		.188	11.68
2.875	.125	3.680		.250	15.37
	.150	4.370		.313	19.03
	.188	5.400		.375	22.55
	.250	7.010	**6.625**	.188	13.00
3.000	.125	3.840		.250	17.00
	.134	4.100		.313	21.10
	.150	4.570		.375	25.10
	.188	5.660	**8.625**	.188	17.00
	.250	7.350		.250	22.40
3.500	.150	5.370		.313	27.80
	.188	6.660		.375	33.10
	.210	7.390		.438	38.40
	.250	8.690		.500	43.40
	.313	10.660	**10.750**	.250	28.10
3.750	.100	3.900		.313	34.90
	.110	4.280		.375	41.60
	.125	4.850		.438	48.30
	.134	5.180		.500	54.80
	.150	5.780	**12.750**	.250	33.40
	.188	7.160		.313	41.60

O.D. (INCHES)	WALL THICKNESS	LBS./ FT.	O.D. (INCHES)	WALL THICKNESS	LBS./ FT.
	.210	7.950		.375	49.60
	.250	9.360		.438	57.70
4.000	.125	5.170		.500	65.50
	.134	5.530			

CARBON STEEL TUBING – SQUARE ERW SIZES – LOW CARBON STRUCTURAL SIZES – ASTM A500 GRADE B

SIZE (INCHES)	WALL THICKNESS	LBS./ FT.	SIZE (INCHES)	WALL THICKNESS	LBS./ FT.
1/2 × 1/2	0.065	0.385	**2 × 2**	0.065	1.710
5/8 × 5/8	0.065	0.495		0.083	2.164
3/4 × 3/4	0.049	0.467		0.120	3.120
	0.065	0.606		0.145	3.250
	0.083	0.753		0.188	4.320
	0.120	1.030		0.250	5.410
1 × 1	0.049	0.634	**2-1/2 × 2-1/2**	0.083	2.728
	0.065	0.827		0.120	3.980
	0.072	0.909		0.188	5.590
	0.083	1.035		0.250	7.110
	0.120	1.436	**3 × 3**	0.083	3.290
1-1/4 × 1-1/4	0.049	0.800		0.120	4.830
	0.065	1.048		0.188	6.870
	0.083	1.317		0.250	8.810
	0.120	1.844		0.312	10.580
	0.188	2.408		0.375	12.170
1-1/2 × 1-1/2	0.065	1.268	**3-1/2 × 3-1/2**	0.120	5.680
	0.083	1.599		0.188	8.150
	0.120	2.252		0.250	10.510
	0.188	3.047		0.312	13.190
	0.250	4.067		0.375	14.720
1-3/4 × 1-3/4	0.083	1.882			
	0.120	2.660			
	0.188	3.680			

CARBON STEEL TUBING – SQUARE
ERW SIZES – LOW CARBON
STRUCTURAL SIZES – ASTM A500 GRADE B

SIZE (INCHES)	WALL THICKNESS	LBS./ FT.	SIZE (INCHES)	WALL THICKNESS	LBS./ FT.
4 × 4	0.120	6.530	**8 × 8**	0.250	25.820
	0.188	9.420		0.313	31.840
	0.250	12.210		0.375	37.690
	0.313	14.830		0.500	48.850
	0.375	17.270		0.625	59.320
	0.500	21.630	**10 × 10**	0.188	24.730
4-1/2 × 4-1/2	0.188	10.700		0.250	32.630
	0.250	13.910		0.313	40.350
5 × 5	0.188	11.970		0.375	47.900
	0.250	15.620		0.500	62.460
	0.313	19.080		0.625	76.330
	0.375	22.370	**12 × 12**	0.250	39.430
	0.500	28.430		0.313	48.860
6 × 6	0.188	14.530		0.375	58.100
	0.250	19.020		0.500	76.010
	0.312	23.340		0.625	93.340
	0.375	27.480	**14 × 14**	0.313	57.360
	0.500	35.240		0.375	68.310
7 × 7	0.188	17.080		0.500	89.680
	0.250	22.420		0.625	110.350
	0.312	27.590	**16 × 16**	0.313	65.870
	0.375	32.580		0.375	78.520
	0.500	42.050		0.500	103.300
8 × 8	0.188	19.630		0.625	127.360

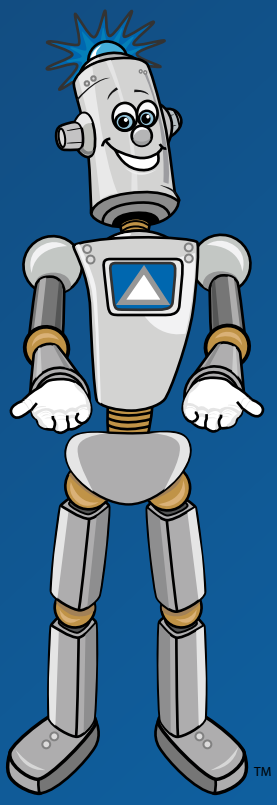
COLD DRAWN SEAMLESS STEEL HYDRAULIC LINE TUBE
SOFT ANNEALED TO J.I.C. STANDARDS and AIRCRAFT SPECS AMS 5050 G, J524B
SPECIFICATION SAE 1008

Stock Lengths – Random 17-24'

O.D.	WALL	I.D.	LBS/FT.	Theoretical Working Pressure	Theoretical bursting pressure (PSI)
3/16	.035	.117	.0572	5610	18513
1/4	.035	.180	.0804	4200	13860
	.049	.152	.1052	5890	19437
	.065	.120	.1284	7850	25905
	.095	.060	.1573	10820	37620
5/16	.035	.242	.1039	3370	11121
	.049	.214	.1404	4710	15543
	.065	.182	.1722	6290	20757
3/8	.035	.305	.1271	2800	9240
	.049	.277	.1706	3920	12936
	.065	.245	.2152	5240	17292
1/2	.035	.430	.1738	2100	6930
	.049	.402	.2326	2940	9702
	.065	.370	.3020	3925	12953
	.083	.334	.3696	5000	16500
	.095	.310	.4109	5720	18876
9/16	.035	.493	.1974	1870	6174
	.065	.432	.3456	3490	11517
5/8	.035	.555	.2205	1680	5544
	.049	.527	.3014	2350	7755
	.065	.495	.3888	3140	10362
	.083	.459	.4805	4000	13200
	.095	.435	.5377	4580	15114
3/4	.035	.680	.2673	1400	4620
	.049	.652	.3668	1960	6468
	.065	.620	.4755	2600	8580
	.083	.584	.5913	3320	10956
	.095	.560	.6646	3800	12540
	.109	.532	.7462	4360	14388
	.120	.510	.8074	4800	15840
7/8	.035	.805	.3140	1200	3960
	.049	.777	.4406	1680	5544
	.065	.745	.5623	2225	7342
	.083	.709	.702	2845	9388
	.095	.680	.791	3255	10741
	.109	.657	.891	3750	12342
1	.035	.930	.360	1050	3465
	.049	.902	.497	1470	4851
	.065	.870	.649	1950	6435
	.083	.834	.812	2490	8217
	.095	.810	.918	2850	9405
	.109	.782	1.037	3270	10791

O.D.	WALL	I.D.	LBS/FT.	Theoretical Working Pressure	Theoretical bursting pressure (PSI)
1	.120	.760	1.128	3600	11880
	.134	.732	1.239	4020	13266
1-1/8	.065	.995	.735	1735	5725
	.120	.885	1.288	3200	10560
1-1/4	.065	1.120	.822	1560	5148
	.083	1.084	1.034	1992	6574
	.095	1.060	1.172	2280	7524
	.120	1.010	1.448	2880	9504
	.134	.982	1.597	3216	10613
1-3/8	.065	1.245	.909	1418	4679
1-1/2	.065	1.370	.996	1300	4290
	.083	1.334	1.285	1660	5478
	.095	1.310	1.426	1900	6270
	.125	1.260	1.769	2400	7920
	.134	1.232	1.955	2680	8844
1-5/8	.134	1.357	2.134	2474	8164
	.156	1.312	2.344	2880	9504
1-3/4	.095	1.560	1.679	1629	5376
1-7/8	.065	1.745	1.257	1040	3432
2	.065	1.870	1.343	975	3218
	.095	1.810	1.933	1425	4203
	.120	1.760	2.409	1800	5940
	.156	1.688	3.072	2340	7722

SPECIALTY METAL PRODUCTS



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EXPANDED AND PERFORATED

DATA AND SPECIFICATIONS

304

Similar to Type 302 with excellent mechanical properties, resistance to many corrosive agents. Useful where sanitation and cleanliness are important. Non-magnetic in the annealed condition.

316

Low-carbon “18-8” chromium-nickel stainless steel with molybdenum added to increase corrosion resistance and mechanical properties at elevated temperatures. Non-magnetic in the annealed condition.

3003-H14 ALUMINUM SHEET

This is the most widely used of all aluminum alloys. It is essentially commercially pure aluminum with the addition of Manganese which increases strength some 20% over 1100. Excellent corrosion resistance and workability.

“We reduced our in-house metal inventory by shopping at Metal Supermarkets. They are our one stop shopping source for any metal we need.”

EXPANDED METAL

TERMS

SWD – Nominal dimensions, Short Way of Design

LWD – Nominal dimension, Long Way of Design

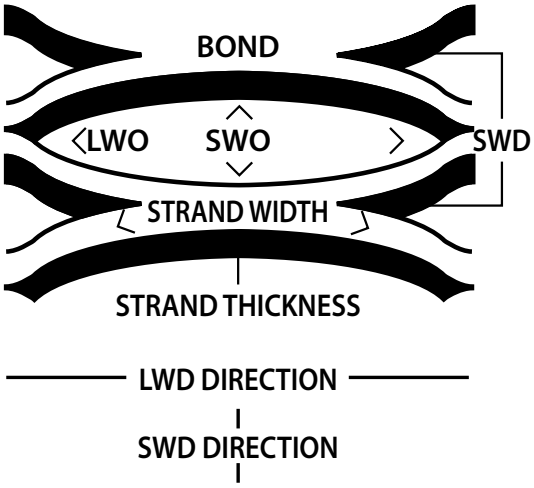
When referring to a sheet size the SWD is always referred to before the LWD. For example a 4x8 sheet means 4 foot dimension is in the SWD direction and 8 foot dimension is in the LWD direction.

SWO – Short Way of Opening

LWO – Long Way of Opening

Strand Thickness – Gauge thickness of the base metal.

Strand Width – Amount of metal fed under dies to produce one strand.



Edge Configuration – Condition of the edge of an expanded metal sheet. Usually refers to "open" (random) or "Closed" (bond) diamond edges produced from shearing.

Expanding – An expanding press simultaneously slits and stretches base material to form a diamond pattern.

Levelling – Expand metal is usually levelled after the expansion process by a levelling roller.

Raised (abbreviated R) – Expanded metal as it comes from the press. The strands and bonds are set at a uniform angle to the plane of the sheet. This gives added stength and rigidity, as well as a skid-resistant surface.

Flattened (abbreviated F) – Expanded metal that has been cold-rolled after expansion, to provide a smooth, flat and level sheet. The flattening process reduces the original gauge of the base metal and the strand width increases slightly. Some of the heavier expanded metals cannot be flattened.

Shearing – Cutting expanded metal to size to produce various sheet sizes. May be 'bond" or "random" sheared. See next page.

EXPANDED METAL

SAMPLES

SHEARING

Side Shearing – Cutting a piece of expanded metal parallel to the long dimension of the diamond.

Random Side Shearing – Cut made parallel to the LWD dimension of the sheet which usually leaves open diamonds. Standard tolerance SWD is ± 1/16" when both sides are sheared.

Bond Side Shearing – Cut is made along the length of the sheet on the center line of the bond over the specifed width.Typically it is not practical to attempt this with regular or attened expanded metal due to camber.

End Shearing – Cutting a piece of expanded metal parallel to the short way of the diamond.

End Random Shearing – Shearing a piece of expanded metal to a specifed length (LWD) which normally leaves open diamonds at both ends while accomplishing close tolerance (± 1/16") when both ends are sheared.

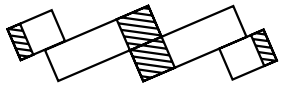
End Bond Shearing – Shearing a piece of expanded metal to a specifed length (LWD). A ± 1/16" tolerance applies when both ends are sheared. One end is cut on the Bond parallel to the SWD with the other end having open diamonds.

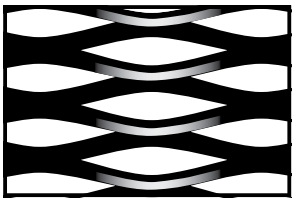
NOTE: When End Bond Shearing is requested for both ends, the sheet is sheared at the center line of the bond over the specififed length with a minus 0 plus 1/2 diamond being applied. End Bond Shearing can be possible, however, care must be applied to maintain sheet squareness.

Squareness – When all four sides are sheared a maximum tolerance of ± 1/16" per foot of width is maintained.

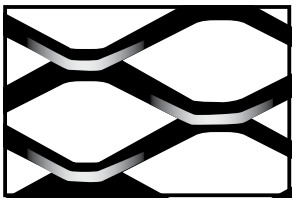
REGULAR EXPANDED METAL

Regular Expanded Metal is a finished product coming from the press alter having been die cut and expanded. The illustration shows that the strands and bonds form a sharp angle to the original plane of the solid sheet.

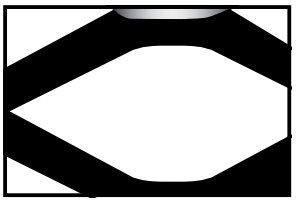




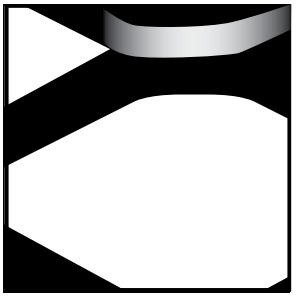
1/4" #20 Regular



1/2" #16 Regular



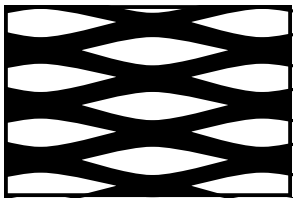
3/4" #13 Regular



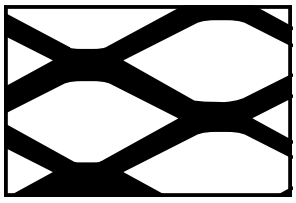
1-1/2" #9 Regular

FLATTENED EXPANDED METAL

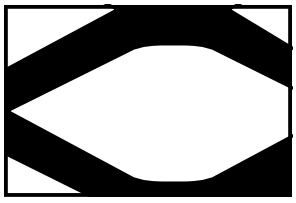
Regular Expanded Metal is expanded metal that has been cold rolled which leaves it with a flat, smooth surface.



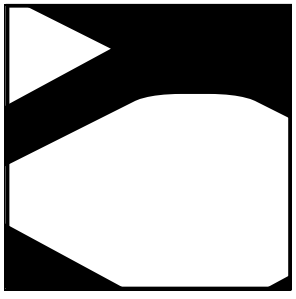
1/4" #20 Flattened



1/2" #16 Flattened



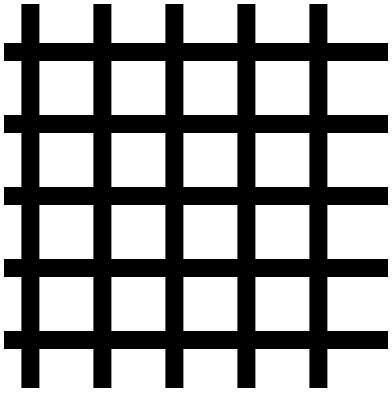
3/4" #13 Flattened



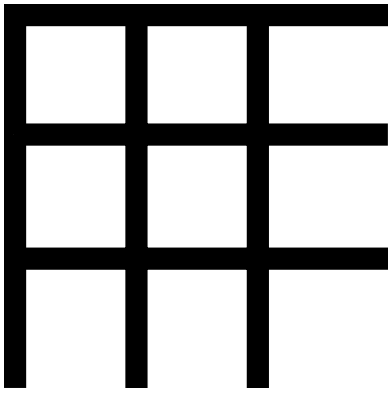
1-1/2" #9 Flattened

PERFORATED SHEET

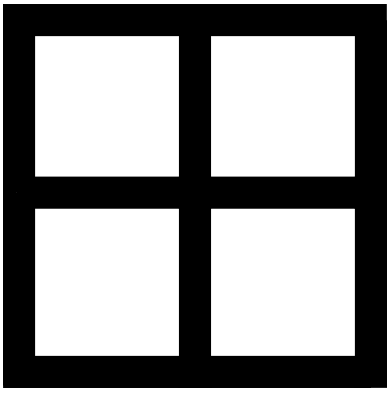
SAMPLES



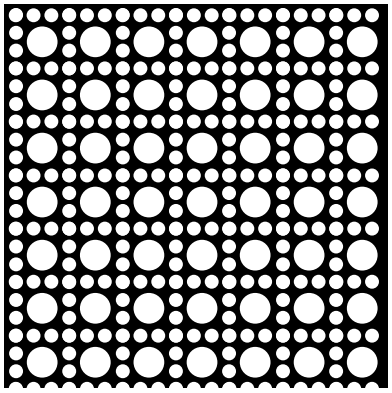
2/10” Square (.20”)
1/4” Centers Straight
64% Open



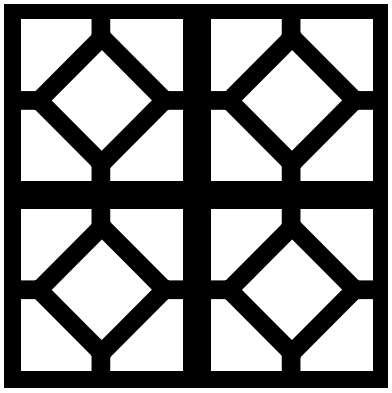
3/8”Square
1/2” Centers Straight
56% Open



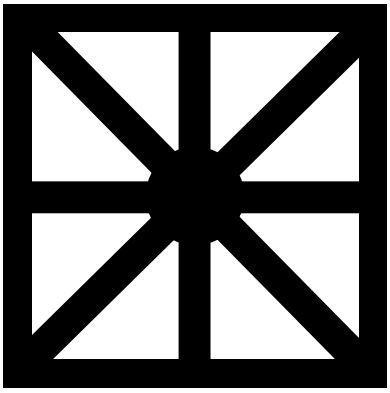
1/2” Square
11/16” Centers Straight
59% Open



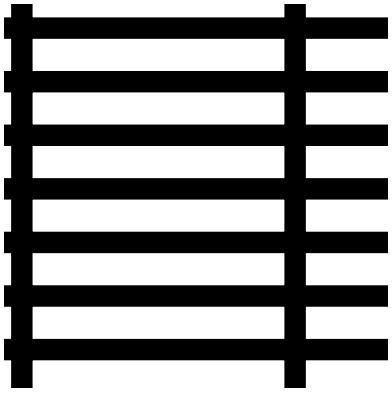
Lincane
44% Open



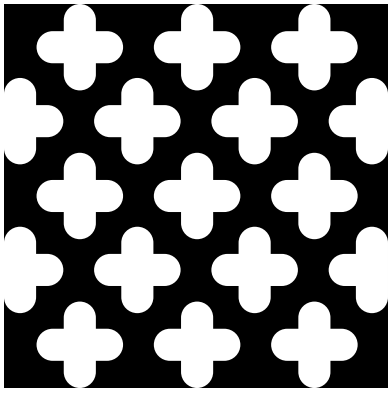
Tri-Square
47% Open



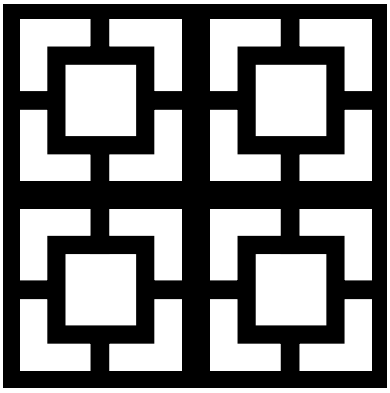
Union Jack
40% Open



Airline
68%Open



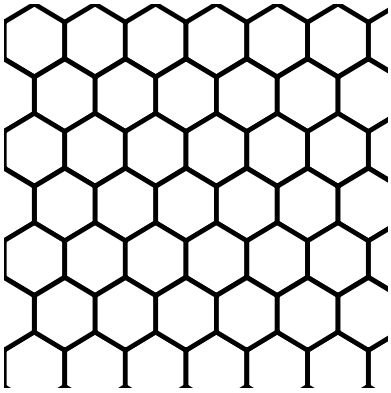
Full Clover
51% Open



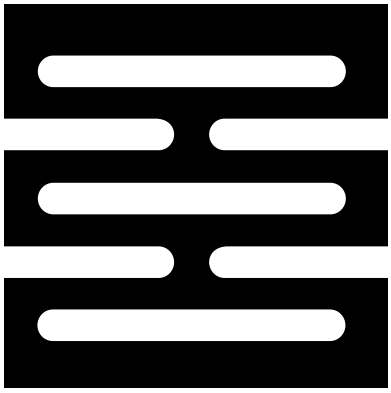
Style A-1
45% Open

PERFORATED SHEET

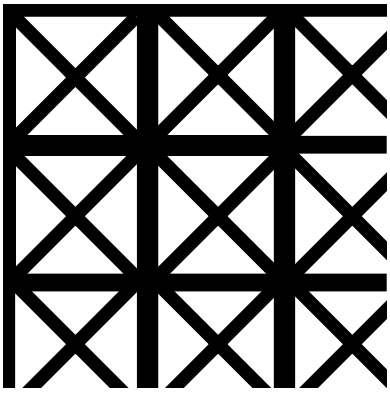
SAMPLES



1/4" Hexagonal
79% Open



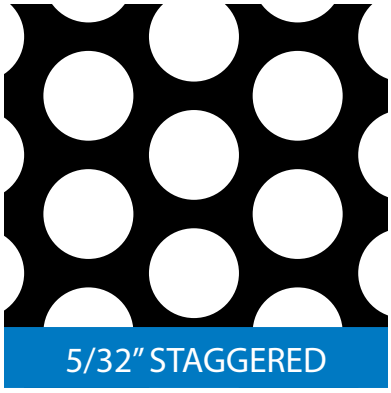
1/8"x 1"
Oblong Side Staggered
1/4" Centers
43% Open



Grecian
35% Open

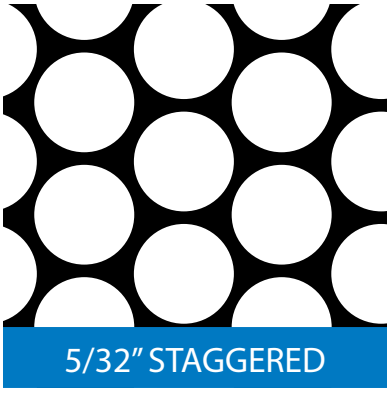
9/64" STAGGERED

.141" Dia. (3.572mm)
3/16" Centers (4.763mm)
33 holes/sq. in.
51%Open



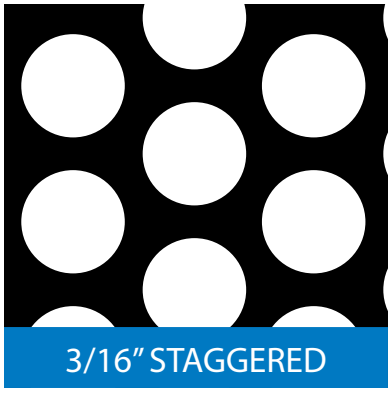
5/32" STAGGERED

.156"Dia. (3.969mm)
7/32" Centers (5.556mm)
24 holes/sq. in.
46%Open



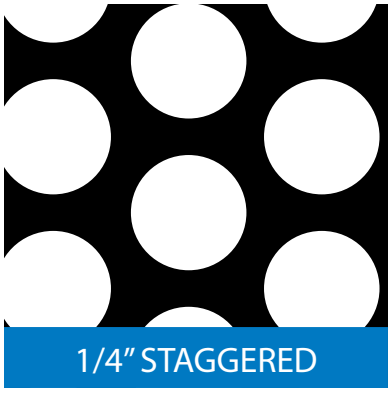
5/32" STAGGERED

.156"Dia. (3.969mm)
3/16" Centers (4.763mm)
33 holes/sq. in.
63%Open



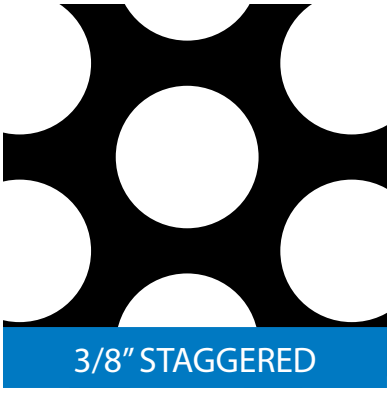
3/16" STAGGERED

.1875" Dia. (4.763mm)
1/4"Centers (6.350mm)
18.5 holes/sq. in.
51% Open



1/4" STAGGERED

.250"Dia. (6.350mm)
3/8" Centers (9.525mm)
40%Open



3/8" STAGGERED

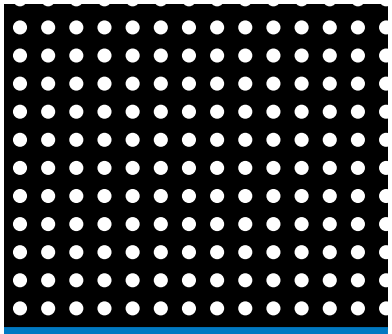
.375" Dia. (9.525mm)
1/2"Centers (12.700mm)
51%Open

PERFORATED SHEET

SAMPLES

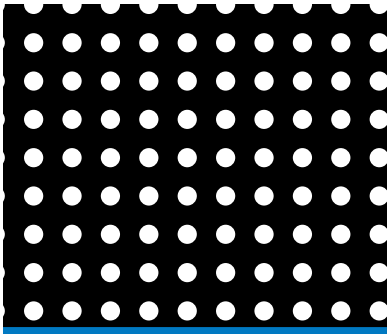
1/2" STAGGERED

.500" Dia. (12.700mm)
11/16" Centers (17.463mm)
18.5 holes/sq. in.
48% Open



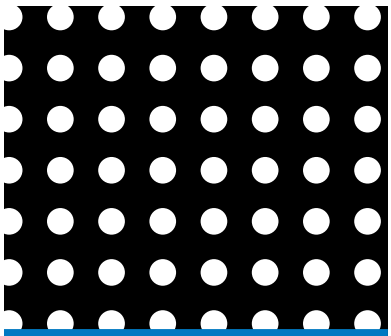
No. 2 STRAIGHT

.033"Dia. (0.838mm)
0.056" Centers (1.397mm)
331 holes/sq. in.
28%Open



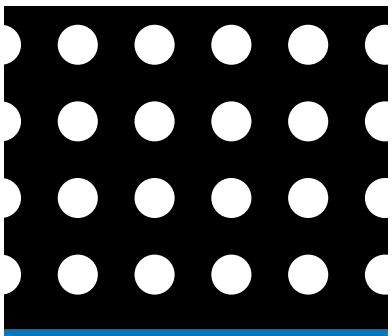
No. 3 1/2 STRAIGHT

.045" Dia. (1.143mm)
0.066" Centers (1.676mm)
230 holes/sq. in.
37%Open



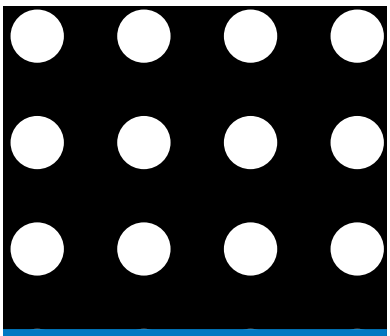
1/16" STAGGERED

.0625" Dia. (1.588mm)
1/8"Centers (3.175mm)
74 holes/sq. in.
23% Open



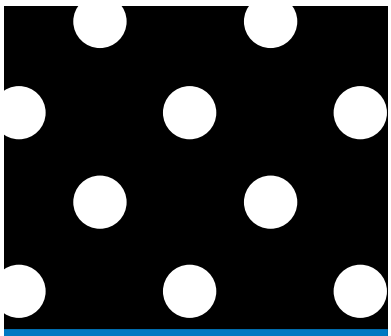
3/32" STAGGERED

.094" Dia. (2.361mm)
5/32" Centers (3.969mm)
47 holes/sq. in.
33%Open



1/8" STAGGERED

.125" Dia. (3.175mm)
3/16" Centers (4.763mm)
33 holes/sq. in.
40%Open



1/8" STAGGERED

.125" Dia. (3.175mm)
7/32" Centers (5.556mm)
24 holes/sq. in.
30%Open

3003 – H14 ALUMINUM – FLATTENED EXPANDED SHEET

All weights and dimensions are approximate

Style	LBS./ 100 Sq. Ft.	Standard SHEET SIZE		DESIGN SIZE (INCHES)		OPENING SIZE (INCHES)		STRAND SIZE (INCHES)		OVERALL THICKNESS (INCHES)	OPEN AREA (%)	NORMAL STOCK
		SWD	LWD	SWD	LWD	SWO	LWO	width	thick-ness			
1/2"- #051F	24	8/4	4/8	.500	1.270	.312	1.000	.091	.040	.040	61	8 × 4 4 × 8
1/2"- #081F	39	8/4	4/8/10	.500	1.270	.312	1.000	.091	.060	.060	58	8 × 4 4 × 8
3/4"- #051F	16	8/4	4/8	.923	2.125	.750	1.812	.122	.040	.040	72	8 × 4
3/4"- #081LTF	25	8/4	4/8	.923	2.125	.687	1.750	.134	.070	.070	70	–
3/4"- #081HF	39	8/4	4/8/10	.923	2.125	.687	1.750	.181	.070	.070	63	8 × 4 4 × 8
3/4"- .125F	62	8/4	4/8/10	.923	2.125	.625	1.750	.187	.095	.095	62	8 × 4 4 × 8
1"- .188F	1.15	8	4	1.000	2.000	.540	1.400	.280	.165	.165	60	–
1 1/2"- #.081F	21	8/4	4/8	1.330	3.150	1.062	2.750	.143	.055	.055	77	–
1 1/2"-.125F	41	8/4	4/8/10	1.330	3.150	1.000	2.750	.181	.095	.095	70	4 × 8 8 × 4
1 1/2"-#.188	72	8/4	4/8/10	.923	2.125	.575	1.600	.200	.170	.170	58	8 × 4 4 × 8

3003 – H14 ALUMINUM – RAISED EXPANDED SHEET

All weights and dimensions are approximate

Style	LBS./ 100 Sq. Ft.	Standard SHEET SIZE		DESIGN SIZE (INCHES)		OPENING SIZE (INCHES)		STRAND SIZE (INCHES)		OVERALL THICKNESS (INCHES)	OPEN AREA (%)	NORMAL STOCK
		SWD	LWD	SWD	LWD	SWO	LWO	Width	Thick-ness			
3/16"-.032 SPECIAL ORDER ONLY	28	8	4	.203	.500	.080	.313	.060	.032	.080	40	8 × 4
1/2"-#051	25	8/4	4/8	.500	1.200	.375	.937	.080	.051	.158	65	4 × 8 8 × 4
1/2"-#081	41	8/4	4/8/10	.500	1.200	.375	.937	.080	.081	.186	60	4 × 8 8 × 4
3/4"-#051	17	8/4	4/8	.923	2.00	.812	1.75	.109	.051	.200	78	8 × 4
3/4"-#081 LT	27	8/4	4/8	.923	2.00	.750	1.68	.110	.081	.200	76	–
3/4"-#081 HVY	41	8/4	4/8/10	.923	2.00	.750	1.68	.165	.081	.300	69	4 × 8 8 × 4
3/4"-.125	65	8/4	4/8/10	.923	2.00	.687	1.68	.169	.125	.305	68	4 × 8 8 × 4
3/4"-.188	127	8/4	4/8/10	.923	2.00	.600	1.68	.221	.188	.400	60	4 × 8 8 × 4
1-1/2"-.081	22	8/4	4/8	1.33	3.00	1.187	2.50	.129	.081	.240	85	–
1-1/2"-.125	43	8/4	4/8/10	1.33	3.00	1.187	2.50	.162	.125	.300	79	4 × 8 8 × 4
1-1/2"-.188	79	8/4	4/8	1.33	3.00	1.00	2.50	.200	.188	.380	70	–

CARBON STEEL – FLATTENED EXPANDED SHEET

All weights and dimensions are approximate

Style	LBS./ 100 Sq. Ft.	Standard SHEET SIZE		DESIGN SIZE (INCHES)		OPENING SIZE (INCHES)		STRAND SIZE (INCHES)		OVERALL THICKNESS (INCHES)	OPEN AREA (%)
		SWD	LWD	SWD	LWD	SWO	LWO	Width	Thick-ness		
3/16"-#22F SPECIAL ORDER ONLY	72	8/4	4/8	.218	.500	.094	.343	.063	.027	.027	43
3/16"-#20F SPECIAL ORDER ONLY	86	8/4	4/8	.218	.500	.094	.343	.063	.032	.032	43
1/4"-#20F	88	8/4	4/8	.250	1.05	.084	.715	.079	.030	.030	35
1/4"-#18F	108	8/4	4/8	.250	1.05	.075	.715	.080	.040	.040	35
5/16"-#18F	95	8/4	4/8	.333	1.03	.172	.813	.099	.040	.040	45

CARBON STEEL – FLATTENED EXPANDED SHEET

All weights and dimensions are approximate

Style	LBS./ 100 Sq. Ft.		Standard SHEET SIZE		DESIGN SIZE (INCHES)		OPENING SIZE (INCHES)		STRAND SIZE (INCHES)		OVERALL THICK-NESS (INCHES)	OPEN AREA (%)
	PLAIN	HD GAL.	SWD	LWD	SWD	LWD	SWO	LWO	Width	Thick-ness		
1/2"- #20F	40	51	8/4	4/8	.500	1.25	.375	1.00	.079	.029	.029	65
1/2"- #18F	66	83	8/4	4/8	.500	1.25	.312	1.00	.097	.039	.039	60
1/2"- #16F	82	98	8	4	.500	1.25	.312	1.00	.096	.056	.056	63
1/2"- #13F	140	161	4	8	.500	1.25	.312	1.00	.107	.070	.070	52
3/4"- #16F	51	57	8	4	.923	2.10	.750	1.75	.111	.048	.048	74
3/4"- #13F	75	88	4	8	.923	2.10	.688	1.781	.106	.070	.070	74
3/4"- #10F(13)F	114	128	4	10	.923	2.10	.637	1.755	.160	.070	.070	68
3/4"- #9F(10)F	171	188	5	10	.923	2.10	.563	1.688	.165	.120	.120	63

CARBON EXPANDED SHEET – FLATTENED

All weights and dimensions are approximate

Style	LBS./ 100 Sq. Ft.		Standard SHEET SIZE		DESIGN SIZE (INCHES)		OPENING SIZE (INCHES)		STRAND SIZE (INCHES)		OVERALL THICK-NESS (INCHES)	OPEN AREA (%)
	PLAIN	HD GAL.	SWD	LWD	SWD	LWD	SWO	LWO	Width	Thick-ness		
1" - #16F	44	50	4	8	1.00	2.30	.813	2.10	.098	.050	.050	78
1" - #14F	63	72	4	10	1.00	2.30	.813	2.00	.125	.070	.070	80
1" - #12F	98	113	8	4	1.00	2.30	.813	2.00	.156	.085	.085	74
1" - #10F	165	179			1.00	2.30	.750	1.90	.160	.110	.110	58
1 1/2" - #16F	38	44			1.33	3.20	1.062	2.75	.119	.048	.048	83
1 1/2" - #13F	57	66	8	4	1.33	3.20	1.062	2.75	.116	.070	.070	80
1 1/2" - #12F	66	76	4	8	1.41	3.20	1.296	2.625	.116	.085	.085	85
1 1/2" - #9F	114	125	4	10	1.33	3.20	1.00	2.563	.158	.110	.110	75
1 1/2" - #10F	165	179			1.33	3.20	.90	2.563	.188	.110	.110	63

CARBON STEEL – RAISED EXPANDED SHEET

All weights and dimensions are approximate

Style	LBS./ 100 Sq. Ft.	Standard SHEET SIZE		DESIGN SIZE (INCHES)		OPENING SIZE (INCHES)		STRAND SIZE (INCHES)		OVERALL THICKNESS (INCHES)	OPEN AREA (%)
		SWD	LWD	SWD	LWD	SWO	LWO	Width	Thick-ness		
3/16" - #22	56	8/4	4/8	.203	.500	.110	.313	.047	.030	.070	55
3/16" - #20	90	8/4	4/8	.203	.500	.080	.313	.063	.036	.080	40
1/4" - #20	86	8/4	4/8	.250	1.00	.125	.718	.072	.036	.135	45
1/4" - #18	114	8/4	4/8	.250	1.00	.110	.718	.072	.048	.147	43
5/16" - #20	57	8/4	4/8	.333	1.00	.25	.750	.063	.036	.125	60
5/16" - #18	104		4/8	.333	1.00	.188	.688	.094	.048	.170	48

CARBON STEEL – RAISED EXPANDED SHEET

All weights and dimensions are approximate

Style	LBS./ 100 Sq. Ft.		Standard SHEET SIZE		DESIGN SIZE (INCHES)		OPENING SIZE (INCHES)		STRAND SIZE (INCHES)		OVERALL THICK-NESS (INCHES)	OPEN AREA (%)
	PLAIN	HD GAL.	SWD	LWD	SWD	LWD	SWO	LW0	Width	Thick-ness		
1/2" - #20	43	51	8/4	4/8	.500	1.20	.438	.938	.072	.036	.140	80
1/2" - #18	70	88	8/4	4/8	.500	1.20	.438	.938	.088	.048	.172	72
1/2" - #16	86	104	8/4/6	4 8/10 8/10	.500	1.20	.375	.938	.087	.060	.175	65
1/2" - #13	147	174	8/4/6	4 8/10 8/10	.500	1.20	.312	.938	.096	.090	.204	57
1/2" - #13 (.188)	282	310	8/4/6	4 8/10 8/10	.500	1.20	.250	.800	.188	.090	.275	25
3/4" - #16	54	61	8	4	.923	2.00	.813	1.750	.101	.060	.210	78
3/4" - #13	80	94	4	8/10	.923	2.00	.750	1.688	.096	.090	.205	76
3/4" - #10 (13)	120	134	6	8/10	.923	2.00	.750	1.625	.144	.090	.290	72
3/4" - #9 (10)	180	198			.923	2.00	.688	1.562	.150	.135	.312	68
1" - #16	47	54			1.00	2.25	.938	2.000	.087	.060	.192	82

CARBON STEEL – RAISED EXPANDED SHEET

All weights and dimensions are approximate

Style	LBS./ 100 Sq. Ft.		Standard SHEET SIZE		DESIGN SIZE (INCHES)		OPENING SIZE (INCHES)		STRAND SIZE (INCHES)		OVERALL THICK-NESS (INCHES)	OPEN AREA (%)
	PLAIN	HD GAL.	SWD	LWD	SWD	LWD	SWO	LWO	Width	Thick-ness		
1" - #14	78	90	4	8	1.00	2.25	.875	1.563	.125	.074	.225	75
1" - #12	96	110	8	4	1.00	2.25	.907	1.563	.109	.105	.225	78
1" - #10(170)	170	187	4	8 & 10	1.00	2.25	.750	1.563	.155	.135	.375	62
1" - #10H	200	221	6	8 & 10	1.00	2.25	.750	1.563	.180	.135	.390	60
1" - #7	412	453			1.00	2.25	.576	1.563	.275	.183	.550	45
1 1/2" - #16	50	48			1.33	3.00	1.25	2.625	.108	.060	.230	85
1 1/2" - #13	60	68			1.33	3.00	1.888	2.500	.105	.090	.242	85
1 1/2" - #10 (13)	79	90	8	4	1.33	3.00	1.188	2.500	.138	.090	.284	80
1 1/2" - #12	74	85	4	8 & 10	1.33	3.00	1.112	2.375	.109	.105	.225	83
1 1/2" - #9 (10)	120	144	6	8 & 10	1.33	3.00	1.125	2.375	.144	.135	.312	76
1 1/2" - #10H	200	220			1.33	3.00	.830	2.375	.240	.135	.460	72
1 1/2" - #6	250	275			1.33	3.00	1.110	2.313	.203	.198	.433	69

CARBON STEEL EXPANDED STRUCTURAL GRATING

CONCENTRATED LOAD (Lbs./Ft. of Length of Catwalk or Platform)	CLEAR SPAN (Dist. between supports from inside edge of one support to inside edge of next support)							
	23"	30"	35"	42"	47"	54"	60"	72"
50Lbs. Light or Occasional Pedestrian Traffic	3.00 3.14	3.00 3.14	3.00 3.14	3.00 3.14	3.00 3.14	4.00 4.27	5.00 6.25	10.00
100Lbs. Normal or Frequent Pedestrian Traffic	3.00 3.14	3.00 3.14	3.00 3.14	4.00 4.27	5.00 6.25	7.00	7.00	10.00
150Lbs. Heavy or Constant Pedestrian Traffic	3.00 3.14	4.00 4.27	4.00 4.27	5.00 6.25	6.25	7.00	10.00	
200Lbs. Pedestrian Traffic with Light Equipment	3.00 3.14	4.00 4.27	4.27 5.00	6.25	7.00	10.00	10.00	
250Lbs. Pedestrian Traffic with Light Equipment	4.00 4.27	5.00	5.00 6.25	7.00	10.00	10.00		
300Lbs. Heavy Duty Applications. Please Consult Manufacturer	4.00 4.27	5.00 6.25	6.25	10.00	10.00			
350Lbs. Heavy Duty Applications. Please Consult Manufacturer	4.00 4.27	6.25	7.00	10.00	10.00			
500Lbs. Heavy Duty Applications. Please Consult Manufacturer	5.00	7.00	10.00	10.00	10.00			
600Lbs. Heavy Duty Applications. Please Consult Manufacturer	6.25	10.00	10.00	10.00				
800Lbs. Heavy Duty Applications. Please Consult Manufacturer	7.00	10.00	10.00					

CARBON STEEL – EXPANDED STRUCTURAL GRATING

Style	LBS./ 100 Sq. Ft.		Standard SHEET SIZE		DESIGN SIZE (INCHES)		OPENING SIZE (INCHES)		STRAND SIZE (INCHES)		OVER-ALL THICK-NESS (INCH-ES)	No. OF Designs/Ft.		OPEN AREA (%)
	STYLE	Gal. Wt.	SWD	LWD	SWD	LWD	SWO	LWO	Width	Thick-ness		SWO	LWO	
2.00LB	2.00	2.10	**8' × 3' AND 4' 10' × 3' AND 4' 4' × 8' AND 10' 6' × 8' AND10'**		1.33	5.33	1.000	3.44	.267	.120	.480	9.0	2.25	60
3.00LB	3.00	3.15			1.33	5.33	0.940	3.44	.264	.183	.540	9.0	2.25	60
3.14LB	3.14	3.30			2.00	6.00	1.625	4.88	.312	.250	.656	6.0	2.00	69
4.00LB	4.00	4.18	**ALSO AVAIL-ABLE IN 12' LWD**		1.33	5.33	0.940	3.44	.300	.215	.618	9.0	2.25	55
4.27LB	4.27	4.46			1.41	4.00	1.000	2.88	.300	.250	.625	8.5	3.00	58
5.00LB	5.00	5.20			1.33	5.33	0.813	3.38	.331	.250	.655	9.0	2.25	50
6.25LB	6.25	6.47			1.41	5.33	0.813	3.38	.350	.312	.715	8.5	2.25	50
7.00LB	7.00	7.25	4	8	1.41	5.33	0.813	3.38	.391	.312	.740	8.5	2.25	45
10.00LB	10.00		4	8	1.41	5.33	0.533	3.20	.560	.312	.855	8.5	2.25	21

STAINLESS STEEL – FLATTENED EXPANDED SHEET

All weights and dimensions are approximate

Style	LBS./ 100 Sq. Ft.	Standard SHEET SIZE		DESIGN SIZE (INCHES)		OPENING SIZE (INCHES)		STRAND SIZE (INCHES)		OVER-ALL THICK-NESS (INCH-ES)	OPEN AREA (%)	NOR-MAL STOCK
		SWD	LWD	SWD	LWD	SWO	LWO	Width	Thick-ness			
1/2"- #20F	48	8/4	4/8	.500	1.26	.312	1.00	.091	.033	.033	60	4X8
1/2"-#18F	65	8/4	4/8	.500	1.26	.312	1.00	.091	.040	.040	60	4X8
1/2"-#16F	81	8/4	4/8/10	.500	1.26	.312	1.00	.091	.050	.050	60	4X8
1/2"- #13F	178	8/4	4/8/10	.500	1.26	.240	.915	.132	.080	.080	57	4X8
3/4"- #16F	57	8/4	4/8	.923	2.10	.750	1.812	.118	.050	.050	75	4X8
3/4"-#13F	86	8/4	4/8/10	.923	2.10	.625	1.750	.120	.070	.070	75	4X8
3/4"- #9(10)F	183	8/4	4/8/10	.923	2.10	.562	1.687	.155	.119	.119	61	4X8
1 1/2"- #16F	39	8/4	4/8/10	1.33	3.15	1.062	2.75	.119	.050	.050	80	4X8
1 1/2"-#13F	59	8/4	4/8	1.33	3.15	1.00	2.625	.121	.079	.079	80	4X8
1 1/2"- #9(10)F	131	8/4	4/8	1.33	3.15	.937	2.625	.165	.119	.119	75	4X8

STAINLESS STEEL – RAISED EXPANDED SHEET

All weights and dimensions are approximate

Style	LBS./ 100 Sq. Ft.	Standard SHEET SIZE		DESIGN SIZE (INCHES)		OPENING SIZE (INCHES)		STRAND SIZE (INCHES)		OVER-ALL THICK-NESS (INCH-ES)	OPEN AREA (%)	NOR-MAL STOCK
		SWD	LWD	SWD	LWD	SWO	LWO	Width	Thick-ness			
1/2" - #20	50	8/4	4/8	.500	1.200	.437	.937	.080	.037	.164	70	4 × 8
1/2" - #18	67	8/4	4/8	.500	1.200	.437	.937	.080	.050	.164	70	4 × 8
1/2"-#16	84	8/4	4/8/10	.500	1.200	.437	.937	.080	.062	.164	70	4 × 8
1/2"-#13	187	8/4	4/8/10	.500	1.200	.325	.875	.119	.093	.225	65	4 × 8
3/4"- #16	60	8/4	4/8	.923	2.00	.812	1.750	.106	.062	.202	83	4 × 8
3/4"-#13	91	8/4	4/8/10	.923	2.00	.750	1.687	1.07	.093	.202	80	4 × 8
3/4"- #9(10)	193	8/4	4/8/10	.923	2.00	.687	1.562	.150	.140	.308	67	4 × 8
1 1/2"-#16	41	8/4	4/8	1.33	3.00	1.250	2.750	.106	.062	.222	85	4 × 8
1 1/2"-#13	62	8/4	4/8	1.33	3.00	.250	2.625	.106	.093	.222	83	4 × 8
1 1/2"-#9(10)	137	8/4	4/8/10	1.33	3.00	1.125	2.500	.155	.140	.280	77	4 × 8

3003 – H14 ALUMINUM PERFORATED SHEET

Hole Diameter	Stag. Inline Ctrs.	Style	Gauge	Sheet Size	Open Size (%)
1/16	**1/8**		**.032**	**48 × 120**	**23**
3/32	**5/32**		**.032**	**36 × 120**	**33**
3/32	**5/32**		**.040**	**36 × 120**	**33**
3/32	**5/32**		**.063**	**36 × 120**	**33**
3/32	**5/32**		**.032**	**48 × 120**	**33**
1/8	**3/16**		**.050**	**48 × 120**	**40**
1/8	**3/16**		**.063**	**36 × 120**	**40**
1/8	**3/16**	**STAGGERED**	**.032, .063**	**48 × 120**	**40**
1/8	**3/16**		**.125**	**48 × 120**	**40**
1/8	**7/32**		**.032**	**48 × 96**	**29.6**
5/32	**3/16**		**.063**	**48 × 120**	**63**
3/16	**1/4**		**.032**	**36 × 120**	**50**
3/16	**1/4**		**.063**	**48 × 120**	**50**
3/16	**5/16**		**.063**	**48 × 120**	**32**
1/4	**3/8**	**STAGGERED**	**.032, .125**		**42**
1/4	**3/8**		**.063**	**48 × 96**	**40**
1/2	**11/16**	**STAGGERED**	**.063, 0.125**		**48**

CARBON STEEL PERFORATED SHEET

Hole Diameter	Stag. Ctrs.	Style	Gauge	Sheet Size	Open Size (%)
.045	.066	STRAIGHT	20	48 × 120	41
1/16	3/32		22	36 × 120	41
1/16	7/64	STAGGERED	16	36 × 120	30
1/16	1/8		20, 16	36 × 120	23
5/64	1/8		22	48 × 120	35
5/64	1/8		16, 18	48 × 96	35
5/64	7/64	STAGGERED	20		46
3/32	5/32		22, 18, 16, 14	36 × 120	33
3/32	3/16		18	36 × 120	25
1/8	3/16	STAGGERED	22		41
1/8	3/16		20	48 × 120	40
1/8	3/16		18	48 × 120	40
1/8	3/16		16	48 × 120	40
1/8	3/16		16	36 × 120	40
1/8	3/16		11	48 × 120	40
1/8	7/32		16, 12	48 × 120	29
9/64	7/32	STAGGERED	20	48 × 120	38
5/32	3/16		22	36 × 120	63
5/32	3/16		20, 14		63
5/32	3/16		18	48 × 120	63
5/32	3/16		16	36 × 120	63
3/16	5/16	STAGGERED	16, 11, 10, 3/16"		32
3/16	1/4		22	36 × 120	50
3/16	1/4		20	36 × 120	50
3/16	1/4		16	36 × 120	50
3/16	1/4		12	48 × 96	50
3/16	1/4		11	48 × 120	50
3/16	1/4	STAGGERED	10		51
1/8	5/32	SQUARES/ STRAIGHT	22		66
1/4	3/8	SQUARES/ STRAIGHT	20		45
1/2	11/16	SQUARES/ STRAIGHT	16, 12		53

CARBON STEEL PERFORATED SHEET

Hole Diameter	Stag. Ctrs.	Style	Gauge	Sheet Size	Open Size (%)
1/4	5/16	STAGGERED	16, 14, 12	48 × 120	58
1/4	3/8		20	48 × 120	40
1/4	3/8		16	48 × 120	40
1/4	3/8		11	48 × 96	40
1/4	3/8	STAGGERED	18, 14, 3/16", 1/4"	48 × 96	42
1/4	1/2	STRAIGHT	16		20
1/4	1	STRAIGHT	18		5
5/16	3/8	STAGGERED	16		63
5/16	7/16	STAGGERED	18, 16, 11, 1/4"		46
3/8	1/2		14	48 × 120	51
3/8	1/2	STAGGERED	20, 16, 11, 3/16", 1/4"	48 × 120	51
3/8	9/16	STAGGERED	16, 11, 3/16", 1/4"	48 × 120	40
1/2	11/16		16	48 × 120	48
1/2	11/16		11	48 × 120	48
3/4	1"	STAGGERED	16, 11, 3/16", 1/4"		51
1"	1-1/4"	STAGGERED	11, 3/16", 1/4"		58
1/4 HEX	.285			48 × 120	76
R-20 GRECIAN CANE			22, 24	48 × 120	35
R-3 OCTAGON CANE			22	48 × 120	40
*3/8 sq.	1/2		16	36 × 120	51
**1/8 X 1	1/4 X 1-1/8		16	48 × 96	43

* Straight Rows
** Round End slot, Straight Rows - Length of Slots 48" Dim

T316 STAINLESS STEEL PERFORATED SHEET

Hole Diameter	Stag. Inline Ctrs.	Style	Gauge	Sheet Size	Open Size (%)
.033	.055		26	36 × 120	28
1/16	1/8	STAGGERED	16		23
3/32	3/16	STAGGERED	22,16		23
1/8	3/16	STAGGERED	18,16, 14	48 × 96	40
1/8	3/16		11	48 × 120	40
3/16	1/4		16	48 × 96	50
3/16	1/4		20	48 × 120	50
3/16	5/16		12	36 × 120	33
1/4	3/8	STAGGERED	16, 11	48 × 96	40

T304 STAINLESS STEEL PERFORATED SHEET

Hole Diameter	Stag. Ctrs.	Style	Gauge	Sheet Size	Open Size (%)
.033	.055	STRAIGHT	26	36 × 120	28
.045	.066	STRAIGHT	26	36 × 120	37
1/16	3/32		22, 20	36 × 120	41
1/16	1/8		16, 18, 20, 22	36 × 120	23
5/64	7/64	STAGGERED	22		45
3/32	5/32		22,16	36 × 120	33
3/32	5/32		20	36 × 120	33
3/32	5/32		18	36 × 120	33
3/32	3/16	STAGGERED	22, 18, 16	48 × 120	23
3/32	1/4		20	36 × 120	12
1/8	3/16	STAGGERED	26,22,20	48 × 96	40
1/8	3/16		18	48 × 120	40
1/8	3/16		16	48 × 120	40
1/8	3/16		14	48 × 96	40
1/8	3/16		11	48 × 96	40
5/64	7/64	STAGGERED	22		45
5/32	3/16		22	36 × 96	63
5/32	3/16		20	36 × 120	63
5/32	3/16		18	36 × 120	63
5/32	3/16		16	48 × 96	63
3/16	5/16	STAGGERED	16	36 × 120	32
3/16	5/16	STAGGERED	11	48 × 96	32
1/4	5/16		22	48 × 120	58
1/4	5/16		18	36 × 120	58
1/4	5/16	STAGGERED	16	48 × 120	58
1/4	5/16	STAGGERED	20, 11	48 × 120	58
1/4	3/8	STAGGERED	22	36 × 120	40
1/4	3/8	STAGGERED	22, 18, 3/16"		42
1/4	3/8		20	48 × 120	40
1/4	3/8		16	48 × 120	40
1/4	3/8		11	48 × 96	40
5/16	7/16	STAGGERED	16		46
3/8	1/2	STAGGERED	16, 11		32
3/8	9/16	STAGGERED	22, 16, 11		40
1/2	11/16	STAGGERED	16	48 × 96	48

PRE-GALVANIZED PERFORATED SHEET

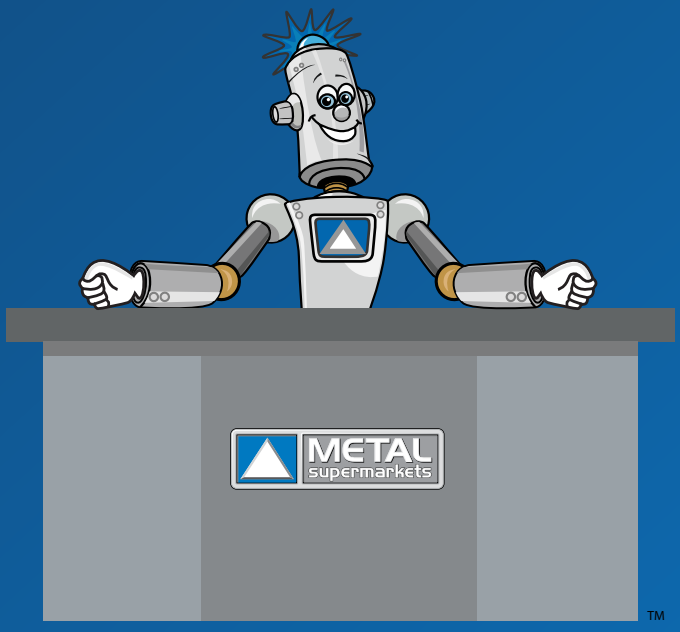
Hole Diameter	Stag. Ctrs.	Style	Gauge	Sheet Size	Open Size (%)
3/32	5/32	STAGGERED	22, 16		33
3/32	3/16	STAGGERED	22, 18, 16		23
1/8	3/16	STAGGERED	22, 16		41
1/8	7/32	STAGGERED	22		51
3/16	1/4	STAGGERED	20, 18		51
1/4	3/8	STAGGERED	16		42
1/2	11/16	STAGGERED	22		48

TYPICAL STOCK SHEET SIZES: 36” X 96”, 36” X 120”, 48” X 96”, 48” X 120”

DECORATIVE PATTERNS PERFORATED SHEET

Hole Diameter	Stag. Ctrs.	Style	Gauge	Sheet Size	Open Size (%)
Windsor			24		45
Tread Plate/ Dimple Pattern			16, 14, 12		5
1/8” × 1” Oblong Slot			16		43
1/2” Hex	9/16”	STAGGERED	16		80

TOOL STEEL



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TOOL STEEL

SELECTOR GUIDE

Application	Suggested Grades
Arbors	O1, A2, A6
Battering Tools	S5, S1, S7
Blacksmith Tools	S5, S1
Boiler-Shop Tools	S5, S1, S7
Bolt Clippers	S5, S1
Boring Tools	M2
Broaches	M2
Burnishing Tools	D3, D2
Bushings	O1, O6, A2, A-HT
Cams	A2, A6
Chasers (thread cutting)	O1, M1
Chisels:	
Blacksmith	S5, S1, S7
Cold Working	S5, S1, S7
File Cutting	D2, M2
Hand Cutting	S1
Hot Working	S7
Stone	S5
Woodworking	S5
Chuck Jaws	S5, S7
Clutch parts	S5, S1, S7
Collets	S5, O1, S7
Concrete Breakers	S5
Counterbores	M2
Cutters:	
Formtool	M2
Milling	M2
Inserted Blade.	M2
Paper	D2, M2
Threading	M2
Woodworking	M2
Cut-off Tools	M2
Dies:	
Bending	A-HT, A2, D2, A6
Blanking (long run)	D2, A-HT, D3, D5
Blanking (med. run)	A2, A6, O1
Coining	A2, D2, A6
Cold Heading Die Inserts	D2, M2, A-HT
Cold Heading Die Casings	H13

Application	Suggested Grades
Die Casting Dies and Cores for Zinc	H13
Die Casting Dies and Cores for Aluminum	H13
Die Casting Dies and Cores for Brass	H19
Embossing	A2, D2, A-HT, A6
Extrusion, Cold	D2, M2
Extrusion, Hot, for Aluminum and Magnesium	H12, H13, H19
Extrusion for Copper and Brass	H19
Forging, Hot.	H12, H13, H19
Forming, Cold	A-HT, A2, D2, D5, O1
Gripper, Cold	S5, S7
Gripper,Hot	S7, S1, H13
Lamination	D2, D3, A-HT, A2, D5
Swaging, Cold	A2, D2, S7
Swaging, Hot.	H13, S1, S7
Thread Roll	D2, D5, M2
Trimming, Cold	A2, D2, A6, O1
Trimming, Hot	S1, S7, H13, D5
Wire Drawing	D2, D3
Drills:	
Flat Spade Type	M2, M3
Twist	M2
Drill Bushings	O1, O6, S5
Dummy Blacks (Hot Extrusion)	H13, H12, H19
End Mills	M2
Gages	O1, A2, D2
Hobs (for cutting)	M2
Knives:	
Chipper	A8, A2, S7
Paper	M2, D2
Rotary Slitters	D2, A8, A-HT, S5, M2
Shear, Cold	D2, A-HT, A8, A2, S5, S7
Shear, Hot.	H13, H12, A8, S7
Woodworking	A2, D2, M2
Knurling Tools	M2, D2, 01
Lathe Centers	A2, A6, D2
Lathe Tools	M2, M3, M42

TOOL STEEL — A2

DATA AND SPECIFICATIONS

AISI A2 AIR HARDENING TOOL STEEL

A2 is a 1% carbon, 5% chrome, air-hardening tool steel. A2 is known as a versatile, general purpose grade and has better resistance to abrasion and wear than the “S” series shock resisting tool steels and more toughness and impact strength than the”D” series wear steels. It is used for a wide range of tooling applications ranging from general purpose punches and dies to components for plastic injection molding.

Typical Chemistry: C - 1.00 Mo - 1.00 Cr - 5.00 V 0.20

Machinability: When properly annealed, A2 has a machinability rating of 60 as compared with a 1% Carbon Steel rated at 100.

Dimensional Stability: When air quenched from the proper hardening temperature, this grade can be expected to expand approximately .001 in. per in. Note: Distortion (bending, bowing and twisting) as well as part geometry can add to the variations in movement of a part being hardened.

Thermal Cycling: To avoid decarburization, this grade should be annealed and/or hardened in a controlled neutral atmosphere, vacuum or neutral salt furnace environment.

1. Anneal: Heat to 1650° F. Soak two hours per inch of thickness. Cool 40° F per hour to 900° F. Air cool to room temperature. Approximate annealed hardness 235 HB Max.
2. Stress Relief of Unhardened Material: Heat slowly to 1200° to 1250° F. Soak for two hours per inch of thickness at heat. Slow cool (furnace cool if possible) to room temperature.
3. Hardening:
   a. Preheat: Heat to 1200° F. Hold at this temperature until thoroughly soaked.
   b. Harden: Heat to 1750° to 1800° F. Soak at heat for 45 to 60 minutes per inch of greatest thickness.
   c. Quench: Air quench to 150° F. Temper immediately.
   d. Temper: Double temper is mandatory. Soak for two hours per inch of thickness at heat. Slow cool to room temperature between tempers.

Temper° F	Rockwell “C”	Temper° F	Rockwell “C”
As-quenched	64	900	56
400	60	1000	56
500	56	1100	50
600	56	1200	43
800	56	1300	34

   Specimens 1”diameter were quenched from 1775° F.
4. Stress Relief Temper: A stress relief temper for hardened material is strongly recommended after significant grinding, or welding, or EDM. Select a temperature that is 25° or 50° F lower than the last tempering temperature used.

The values shown in this data sheet are to be used as a guide for estimating purposes only.

TOOL STEEL — D2

DATA AND SPECIFICATIONS

AISI D2 High Carbon • High Chrome

D2 is a high carbon, high chromium, air-hardening tool steel. It was formulated to combine excellent abrasion resistance and air-hardening characteristics and has become the tool and die standard against which other tool steels are measured for abrasion resistance, dimensional stability in hardening and air-hardening characteristics.

Typical Chemistry: C - 1.55 Mo - 0.80 Cr - 11.50 V - 0.90

Machinability: When properly annealed, D2 has a machinability rating of 45 as compared to a 1% Carbon Steel rated at 100.

Dimensional Stability: D2 has the minimum distortion in heat treatment as compared to other tool steels. When air quenched from the proper hardening temperature, this grade can be expected to expand or contract approximately .0005 in. per in. Note: Distortion (bending, bowing and twisting) as well as part geometry can add to the variations in movement of a part being hardened.

Thermal Cycling: In order to avoid decarburization, this grade should be annealed and/or hardened in a controlled neutral atmosphere, vacuum or neutral salt furnace environment.

1. Anneal: Heat to 1650’ F. Soak one and one-half hours per inch of thickness. Cool 20° F per hour to 900° F. Cool in furnace to room temperature. Approximate hardness 220 HB Max.
2. Stress Relief of Unhardened Material: Heat slowly to 1200° to 1250° F. Soak for two hours per in. of thickness at heat. Soak, slow cool (furnace cool if possible) to room temperature.
3. Hardening:
   a. Preheat: Heat to 1250° F. Hold at this temperature until thoroughly soaked.
   b. Harden: Heat to 1850° F. Soak at heat for 45 to 60 minutes per inch of thickness. Soak sufficiently long enough to get all of the alloying elements into solid solution during the austenitizing cycle. Proper response to heat treatment will depend on this. Therefore, for items under one inch in thickness, soaking time should be 45 to 60 minutes minimum.
   c. Quench: Air quench to 150° F. Temper immediately.
   d. Temper: Double tempering is mandatory, three tempers are sometimes preferred. Soak for two hours per inch of thickness at heat. Air cool to room temperature between tempers. Double temper at the range of secondary hardness (900° to 960° F) strongly recommended.

Temper° F	Rockwell “C”	Temper° F	Rockwell “C”
As-quenched	64	800	56
400	60	900/960	58/60
500	58	1000	56
600	58	1100	48

Specimens were air quenched from 1850° F.

The values shown in this data sheet are to be used as a guide for estimating purposes only.

TOOL STEEL — O1

DATA AND SPECIFICATIONS

AISI O1 Oil Hardening Tool Steel

O1 Tool Steel is a general purpose oil-hardening tool and die steel. Normal care in heat treatment gives good results in hardening and produces small dimensional changes. O1 has good abrasion resistance and sufficient toughness for a wide variety of tool and die applications.

Typical Chemistry: C - 0.90 Mn - 1.20 V - 0.20 W - 0.50 Cr 0.50

Machinability: When properly annealed, O1 has a machinability rating of 90 when compared to a 1% Carbon Steel rated at 100.

Dimensional Stability: When oil quenched from the proper hardening temperature, this grade can be expected to expand approximately .0015 in. per in. Note: Distortion (bending, bowing and twisting) and part geometry can add to the variations in movement of a part being hardened.

Thermal Cycling: In order to avoid decarburization, this grade should be annealed and/or hardened in a controlled neutral atmosphere, vacuum, or neutral salt furnace.

1. Anneal: Heat slowly to 1450° F, soak thoroughly. Cool 25° F per hour to 900° F. Air cool to room temperature. Approximate annealed hardness, 221 Maximum Brinell.
2. Stress Relief of Unhardened Material: Heat slowly to 1250° F. Soak for two hours per inch of thickness at heat. Slow cool (furnace cool if possible) to room temperature.
3. Hardening:
   a. Preheat: Heat to 1200° F, and hold at this temperature until thoroughly soaked.
   b. Hardening: Heat to 1475° to 1500° F. Soak at heat for 30 minutes per inch of thickness.
   c. Quench: Oil quench to 150° to 200° F. Temper immediately.
   d. Temper: Normally oil hardening steels need to be single tempered only. However, double tempering may sometimes be preferred. Soak at heat for 2 hours per inch of thickness for each temper. Air cool to room temperature between tempers. The normal tempering range for this grade is 300° to 450° F.

Temper° F	Rockwell "C"	Temper° F	Rockwell "C"
As-quenched	64/65	700	53
350	62/63	800	50
400	62	1000	44
500	60	1000	44
600	57	1100	39

   1"diameter specimens, oil quenched from 1475° F.

4. Stress Relief Temper: A stress relief temper for hardened material is strongly recommended after significant grinding, or welding, or EDM. Select a temperature that is 25° or 50° F lower than the last tempering temperature used.

The values shown in this data sheet are to be used as a guide for estimating purposes only.

TOOL STEEL — W1

DATA AND SPECIFICATIONS

W1 Water Hardening Tool Steel

W1 Water Hardening is a cold work tool steel. This steel grade depends on its relatively high carbon content for its useful properties. It's known for its easy machining characteristic, ability to develop a keen cutting edge, high surface case hardness, and its soft, ductile, inner core.

Machinability: When properly annealed, W1 has a machinability rating of 100 when compared to a 1% Carbon Steel rated at 100.

Typical Chemistry: C - 0.70/1.30

Dimensional Stability: When water quenched from the proper hardening temperature, this grade can be expected to expand approximately .002 to .004 in. per in. Note: Distortion (bending, bowing and twisting) as well as part geometry can add to the variations in movement of a part being hardened.

Thermal Cycling: In order to avoid decarburization, this grade should be annealed and/or hardened in a controlled neutral atmosphere, vacuum, or neutral salt furnace environment.

1. Anneal: Heat to 1375° to 1400° F, soak until uniformly heated, approximately, one half hour per inch. Furnace cool 50° F per hour to 975° F, air cool to room temperature. Approximate annealed hardness 200 Max. Brinell.
2. Stress Relief of Unhardened Material: Heat slowly to 1200° to 1250° F. Soak for two hours per inch of thickness at heat. Soak, slow cool (furnace cool if possible) to room temperature.
3. Hardening:
   a. Preheat: Heat to 1200° F, hold at this temperature until thoroughly soaked.
   b. Harden: Heat to 1425° to 1475° F. Soak at heat for 30 minutes per inch of thickness. Temperatures on the high side of the range will increase the depth of the case.
   c. Quench: This material may be water quenched, but brine quenching is preferred. Water or brine quench to 150° to 200° F. Oil quenching is sometimes used for light sections and where maximum hardness is not required.
   d. Temper: Normally water hardening steels need be single tempered only. However, double tempering may sometimes be preferred. Soak at heat for two hours per inch of thickness for each temper. Air cool to room temperature between tempers.

Water Quenched from °F	Depth of Chill 64ths.	Tempering Temperature °F	Rockwell "C" Hardness
1450	8.5	As-quenched	67
1450	8.5	300	64
1450	8.5	400	61
1450	8.5	500	59
1450	8.5	600	55

3/4" diameter specimens, three inches long were tested.

The values shown in this data sheet are to be used as a guide for estimating purposes only.

AVAILABLE UPON REQUEST: H13, P20, S5, S7, M2

TOOL STEEL – DRILL ROD

DATA AND SPECIFICATIONS

A2 Air Hardening

Typical Analysis:		
C - 1.00	Mn - .60	Cr - 5.25
Si - .30	V - .25	Mo - 1.10

A2 is recommended over O1 for increased wear resistance, safer hardening and less distortion.

D2 High Carbon – High Chrome

Typical Analysis:		
C - 1.500	Mo - .75 Cr - 12.00	V - .25/.80

Air hardening steel known for maximum wear resistance. Ideal for tools and dies used in long production runs.

M2 Molybdenum-Tungsten High Speed

Typical Analysis:		
C - .83	Cr - 4.15	Mo - 5.00
V - 1.90	W - 6.35	

Most widely used high speed steel which can be used for the same applications as T1 high speed. Higher carbon content and balanced analysis produce properties which make M2 applicable to all general purpose high-speed uses.

O1 Oil Hardening

Typical Analysis:		
C - .90	Mn - 1.20	Cr - .50
Si - .30	V - .20	

The most widely used grade of drill rod. General purpose, outstanding for reliability in hardening, good wear resistance and excellent toughness.

S7 Air Hardening Super Shock

Typical Analysis:		
C - .50	Mn - .70	Cr - 3.25
Si - .25	V - .20	Mo - 1.40

Toughest, strongest drill rod for a wide range of jobs requiring maximum strength and impact.

W1 Water Hardening

Typical Analysis:
C - .95/1.10

Typically for machine shop average work needs where better grades of tool steel rod are not required.

FINE STANDARD TOLERANCES

	DIMENSIONAL TOLERANCES		
	Standard Tolerance* (section)	**Straightness Max. T.I.R.**	**Standard Tolerance (length)**
Round Drill Rod:			
2.000" to 1.500"	±.00075"	.005"	+1/8", - .0
1.500" thru .125" dia.	±.0005"	.005"	+1/8", - .0
.124" and smaller dia.	±.0003"	.005"	+1/8", - .0
Flat and Square Drill Rod:			
1.000" thru .750" (largest dim.)	±.0015"		+1/8", - .0
.749" thru .250" (largest dim.)	±.001"		+1/8", - .0
.249" and smaller	±.0005"		+1/8", - .0

* Closer tolerances than standard can be produced upon special request.
Data shown are typical and should not be taken as specific values for final design.

TOOL STEEL – PGFS

DATA AND SPECIFICATIONS

A2 Air Hardening

Typical Analysis:		
C - 1.00	Mn - .60	Cr - 5.25
V - .25	Mo - 1.10	

A2 is recommended over O1 for increased wear resistance, safer hardening and less distortion.

A6 Air Hardening

Typical Analysis:
C - .95/1.10

Typically for machine shop average work needs where better grades of tool steel rod are not required.

D2 High Carbon – High Chrome

Typical Analysis:	
C - 1.500	Mo - .75
Cr - 12.00	V - .25/.80

Air hardening steel known for maximum wear resistance. Ideal for tools and dies used in long production runs.

Low Carbon

Typical Analysis:	
C - .15/.20	P - .04 Max.

M2 Molybdenum-Tungsten High Speed

Typical Analysis:		
C - .83	Cr - 4.15	Mo - 5.00
V - 1.90	W - 6.35	

Most widely used high speed steel which can be used for the same applications as T1 high speed. Higher carbon content and balanced analysis produce properties which make M2 applicable to all general purpose high-speed uses.

O1 Oil Hardening

Typical Analysis:		
C - .90	Mn - 1.20	Cr - .50
Si - .30	V - .20	

The most widely used grade of flat stock. General purpose, outstanding for reliability in hardening, good wear resistance and excellent toughness.

S7 Air Hardening Super Shock

Typical Analysis:		
C - .50	Mn - .70	Cr - 3.25
Si - .25	Mo - 1.40	

Toughest, strongest flat stock for a wide range of jobs requiring maximum strength and impact.

TOLERANCES

	Precision	Oversize
Thickness	±.001 to .1.250 thick incl. ±.002 over .1250 thick	+.010 to .015 +.010 to .015
Width	+.005- .000	+.010 to .015
Length	+1/16 Min.	+1/16 Min.

Non-standard sizes available upon request.
Data shown are typical and should not be taken as specific values for final design.

A2 AIR HARDENING TOOL STEEL ROUNDS – DECARB FREE

Standard Diameter Sizes							
1/4	1	2	3	5	7	9	12
5/16	1-1/8	2-1/8	3-1/8	5-1/4	7-1/4	9-1/4	
3/8	1-1/4	2-1/4	3-1/4	5-1/2	7-1/2	9-1/2	
7/16	1-3/8	2-3/8	3-3/8	5-3/4	7-3/4	9-3/4	
1/2	1-1/2	2-1/2	3-1/2				
9/16	1-5/8	2-5/8	3-3/4	6	8	10	
5/8	1-3/4	2-3/4		6-1/4	8-1/4	10-1/2	
11/16	1-7/8	2-7/8	4	6-1/2	8-1/2		
3/4			4-1/4	6-3/4	8-3/4	11	
13/16			4-1/2			11-1/2	
7/8			4-3/4				
15/16							

D2 HIGH CARBON•HIGH CHROME TOOL STEEL ROUNDS – DECARB FREE

Standard Diameter Sizes							
1/4	1	2	3	5	7	9	12
5/16	1-1/8	2-1/8	3-1/8	5-1/4	7-1/4	9-1/4	
3/8	1-1/4	2-1/4	3-1/4	5-1/2	7-1/2	9-1/2	
7/16	1-3/8	2-3/8	3-3/8	5-3/4	7-3/4	9-3/4	
1/2	1-1/2	2-1/2	3-1/2				
9/16	1-5/8	2-5/8	3-3/4	6	8	10	
5/8	1-3/4	2-3/4		6-1/4	8-1/4	10-1/2	
11/16	1-7/8	2-7/8	4	6-1/2	8-1/2		
3/4			4-1/4	6-3/4	8-3/4	11	
13/16			4-1/2			11-1/2	
7/8			4-3/4				
15/16							

O1 OIL HARDENING TOOL STEEL ROUNDS - DECARB FREE

Standard Diameter Sizes							
1/4	1	2	3	5	7	9	12
5/16	1-1/8	2-1/8	3-1/8	5-1/4	7-1/4	9-1/4	
3/8	1-1/4	2-1/4	3-1/4	5-1/2	7-1/2	9-1/2	
7/16	1-3/8	2-3/8	3-3/8	5-3/4	7-3/4	9-3/4	
1/2	1-1/2	2-1/2	3-1/2				
9/16	1-5/8	2-5/8	3-3/4	6	8	10	
5/8	1-3/4	2-3/4		6-1/4	8-1/4	10-1/2	
11/16	1-7/8	2-7/8	4	6-1/2	8-1/2		
3/4			4-1/4	6-3/4	8-3/4	11	
13/16			4-1/2			11-1/2	
7/8			4-3/4				
15/16							

O1 OIL HARDENING GROUND and POLISHED DRILL ROD

Standard Diameter Sizes						Metric Sizes	
1/16	.0625	39/64	.6093	1-5/32	1.1562	2	.0787
5/64	.0781	5/8	.6250	1-11/64	1.1718	3	.1181
3/32	.0937	41/64	.6406	1-3/16	1.1875	4	.1575
7/64	.1093	21/32	.6562	1-13/64	1.2031	5	.1969
1/8	.1250	43/64	.6718	1-7/32	1.2187	6	.2362
9/64	.1406	11/16	.6875	1-15/64	1.2343	7	.2756
5/32	.1562	45/64	.7031	1-1/4	1.2500	8	.3150
11/64	.1718	23/32	.7187	1-17/64	1.2656	9	.3543
3/16	.1875	47/64	.7343	1-9/32	1.2812	10	.3937
13/64	.2031	3/4	.7500	1-19/64	1.2968	11	.4331
7/32	.2187	49/64	.7656	1-5/16	1.3125	12	.4724
15/64	.2343	25/32	.7812	1-21/64	1.3281	13	.5118
1/4	.2500	51/64	.7968	1-11/32	1.3437	14	.5512
17/64	.2656	13/16	.8125	1-23/64	1.3593	15	.5906
9/32	.2812	53/64	.8281	1-3/8	1.3750	16	.6299
19/64	.2968	27/32	.8437	1-25/64	1.3906	17	.6693
5/16	.3125	55/64	.8593	1-13/32	1.4062	18	.7087
21/64	.3281	7/8	.8750	1-27/64	1.4218	19	.7480
11/32	.3437	57/64	.8906	1-7/16	1.4375	20	.7874
23/64	.3593	29/32	.9062	1-29/64	1.4531	21	.8268
3/8	.3750	59/64	.9218	1-15/32	1.4687	22	.8661
25/64	.3906	15/16	.9375	1-31/64	1.4843	23	.9055
13/32	.4062	61/64	.9531	1-1/2	1.5000	24	.9449
27/64	.4218	31/32	.9687	1-9/16	1.5625	25	.9843
7/16	.4375	63/64	.9843	1-5/8	1.6250		
29/64	.4531	1	1.0000	1-11/16	1.6875		
15/32	.4687	1-1/64	1.0156	1-3/4	1.7500		
31/64	.4843	1-1/32	1.0312	1-13/16	1.8125		
1/2	.5000	1-3/64	1.0468	1-7/8	1.8750		
33/64	.5156	1-1/16	1.0625	1-15/16	1.9375		
17/31	.5312	1-5/64	1.0781	2	2.0000		
35/64	.5468	1-3/32	1.0937				
9/16	.5625	1-7/64	1.1093				
37/64	.5781	1-1/8	1.1250				
19/32	.5937	1-9/64	1.1406				

O1 OIL HARDENING PRECISION GROUND FLAT STOCK

18" and 36" Standard Lengths				
1/64 × 1/2*	1/16 × 1/4	3/32 × 1-1/2	1/8 × 7	3/16 × 1
1/64 × 3/4*	1/16 × 5/16	3/32 × 1-3/4	1/8 × 8	3/16 × 1-1/4
1/64 × 1*	1/16 × 3/8	3/32 × 2	1/8 × 10	3/16 × 1-1/2
1/64 × 1-1/4*	1/16 × 1/2	3/32 × 2-1/2	1/8 × 12	3/16 × 1-3/4
1/64 × 1-1/2*	1/16 × 5/8	3/32 × 3	1/8 × 14	3/16 × 2
1/64 × 2*	1/16 × 3/4	3/32 × 4		3/16 × 2-1/2
1/64 × 2-1/2*	1/16 × 1	3/32 × 5	9/64 × 9/64*	3/16 × 3
1/64 × 3*	1/16 × 1-1/4	3/32 × 6	9/64 × 1/2*	3/16 × 3-1/2
1/64 × 4*	1/16 × 1-1/2	3/32 × 8	9/64 × 3/4*	3/16 × 4
	1/16 × 1-3/4	3/32 × 10	9/64 × 1*	3/16 × 5
1/32 × 1/2	1/16 × 2		9/64 × 1-1/4*	3/16 × 6
1/32 × 3/4	1/16 × 2-1/2	7/64 × 1/2*	9/64 × 1-1/2*	3/16 × 8
1/32 × 1	1/16 × 3	7/64 × 3/4*	9/64 × 2*	3/16 × 10
1/32 × 1-1/4	1/16 × 3-1/2	7/64 × 1*	9/64 × 3*	3/16 × 12
1/32 × 1-1/2	1/16 × 4	7/64 × 1-1/4*	9/64 × 4*	
1/32 × 2	1/16 × 5	7/64 × 1-1/2*		7/32 × 7/32
1/32 × 2-1/2	1/16 × 6	7/64 × 2*	5/32 × 5/32	7/32 × 5/16
1/32 × 3	1/16 × 8	7/64 × 2-1/2*	5/32 × 1/4	7/32 × 3/8
1/32 × 4	1/16 × 10	7/64 × 3*	5/32 × 3/8	7/32 × 1/2
1/32 × 6		7/64 × 4*	5/32 × 1/2	7/32 × 3/4
	5/64 × 1/4*	7/64 × 6*	5/32 × 3/4	7/32 × 1
3/64 × 1/4*	5/64 × 5/16*		5/32 × 1	7/32 × 1-1/4
3/64 × 5/16*	5/64 × 3/8*	1/8 × 1/8	5/32 × 1-1/4	7/32 × 1-1/2
3/64 × 3/8*	5/64 × 1/2*	1/8 × 1/4	5/32 × 1-1/2	7/32 × 2
3/64 × 1/2*	5/64 × 3/4*	1/8 × 5/16	5/32 × 1-3/4	7/32 × 2-1/2
3/64 × 3/4*	5/64 × 1*	1/8 × 3/8	5/32 × 2	7/32 × 3
3/64 × 1*	5/64 × 1-1/4*	1/8 × 1/2	5/32 × 2-1/2	7/32 × 4
3/64 × 1-1/4*	5/64 × 1-1/2*	1/8 × 5/8	5/32 × 3	7/32 × 6
3/64 × 1-1/2*	5/64 × 2*	1/8 × 3/4	5/32 × 3-1/2	7/32 × 8
3/64 × 1*	5/64 × 2-1/2*	1/8 × 1	5/32 × 4	
3/64 × 2*	5/64 × 3*	1/8 × 1-1/4	5/32 × 5	
3/64 × 2-1/2*	5/64 × 4*	1/8 × 1-1/2	5/32 × 6	
3/64 × 3*	5/64 × 6*	1/8 × 1-3/4	5/32 × 8	
3/64 × 3-1/2*		1/8 × 2		
3/64 × 4*	3/32 × 1/4	1/8 × 2-1/2	3/16 × 3/16	
3/64 × 6*	3/32 × 5/16	1/8 ×3	3/16 × 1/4	
	3/32 × 3/8	1/8 × 3-1/2	3/16 × 5/16	
	3/32 × 1/2	1/8 ×4	3/16 × 3/8	
	3/32 × 3/4	1/8 × 4-1/2	3/16 × 1/2	
	3/32 × 1	1/8 × 5	3/16 × 5/8	
	3/32 × 1-1/4	1/8 × 6	3/16 × 3/4	

*Sizes not available in oversize tolerance.

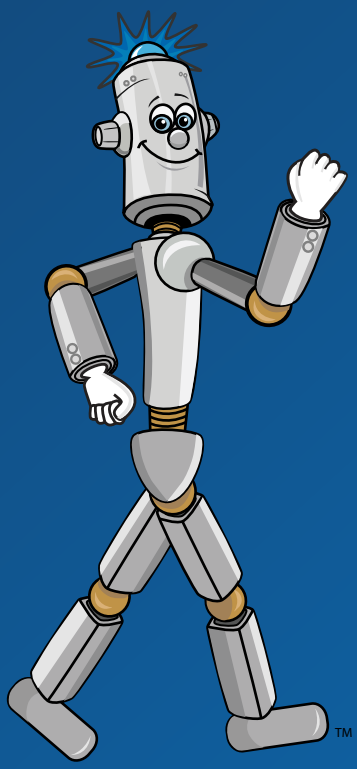
O1 OIL HARDENING PRECISION GROUND FLAT STOCK

18" and 36" Standard Lengths				
1/4 × 1/4	5/16 × 1-1/4	7/16 × 2	5/8 × 5	1 × 5
1/4 × 5/16	5/16 × 1-1/2	7/16 × 2-1/2	5/8 × 6	1 × 6
1/4 × 3/8	5/16 × 1-3/4	7/16 × 3	5/8 × 7	1 × 8
1/4 × 1/2	5/16 × 2	7/16 × 4	5/8 × 8	1 × 10
1/4 × 5/8	5/16 × 2-1/2	7/16 × 6	5/8 × 10	1 × 12
1/4 × 3/4	5/16 × 3		5/8 × 12	
1/4 × 1	5/16 × 3-1/2	1/2 × 1/2		1-1/8 × 1-1/8
1/4 × 1-1/4	5/16 × 4	1/2 × 5/8	3/4 × 3/4	1-1/8 × 1-1/2
1/4 × 1-1/2	5/16 × 4-1/2	1/2 × 3/4	3/4 × 1	1-1/8 × 2
1/4 × 1-3/4	5/16 × 5	1/2 × 1	3/4 × 1-1/4	1-1/8 × 3
1/4 × 2	5/16 × 6	1/2 × 1-1/4	3/4 × 1-1/2	1-1/8 × 4
1/4 × 2-1/2	5/16 × 7	1/2 × 1-1/2	3/4 × 2	1-1/8 × 6
1/4 × 3	5/16 × 8	1/2 × 1-3/4	3/4 × 2-1/2	
1/4 × 3-1/2	5/16 × 10	1/2 × 2	3/4 × 3	1-1/4 × 1-1/4
1/4 × 4	5/16 × 12	1/2 × 2-1/2	3/4 × 3-1/2	1-1/4 × 1-1/2
1/4 × 4-1/2		1/2 × 3	3/4 × 4	1-1/4 × 2
1/4 × 5	3/8 × 3/8	1/2 × 3-1/2	3/4 × 4-1/2	1-1/4 × 2-1/2
1/4 × 5-1/2	3/8 × 1/2	1/2 ×4	3/4 × 5	1-1/4 × 3
1/4 × 6	3/8 × 5/8	1/2 × 4-1/2	3/4 × 6	1-1/4 × 4
1/4 × 7	3/8 × 3/4	1/2 × 5	3/4 × 8	1-1/4 × 5
1/4 × 8	3/8 × 1	1/2 × 6	3/4 × 10	1-1/4 × 6
1/4 × 10	3/8 × 1-1/4	1/2 × 7	3/4 × 12	1-1/4 × 8
1/4 × 12	3/8 × 1-1/2	1/2 × 8		1-1/4 × 10
1/4 × 14	3/8 × 1-3/4	1/2 × 10	7/8 × 7/8	
	3/8 × 2	1/2 × 12	7/8 × 1	1-1/2 × 1-1/2
9/32 × 9/32	3/8 × 2-1/2	1/2 × 14	7/8 × 1-1/4	1-1/2 × 2
9/32 × 1/2	3/8 × 3		7/8 × 1-1/2	1-1/2 × 2-1/2
9/32 × 3/4	3/8 × 3-1/2	9/16 × 9/16	7/8 × 2	1-1/2 × 3
9/32 × 1	3/8 × 4	9/16 × 3/4	7/8 × 2-1/2	1-1/2 × 3-1/2
9/32 × 1-1/4	3/8 × 4-1/2	9/16 × 1	7/8 × 3	1-1/2 × 4
9/32 × 1-1/2	3/8 × 5	9/16 × 1-1/4	7/8 × 3-1/2	1-1/2 × 5
9/32 × 1-3/4	3/8 × 5-1/2	9/16 × 1-1/2	7/8 × 4	1-1/2 × 6
9/32 × 2	3/8 × 6	9/16 × 2	7/8 × 6	1-1/2 × 8
9/32 × 2-1/2	3/8 × 7			1-1/2 × 10
9/32 × 3	3/8 × 8	5/8 × 5/8	1 × 1	
9/32 × 4	3/8 × 10	5/8 × 3/4	1 × 1-1/4	2 × 2
9/32 × 6	3/8 × 12	5/8 × 1	1 × 1-1/2	2 × 3
		5/8 × 1-1/4	1 × 1-3/4	2 × 4
5/16 × 5/16	7/16 × 7/16	5/8 × 1-1/2	1 × 2	2 × 6
5/16 × 3/8	7/16 × 1/2	5/8 × 2	1 × 2-1/2	
5/16 × 1/2	7/16 × 3/4	5/8 × 2-1/2	1 × 3	2-1/2 × 2-1/2
5/16 × 5/8	7/16 × 1	5/8 × 3	1 × 3-1/2	
5/16 × 3/4	7/16 × 1-1/4	5/8 × 3-1/2	1 × 4	3 × 3
5/16 × 1	7/16 × 1-1/2	5/8 × 4	1 × 4-1/2	
	Other grades and sizes available upon request.			4 × 4

Other grades and sizes available upon request.

NOTES

DATA



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NOTES

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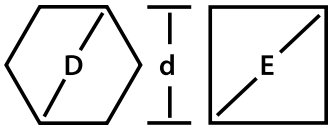
DISTANCE ACROSS CORNERS OF HEXAGONS and SQUARES



D = 1.1547d E = 1.412d

INCHES			INCHES			INCHES		
d	D	E	d	D	E	d	D	E
1/4	0.2886	0.3535	1-1/4	1.4434	1.7677	2-5/16	2.6702	3.2703
9/32	0.3247	0.3977	1-9/32	1.4794	1.8119	2-3/8	2.7424	3.3587
5/16	0.3608	0.4419	1-5/16	1.5155	1.8561	2-7/16	2.8145	3.4471
11/32	0.3968	0.4861	1-11/32	1.5516	1.9003	2-1/2	2.8867	3.5355
3/8	0.4329	0.5303	1-3/8	1.5877	1.9445	2-9/16	2.9583	3.6239
13/32	0.4690	0.5745	1-13/32	1.6238	1.9887	2-5/8	3.0311	3.7123
7/16	0.5051	0.6187	1-7/16	1.6598	2.0329	2-11/16	3.1032	3.8007
15/32	0.5412	0.6629	1-15/32	1.6959	2.0771	2-3/4	3.1754	3.8891
1/2	0.5773	0.7071	1-1/2	1.7320	2.1213	2-13/16	3.2476	3.9794
17/32	0.6133	0.7513	1-17/32	1.7681	2.1655	2-7/8	3.3197	4.0658
9/16	0.6494	0.7955	1-9/16	1.8042	2.2097	2-15/16	3.3919	4.1542
19/32	0.6855	0.8397	1-19/32	1.8403	2.2539	3	3.4641	4.2426
5/8	0.7216	0.8839	1-5/8	1.8764	2.2981	3-1/16	3.5362	4.3310
21/32	0.7576	0.9281	1-21/32	1.9124	2.3423	3-1/8	3.6084	4.4194
11/16	0.7939	0.9723	1-11/16	1.9485	2.3865	3-3/16	3.6806	4.5078
23/32	0.8298	1.0164	1-23/32	1.9846	2.4306	3-1/4	3.7527	4.5962
3/4	0.8659	1.0606	1-3/4	2.0207	2.4708	3-5/16	3.8249	4.6846
25/32	0.9020	1.1048	1-25/32	2.0568	2.5190	3-3/8	3.8971	4.7729
13/16	0.9380	1.1490	1-13/16	2.0929	2.5362	3-7/16	3.9692	4.8613
27/32	0.9741	1.1932	1-27/32	2.1289	2.6074	3-1/2	4.0414	4.9497
7/8	1.0102	1.2374	1-7/8	2.1650	2.6516	3-9/16	4.1136	5.0381
29/32	1.0463	1.2816	1-29/32	2.2011	2.6958	3-5/8	4.1857	5.1265
15/16	1.0824	1.3258	1-15/16	2.2372	2.7400	3-11/16	4.2579	5.2149
31/32	1.1184	1.3700	1-31/32	2.2733	2.7842	3-3/4	4.3301	5.3033
1	1.1547	1.4142	2	2.3094	2.8284	3-13/16	4.4023	5.3917
1-1/32	1.1907	1.4584	2-1/32	2.3453	2.8726	3-7/8	4.4744	5.4801
1-1/16	1.2268	1.5026	2-1/16	2.3815	2.9168	3-15/16	4.5466	5.5684
1-3/32	1.2629	1.5468	2-3/32	2.4176	2.9610	4	4.6188	5.6568
1-1/8	1.2990	1.5910	2-1/8	2.4537	3.0052	4-1/8	4.7631	5.8336
1-5/32	1.3351	1.6352	2-5/32	2.4998	3.0494	4-1/4	4.9074	6.0104
1-3/16	1.3712	1.6793	2-3/16	2.5259	3.0936	4-3/8	5.0518	6.1872
1-7/32	1.4073	1.7235	2-1/4	2.5981	3.1820	4-1/2	5.1961	6.3639

BEND RADII – RECOMMENDED SHEET AND PLATE

TABLE 1.2 – RECOMMENDED MINIMUM BEND RADII FOR 90-DEGREE COLD FORMING OF SHEET AND PLATE
1 2 3 4 5

		Radii for various Thicknesses Expressed in terms of Thickness "t"							
Alloy	**Temper**	**1/64 in.**	**1/32 in.**	**1/16 in.**	**1/8 in.**	**3/16 in.**	**1/4 in.**	**3/8 in.**	**1/2 in.**
1100	0	0	0	0	0	1/2t	1t	1t	1-1/2t
	H12	0	0	0	1/2t	1t	1t	1-1/2t	2t
	H14	0	0	0	1t	1t	1-1/2t	2t	2-1/2t
	H16	0	1/2t	1t	1-1/2t	1-1/2t	2-1/2t	3t	4t
	H18	1t	1t	1-1/2t	2-1/2t	3t	3-1/2t	4t	4-1/2t
	0	0	0	0	1/2t	1t	1t	2-1/2t	4t
2014	T3	1-1/2t	2-1/2t	3t	4t	5t	5t	6t	7t
	T4	1-1/2t	2-1/2t	3t	4t	5t	5t	6t	7t
	T6	3t	4t	4t	5t	6t	8	8-1/2t	9-1/2t
	0	0	0	0	1/2t	1t	1t	2-1/2t	4t
	T3	2-1/2t	3t	4t	5t	5t	6t	7t	7-1/2t
2024	T3615	3t	4t	5t	6t	6t	8t	8-1/2t	9-1/2t
	T4	2-1/2t	3t	4t	5t	5t	6t	7t	7-1/2t
	T81	4-1/2t	5-1/2t	6t	7-1/2t	8t	9t	10t	10-1/2t
	T8615	5t	6t	7t	8-1/2t	9-1/2t	10t	11-1/2t	11-1/2t
2036	T4	–	1t	1t	–	–	–	–	–
	0	0	0	0	0	1/2t	1t	1t	1-1/2t
	H12	0	0	0	1/2t	1t	1t	1-1/2t	2t
3003	H14	0	0	0	1t	1t	1-1/2t	2t	2-1/2t
	H16	1/2t	1t	1t	1-1/2t	2-1/2t	3t	3-1/2t	4t
	H18	1t	1-1/2t	2t	2-1/2t	3-1/2t	4-1/2t	5-1/2t	6-1/2t
	0	0	0	0	1/2t	1t	1t	1t	1-1/2t
	H32	0	0	1/2t	1t	1t	1-1/2t	1-1/2t	2t
3004	H34	0	1t	1t	1-1/2t	1-1/2t	2-1/2t	2-1/2t	3t
	H36	1t	1t	1-1/2t	2-1/2t	3t	3-1/2t	4t	4-1/2t
	H38	1t	1-1/2t	2-1/2t	3t	4t	5t	5-1/2t	6-1/2t
3105	H25	1/2t	1/2t	1/2t	–	–	–	–	–
	0	0	0	0	0	1/2t	1t	1t	1-1/2t
	H12	0	0	0	1/2t	1t	1t	1-1/2t	2t
	H14	0	0	0	1t	1-1/2t	1-1/2t	2t	2-1/2t
	H16	1/2t	1t	1t	1-1/2t	2-1/2t	3t	3-1/2t	4t
5005	H18	1t	1-1/2t	2t	2-1/2t	3-1/2t	4-1/2t	5-1/2t	6-1/2t
	H32	0	0	0	1/2t	1t	1t	1-1/2t	2t
	H34	0	0	0	1t	1-1/2t	1-1/2t	2t	2-1/2t
	H36	1/2t	1t	1t	1-1/2t	2-1/2t	3t	3-1/2t	4t
	H38	1t	1-1/2t	2t	2-1/2t	3-1/2t	4-1/2t	5-1/2t	6-1/2t
	0	0	0	0	1/2t	1t	1t	1-1/2t	1-1/2t
	H32	0	0	0	1t	1t	1-1/2t	–	–
5050	H34	0	0	1t	1-1/2t	1-1/2t	2t	–	–
	H36	1t	1t	1-1/2t	2t	2-1/2t	3t	–	–
	H38	1t	1-1/2t	2-1/2t	3t	4t	5t	–	–
	0	0	0	0	1/2t	1t	1t	1-1/2t	1-2t
	H32	0	0	1t	1-1/2t	1-1/2t	1-1/2t	1-1/2t	2t
5052	H34	0	1t	1-1/2t	2t	2t	2-1/2t	2-1/2t	3t
	H36	1t	1t	1-1/2t	2-1/2t	3t	3-1/2t	4t	4-1/2t
	H38	1t	1-1/2t	2-1/2t	3t	4t	5t	5-1/2t	6-1/2t
5083	0	–	–	1/2t	1t	1t	1t	1-1/2t	1-1/2t
	H321	–	–	1t	1-1/2t	1-1/2t	1-1/2t	2t	2-1/2t
	0	0	0	1/2t	1t	1t	1t	1-1/2t	1-1/2t
	H32	0	1/2t	1t	1-1/2t	1-1/2t	2t	2-1/2t	3t
5086	H34	1/2t	1t	1-1/2t	2t	2-1/2t	3t	3-1/2t	4t
	H36	1-1/2t	2t	2-1/2t	3t	3-1/2t	4t	4-1/2t	5t

For all numbered footnotes, see next page.

BEND RADII – RECOMMENDED SHEET AND PLATE

TABLE 1.2 – RECOMMENDED MINIMUM BEND RADII FOR 90-DEGREE COLD FORMING OF SHEET AND PLATE
1 2 3 4 5 (continued)

		Radii for various Thicknesses Expressed in terms of Thickness "t"							
Alloy	**Temper**	**1/64 in.**	**1/32 in.**	**1/16 in.**	**1/8 in.**	**3/16 in.**	**1/4 in.**	**3/8 in.**	**1/2 in.**
5154	0	0	0	1/2t	1t	1t	1t	1-1/2t	1-1/2t
	H32	0	1/2t	1t	1-1/2t	1-1/2t	2t	2-1/2t	3-1/2t
	H34	1/2t	1t	1-1/2t	2t	2-1/2t	3t	3-1/2t	4t
	H36	1t	1-1/2t	2t	3t	3-1/2t	4t	4-1/2t	5t
5252	H25	0	0	1t	2t	–	–	–	–
	H28	1t	1-1/2t	2-1/2t	3t	–	–	–	–
	0	0	0	1/2t	1t	1t	1t	1-1/2t	1-12t
	HJ2	0	1/2t	1t	1-1/2t	1-1/2t	2t	2-1/2t	3-1/2t
5254	H34	1/2t	–	1-1/2t	2t	2-1/2t	3t	3-1/2t	4t
	H36	1t	1-1/2t	2t	3t	3-1/2t	4t	4-1/2t	5t
	HJ8	1-1/2t	2-1/2t	3t	4t	5t	5t	6-1/2t	6-1/2t
	0	0	1/2t	1t	1t	1t	1-1/2t	1-1/2t	2t
5454	H32	1/2t	1/2t	1t	2t	2t	2-1/2t	3t	4t
	H34	1/2t	1t	1-1/2t	2t	2-1/2t	3t	3-1/2t	4t
5456	0	–	–	1t	1t	1-1/2t	1-1/2t	2t	2t
	H321	–	–	–	2t	2t	2-1/2t	3t	3-1/2t
5457	0	0	0	0	1/2t	4t	1t	1t	1-1/2t
	0	0	0	0	1/2t	1t	1t	1-1/2t	1-1/2t
	H32	0	0	1t	1-1/2t	1-1/2t	1-1/2t	1-1/2t	2t
5652	H34	0	1t	1-1/2t	2t	2t	2-1/2t	2-1/2t	3t
	H36	1t	1t	1-1/2t	2-1/2t	3t	3-1/2t	4t	4-1/2t
	H38	1t	1-1/2t	2-1/2t	3t	4t	5t	5-1/2t	6-1/2t
5657	H25	0	0	0	1t	–	–	–	–
	H28	1t	1-1/2t	2-1/2t	3t	–	–	–	–
	0	0	0	0	1t	1t	1t	1-1/2t	2t
6061	T4	0	0	1t	1-1/2t	2-1/2t	3t	3-1/2t	4t
	T6	1t	1t	1-1/2t	2-1/2t	3t	3-1/2t	4-1/2t	5t
7050	T7	–	–	–	–	–	8t	9t	9-1/2t
	0	0	0	–	–	–	–	–	–
7072	H14	0	0	–	–	–	–	–	–
	H18	1t	1t	–	–	–	–	–	–
7075	0	0	0	1t	1t	1-1/2t	2-1/2t	3-1/2t	4t
	T6	3t	4t	5t	6t	6t	8t	9t	9-1/2t
7178	0	0	0	1t	1-1/2t	1-1/2t	2-1/2t	3-1/2t	4t
	T6	3t	4t	5t	6t	6t	8t	9t	9-1/2t

[1] The radii listed are the minimum recommended for bending sheets and plates without fracturing in a standard press brake with air bend dies. 0ther types of bending operations may require larger radii or permit smaller radii. The minimum permissible radii will also vary with the design and condition of the tooling.

[2] Alclad sheet in the heat-treatable alloys can be bent over slightly smaller radii than the corresponding tempers of the bare alloy.

[3] Heat-treatable alloys can be formed over appreciably smaller radii immediately after solution heat treatment.

[4] The H112 temper (applicable to non-heat treatable alloys) is supplied in the as-fabricated condition without special property control but usually can be formed over radii applicable to the H14 (or H34) temper or smaller.

[5] Tempers T361 and T861 formerly designated T36 andT86, respectively.

[6] The reference test method is ASTM E 290.

CHEMICAL COMPOSITION STANDARD WROUGHT S.S.

STANDARD WROUGHT STAINLESS STEELS – CHEMICAL COMPOSITION LIMITS†

ASTM/ AISI GRADE	SAE No.	UNS NUMBER	COMPOSITION LIMITS, PER CENT†							
			C Max.	Mn Max.	Si Max.	P Max.	S Max.	CR	NI	OTHER ELEMENTS
201	30201	S20100	0.15	5.50/7.50	1.00	0.060	0.030	16.00/18.00	3.50/5.50	N 0.25 Max.
202	30202	S20100	0.15	7.50/10.00	1.00	0.060	0.030	17.00/19.00	4.00/6.00	N 0.25 Max.
205	....	S20500	0.12/0.25	14.00/15.50	1.00	0.060	0.030	16.50/18.00	1.00/1.75	N 0.32/0.40 Max.
301	30301	S30100	0.15	2.00	1.00	0.045	0.030	16.00/18.00	6.00/8.00	N 0.10 Max.
302	30302	S30200	0.15	2.00	1.00*	0.045	0.030	17.00/19.00	8.00/10.00	N 0.10 Max.
302B	30302B	S30215	0.15	2.00	2.00/3.00	0.045	0.030	17.00/19.00	8.00/10.00	.....
303	30303	...S30300	....0.15	....2.00	....1.00	....0.20	....0.15 MIN.	17.00/19.00	8.00/10.00	Mo. Max. 0.75
303SE	30303Se	S30323	0.15	2.00	1.00	0.20	0.060	17.00/19.00	8.00/10.00	Se 0.15 Min.
304	30304	S30400	0.08	2.00	1.00*	0.045	0.030	18.00/20.00	8.00/10.50	N 0.10 Max.
304L	30304L	S30403	0.030	2.00	1.00*	0.045	0.030	18.00/20.00	8.00/12.00	N 0.10 Max.
304H	....	S30409	0.04/.10	2.00	0.75	0.045	0.030	18.00/20.00	8.00/10.50	.....
304N	....	S30451	0.08	2.00	1.00*	0.045	0.030	18.00/20.00	8.00/10.50	N 0.10/0.16 Max.
305	30305	S30500	0.12	2.00	1.00*	0.045	0.030	17.00/19.00	10.50/13.00	.....
308	30308	S30800	0.08	2.00	1.00	0.045	0.030	19.00/21.00	10.00/12.00	.....
309	30309	...S30900	....0.20	....2.00	....1.00	....0.045	0.030	.22.00/24.00	12.00/15.00	.....
309S	30309S	S30908	0.08	2.00	1.00*	0.045	0.030	22.00/24.00	12.00/15.00	.....
310	30310	S31000	0.25	2.00	1.50	0.045	0.030	24.00/26.00	19.00/22.00	.....
310S	30310S	S31008	0.08	2.00	1.50	0.045	0.030	24.00/26.00	19.00/22.00	.....
314	30314	S31400	0.25	2.00	1.5/3.00	0.045	0.030	23.00/26.00	19.00/22.00	.....
316	30316	S31600	0.08	2.00	1.00*	0.045	0.030	16.00/18.00	10.00/14.00	Mo 2.00/3.00, N 0.10 Max.
316F	....	S31620	0.08	2.00	1.00	0.20	0.10 MIN.	16.00/18.00	10.00/14.00	Mo 1.75/2.50, N 0.10 Max.
316L	.....30316L	...S31603	...0.030	....2.00	....1.00*	....0.045	....0.030	16.00/18.00	10.00/14.00	Mo 2.00/3.00, N 0.10 Max.
316N	....	S31651	0.08	2.00	1.00*	0.045	0.030	16.00/18.00	10.00/14.00	Mo 2.00/3.00, N 0.10/0.16 Max.
317	30317	S31700	0.08	2.00	1.00*	0.045	0.030	18.00/20.00	11.00/15.00	Mo 3.00/4.00, N 0.10 Max
317L	....	S31703	0.030	2.00	1.00*	0.045	0.030	18.00/20.00	11.00/15.00	Mo 3.00/4.00, N 0.10 Max.
321	30321	S32100	0.08	2.00	1.00*	0.045	0.030	17.00/19.00	9.00/12.00	Ti 5x (C+N) Min.-0.70 Max.
329	....	S32900	0.08	2.00	0.75	0.040	0.030	23.00/28.00	2.50/5.00	Mo 1.00/2.00
330	30330	N08330	0.08	2.00	.075/1.50	0.040	0.030	17.00/20.00	34.00/37.00	.....
347	30347	S34700	0.08	2.00	1.00*	0.045	0.030	17.00/19.00	9.00/13.00	Cb + Ta 10xC Min
348	30348	S34800	0.08	2.00	1.00*	0.045	0.030	17.00/19.00	9.00/13.00	Cb + Ta 10xC Min., Ta 0.10 Max., Co 0.20 Max.
384	30384	384000	0.08	2.00	1.00	0.045	0.030	15.00/17.00	17.00/19.00	.....
...	30385	S38500	0.08	2.00	1.00	0.045	0.030	11.50/13.50	14.00/16.00	.....

† Maximums unless otherwise indicated.
• Bars 1.00 Max., Sheet/Plate 0.75 Max., Tubing Varies Depending on Specific Action.

CHEMICAL COMPOSITION STANDARD WROUGHT S.S.

STANDARD WROUGHT STAINLESS STEELS – CHEMICAL COMPOSITION LIMITS†

ASTM/ AISI GRADE	SAE No.	UNS NUMBER	COMPOSITION LIMITS, PER CENT†								
			C Max.	Mn Max.	Si Max.	P Max.	S Max.	CR	NI	OTHER ELEMENTS
17.4	–	S17400	0.07	1.00	1.00	0.040	0.030	15.00/17.50	3.00/5.00	CU 3.00-5.00, CB + TA (0.15-0.45)
17.7PH*	–	S17700	0.09	1.00	1.00	0.040	0.040	16.00/18.00	6.50/7.75	AL .75-1.50
403	51403	S40300	0.15	1.00	050	0.040	0.030	11.50/13.00	–	.....
405	51405	S40500	0.08	1.00	1.00	0.040	0.030	11.50/14.50	–	AL .10-.30
409	51409	S40900	0.08	1.00	1.00	0.045	0.030	10.50/13.50	0.50	TI 6XC MIN. TO .75 MAX.
410	51410	...S41000	0.15	1.00	1.00	0.040	0.030	11.50/13.50	0.75	.....
414	51414	S41400	0.15	1.00	1.00	0.040	0.030	11.50/13.50	1.25/2.50	.....
416	51416	S41600	0.15	1.25	1.00	0.060	0.15 MIN	12.00/14.00	–	ZR OR MO MAX. 0.60
416SE	51416SE	S41623	0.15	1.25	1.00	0.060	0.060	12.00/14.00	–	SE 0.15 MIN.
420	51420	...S42000	0.16MIN	1.00	1.00	0.040	0.030	12.00/14.00	–	.....
420F	51420F	S42020	0.16MIN	1.25	1.00	0.060	0.15 MIN	12.00/14.00	–	MO 0.60 MAX.....
–	51420FSE	S42023	0.30/0.40	1.25	1.00	0.060	0.060	12.00/14.00	–	SE 0.15 MIN.
422	–	S42200	0.20/0.25	0.50/1.00	0.50	0.025	0.025	11.00/12.50	0.50/1.00	MO 0.90/1.25, V 0.20/0.30, W 0.90/1.25
429	51429	S42900	0.12	1.00	1.00	0.040	0.030	16.00/18.00	–	.....
430	...51430	...S43000	0.12	1.00	1.00	0.040	0.030	16.00/18.00	0.75	.....
430F	51430F	S43020	0.12	1.25	1.00	0.060	0.15 MIN	16.00/18.00	–	MO MAX.0.60
430FSE	51430FSE	S43023	0.12	1.25	1.00	0.060	0.060	15.00/17.00	–	SE 0.15 MIN.
431	51431	S43100	0.20	1.00	1.00	0.040	0.030	16.00/18.00	1.25/2.50	.....
434	...51434	S43400	0.12	1.00	1.00	0.040	0.030	16.00/18.00	–	MO 0.75/1.25
436	51436	S43600	0.12	1.00	1.00	0.040	0.030	16.00/18.00	–	MO 0.75/1.25 CB X TA; 5XC MIN.
440A	51440A	S44002	0.60/0.75	1.00	1.00	0.040	0.030	16.00/18.00	–	MO 0.75 MAX. 0.70 MAX.
440B	51440B	S44003	0.75/0.95	1.00	1.00	0.040	0.030	16.00/18.00	–	MO 0.75 MAX.
440C	..51440(	S44004	0.95/1.20	1.00	1.00	0.040	0.030	16.00/18.00	–	MO 0.75 MAX.
440F	51440F	S44020	0.95/1.20	1.25	1.00	0.06	0.15 MIN	16.00/18.00	–	ZR OR MO MAX. 0.75
440FSE	51440FSE	S44023	0.95/1.20	1.25	1.00	0.06	0.06	16.00/18.00	–	SE 0.15 MIN., MO .60 MAX.
442	51446	S44200	0.20	1.00	1.00**	0.040	0.030 MAX	18.00/23.00	–	N 0.25 MAX.
446	51446	S44600	0.20	150	1.00	0.040	0.030	23.0/27.00	–	N 0.25 MAX.
501	51501	S50100	0.10 MIN	1.00	1.00	0.040	0.030	4.00/6.00	–	MO 0.40/0.65
502	51502	S50200	0.10	1.00	1.00	0.040	0.030	4.00/6.00	–	MO 0.40/0.65

† Maximums unless otherwise indicated.

• Bars 1.00 Max., Sheet/Plate 0.75 Max., Tubing Varies Depending on Specific Action.

COMBINED AISI AND SAE STANDARD STEEL LISTS

BASIC OPEN HEARTH AND ACID BESSEMER STEELS

Chemicals Composition Limits, Per Cent

A.I.S.I.	Number Carbon	Manganese	Phosphorus	Sulphur	S.A.E. Number
C 1005	0.06 Max.	0.35/Max.	0.040 Max.	0.050 Max.	....
C 1006	0.08 Max.	0.25/0.40	0.040 Max.	0.050 Max.	1006
C 1008	0.10 Max.	0.25/0.50	0.040 Max.	0.050 Max.	1008
C 1010	0.08/0.13	0.30/0.60	0.040 Max.	0.050 Max.	1010
C 1011	0.08/0.13	0.60/0.90	0.040 Max.	0.050 Max.	....
C 1012	0.10/0.15	0.30/0.60	0.040 Max.	0.050 Max.	....
C 1013	0.11/0.16	0.50/0.80	0.040 Max.	0.050 Max.	....
C 1015	0.13/0.18	0.30/0.60	0.040 Max.	0.050 Max.	1015
C 1016	0.13/0.18	0.60/0.90	0.040 Max.	0.050 Max.	1016
C 1017	0.15/0.20	0.30/0.60	0.040 Max.	0.050 Max.	1017
C 1018	0.15/0.20	0.60/0.90	0.040 Max.	0.050 Max.	1018
C 1019	0.15/0.20	0.70/1.00	0.040 Max.	0.050 Max.	1019
C 1020	0.18/0.23	0.30/0.60	0.040 Max.	0.050 Max.	1020
C 1021	0.18/0.23	0.60/0.90	0.040 Max.	0.050 Max.	1021
C 1022	0.18/0.23	0.70/1.00	0.040 Max.	0.050 Max.	1022
C 1023	0.20/0.25	0.30/0.60	0.040 Max.	0.050 Max.	....
C 1024	0.19/0.25	1.35/1.65	0.040 Max.	0.050 Max.	1024
C 1025	0.22/0.28	0.30/0.60	0.040 Max.	0.050 Max.	1025
C 1026	0.22/0.28	0.60/0.90	0.040 Max.	0.050 Max.	1026
C 1027	0.22/0.29	1.20/1.50	0.040 Max.	0.050 Max.	1027
C 1029	0.25/0.31	0.60/0.90	0.040 Max.	0.050 Max.	....
C 1030	0.28/0.34	0.60/0.90	0.040 Max.	0.050 Max.	1030
C 1031	0.28/0.34	0.30/0.60	0.040 Max.	0.050 Max.	....
C 1032	0.30/0.36	0.60/0.90	0.040 Max.	0.050 Max.	....
C 1033	0.30/0.36	0.70/1.00	0.040 Max.	0.050 Max.	1033
C 1034	0.32/0.38	0.50/0.80	0.040 Max.	0.050 Max.	....
C 1035	0.32/0.38	0.60/0.90	0.040 Max.	0.050 Max.	1035
C 1036	0.30/0.37	1.20/1.50	0.040 Max.	0.050 Max.	1036
C 1037	0.32/0.38	0.70/1.00	0.040 Max.	0.050 Max.	....
C 1038	0.35/0.42	0.60/0.90	0.040 Max.	0.050 Max.	1038
C 1039	0.37/0.44	0.70/1.00	0.040 Max.	0.050 Max.	1039
C 1040	0.37/0.44	0.60/0.90	0.040 Max.	0.050 Max.	1040
C 1041	0.36/0.44	1.35/1.65	0.040 Max.	0.050 Max.	1041

COMBINED AISI AND SAE STANDARD STEEL LISTS

BASIC OPEN HEARTH AND ACID BESSEMER STEELS

Chemicals Composition Limits, Per Cent

A.I.S.I.	Number Carbon	Manganese	Phosphorus	Sulphur	S.A.E. Number
C 1042	0.40/0.47	0.60/0.90	0.040 Max.	0.050 Max.	1042
C 1043	0.40/0.47	0.70/1.00	0.040 Max.	0.050 Max.	1043
C 1045	0.43/0.50	0.60/0.90	0.040 Max.	0.050 Max.	1045
C 1046	0.43/0.50	0.70/1.00	0.040 Max.	0.050 Max.	1046
C 1049	0.46/0.53	0.60/0.90	0.040 Max.	0.050 Max.	1049
C 1050	0.48/0.55	0.60/0.90	0.040 Max.	0.050 Max.	1050
C 1051	0.45/0.56	0.85/1.15	0.040 Max.	0.050 Max.	....
C 1052	0.47/0.55	1.20/1.50	0.040 Max.	0.050 Max.	1052
C 1053	0.48/0.55	0.70/1.00	0.040 Max.	0.050 Max.	....
C 1054	0.50/0.60	0.50/0.80	0.040 Max.	0.050 Max.	....
C 1055	0.50/0.60	0.60/0.90	0.040 Max.	0.050 Max.	1055
C 1057	0.50/0.61	0.85/1.15	0.040 Max.	0.050 Max.	....
C 1059	0.55/0.65	0.50/0.80	0.040 Max.	0.050 Max.	....
C 1060	0.55/0.65	0.60/0.90	0.040 Max.	0.050 Max.	1060
C 1061	0.54/0.65	0.75/1.05	0.040 Max.	0.050 Max.	....
C 1062	0.54/0.65	0.85/1.15	0.040 Max.	0.050 Max.	1062
C 1064	0.60/0.70	0.50/0.80	0.040 Max.	0.050 Max.	1064
C 1065	0.60/0.70	0.60/0.90	0.040 Max.	0.050 Max.	1065
C 1066	0.60/0.71	0.85/1.15	0.040 Max.	0.050 Max.	1066
C 1069	0.65/0.75	0.40/0.70	0.040 Max.	0.050 Max.	....
C 1070	0.65/0.75	0.60/0.90	0.040 Max.	0.050 Max.	1070
C 1071	0.65/0.76	0.75/1.05	0.040 Max.	0.050 Max.	....
C 1072	0.65/0.76	1.00/1.30	0.040 Max.	0.050 Max.	....
C 1074	0.70/0.80	0.50/0.80	0.040 Max.	0.050 Max.	1074
C 1075	0.70/0.80	0.40/0.70	0.040 Max.	0.050 Max.	....
C 1078	0.72/0.85	0.30/0.60	0.040 Max.	0.050 Max.	1078
C 1080	0.75/0.88	0.60/0.90	0.040 Max.	0.050 Max.	1080
C 1084	0.80/0.93	0.60/0.90	0.040 Max.	0.050 Max.	....
C 1085	0.80/0.93	0.70/1.00	0.040 Max.	0.050 Max.	1085
C 1086	0.82/0.95	0.30/0.50	0.040 Max.	0.050 Max.	1086
C 1090	0.85/0.98	0.60/0.90	0.040 Max.	0.050 Max.	1090
C 1095	0.90/1.03	0.30/0.50	0.040 Max.	0.050 Max.	1095
B 1006	0.08 Max.	0.45 Max.	0.07/0.12	0.060 Max.	....
B 1010	0.13 Max	0.30/0.60	0.07/0.12	0.060 Max.	....

COMBINED AISI AND SAE STANDARD STEEL LISTS

BASIC OPEN HEARTH AND ACID BESSEMER SULPHURIZED STEELS

Chemicals Composition Limits, Per Cent

A.I.S.I.	Number Carbon	Manganese	Phosphorus	Sulphur	S.A.E. Number
C 1106	0.08 Max.	0.30/0.60	0.040 Max.	0.08/0.13	....
C 1108	0.08/0.13	0.50/0.80	0.040 Max.	0.08/0.13	....
C 1109	0.08/0.13	0.60/0.90	0.040 Max.	0.08/0.13	1109
C 1110	0.08/0.13	0.30/0.60	0.040 Max.	0.08/0.13	....
C 1111	0.08/0.13	0.60/0.90	0.040 Max.	0.16/0.23	....
C 1113	0.10/0.16	1.00/1.30	0.040 Max.	0.24/0.33	....
C 1114	0.10/0.16	1.00/1.30	0.040 Max.	0.08/0.13	1114
C 1115	0.13/0.18	0.60/0.90	0.040 Max.	0.08/0.13	1115
C 1116	0.14/0.20	1.10/1.40	0.040 Max.	0.16/0.23	1116
C 1117	0.14/0.20	1.00/1.30	0.040 Max.	0.08/0.13	1117
C 1118	0.14/0.20	1.30/1.60	0.040 Max.	0.08/0.13	1118
C 1119	0.14/0.20	1.00/1.30	0.040 Max.	0.24/0.33	1119
C 1120	0.18/0.23	0.70/1.00	0.040 Max.	0.08/0.13	1120
C 1125	0.22/0.28	0.60/0.90	0.040 Max.	0.08/0.13	...
C 1126	0.23/0.29	0.70/1.00	0.040 Max.	0.08/013	1126
C 1132	0.27/0.34	1.35/1.65	0.040 Max.	0.08/013	1132
C 1137	0.32/0.39	1.35/1.65	0.040 Max.	0.08/013	1137
C 1138	0.34/0.40	0.70/1.00	0.040 Max.	0.08/013	1138
C 1140	0.37/0.44	0.70/1.00	0.040 Max.	0.08/013	1140
C 1141	0.37/0.45	1.35/1.65	0.040 Max.	0.08/013	1141
C 1144	0.40/0.48	1.35/1.65	0.040 Max.	0.24/0.33	1144
C 1145	0.42/0.49	0.70/1.00	0.040 Max.	0.04/0.07	1145
C 1146	0.42/0.49	0.70/1.00	0.07/0.12	0.08/0.13	1146
C 1148	0.45/0.52	0.70/1.00	0.040 Max.	0.04/0.07	....
C 1151	0.48/0.55	0.70/1.00	0.040 Max.	0.08/0.13	1151
C 1211	0.13 Max.	0.60/0.90	0.07/0.12	0.08/0.15	....
C 1212	0.13 Max.	0.70/1.00	0.07/0.12	0.16/0.23	....
C 1213	0.13 Max.	0.70/1.00	0.07/0.12	0.24/0.33	.
C 12L14	0.15 Max.	0.85/1.15	0.04/0.09	0.26/0.35	12L14
C 1215	0.09 Max.	0.75/1.05	0.04/0.09	0.26/0.35	....
B 1111	0.13 Max.	0.60/0.90	0.07/0.12	0.08/0.15	1111
B 1112	0.13 Max.	0.70/1.00	0.07/0.12	0.16/0.23	1112
B 1113	0.13 Max.	0.70/1.00	0.07/0.12	0.24/0.33	1113

SILICON: When a Silicon range is specified, standard limitations are as follows for Open Hearth Steels:

To C 1015 Exclusive ..... 10 Max.
C 1015 To C 1025 incl. ..... 10 Max., .10/.20 or .15/.30
Over C 1025 ..... 10/.20 or .15/.30
To C 1113 Exclusive..... .10 Max.
C 1113 and OveR..... 10 Max., .10/.20 or .15/.30
C 12L14 - Pb ..... 15/.35 Lead Added
Acid Bessemer Steel is not furnished with specified silicon content.

COMBINED AISI AND SAE – OPEN HEARTH/ELECTRIC FURNACE ALLOY STEELS

Chemicals Composition Limits, Per Cent

A.I.S.I. NUMBER	CARBON	MANGANESE	PHOSPHOROUS MAX.	SULFUR MAX.	SILICON	NICKEL	CHROMIUM	MOLYBDENUM	S.A.E. NUMBER
5015	0.12/0.17	030/0.50	0.040	0.040	0.20/0.35	....	0.30/0.50	....	5015
5046	0.43/0.50	0.75/1.00	0.040	0.040	0.20/0.35	....	0.20/0.35	....	5046
5117	0.15/0.20	0.70/0.90	0.040	0.040	0.20/0.35	....	0.70/0.90	....	5117
5120	0.17/0.22	0.70/0.90	0.040	0.040	0.20/0.35	....	0.70/0.90	....	5120
5130	0.28/0.33	0.70/0.90	0.040	0.040	0.20/0.35	....	0.80/1.10	....	5130
5132	0.30/0.35	0.60/0.80	0.040	0.040	0.20/0.35	....	0.75/1.00	....	5132
5135	0.33/0.38	0.60/0.80	0.040	0.040	0.20/0.35	....	0.80/1.05	....	5135
5140	0.38/0.43	0.70/0.90	0.040	0.040	0.20/0.35	....	0.70/0.90	....	5140
5145	0.43/0.48	0.70/0.90	0.040	0.040	0.20/0.35	....	0.70/0.90	....	5145
5147	0.45/0.52	0.70/0.95	0.040	0.040	0.20/0.35	....	0.85/1.15	....	5147
5150	0.48/0.53	0.70/0.90	0.040	0.040	0.20/0.35	....	0.70/0.90	....	5150
5152	0.48/0.55	0.70/0.90	0.040	0.040	0.20/0.35	....	0.90/1.20	....	5152
5155	0.50/0.60	0.70/0.90	0.040	0.040	0.20/0.35	....	0.70/0.90	....	5155
5160	0.55/0.65	0.75/1.00	0.040	0.040	0.20/0.35	....	0.70/0.90	....	5160
E5010	0.95/1.10	0.25/0.45	0.025	0.025	0.20/0.35	....	0.40/0.60	....	5010
E5110	0.95/1.10	0.25/0.45	0.025	0.025	0.20/0.35	....	0.90/1.15	....	5110
E5210	0.95/1.10	0.25/0.45	0.025	0.025	0.20/0.35	....	1.30/1.60	....	5210
6117*	0.15/0.20	0.70/0.90	0.040	0.040	0.20/0.35	....	0.70/0.90	....	6177
6120*	0.17/0.22	0.70/0.90	0.040	0.040	0.20/0.35	....	0.70/0.90	....	6120
6145**	0.43/0.48	0.70/0.90	0.040	0.040	0.20/0.35	....	0.80/1.10	....	6145
6150**	0.48/0.53	0.70/0.90	0.040	0.040	0.20/0.35	....	0.80/1.10	....	6150
8615	0.13/0.18	0.70/0.90	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/.25	8615
8617	0.15/0.20	0.70/0.90	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/.25	8617

*Vanadium 0.10 Minimum ** Vanadium 0.15 Minimum NOTE: Small quantities of certain elements may be found in alloy steel which are not speci ed or required.
These elements are to be considered as incidental and acceptable to the following maximum amounts: copper, 0.35 per cent; nickel, 0.025 per cent; chromium, 0.20 per cent; molybdenum, 0.06 per cent.

COMBINED AISI AND SAE – OPEN HEARTH/ELECTRIC FURNACE ALLOY STEELS

Chemicals Composition Limits, Per Cent

A.I.S.I. NUMBER	CARBON	MANGANESE	PHOSPHOROUS MAX.	SULFUR MAX.	SILICON	NICKEL	CHROMIUM	MOLYBDENUM	S.A.E. NUMBER
8620	0.18/0.23	0.70/0.90	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8620
8622	0.20/0.25	0.70/0.90	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8622
8625	0.23/0.28	0.70/0.90	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8625
8627	0.25/0.30	0.70/0.90	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8627
8630	0.28/0.33	0.70/0.90	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8630
8635	0.33/0.38	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8635
8637	0.35/0.40	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8637
8640	0.38/0.43	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8640
8641	0.38/0.43	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8641
			0.060						
8642	0.40/0.45	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8642
8645	0.43/0.48	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8645
8650	0.48/0.53	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8650
8653	0.50/0.56	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.50/0.80	0.15/0.25	8653
8655	0.50/0.60	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8655
8660	0.55/0.65	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.15/0.25	8660
8715	0.13/0.18	0.70/0.90	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.20/0.30	8715
8717	0.15/0.20	0.70/0.90	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.20/0.30	8717
8720	0.18/0.23	0.70/0.90	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.20/0.30	8720
8735	0.33/0.38	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.20/0.30	8735
8740	0.38/0.43	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.20/0.30	8740
8742	0.0/0.45	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.20/0.30	8742
8750	0.48/0.53	0.75/1.00	0.040	0.040	0.20/0.35	0.40/0.70	0.40/0.60	0.20/0.30	8750
9255	0.50/0.60	0.70/0.95	0.040	0.040	1.80/2.20	....	....	....	9255
9260	0.55/0.65	0.70/1.00	0.040	0.040	1.80/2.20	....	....	....	9260
9261	0.55/0.65	0.70/1.00	0.040	0.040	1.80/2.20	....	0.10/0.25	....	9261
9262	0.55/0.65	0.70/1.00	0.040	0.040	1.80/2.20	....	0.25/0.40	....	9262
E9310	0.08/0.13	0.45/0.65	0.025	0.025	0.20/0.35	3.00/3.50	1.00/1.40	0.08/0.15	9310
E9314	0.11/0.17	0.40/0.70	0.025	0.025	0.20/0.35	3.00/3.50	1.00/1.40	0.08/0.15	9314
9840	0.38/0.43	0.70/0.90	0.040	0.040	0.20/0.35	0.85/1.15	0.70/0.90	0.20/0.30	9840
9845	0.43/0.48	0.70/0.90	0.040	0.040	0.20/0.35	0.85/1.15	0.70/0.90	0.20/0.30	9845
9850	0.48/0.53	0.70/0.90	0.040	0.040	0.20/0.35	0.85/1.15	0.70/0.90	0.20/0.30	9850

* Vanadium 0.10 Minimum ** Vanadium 0.15 Minimum NOTE: Small quantities of certain elements may be found in alloy steel which are not specified or required. These elements are to be considered as incidental and acceptable to the following maximum amounts: copper, 0.35 per cent; nickel, 0.025 per cent; chromium,0.20 per cent; molybdenum, 0.06 per cent.

DESIGNATION SYSTEM ALLOY AND TEMPER FOR ALUMINUM

A system of four digit numerical designations is used to identify wrought aluminum alloys. Additional letters and numbers indicate strain-hardened temper or thermal treatment and product form.

Four Digit Numerical ALLOY Designations

First digit is indicative of principal alloy group.

Second digit indicates modifications in impurity limits and/or alloy modifications. Third and Fourth digits designate the different alloys in a group.

The first digit identifies the following alloy groups:

Aluminum, 99.00 percent minimum	1 XXX
Copper	2 XXX
Manganese	3 XXX
Silicon	4 XXX
Magnesium	5 XXX
Magnesium and Silicon	6 XXX
Zinc.	7 XXX
Other Elements	8 XXX
Unused Series	9 XXX

Basic Tempers

F as fabricated, no special control and there are no mechanical property limits.

0 annealed

H strain-hardened or work hardened. Strength is increased by strain hardening and the H will always be followed by two or more numerical digits.

T thermally treated to produce stable tempers with or without supplementary strain- hardening. The T will always be followed by one or more numerical digits.

DESIGNATION SYSTEM ALLOY AND TEMPER

Basic Combinations of H Temper

H1 strain-hardened only

H2 strain-hardened and partially annealed.

H3 strain-hardened and stabilized.

- The digit immediately following the designation H1, H2 and H3 identifies the degree of strain-hardening.

H x 2 : 1/4 hard

H x 4 : 1/2 hard

H x 6 : 3/4 hard

H x 8 : Full hard

H x 9 : Extra hard (must exceed the minimum ultimate tensile strength of H x 8 by 2 ksi or more)

- Numerical digits of 1, 3, 5, and 7 indicate tempers in between those listed above.
- When a third digit is used, it indicates a close variation of the two digit temper from the original two digit temper.

Some Basic Combinations of T Temper

T1 cooled from an elevated temperature shaping process and naturally aged to a substantially stable condition.

T3 solution heat-treated, cold worked and naturally aged to a substantially stable condition.

T4 solution heat-treated and naturally aged to a substantially stable condition.

T5 cooled from an elevated temperature shaping process and then artificially aged.

T6 solution heat-treated and then artificially aged.

T7 solution heat-treated and overaged/stabilized.

T8 solution heat-treated, cold worked and then artificially aged.

T10 cooled from an elevated temperature shaping process, cold worked and then artificially aged.

Additional Digits of T Tempers

T x 51 stress relieved by stretching

T x 511 these products may receive minor straightening after stretching to meet standard tolerances.

T x 52 stress relieved by compressing.

GAUGE CHART

GAUGE NUMBER	Brass and aluminum sheets		Cold and Hot Rolled Steel Sheets	
	AMERICAN OR BROWNE AND SHARPE		MANUFACTURERS STANDARD	
	INCHES	MM	Inches	MM
3	.2294	5.827	.2391	6.073
4	.2043	5.189	.2242	5.694
5	.1819	4.620	.2092	5.313
6	.1620	4.115	.1943	4.935
7	.1443	3.665	.1793	4.554
8	.1285	3.264	.1644	4.175
9	.1144	2.906	.1495	3.797
10	.1019	2.588	.1345	3.416
11	.09074	2.305	.1196	3.038
12	.08081	2.053	.1046	2.656
13	.07196	1.828	.0897	2.278
14	.06408	1.628	.0747	1.897
15	.05707	1.450	.0673	1.709
16	.05082	1.291	.0598	1.518
17	.04526	1.150	.0538	1.366
18	.04030	1.024	.0478	1.214
19	.03589	.912	.0418	1.061
20	.03196	.812	.0359	.911
21	.02846	.723	.0329	.835
22	.02535	.644	.0299	.759
23	.02257	.573	.0269	.683
24	.02010	.511	.0239	.607
25	.01790	.455	.0209	.531
26	.01594	.405	.0179	.454
27	.01420	.361	.0164	.416
28	.01264	.321	.0149	.378
29	.01126	.286	.0135	.343
30	.01003	.255	.0120	.305

GAUGE CHART

Aluminum, Brass, Copper, Steel Tubes, Copper Sheets, Hoop Steel		Stainless Steel Sheets		Galvanized Steel Sheets		GAUGE NUMBER
BIRMINGHAM WIRE GAUGE		UNITED STATES STANDARD		GALVANIZED SHEET GAUGE		
INCHES	MM	Inches	MM	Inches	MM	
.259	6.579					3
.238	6.045					4
.220	5.588					5
.203	5.156					6
.180	4.572					7
.165	4.191	.17187	4.365	.1681	4.269	8
.148	3.759	.15625	3.968	.1532	3.891	9
.134	3.404	.14062	3.571	.1382	3.510	10
.120	3.048	.125	3.175	.1233	3.1318	11
.109	2.769	.10937	2.778	.1084	2.753	12
.095	2.413	.09375	2.381	.0934	2.372	13
.083	2.108	.07812	1.984	.0785	1.9939	14
.072	1.829	.07031	1.785	.0710	1.803	15
.065	1.651	.0625	1.587	.0635	1.6129	16
.058	1.473	.05625	1.4287	.0575	1.460	17
.049	1.245	.050	1.270	.0516	1.310	18
.042	1.067	.04375	1.111	.0456	1.158	19
.035	.889	.0375	.9525	.0396	1.005	20
.032	.813	.03437	.873	.0366	.929	21
.028	.711	.03125	.7937	.0336	.853	22
.025	.635	.02812	.714	.0306	.777	23
.022	.559	.025	.635	.0276	.701	24
.020	.508	.02187	.555	.0247	.627	25
.018	.457	.01875	.476	.0217	.551	26
.016	.406	.01718	.436	.0202	.513	27
.014	.356	.01562	.396	.0187	.474	28
.013	.330	.01406	.357	.0172	.436	29
.012	.305	.0125	.3175	.0157	.398	30

APPROXIMATE HARDNESS CONVERSION FOR STEEL

BASED ON BRINELL HARDNESS NUMBERS

BRINELL INDENTATION DIAM. MM	BRINELL HARDNESS NO.10-MM TUNGSTEN CARBIDE BALL, 3,000-KG LOAD	ROCKWELL HARDNESS NO.			DIAMOND PYRAMID HARDNESS NO., VICKERS	SHORE SCLEROSCOPE HARDNESS NO.	TENSILE STRENGTH (APPROXIMATE) IN 1,000 PSI
		C-SCALE, 150-KG LOAD, BRALE PENETRATOR	B-SCALE, 100-KG LOAD,1/6IN. DIAM. BALL	A-SCALE, 60-KG LOAD BRALE PENETRATOR			
2.25	745	65.3		84.1	840	91	...
2.30	712	...	...	...	...	...	...
2.35	682	61.7	...	82.2	737	84	...
2.40	653	60,0	...	81.2	697	81	...
2.45	627	58.7	...	80.5	667	79	...
2.50	601	57.3	...	79.8	640	77	...
2.55	578	56,0	...	79.1	615	75	...
2.60	555	54.7	...	78.4	591	73	298
2.65	534	53.5	...	77.8	569	71	288
2.70	514	52.1	...	76,9	547	70	274
2.75	495	51.0	...	76.3	528	68	264
2.80	477	49.6	...	75.6	508	66	252
2.85	461	48.5	...	74,9	491	65	242
2.90	444	47.1	...	74,2	472	63	230
2.95	429	45.7	...	73.4	455	61	219
3.00	415	44.5	...	72,8	440	59	212
3.05	401	43.1	...	72.0	425	58	202
3.10	388	41.8	...	71.4	410	56	193
3.15	375	40,4	...	70,6	396	54	184
3.20	363	39.1	...	70,0	383	52	177
3.25	352	37.9	(110.0)	69.3	372	51	171
3.30	341	36,6	(109,0)	68,7	360	50	164
3.35	331	35.5	(108.5)	68,1	350	48	159
3.40	321	34.3	(108.0)	67.5	339	47	154
3.45	311	33.1	(107.5)	66,9	328	46	149
3.50	302	32.1	(107,0)	66.3	319	45	146
3.55	293	30.9	(106.0)	65.7	309	43	141
3.60	285	29.9	(105.5)	65.3	301		138
3.65	277	28.8	(104.5)	64.6	292	41	134
3.70	269	27.6	(104.0)	64.1	284	40	130
3.75	262	26.6	(103,0)	63,6	276	39	127
3.80	255	25.4	(102.0)	63.0	269	38	123
3.85	248	24.2	(101.0)	62.5	261	37	120
3.90	241	22.8	100,0	61.8	253	36	116
3.95	235	21.7	99.0	61.4	247	35	114
4.00	229	20.5	98.2	60.8	241	34	111
4.05	223	(18.8)	97.3	...	234	...	...
4.10	217	(17.5)	96.4	...	228	33	105
4.15	212	(16.0)	95.5	...	222	...	102
4.20	207	(15.2)	94,6	...	218	32	100
4.25	201	(13.8)	93.8	...	212	31	98
4.30	197	(12.7)	92.8	...	207	30	95
4.35	192	(11.5)	91.9	...	202	29	93
4.40	187	(10.0)	90.7	...	196	...	90
4.45	183	(9.0)	90.0	...	192	28	89
4.50	179	(8.0)	89,0	...	188	27	87
4.55	174	(6.4)	87.8	...	182	...	85
4.60	170	(5.4)	86.8	...	178	26	83
4.65	167	(4.4)	86,0	...	175	...	81
4.70	163	(3.3)	85.0	...	171	25	79
4.80	156	(0.9)	82.9	...	163	...	76
4.90	149	...	80,8	...	156	23	73
5.00	143	...	78.7	...	150	22	71
5.10	137	...	76.4	...	143	21	67
5.20	131		74,0		137		65

NOTE: The values shown are based in SAE J417 DEC 83 and ASTM E-140. Values in () beyond normal range and are for information only.

MECHANICAL PROPERTIES ALUMINUM

TYPICAL PROPERTIES FOR COMPARISON ONLY

ALLOY AND TEMPER		TENSION STRENGTH, % ELONG. KSI ULTIMATE	KSI YIELD	IN 2" 1/16" TH.	IN 2" 1/2" TH.	BRINELL HARDNESS*	ULTIMATE SHEAR STRENGTH, KSI	ENDURANCE[1] LIMIT, KSI	MOD.[2] OF ELAST. KSI × 10^3
	1060-0	10	4	43	..	19	7	3	10.0
	1060-H12	12	11	16	..	23	8	4	10.0
	1060-H14	14	13	12	..	26	9	5	10.0
	1060-H16	16	15	8	..	30	10	6.5	10.0
	1060-H18	19	18	6	..	35	11	6.5	10.0
	1100.0	13	5	35	45	23	9	5	10.0
	1100-HL 2	16	15	12	25	28	10	6	10.0
	1100-H14	18	17	9	20	32	11	7	10.0
	1100-H16	21	20	6	17	38	12	9	10.0
	1100-H18	24	22	5	15	44	13	9	10.0
	1350-0	12	4	..	..	..	8	..	10.0
	1350-H12	14	12	..	..	..	9	..	10.0
	1350-H14	16	14	..	..	..	10	..	10.0
	1350-H16	18	16	..	..	..	11	..	10.0
	1350-H19	27	24	..	..	..	15	7	10.0
	2011-T3	55	43	..	15	95	32	18	10.2
	2011-T8	59	45	..	12	100	35	18	10.2
	2014-0	27	14	..	18	45	18	13	10.6
	2014-T4,T451	62	42	..	20	105	38	20	10.6
	2014-T6,T651	70	60	..	13	135	42	18	10.6
ALCLAD	2014-0	25	10	21	..	..	18		10.5
ALCLAD	2014-T3	63	40	20	..	..	37		10.5
ALCLAD	2014-T4,T451	61	37	22	..	..	37		10.5
ALCLAD	2014-T6,T651	68	60	10	..	..	41		10.5
	2017-0	26	20	..	22	45	18	13	10.5
	2017-T4,T451	62	40	..	22	105	38	18	10.5
	2018-T61	61	46	..	12	120	39	17	10.8
	2024-0	27	11	20	22	47	18	13	10.6
	224-T3	70	50	18	..	120	41	20	10.6
	2024-T4,T351	68	47	20	19	120	41	20	10.6
	2024-T361[5]	72	57	13	..	130	42	18	10.6
ALCLAD	2024-0	26	11	20	..	..	18	..	10.6
ALCLAD	2024-T3	65	45	18	..	..	40	..	10.6
ALCLAD	2024-T4,T351	64	62	19	..	..	40	..	10.6
ALCLAD	2024-T361[5]	67	53	11	..	..	41	..	10.6
ALCLAD	2024-T81,T851	65	60	6	..	..	40		10.6
ALCLAD	2024-T861[5]	70	66	6	..	..	42	..	10.2
	2025-T6	58	37	..	19	110	35	18	10.4
	2036-T4	49	28	24	..	..	..	186	10.3
	2117-T4	43	24	..	27	70	28	14	10.3
	2124-T851	70	64	..	8	..	..	..	10.6
	2218-T72	48	37	..	11	95	30	..	10.8

MECHANICAL PROPERTIES ALUMINUM

TYPICAL PROPERTIES FOR COMPARISON ONLY

ALLOY AND TEMPER	TENSION STRENGTH, % ELONG. KSI ULTIMATE	KSI YIELD	IN 2" 1/16" TH.	IN 2" 1/2" TH.	BRINELL HARDNESS*	ULTIMATE SHEAR STRENGTH, KSI	ENDURANCE[1] LIMIT, KSI	MOD.[2] OF ELAST. KSI × 10^3
2219-0	25	11	18					10.6
2219-T42	52	27	20					10.6
2219-T31,T351	52	36	17					10.6
2219-T37	57	46	11					10.6
2219-T62	60	42	10				15	10.6
2219-T81,T851	66	51	10				15	10.6
2219-T87	69	57	10				15	10.6
2618-T61	64	54		10	115	38	18	10.8
3003-0	16	6	30	40	28	11	7	10.0
3003-H12	19	18	10	20	35	12	8	10.0
3003-H14	22	21	8	16	40	14	9	10.0
3003-H16	26	25	5	14	47	15	10	10.0
3003-H18	29	27	4	10	55	16	10	10.0
ALCLAD 3003-0	16	6	30	40		11		10.0
ALCLAD 3003-H12	19	18	10	20		12		10.0
ALCLAD 3003-H14	22	21	8	16		14		10.0
ALCLAD 3003-H16	26	25	5	14		15		10.0
ALCLAD 3003-H18	29	27	4	10		16		10.0
3004-0	26	10	20	25	45	16	14	10.0
3004-H32	31	25	10	17	52	17	15	10.0
3004-H34	35	29	9	12	63	18	15	10.0
3004-H36	38	33	5	9	70	20	16	10.0
3004-H38	41	36	5	6	77	21	16	10.0
ALCLAD 3004-0	26	10	20	25		16		10.0
ALCLAD 3004-H32	31	25	10	17		17		10.0
ALCLAD 3004-H34	35	29	9	12		18		10.0
ALCLAD 3004-H36	38	33	5	9		20		10.0
ALCLAD 3004-H38	41	36	5	6		21		10.0
3105-0	17	8	24			12		10.0
3105-H12	22	19	7			14		10.0
3105-H14	25	22	5			15		10.0
3105-H16	28	25	4			16		10.0
3105-H18	31	28	3			17		10.0
3105-H25	26	23	8			15		10.0
4032-T6	55	46		9	120	38	16	11.4
5005-0	18	6	25		28	11		10.0
5005-H12	20	19	10			14		10.0
5005-H14	23	22	6			14		10.0
5005-H16	26	25	5			15		10.0
5005-H18	29	28	4			16		10.0
5005-H32	20	17	11		36	14		10.0
5005-H34	23	20	8		41	14		10.0
5005-H36	26	24	6		46	15		10.0
5005-H38	29	27	5		51	16		10.0

MECHANICAL PROPERTIES ALUMINUM

TYPICAL PROPERTIES FOR COMPARISON ONLY

ALLOY AND TEMPER	TENSION STRENGTH, % ELONG.				BRINELL HARDNESS*	ULTIMATE SHEAR STRENGTH, KSI	ENDURANCE[1] LIMIT, KSI	MOD.[2] OF ELAST. KSI × 10^3
	KSI		IN 2"					
	ULTIMATE	YIELD	1/16" TH.	1/2" TH.				
5050-0	21	8	24	..	36	15	1	10.0
5050-H32	25	21	9	..	46	17	13	10.0
5050-H34	28	24	8	..	53	18	13	10.0
5050-H36	30	26	7	..	58	19	14	10.0
5050-H38	32	29	6	..	63	20	14	10.0
5052-0	28	13	25	30	47	18	16	10.2
5052-H32	33	28	12	18	60	20	17	10.2
5052-H34	38	31	10	14	68	21	18	10.2
5052-H36	40	35	8	10	73	23	19	10.2
5052-H38	42	37	7	8	77	24	20	10.2
5056-0	42	22	..	35	65	26	20	10.3
5056-H18	63	59	..	10	105	34	22	10.3
5056-H38	60	50	..	15	100	32	22	10.3
5083-0	42	21	..	22	..	25	..	10.3
5083-H321, H116	46	33	--	16	..	23	..	10.3
5086-0	38	17	22	..	..	23	..	10.3
5086-H32, H116	42	30	12	..	..	..	..	10.3
5086-H34	47	37	10	..	..	27	..	10.3
5086-HL12	39	19	14	..	..	..	..	10.3
5154-0	35	17	27	..	58	22	17	10.2
5154-H32	39	39	15	..	67	22	18	10.2
51541-H34	42	33	13	..	73	24	19	10.2
5154-H36	45	36	12	..	78	26	20	10.2
5154-H38	48	39	10	..	80	28	21	10.2
5154-H112	35	17	25	..	63	..	17	10.2
5252-H25	34	25	11	..	68	21	..	10.0
5252-H38, H28	41	35	5	..	75	23	..	10.0
5254-0	35	17	27	..	58	22	17	10.2
5254-H32	39	30	15	..	67	22	18	10.2
5254-H34	42	33	13	..	73	24	19	10.2
5254-H36	45	36	12	..	78	26	20	10.2
5254-H38	48	39	10	..	80	28	21	10.2
5254-H112	35	17	25	..	63	..	17	10.2
5454-0	36	17	22	..	62	23	..	10.2
5454-H32	40	30	10	..	73	24	..	10.2
5454-H34	44	35	10	..	81	26	..	10.2
5454-H111	38	26	14	..	70	23	..	10.2
5454-H112	36	18	18	..	62	23	..	10.2
5456-0	45	23	..	24	..	..	..	10.3
5456-H112	45	24	..	22	..	..	..	10.3
5456-H321,H116	51	37	..	16	90	30	..	10.3
5457-0	19	7	22	..	32	12	..	10.0
5457-H25	26	23	12	..	48	16	..	10.0
5457-H38, H28	30	27	6	..	55	18	..	10.0

MECHANICAL PROPERTIES ALUMINUM

TYPICAL PROPERTIES FOR COMPARISON ONLY

ALLOY AND TEMPER		TENSION STRENGTH, % ELONG. KSI ULTIMATE	KSI YIELD	IN 2" 1/16" TH.	IN 2" 1/2" TH.	BRINELL HARDNESS*	ULTIMATE SHEAR STRENGTH, KSI	ENDURANCE[1] LIMIT, KSI	MOD.[2] OF ELAST. KSI × 10^3
	5652-0	28	13	25	30	47	18	16	10.2
	5652-H32	33	28	12	18	60	20	17	10.2
	5652-H34	38	31	10	14	68	21	18	10.2
	5652-H36	40	35	8	10	73	23	19	10.2
	5652-H38	42	37	7	8	77	24	20	10.2
	5657-H25	23	20	12	..	40	14	..	10.0
	5657-H38, H28	28	24	7	..	50	15	..	10.0
	6061-0	18	8	25	30	30	12	9	10.0
	6061-T4,T451	35	21	22	25	65	24	14	10.0
	6061-T6, T651	45	40	12	17	95	30	14	10.0
ALCLAD	6061-0	17	7	25	..	..	11	..	10.0
ALCLAD	6061-T4, T451	33	19	22	..	..	22	..	10.0
ALCLAD	6061-T6, T651	42	37	12	..	..	27	..	10.0
	6063-0	13	7	..	..	25	10	8	10.0
	6063-T1	22	13	20	..	42	14	9	10.0
	6063-T4	25	13	22	..	..	..	..	10.0
	6063-T5	27	21	12	..	60	17	10	10.0
	6063-T6	35	31	12	..	73	22	10	10.0
	6063-T83	37	35	9	..	82	22	..	10.0
	6063-T831	30	27	10	..	70	18	..	10.0
	6063-T832	42	39	12	..	95	27	..	10.0
	6066-0	22	12	..	18	43	14	..	10.0
	6066-T4, T451	52	30	..	18	90	29	..	10.0
	6066-T6, T651	57	52	..	12	120	34	16	10.0
	6070-T6	55	51	10	..	..	34	14	10.0
	6101-H111	14	11	..	..	..	..	..	10.0
	6101-T6	32	28	15	..	71	20	..	10.0
	6262-T9	58	55	..	10	120	35	13	10.0
	6463-T1	22	13	20	..	42	14	10	10.0
	6463-T5	27	21	12	..	60	17	10	10.0
	6463-T6	35	31	12	..	74	22	10	10.0
	7050-T7451	76	68	..	11	..	44	..	10.4
	7075-0	33	15	17	16	60	22	..	10.4
	7075-T6, T651	83	73	11	11	150	48	23	10.4
ALCLAD	7075-0	32	14	17	..	..	22	..	10.4
ALCLAD	7075-T6, T651	76	67	11	..	..	46	..	10.4
	7178-0	33	15	15	16	..	..	..	10.4
	7178-T6, T651	88	78	10	11	..	..	..	10.4
	7178-T76, T7651	83	73	..	11	..	..	..	10.3
ALCLAD	7178-0	32	14	16	..	..	..	..	10.4
ALCLAD	7178-T6, T651	81	71	10	..	..	..	..	10.4

*500 kg load; 10mm ball.
1. Based on 50,000,000,000 cycles of completely reversed stress using the R.R. Moore type of machine and specimen.
2. Average of tension and compression moduli. Compression modulus is about 2% greater than tension modulus.
3. 1350-0 wire will have an elongation of approximately 23% in 10 inches.
4. 1350-H19 wire will have an elongation of approx 1 1/2% in 10 inches.
5. Tempers T361 and T 861 were formerly designated T36 and T86.
6. Based on 10^7 cycles using flexural type testing of sheet specimens.

COPPER AND COPPER ALLOY PRODUCTS — NOMINAL CHEMICAL COMPOSITION AND TYPICAL MECHANICAL PROPERTIES

COMBINED AISI & SAE STANDARD STEEL LISTS OPEN HEARTH ALLOY AND ELECTRIC FURNACE ALLOY STEELS

These figures are NOT GUARANTEED and are given only as an indication of what may be expected and should under no circumstances be used in specifying the raw materials. It must not be assumed that these properties will be obtained in all cases, as they vary widely with permissible variations in analysis and size of section. These figures cannot be used as a basis of acceptance or rejection of material.

				COMPOSITION %						MECHANICAL				PHYSICAL		
Copper Alloy	UNS Number	Description	Temper	Copper	Zinc	Lead	Tin	Nickel	Others	Tensile Strength ksi†	Yield Strength ksi†	Elongation in 2" %	Rockwell Hardness	Melting Point °F	Electrical Conductivity (Annelaed) %	Machinability Rating %*
ROD	**(1.00"DIA.)****															110
110	C11000	Copper	1/8H	99.9+	–	–	–	–	–	32.0	10.0	55	F40	1981	101	20
			HARD	"	–	–	–	–	–	48.0	44.0	16	B47	"	"	"
145	C14500	Tellurium Copper (FC)	1/2H	99.5	–	–	–	–	TE.55	42.0	40.0	25	B42	1967	85 MIN	85
			HARD	"	–	–	–	–		48.0	44.0	20	B48	"	"	
147	C14700	Sulfur Copper	1/2H	99.6	–	–	–	–	"	43.0	40.0	20	B43	1969	90MIN	85
182	C18200	Chromium Copper	–	98.5	–	–	–	–	S. 40	72.0	65.0	18	B80	1967	80	20
314	C31400	Commercial Bronze	BEND-ING	89.0	9.1	1.9	–	–	CR1.0	45.0	28.0	22	–	1900	42	80
316	C31600	Commercial Bronze	1/2H	89.0	8.1	1.9	–	1.0	–	65.0	57.0	15	B70	1900	32	80
			BEND-ING	"	"	"	–	"	–	45.0	27.5	20	–	"	"	"
353	C35300	Flanging Brass	1/4H	62.0	35.5	2.5	–	–	–	54.0	40.0	20	B70	1660	26	90
360	C36000	Free Cutting Brass	1/2H	61.5	35.5	3.0	–	–	–	58.0	45.0	25	B78	1650	26	100
464	C46400	Naval Brass (Nonleaded)	HARD	60.0	39.2	–	0.8	–	–	88.0	66.0	18	B95	1650	26	30
485	C48500	Naval Brass (leaded)	1/2H	60.0	37.5	1.8	0.7	–	–	75.0	53.0	15	882	1650	26	70
544	C54400	Phosphor Bronze (FC)	HARD	88.0	4.0	4.0	4.0	–	–	68.0	57.0	20	B80	1830	19	80
624	C62400	Aluminum Bronze	–	85.5	–	–	–	–	FE 3.5 AI 10.5	105.0	52.0	14	B92	1900	12	50
630	C63000	Nickel-Aluminum Bronze	HR50	81.0	–	–	–	5.0	FE 2.5 AI 10.0	118.0	75.0	15	B98	1930	9	30
642	C64200	Aluminum Silicon Bronze	HR50	91.2	–	–	–	–	SI 1.8 AL 7.0	102.0	68.0	22	B94	1840	8	60
792	C79200	Nickel Silver (Leaded)	Hard	61.5	25.5	1.0	–	120	–	82.0	70.0	16	B84	1810	8	60
932	C93200	Bronze Bushing	–	83.0	3.0	7.0	7.0	–	–	44.0	24.0	18	F76	1790	12	70

*FC Brass = 100% †1 ksi= 1000 psi **Alloy 954 Aluminum Bronze and Ampco Rod: See Page 250

COPPER AND COPPER ALLOY PRODUCTS — NOMINAL CHEMICAL COMPOSITION AND TYPICAL MECHANICAL PROPERTIES

These figures are NOT GUARANTEED.

				COMPOSITION %						MECHANICAL				PHYSICAL		
Copper Alloy	UNS Number	Description	Temper	Copper	Zinc	Lead	Tin	Nickel	Others	Tensile Strength ksi†	Yield Strength ksi†	Elongation 1n 2" %	Rockwell Hardness	Melting Point °F	Electrical Conductivity (Annelaed) %	Machinability Rating %*
SHEET	**(0.40" THICK)**															
110	C11000	Cooper	SOFT	99.9+	-	-	-	-	-	32.0	10.0	45	F40	1981	101	20
			1/8-1/4H	"	-	-	-	-	-	37.0	29.0	27	F69	"	"	"
			1/2H	"	-	-	-	-	-	42.0	36.0	14	B40	"	"	"
122	C12200	(DHP) Cooper	1/8-1/4H	99.9+	-	-	-	-	P.02	38.0	30.0	25	F70	1981	85	20
-	-	Roofing Copper	SOFT	99.9+	-	-	-	-	-	34.0	11.0	45	F45	1981	98	20
			H00	"	-	-	-	-	-	36.0	28.0	30	F60	"	"	"
220	C220000	Commercial Bronze	SOFT	90.0	10.0	-	-	-	-	37.0	10.0	45	F53	1910	44	20
			1/4H	"	"	-	-	-	-	47.0	37.0	25	B47	"	"	"
			1/2H	"	"	-	-	-	-	52.0	45.0	11	B58	"	"	"
230	C23000	Red Brass	SOFT	85.0	15.0	-	-	-	-	40.0	12.0	47	F59	1880	37	30
260	C26000	Brass	SOFT	70.0	30.0	-	-	-	-	47.0	15.0	62	F64	1750	28	30
			1/4H	"	"	-	-	-	-	54.0	40.0	43	B55	"	"	"
			1/2H	"	"	-	-	-	-	62.0	52.0	25	B70	"	"	"
			3/4H	"	"	-	-	-	-	69.0	57.0	15	B70	"	"	"
			HARD	"	"	-	-	-	-	76.0	63.0	8	B82	"	"	"
			SPRING	"	"	-	-	-	-	94.0	65.0	3	B91	"	"	"
280	C28000	Muntz Metal	CR	60.0	40.0	-	-	-	-	60.0	35.0	30	B55	1660	28	40
353	C35300	Leaded Brass	1/2H	61.5	36.7	1.8	-	-	-	61.0	50.0	20	B70	1670	26	90
464	C46400	Naval Brass	CR	60.0	39.25	-	0.75	-	-	62.0	41.0	42	B60	1650	26	30
510	C51000	Phosphor Bronze	HARD	94.8	-	-	5.0	-	P .20	81.0	75.0	10	B87	1920	15	20
			SPRING	"	-	-	"	-	"	100.0	80.0	4	B95	"	"	"
614	C61400	Aluminum Bronze**	SOFT	91.0	-	-	-	-	FE 2.0 AL 7.0	78.0	35.0	42	B80	1915	14	20
752	C75200	Nickel Silver	Soft	65.0	17.0	-	-	18.0	-	58.0	25.0	40	B40	2030	6	20

* FC Brass = 100% ** Based on 1/8" † 1 ksi= 1000 psi

COPPER AND COPPER ALLOY PRODUCTS — NOMINAL CHEMICAL COMPOSITION AND TYPICAL MECHANICAL PROPERTIES

These figures are NOT GUARANTEED.

				COMPOSITION %						MECHANICAL				PHYSICAL		
Copper Alloy	UNS Number	Description	Temper	Copper	Zinc	Lead	Tin	Nickel	Others	Tensile Strength ksi††	Yield Strength ksi†	Elongation In 2" %	Rockwell Hardness	Melting Point °F	Electrical Conductivity (Annelaed) %	Machinability Rating %*
PLATE	**(1.00"THICK)**															
110	C11000	COPPER	Soft	99.9+	–	–	–	–	–	32.0	10.0	50	F40	1981	101	20
			1/8-1/4h	"	–	–	–	–	–	38.0	30.0	25	F70	"	"	"
122	C12200	(DHP) COOPER	1/8-1/4h	99.9+	–	–	–	–	P .02	32.0	10.0	50	F40	1981	85	20
280	C28000	MUNTZ METAL	Cr	60.0	40.0	–	–	–	–	60.0	35.0	30	B55	1660	28	40
353	C35300	LEADED BRASS	1/2h	61.5	36.7	1.8	–	–	–	61.0	50.0	20	B70	1670	26	90
464	C46400	Naval Brass	Hr	60.0	39.25	–	0.75	–	–	55.0	25.0	50	B55	1650	26	30
614	C61400	ALUMINUM BRONZE**	Soft	910	–	–	–	–	Fe 2.0 Ai 7.0	78.0	35.0	42	B80	1915	14	20
TUBE (1.00" OD x .065 Wall)																
122	C12200	(DHP) COPPER	Soft	99.9+	–	–	–	–	P .02	32.0	10.0	45	F40	1981	85	20
			Dgp	"	–	–	–	–	"	40.0	32.0	25	F77	"	"	"
272	C27200	Brass	Dgp	63.0	37.0	–	–	–	–	54.0 Min			53 Min 30t	1690	26	40
330	C33000	Brass	Dgp	66.0	33.5	.05	–	–	–	54.0 Min			53 Min 30t	1720	26	60
932	C93200	Bronze Bushing †	–	83.0	3.0	7.0	7.0	–	–	44.0	24.0	18	F76	1790	12	70
954	C95400	Aluminum Bronze	–	85.0				Fe 4.0 Al 11.0		89.0	35.0	14	B89	1900	14	60
PIPE (3/4" SPS)																
122	C12200	(Dhp) Copper	Hard	99+	–	–	–	–	P .02	55.0	50.0	12	B55	1981	85	20
230	C23000	Red Brass	Dgp	85.0	15.0	–	–	–	–	50.0	40.0	30	B55	1880	37	30

*FC Brass = 100% ** Based on 1/8" † Based on 7/8" IDX 1-3/8" 0D DGP - Drawn General Purpose †† 1 ksi= 1000 psi

COPPER AND COPPER ALLOY PRODUCTS — NOMINAL CHEMICAL COMPOSITION AND TYPICAL MECHANICAL PROPERTIES

These figures are NOT GUARANTEED.

					COMPOSITION %						MECHANICAL				PHYSICAL		
Ampco Alloy	Copper Alloy	UNS Number	Description	Temper	Copper	Zinc	Iron	Alum.	Nickel	Chrom.	Tensile Strength ksi†	Yield Strength ksi†	Elongation In 2" %	Rockwell Hardness	Melting Point °F	Electrical Conductivity (Annelaed) %	Machinability Rating %*
ALUMINUM BRONZE																	
–	954	C95400	Cast Rod	–	85.5	–	3.5	105	–	–	89.0	35.0	14	B90	1900	14	60
–	954	C95400	Cast Sq	–	85.5	–	3.5	10.5	–	–	89.0	35.0	14	B90	1900	14	60
–	954	C95400	Cast Rect	–	85.5	–	3.5	10.5	–	–	89.0	35.0	14	B90	1900	14	60
–	954	C95400	Cast Tube	–	85.5	–	3.5	10.5	–	–	89.0	35.0	14	B90	1900	14	60
WIRE (.080"DIA.)																	
–	110	C11000	Cop-per	Soft	99.9	–	–	–	–	–	35.0	–	35**	–	1981	101	20
–	260	C26000	Brass	Soft	70.0	30.0	–	–	–	–	52.0	–	58	–	1760	28	30
				1/2H	"	"	–	–	–	–	70.0	–	20	–	"	"	"
				Spring	"	"	–	–	–	–	130.0	–	3	–	"	"	"
AMPCO																	
18	624	C62400	Ext Rod††	HR50	85.5	–	3.5	10.5	–	–	105.0	35.0	14	B90	1900	12	50
45	630	C63000	3"& Under	HR50	80.0	–	3.5	10.0	5.0	–	118.0	75.0	15	B98	1930	9	30
			Over 3"	TQ50	"	–	"	"	"	–	108.0	57.0	15	B97	"	"	"

* FC Brass = 100% † KSI = 1000psi ** Elongation in 10" ††Based on 1.00" Dia.

"When our assembly line went down, we needed a piece of cold rolled steel cut to size. Within minutes, Metal Supermarkets delivered it to our back door."

TYPICAL MECHANICAL PROPERTIES OF STANDARD ALLOY AND CARBON STEELS

These figures are NOT GUARANTEED.

ASTM/AISI Grade	Condition of Steel	MECHANICAL PROPERTIES				Typical Hardness		Average Machinability % of CD 1212
		Tensile Strength ksi††	Yield Strength ksi††	Elongation in 2" %	Reduction of Area %	BHN	Rockwell	
1215	Cold Drawn	80/95	70/80	10/15	34/45	150/210	B80/95	135
12L14	Cold Drawn	70/85	60/75	12/18	40/50	150/180	B80/90	185
12L14+Te	Cold Drawn	70/85	60/75	12/18	40/50	150/180	B80/90	250
1214 SA	Cold Drawn	70/85	60/75	12/18	40/50	150/180	B80/90	185
4130	Normalized Cold Drawn	85/110	70/85	20/30	50/60	185/217	B90/96	70
4142*	Hot Rolled Annealed	90/100	60/70	20/30	50/60	185/210	B90/95	55
	Annealed Cold Drawn	105/120	85/95	15/25	45/55	215/235	B96/100	65
4142/50	HR & CF	130 MIN	110 MIN	16 MIN	50 MIN	269/321	C28/34	50
	Heat Treated - 11/2 and under	125 MIN	105 MIN	16 MIN	50 MIN	269/321	C28/34	
	———— ———— - Over 11/2-21/2 incl.	115 MIN	95 MIN	16 MIN	50 MIN	269/321	C28/34	————
41L42/50	HR & CF - Over 4-7 incl.	110 MIN.	85 MIN	16 MIN	45 MIN	262/311	C26/33	63
	Heat Treated - Over 7-91/2 incl.	105 MIN	80 MIN	15 MIN	40 MIN	262/311	C26/33	
4150*	Hot Rolled Annealed	90/110	65/75	20/30	45/55	185/215	B90/96	52

** With the addition of .15/.35% lead, longitudinal mechanical properties are not appreciably affected and machinability is increased approximately 25%.
††1 ksi= 1000 psi.

TYPICAL MECHANICAL PROPERTIES OF STANDARD CARBON STEELS

These figures are NOT GUARANTEED.

- These figures show the APPROXIMATE ranges of mechanical properties of steel in common use in 1" Rounds and cannot be used as a basis of acceptance or rejection of material.
- They are NOT GUARANTEED and are given only as an indication of what may be expected and should under no circumstances be used in specifying the raw materials. It must not be assumed that these properties will be obtained in all cases, as they vary widely with permissible variations in analysis, size of section, rolling conditions, grain size, and methods of heat treatment.
- Dependable mechanical properties can only be obtained through carefully controlled heat treatment or special processing.

		MECHANICAL PROPERTIES				Typical Hardness		
ASTM/AISI Grade	Condition of Steel	Tensile Strength ksi††	Yield Strength ksi††	Elongation in 2" %	Reduction of Area %	BHN	Rockwell	Average Machinability % of CD 1212
1008	Hot Rolled	42/52	21/31	25/35	50/60	95/120	B60/67	–
	Cold Drawn	50/65	40/55	20/30	40/50	110/140	B63/80	55
1018**	Hot Rolled	55/70	35/50	30/40	55/65	120/140	B67/80	55
	Cold Drawn	70/85	60/75	18/25	45/55	150/180	B80/90	65
1020	Hot Rolled	55/70	35/50	30/40	55/65	120/140	B67/80	50
M1044	Hot Rolled	75/85	40/50	12/20	35/45	140/170	B80/87	–
1045	Hot Rolled	90/105	55/65	15/25	35/45	190/220	B90/98	55
	Cold Drawn	90/110	75/90	12/20	30/45	195/230	B90/99	58
1050	Hard Drawn							
	Stress Relieved							
	-.524 & Under	145 TYPICAL	100 MIN	5 MIN	–	253 MIN	C25 MIN	50
	-.587 - 1.000 incl.	155 TYPICAL	125 MIN	5 MIN	–	286 MIN	C30 MIN	50
	- Over 1.000	150 MIN	130 MIN	5 MIN	–	319 TYPICAL	C34 TYPICAL	50

** With the addition of .15/.35% lead, longitudinal mechanical properties are not appreciably affected and machinability is increased approximately 25%. †† ksi= 1000 psi.

TYPICAL MECHANICAL PROPERTIES OF STANDARD CARBON STEELS

These figures are NOT GUARANTEED.

ASTM/AISI Grade	Condition of Steel	MECHANICAL PROPERTIES				Typical Hardness		Average Machinability % of CD 1212
		Tensile Strength ksi††	Yield Strength ksi††	Elongation in 2" %	Reduction of Area %	BHN	Rockwell	
1095	Hot Rolled	130/150	75/95	7/17	10/25	260/300	C26/32	–
	Spheroidize Annealed	90/110	55/65	15/25	35/45	190/220	B90/99	42
1117*	Hot Rolled	65/75	40/50	25/35	55/65	135/155	B74/82	80
	Cold Drawn	80/90	65/80	15/20	45/55	150/190	B80/90	90
1137	Hot Rolled	90/105	55/70	15/25	35/50	180/220	B89/98	65
	Cold Drawn	90/110	75/90	9/19	25/35	190/225	B90/99	72
1141**	Hot Rolled Average	95/110	55/70	15/25	30/45	190/220	B90/99	63
	Cold Drawn	100/120	85/105	8/18	25/35	200/250	B93/C24	70
1144	Cold Drawn	100/120	90/110	7/17	20/35	210/250	B96/C24	85
Stress/	Hard Drawn							
	Stress Relieved (1144)							
	Thru 2"	115 MIN	100 MIN	8 MIN	25 MIN	235/285	C22/30	83
ASTM A 311	Over 2" Thru 3"	115 MIN	100 MIN	8 MIN	20 MIN	235/285	C22/30	83
Class B	Over 3" Thru 4-1/2"	115 MIN	100MIN	7 MIN	20 MIN	235/285	C22/30	83
Fatigue-Proof Elevated Temperature Drawn		140 MIN	125 MIN	5/15 MIN	15/30 MIN	280 MIN†	C30 MIN†	80

** With the addition of .15/.35% lead, longitudinal mechanical properties are not appreciably affected and machinability is increased approximately 25%.
† In the event of disagreement between hardness and tensile strength, the tensile strength shall govern. †† ksi= 1000 psi.

TYPICAL MECHANICAL PROPERTIES OF STANDARD STEELS

These figures are NOT GUARANTEED.

ASTM/AISI Grade	Condition of Steel	MECHANICAL PROPERTIES				Typical Hardness		Average Machinability % of CD 1212
		Tensile Strength ksi††	Yield Strength ksi††	Elongation in 2" %	Reduction of Area %	BHN	Rockwell	
4340	Hot Rolled Annealed	100/120	65/85	20/30	45/55	210/250	B95/C25	45
4820	Hot Rolled	105/115	68/78	20/30	50/60	205/235	B94/99	52
E52100	Annealed Cold Drawn	100/120	80/90	12/22	50/60	200/220	B93/100	40
8620**	Hot Rolled	80/95	60/70	18/25	55/65	165/200	B85/93	55
	Cold Drawn	95/105	80/90	15/25	50/60	200/220	B93/97	60
W-1	Spheroidize annealed	80/95	65/75	10/15	30/35	200/230	B94/97	43
O-1	Spheroidize annealed	90/105	75/85	10/15	25/30	200/240	B94/100	39

**** With the addition of .15/.35% lead, longitudinal mechanical properties are not appreciably affected and machinability is increased approximately 25%.
† In the event of disagreement between hardness and tensile strength, the tensile strength shall govern. †† ksi= 1000 psi.

NOMINAL PROPERTIES – AISI STAINLESS STEELS

Alloy Physical Properties	Type 304	Type 321	Type 347	Type 316	Type 317	Type 310	Type 405	Type 409	Type 430	Type 446
Physical Properties-AISI Stainless Steels										
Density ib./cu. In.	.28	.28	.28	.29	.29	.28	.27	1.28	.27	.27
low carbon steel = 1.00	1.01	1.01	1.01	1.02	1.02	1.01	.97	....	.96	.95
Specific Electrical Resistance										
at 68°F										
at microhms/cm.^{3}	70.00	71.00	71.00	72.30	72.30	79.00	60.00	61.00	59.00	67.00
microhms/in.^{3}	27.60	28.00	28.00	28.50	28.50	31.00	23.60	....	23.20	26.40
low carbon steel = 1.00	6.40	6.50	6.50	6.60	6.60	7.20	5.50	....	5.40	6.10
Melting Range °F.	2550-2590	2550-2590	2550-2590	2500-2550	2500-2550	2550-2650	2700-2790	2700-2790	2710-2750	2710-2750
Structure	Austenitic	Austenitic	Austenitic	Austenitic	Austenitic	Austenitic	Ferritic	....	Ferritic	Ferritic
Magnetic Permeability										
as annealed	U=1.00	U=1.00	U=1.00	U=1l.00	U=1.00	U=1.00	Fer-ro-mag-netic		Fer-ro-mag-netic	Fer-ro-mag-netic
after 10% reduction of area	U=1.10	U=1.10	U=1.10	U=1.10	U=1.10	...	Fer-ro-mag-netic		Fer-ro-mag-netic	Fer-ro-mag-netic
Specific Heat										
cal./°C./gm. (0°to 100°C)	.12	.12	.12	.12	.12	.12	.11	.11	.11	.12
B.t.u./°F./lb.(32°to 212°F.)	.12	.12	.12	.12	.12	.12	.11	.11	.11	.12
low carbon steel = 1.00										
(0°to 100°C.)	1.10	1.10	1.10	1.10	1.10	1.10	1.00	....	1.00	1.10
Thermal Conductivity										
cal./cm^2/sec./0C/cm., at 100°c	.03	.03	.03	.03	.03	.03	....	....	.00	.05
B.t.u./sq.ft./hr./°F./in., at 212°F	113.00	112.00	112.00	108.00	108.00	93.00	....	....	181.0	145.0

NOMINAL PROPERTIES – AISI STAINLESS STEELS

Alloy Physical Properties	Type 304	Type 321	Type 347	Type 316	Type 317	Type 310	Type 405	Type 409	Type 430	Type 446
Physical Properties-AISI Stainless Steels										
low carbon steel = 1.00 at 100°C.	.33	.32	.32	.31	.31	.27	....	....	.52	.42
cal./cm^2./sec./°C./cm.,at 500°C.	.05	.05	.05	.05	.05	.04	....	....	.06	.05
B.t.u./sq.ft./hr./°F./in.,at 932°F.	150.00	153.00	153.00	145.00	145.00	125.00	....	....	182.00	169.00
Coefficient of Thermal Expansion										
per °F.x10^{-6} (32°to 212°F.) low carbon steel = 1.00	9.60	9.30	9.30	8.40	8.40	8.00	6.00	6.00	5.80	5.90
(32° to 212°F.)	1.45	1.40	1.40	1.27	1.27	1.21	.91		.88	.90
per °F.x10^{-6} (32° to 932°F.)	10.20	10.30	10.30	9.60	9.60	9.20	6.70		6.30	6.30
Mechanical Properties										
at room Temperatures	Annealed	Annealed	Annealed	Annealed	Annealed	Annealed	Annealed	Annealed	Annealed	Annealed
Tensile Strength 10^3										
lb./sq.in.	75-100	75-100	75-100	75-100	75-100	75-110	6-90	65-105	60-90	70-100
Yield Strength 10^3 lb./sq.in.	30-60	30-60	30-60	30-60	30-60	30-70	30-60	33-65	35-65	40-70
Modulus of Elasticity 10^6										
lb./sq.in.	29	29	29	29	29	29	28	29	29	29
Elongation in 2",%	35-60	35-60	35-60	35-60	35-60	30-55	20-40	20-35	20-30	18-25
Reduction of Area, %	60-80	60-80	60-80	60-80	60-80	60-80	50-70	....	35-60	25-50
Charpy Impact Strength, ft-lb.	77	77	77	77	77	77	60	....	....	....

MECHANICAL PROPERTIES – AISI STAINLESS STEELS

Alloy Physical Properties	Type 304	Type 321	Type 347	Type 316	Type 317	Type 310	Type 405	Type 409	Type 430	Type 446
Mechanical Properties										
Izod Impact Strength,ft-lb.	75-110	75-110	75-110	75-110	75-110	75-110	60-100	....	25-100	....
Endurance Limit (Fatigue), 103lb./sq. In.	35	45	45	43	43	....	....	....	35-50	35-55
Brinell Hardness Number	135-190	135-190	135-190	135-190	135-190	150-210	150-210	....	150-190	150-207
Rockwell Hardness Number	B75-90	B75-90	B75-90	B75-90	B75-90	B80-95	B80-95	B70-85	B80-90	B80-95
Olsen Cup Value, in	....	....	....	....	....	....	....	....	....	....
Stress Causing 1% Elongation (Creep) in 10,000 Hours										
At 1000°F.,lb./sq.In.	17,000	17,000	17,000	25,000	25,000	18,000	....	....	8,500	6,000
At 1200°F.,lb./sq. In.	6,000	6,000	6,000	15,000	15,000	8,000	....	....	2,000	1,500
At 1350°F.,lb./sq. In.	3,000	3,000	3,000	7,000	7,000	3,000	....	....	1,200	600
At 1500°F.,lb./sq. In.	1,000	1,000	1,000	3,000	3,000	900	....	....	....	....
Scaling Temperature, °F, (approximate)	1,650	1,650	1,650	1,650	1,650	2,000	1,300	1,300	1,550	2,100
Initial Forging Temperature, 0°F.	2,200	2,200	2,200	2,200	2,200	2,150	2,000	2,100	2,000	2,000
Finishing Forging Temperature, °F.	Not under 1600-1700	Not under 1600-1700	Not under 1600-1700	Not under 1600-1700	Not under 1600-1700	Not under 1600-1700	....	Not over 1,400	Not over 1,400	Not over 1,400-1450
Annealing Treatment	Heat to 1900-2000°F and Quench	Heat to 1900-2000°F and Quench	Heat to 1900-2000°F and Quench	Heat to 1950-2050°F and Quench	Heat to 1950-2050°F and Quench	Heat to 2000-2100°F and Quench	Heat to 1350-1500°F and Quench	Air-cool from 1350-1500°F	Air-cool from 1400-1500°F	Rapid cool from 1550-1650°F

MECHANICAL PROPERTIES – AISI STAINLESS STEELS

Alloy Physical Properties	Type 304	Type 321	Type 347	Type 316	Type 317	Type 318	Type 405	Type 409	Type 430	Type 446
Abrasion Resistance	Good	GOOD	GOOD	GOOD	GOOD	GOOD	FAIR	.....	FAIR	FAIR
Cold Forming										
(Drawing-Stamping)	Good	GOOD	GOOD	GOOD	GOOD	GOOD	FAIR	FAIR	GOOD	POOR
Machinability										
(Bessemer Screw stock 100%)	about 45%	ABOUT 45%	ABOUT 45%	ABOUT 45%	ABOUT 45%	ABOUT 45%	ABOUT 45%	.....	ABOUT 45%	ABOUT 45%
Welding (Arc, Gas, Resistance, Atomic Hydrogen)	Very Good; anneal heavier than 1/8"-3/16" for maximum corrosion resistance	Very Good; not necessary to anneal.	Very Good; not necessary to anneal.	Very Good; anneal for maximum corrosion resistance.	Very Good; anneal for maximum corrosion resistance.	Very Good; anneal for maximum corrosion resistance.	Good; welding does not harden appreciably	Good	Fair; welds are brittle when cold. Slight response to anneal.	Fair; welds are brittle when cold. Slight response to anneal.
Precautions (See Notes)	(A)	(D)	(D)	(A)	(A)	(A)	(B)		(C)	(C)

(A) Preheat slowly to 1600°F then heat rapidly to the forging temperature. Exposure to temperatures between 800° to 1600°F. produces marked susceptibility to intergranular corrosion. If the metal is unattacked, this can be cured by repeating the annealing treatment.

(B) Preheat slowly to 1450°F then heat rapidly to 2100°F for forging. Maximum corrosion resistance of Type 410 is developed only in the heat-treated condition. (Temper below 850°F. or above 1100°F.)

(C) In forging, preheat slowly to 1450°F. Excessive grain growth takes place above 2000°F. Expert welding is required to avoid excessive grain growth. Prolonged exposure at 850-950°F produces cold brittleness. To prevent this, heat to 1550-1650°F and quench.

(D) For maximum corrosion resistance in high temperature service, heat to 1550°F, hold 2 hours and air-cool.

METRIC SYSTEM

LENGTH	
1 metre (m)	= 10 decimeters (dm) = 100 centimeters (cm) = 1,000 millimeters (mm)
1 dekameter	= 10 meters (m)
1 hectometer	= 100 meters (m)
1 kilometer	= 1,000 meters (m)
WEIGHT	
1 gram (g)	= 10 decigrams (dg) = 100 centigrams (cg) = 1,000 milligrams (mg)
1 dekagram (dkg)	= 10 grams (g)
1 hectogram (hg)	= 100 grams (g)
1 kilogram (kg)	= 1,000 grams (g)
1 metric ton	= 1,000 kilograms (kg) = 1,000,000 grams (g)
VOLUME & CAPACITY	
1 liter (l)	= 1 cubic decimeter (dm3) = 10 deciliter (dl) = 100 centiliters (cl) = 1,000 milliliters (ml) = 1,000 cubic centimeters (cm2 or cc)
1 dekaliter (dkl)	= 10 liters (1)
1 hectoliter (hl)	= 100 liters (1)
1 kiloliter (kil	= 1 cubic meter (m3) = 1 stere (s) = 1,000 liters (l)
AREA	
1 centare (ca)	= 1 Square meter (m2) = 100 square decimeters (dm2) = 10,000 square centimeters (cm2) = 1,000,000 square millimeters (mm2)
1 are (a)	= 1 square dekameter (dkm2) = 100 square meters (m2)
1 hectare (ha)	= 100 ares (a) = 10,000 square meters (m2)
1 sq. kilometer (km2)	= 1,000,000 square meters (m2)
OTHER PREFIXES OCCASIONALLY USED:	
micro - one millionth	myria - 10,000 times
deca - 10 times (same as deka)	mega - 1,000,000 times

METRIC SYSTEM EQUIVALENTS

LENGTH EQUIVALENTS						
Unit	**Millimeters**	**Centimeters**	**Inches**	**Feet**	**Yards**	**Meters**
1 Millimeter =	1	1	.03937	.003281	.001094	.001
1 Centimeter =	10	1	.3937	.032808	.010936	.01
1 Inch=	25.4001	2.54001	1	.083333	.027778	.025400
1 Foot=	304.801	30.4801	12	1	.333333	.304801
1 Yard=	914.402	91.4402	36	3	1	.914402
1 Meter=	1000	100	39.37	3.28083	1.09361	1
Unit	**Feet**	**Yards**	**Meters**	**Rods**	**Furlongs**	**Miles (Statute)**
1 Rod=	16.5	5.5	5.02921	1	0.25 (1/40)	.003125 (1/320)
1 Furlong =	660	220	201.168	40	1	.125 (1/8)
1 Kilometer =	3280.8	1093.6	1000	199	4.971	0.62137
1 Mile (Statute) =	5280	1760	1609.35	320	8	1

1 Nautical Mile = 6080.2 feet = 1.15155 statute miles = 1/.3 league.
1 light year = 5.879 trillion miles = 9.46 trillion kilometers.

WEIGHT EQUIVALENTS							
Unit	**Grains**	**Grams**	**Ounces (Troy)**	**Ounces (Avoir.)**	**Pounds (Troy)**	**Pounds (Avoir.)**	**Kilograms**
1 Grain=	1	.064799	.002083	.002286	.000174	.000143	.000065
1 Gram=	15.4324	1	.032151	.035274	.002679	.002205	.001
1 Ounce (Troy)=	480	31.1035	1	1.09714	083333	.068571	.031104
1 Ounce (Avoir.) =	437.5	28.3495	.911458	1	.075955	.0625	.028350
1 Pound (Troy)=	5760	373.242	12	13.1657	1	.822857	.373242
1 Pound (Avoir.)=	7000	453.592	14.5833	16	1.21528	.1	453592
1 Kilogram	15432.4	1000	32.1507	35.2740	2.67923	2.20462	1

Unit	**Kilograms**	**Pounds (Troy)**	**Pounds (Avoir.)**	**Metric Tons**	**Net (Short) Tons**	**Gross (Long) Tons**
1 Metric Ton =	1000	2679.23	2204.62	1	1.10231	.984206
1 Net (Short) Ton =	907.185	2430.56	2000	.9 07185	1	.892857
1 Gross (Long) Ton=	1016.05	2722.22	2240	1.01605	1.12	1

AREA EQUIVALENTS				
Unit	**Square Inches**	**Square Feet**	**Square Yards**	**Square Meters**
1 Square Foot=	144	1	.1111	.09290
1 Square Yard=	1296	9	1	.83613
1 Square Meter =	1550	10.7639	1.19599	1
1 Square Rod=	39204	272.25	30.25	25.293
1 Are=	155000	1076.39	119.599	100
1 Acre=	6272640	43560	4840	4046.86
1 Square Mile (640 Acres) =	–	27878400	3097600	2589999
1 Square Kilometer =	–	10763867	1195985	1000000

TABLE 1.3 — SHEET AND PLATE THICKNESS TOLERANCES1

(Applicable to ail alloys not included in the Aerospace Alloys Table 1.6 or Not Specified for Aerospace Applications)

Note: Also applicable to alloys when supplied as Alclad.

WEIGHT EQUIVALENTS									
Specified Thickness in.		Up thru 39.37	Over 39.37 Thru 59.06	Over 59.06 Thru 78.74	Over 78.74 Thru 98.43	Over 98.43 Thru 118.11	Over 118.11 Thru 137.80	Over 137.80 Thru 157.48	Over 157.48 Thru 177.17
Over	Thru	Tolerance – in. plus and minus							
0.0059	0.010	0.0010	0.0015	–	–	–	–	–	–
0.010	0.016	0.0010	0.0015	–	–	–	–	–	–
0.016	0.025	0.0020	0.0030	0.0035	–	–	–	–	–
0.025	0.032	0.0020	0.0025	0.0035	0.0040	–	–	–	–
0.032	0.039	0.0020	0.0030	0.0035	0.0045	0.006	–	–	–
0.039	0.047	0.0025	0.0035	0.0045	0.0055	0.007	0.008	–	–
0.047	0.063	0.0030	0.0035	0.006	0.007	0.009	–	–	
0.063	0.079	0.0035	0.0040	0.0055	0.007	0.008	0.010	–	–
0.079	0.098	0.0035	0.0045	0.006	0.007	0.009	0.011	–	–
0.098	0.126	0.0045	0.0055	0.007	0.009	0.011	0.013	–	–
0.126	0.158	0.0055	0.007	0.009	0.011	0.013	0.015	–	–
0.158	0.198	0.007	0.009	0.011	0.013	0.015	0.018	–	–
0.197	0.248	0.009	0.011	0.013	0.015	0.018	0.022	0.027	–
0.248	0.315	0.012	0.014	0.015	0.018	0.022	0.027	0.035	0.043
0.315	0.394	0.015	0.017	0.020	0.023	0.027	0.033	0.041	0.051
0.394	0.630	0.023	0.023	0.027	0.032	0.035	0.043	0.053	0.065
0.630	0.984	0.031	0.031	0.037	0.043	0.047	0.058	0.070	0.085
0.984	1.575	0.039	0.039	0.047	0.055	0.065	0.075	0.090	0.105
1.575	2.362	0.055	0.055	0.060	0.070	0.085	0.100	0.115	–
2.362	3.150	0.075	0.075	0.085		0.105	0.125	–	–
3.150	3.937	0.100	0.100	0.115	0.125	0.130	0.160	–	–
3.937	6.299	0.130	0.130	0.145	0.165	–	–	–	–

Note: Capability to provide tolerances may vary with supplier.

[1] When dimension tolerance is specified other than as an equal bilateral tolerance, the value of the standard tolerance is that which applies to the mean of the maximum and minimum dimensions permissible under tolerance for the dimension under consideration.

TABLE 1.1 — WEIGHT CONVERSION FACTORS

Where weights of aluminum sheet and plate have been computed on the basis of 0.100 pounds per cubic inch, the weights for specific alloys can be determined by means of the "Weight Conversion Factors" listed in the following table.

Aluminum Alloy	Density Lb./cu. ins.	Weight Conversion Factor
1060	0.0975	0.975
1100	0.0980	0.980
1350	0.0975	0.975
2014	0.101	1.01
2024	0.101	1.01
2219	0.103	1.03
2036	0.100	1.00
2124	0.100	1.00
3003	0.099	0.99
3004	0.098	0.98
3005	0.098	0.98
3105	0.098	0.98
5005	0.098	0.98
5050	0.097	0.97
5052	0.097	0.97
5083	0.096	0.96
5086	0.096	0.96
5154	0.096	0.96
5252	0.096	0.96
5254	0.096	0.96
5454	0.097	0.97
5456	0.096	0.96
5457	0.097	0.97
5652	0.097	0.97
5657	0.097	0.97
6061	0.098	0.98
7049	0.103	1.03
7050	0.102	1.02
7075	0.101	1.01
7178	0.102	1.02
7475	0.101	1.01

APPROXIMATE WEIGHT OF VARIOUS METALS

To find the weight of various metals, multiply the contents in cubic inches by the number shown below. The result will be the approximate weight in pounds.

Iron	.27777	Brass	.3112
Steel	.28360	Lead	.41015
Copper	.32118	Zinc	.41015
Tin	.26562	Aluminum	.09375

GLOSSARY OF TERMS

Abrasion - The process of rubbing, grinding, or wearing away by friction.

Acid Steel - Steel melted in a furnace with an acid bottom and lining and under a slag containing an excess of an acid substance such as silica.

Activation - The changing of the passive surface of a metal to a chemically active state. Contrast with passivation.

Aging - In a metal or alloy, a change in properties that generally occurs slowly at room temperature and more rapidly at higher temperatures.

Air - Hardening Steel - A steel containing sufficient carbon in other alloying elements to harden fully during cooling in air or other gaseous mediums form a temperature above its transformation range. The term should be restricted to steels that are capable of being hardened by cooling in air in fairly large sections, about two inches or more in diameter. Same as self-hardening steel.

Alclad - Composite sheet produced by bonding either corrosion-resistant aluminum alloy or aluminum of high purity to base metal of structurally stronger aluminum alloy.

Alloy Steel - Steel containing significant quantities of alloying elements (other than carbon and the commonly accepted amounts of manganese, silicon, sulphur, and phosphorus) added to affect changes in the mechanical or physical properties.

Aluminizing - Forming an aluminum or aluminum alloy coating on a metal by hot dipping, hot spraying, or diffusion.

Annealing - Heating to and holding at a suitable temperature and then cooling at a suitable rate, for such purposes as reducing hardness, improving machine ability, facilitating cold working, producing a desire, micro structure, or obtaining desired mechanical, physical, or other properties. When applicable, the following more specific terms should be used: black annealing, blue annealing, box annealing, bright annealing, flame annealing, graphitizing, intermediate annealing, isothermal annealing, malleablizing, process annealing, quench annealing, recrystallizing annealing and spheroidizing. When applied to ferrous alloys, the term" annealing", without qualification, implies full annealing. When applied to non ferrous alloys, the term "annealing" implies a heat treatment designed to soften a cold worked structure by recrystallizing or subsequent grain growth or to soften an age-harden alloy by causing a nearly complete precipitation of the second phase in relatively course form. Any process or annealing will usually reduce stresses, but if the treatment is applied the sole purpose of such relief, it should be designated stress relieving.

Atomic-Hydrogen Welding - Arc welding with heat from and arc between two tungsten or other suitable electrodes in a hydrogen atmosphere. The use of pressure and filler metal is optional.

Austempering - Quenching a ferrous alloy from a temperature above the transformation range, in a medium having a rate of heat abstraction high enough to prevent the formation of high-temperature transformation products, and then holding the alloy, until transformation is complete, as a temperature below that of pearlite formation and above that of all martensite formation.

Austenite - A solid solution of one or more elements in face-centered cubic iron.

Austenitizing - Forming austenite by heating a ferrous alloy into the transformation range (partial austenitizing) or above the transformation range (complete austenitizing).

Bainite - A decomposition product of austenite consisting of an aggregate of ferrite and carbide. In general, it forms at temperatures lower than those where very fine pearlite forms and higher than that where martensite begins to form on cooling. Its appearance is feathery if formed in the upper part of the temperature range; acicular, resembling tempered martensite, if formed in the lower part.

Banded Structure - A segregated structure of nearly parallel bands aligned in the direction of working.

Bark - The decarburized layer just beneath the scale that results from heating steel in an oxidizing atmosphere.

Basic Steel - Steel melted in a furnace with a basic bottom and lining and under a slag containing an excess of a basic substance such as a magnesia or lime.

Bearing Load - A compressive load supported by a member, usually a tube or a collar, along a line where contact is made with a pin, rivet, axle, or shaft.

Bearing Strength - The maximum bearing load at failure divided by the effective bearing area. In a pinned or riveted joint, the effective area is calculated as the product of the diameter of the hole and the thickness of the bearing member.

Bent Radius - The inside radius of a bent section.

Bend Test -A test for determining relative ductility of metal that is to be formed, usually sheet, strip, plate, or wire, and for determining soundness and toughness of metal. The specimen is usually bent over a specified diameter through a specified angle for a specified number of cycles.

Bessemer Process -A process for making steel by blowing air through molten pig iron contained in a refractory lined vessel so as to remove by oxidation most of the carbon, silicon, and manganese.

Billet - A solid semi-finished round or square product that has been hot worked by forging, rolling or extrusion. An iron or steel billet has a minimum width or thickness of 1 1/2 in. and the cross-sectional area varies from 2 1/4 to 36 sq. in. For non-ferrous metals, it may also be a casting suitable for finished or semi-finished rolling or for extrusion.

Blister -A defect in metal, on or near the surface, resulting from the expansion of gas in a subsurface zone. Very small blisters are called "pinheads" or"pepper blisters".

Bloom -A semi-finished hot rolled product, rectangular in cross section, produced on a blooming mill for iron and steel, the width is not more than twice the thickness, and the cross-sectional area is usually not less than 36 sq. in. Iron and steel blooms are sometimes made by forging.

Blue Annealing - Heating hot rolled ferrous sheet in an open furnace to a temperature within the transformation range and then cooling in air in order to soften the metal. The transformation of a bluish oxide on the surface is incidental.

Blue Brittleness - Brittleness exhibited by some steels after being heated to some temperature within the range of 300° to 6S0°F, and more especially if the steel is worked at the elevated temperature. Killed steels are virtually free of this kind of brittleness.

Bluing - Subjecting the scale-free surface of a ferrous alloy to the action of air, stream, or other agents at a suitable temperature, thus forming a thin blue film of oxide and improving the appearance and resistance to corrosion. NOTE: This term is ordinarily applied to sheet, strip, or finished parts. It is used also to denote the heating of springs after fabrication in order to improve their properties.

Box Annealing -Annealing a metal or alloy in a sealed container under conditions that minimize oxidization. In box annealing a ferrous alloy, the charge is usually heated slowly to a temperature below the transformation range, but sometimes above or within it, and then cooled slowly; this process is also called “close annealing” or”pot annealing’’.

Bright Annealing - Annealing in a protective medium to prevent discoloration of the bright surface.

Brinell Hardness Test -A test for determining the hardness of a material by forcing a hard steel or carbide ball of specified diameter into it under a specified load.

Brittle Fracture - Fracture with little or no plastic deformation.

Burning - (1) Permanently damaging a metal or alloy by heating to cause either incipient melting or intergranular oxidation. See overheating. (2) In grinding getting the work hot enough to cause discoloration or to change the microstructure by tempering or hardening.

Burnishing - Smoothing surfaces through frictional contact between the work and some hard pieces of material such as hardened metal balls.

Camber - (1) Deviation from edge straightness usually referring to the greatest deviation of side edge from a straight line. (2) Sometimes used to denote crown in rolls where the center diameter has been increased to compensate for deflection caused by the rolling pressure.

Canning - A dished distortion in a flat or nearly flat surface sometimes referred to as “oil canning”.

Capped Steel - Semikilled steel cast in a bottle-top mold and covered with a cap fitting into the neck of the mold. The cap causes the top metal to solidify. Pressure is built up in the sealed-in molten metal and results in a surface condition much like that of rimmed steel.

Carbonitriding - Introducing carbon and nitrogen into a solid ferrous alloy by holding above Ac, in an atmosphere that contains suitable gases such as hydrocarbons, carbon monoxide, and ammonia. The carbonitrided alloy is usually quench hardened.

Carbon Steel - Steel containing carbon up to about 2% and only residual quantities of other elements except those added for deoxidization, with silicon usually limited to 0.60% and manganese to about 1.65%. Also termed “plain carbon steel’; “ordinary steel’; and “straight carbon steel’’.

Carburizing - Introducing carbon into a solid ferrous alloy by holding above Ac, in contact with a suitable carbonaceous material, which may be a solid, liquid, or gas. The carburized alloy is usually quench hardened.

Case Hardening - Hardening a ferrous alloy so that the outer portion, or case, is made substantially harder than the inner portion, or core. Typical processes used for case hardening are carburizing, cyaniding, carbonitriding, nitriding, induction hardening, and flame hardening.

Cementite - A compound of iron and carbon, known chemically as iron carbide and having the approximate chemical formula Fe_3C. It is characterized by an orthorhombic crystal structure. When it occurs as a phase in steel, the chemical composition will be altered by the presence of manganese and other carbide-forming elements.

Centrifugal Casting - A casting made by pouring metal into a mold that is rotated or revolved.

Ceramic Tools - Cutting tools made from fused, sintered, or cemented metallic oxides.

Chamfer- (1) A beveled surface to eliminate an otherwise sharp corner. (2) A relieved angular cutting edge at tooth corner.

Charpy Test - A pendulum-type single-blow impact test in which the specimen, usually notched, is supported at bath ends as a simple beam and broken by a falling pendulum. The energy absorbed, as determined by the subsequent rise of the pendulum, is a measure of impact strength or notch toughness.

Chemical Milling - Removing metal stock by controlled selective chemical etching.

Chromadizing (Chromodizing, Chromatizing) - Forming an acid surface to improve paint adhesion on aluminum or aluminum alloys, mainly aircraft skins, by treatment with a solution of chromic acid.

Chromizing -A surface treatment at elevated temperature, generally carried out in pack, vapor, or salt bath, in which an alloy is formed by the inward diffusion of chromium into the base metal.

Clad Metal -A composite metal containing two or three layers that have been bonded together. The bonding may have been accomplished by corolling, welding, casting, heavy chemical deposition, or heavy electroplating.

Coil Breaks - Creases or ridges across a metal sheet transverse to the direction of coiling, occasionally occurring when the metal has been coiled hot and uncoiled cold.

Cold Short - A condition of brittleness existing in some metals at temperatures below the recrystallization temperature.

Cold Shut - (1) A discontinuity that appears on the surface of cast metal as a result of two streams of liquid meeting and failing to unite. (2) A portion of the surface of a forging that is separated, in part, from the main body of metal oxide.

Cold Work - Permanent strain produced by an external force in a metal below its recrystallization temperature.

Compressive Strength - The maximum compressive stress that a material is capable of developing based on original area of cross section. In the case of a material which fails in compression by shattering fracture, the compressive strength has a very definite value. In the case of materials which do not fail in compression by a shattering fracture, the value obtained for compressive strength is an arbitrary value depending upon the degree of distortion that is regarded as indicating complete failure of the material.

Continuous Casting - A casting technique in which an ingot, billet, tube, or other shape is continuously solidified while it is being poured, so that its length is not determined by mold dimensions.

Corrosion Embrittlement - The severe loss of ductility of a metal resulting from corrosive attack, usually intergranular and often not visually apparent.

Corrosion Fatigue - Effect of the application of repeated or fluctuating stresses in a corrosive environment characterized by shorter life than would be encountered as a result of either the repeated or fluctuating stresses alone or the corrosive environment alone.

Covered Electrode -A filler-metal electrode, used in arc welding, consisting of a metal core wire with a relatively thick covering which provides protection for the molten metal from the atmosphere, improves the properties of the weld metal and stabilizes the arc. The covering is usually mineral or metal powders mixed with cellulose or other binder.

Creep - Time-dependent strain occurring under stress. The creep strain occurring at the diminishing rate is called primary creep; that occurring at a minimum and almost constant rate, secondary creep; that occurring at an accelerating rate, tertiary creep.

Creep Limit - (1) The maximum stress that will cause less then a specified quantity of creep in a given time. (2) The maximum nominal stress under which the creep strain rate decreases continuously with time under constant load and at a constant temperature. Sometimes used synonymously with creep strength.

Creep Strength - (1) The constant nominal stress that will cause a specified quantity of creep in a given time at a constant temperature. (2) The constant nominal stress that will cause a specified creep rate at a constant temperature.

Crevice Erosion - A type of concentration-cell corrosion; corrosion of a metal that is caused by the concentration of dissolved salts, metal ions, oxygen, or other gases, and such, in crevices or pockets remote from the principal fluid stream, with a resultant building up of differential cells that ultimately cause deep pitting.

Critical Cooling Rate - The minimum rate of continuous cooling just sufficient to prevent undesired transformations. For steel, the slowest rate at which it can be cooled from above the upper critical temperature to prevent the decomposition of austenite at any temperature above the M,

Critical Point - (1) The temperature or pressure at which a change in crystal structure phase, or physical properties occurs. Same as a transformation temperature. (2) In an equilibrium diagram, that specific value of composition, temperature and pressure, or combinations thereof, at which the phases of a heterogeneous systems are in equilibrium.

Cross Rolling - The rolling of a sheet so that the direction of rolling changed about 90° from the direction of the previous rolling.

Crown - A counter on a sheet or roll where the thickness of diameter increases from edge to center.

Cutting Speed - The linear or peripheral speed of relative motion between the tool and workpiece in the principal direction of cutting.

Cyaniding - Introducing carbon and nitrogen into a solid ferrous alloy by holding above Ac, in contact with molten cyanide or suitable composition. The cyanided alloy is usually quench hardened.

DC (Direct Chill) Casting -A continuous method of making ingots or billets for sheet or extrusion by pouring the metal into a short mold. The base of the mold is a platform that is gradually lowered while the metal solidifies, the frozen shell of metal acting as a retainer for the liquid metal below the wall of the mold. The ingot is usually cooled by the impingement of water directly on the mold or on the walls of the solid metal as it is lowered. The length of the ingot is limited by the depth to which the platform can be lowered: therefore, it is often called semi-continuous casting.

Decarburization - The loss of carbon from the surface of the ferrous alloy as a result of heating in a medium that reacts with the carbon at the surface.

Drawing - (1) Forming recessed parts by forcing the plastic flow of metal in dies. (2) Reducing the cross section of wire or tubing by pulling it through a die. (3) A misnomer of tempering.

Drop Forging -A forging made with a drop hammer.

Drop Hammer - A forging hammer that depends on gravity for its force.

Ductility- The ability of a material to deform plastically without fracturing, being measured by elongation or reduction of area in a tensile test, by height of cupping in an Erichsen test or by other means.

Duralumin (obsolete) -A term formerly applied to the class of age-hardened aluminum copper alloys containing manganese, magnesium, or silicon.

Earing - The formation of scallops (ears) around the top edge of a drawn part caused by differences in the directional properties of the sheet metal used.

Eddy-Current Testing - Nondestructive testing method in which eddy-current flow is induced in the test object. Changes in the flow caused by variations in the object are reflected into a nearby coil or coils for subsequent analysis by suitable instrumentation and techniques.

Elastic Limit - The maximum stress to which a material may be subjected without any permanent strain remaining upon complete release of stress.

Elongation - In tensile testing, the increase in gauge length, measured after fracture of the specimen within the gauge length, usually expressed as a percentage of the original gauge length.

Endurance Limit - Same as fatigue limit.

Fatigue - The phenomenon leading to fracture under repeated or fluctuating stresses having a maximum of value less than the tensile strength of the material. Fatigue fractures are progressive, beginning as minute cracks that grow under the action of fluctuating stress.

Fatigue Life - The number of cycles of stress that can be sustained prior to failure for a stated test condition.

Fatigue Limit - The maximum stress below which a material can presumably endure an infinite number of stress cycles. If the stress is not completely reversed, the value of the mean stress, the minimum stress or the stress ratio should be stated.

Fatigue Strength - The maximum stress that can be sustained for a specified number of cycles without failure, the stress being completely reversed within each cycle unless otherwise stated.

Ferrite - A solid solution of one or more elements in body-centered cubic iron. Unless otherwise designated (for instance, chromium ferrite), the solute is generally assumed to be carbon. On some equilibrium diagrams there are two ferrite regions separated by an austenite area. The lower area is alpha ferrite; the upper, delta ferrite. If there is no designation, alpha ferrite is assumed.

Ferrite Banding - Parallel bands of free ferrite aligned in the direction of working. Sometimes referred to as ferrite streaks.

Fiber Stress- Local stress through a small area (a point of line) on a section where the stress is not uniform, as in a beam under a bending load.

Flakes - Short, discontinuous internal fissures in ferrous metals attributed to stresses produced by localized transformations and decreased solubility of hydrogen during cooling after hot working. In a fractured surface, flakes appear as bright silvery areas; on an etched surface they appear as short discontinuous cracks. Also called “shatter cracks” and “snowflakes”.

Flame Annealing - Annealing in which the heat is applied directly by a flame.

Flame Hardening - Quench hardening in which the heat is applied directly by a flame.

Flash - (1) In forging, the excess metal forced between the upper and lower dies. (2) In die casting, the fin of metal which results from leakage between the mating die surfaces. (3) In resistance butt welding, a fin formed perpendicular to the direction of app lied pressure.

Flash Welding - A resistance butt welding process in which the weld is produced over the entire abutting surface by pressure and heat, the heat being produced by electric arcs between the members being welded.

Foil - Metal in sheet form less then 0.006 in. in thickness.

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

Fracture Test- Breaking a specimen and examining the fractured surface with the unaided eye or with a low-power microscope to determine such things as composition, grain size, case depth, soundness, and presence of defects.

Free Machining - Pertains to the machining characteristics of an alloy to which an ingredient has been introduced to give small broken chips, lower power consumption, better surface finish, and longer tool life; among such additions are sulphur or lead to steel, lead to brass, lead and bismuth to aluminum, and sulphur or selenium to stainless steel.

Full Annealing - Annealing a ferrous alloy by austenitizing and then cooling slowly through the transformation range. The ausenitizing temperature to hypoeutectoid steel is usual above Ac3; and for hypereutectoid steel, usually between Ac_3; and Ac_1 and Ac_{cm}..

Galling - Developing a condition on the rubbing surface of one or bath mating parts where excessive friction between high spots results in localized welding with substantial spalling and a further roughening of the surface.

Galvanic Corrosion - Corrosion associated with the current of a galvanic cell consisting of two dissimilar conductors in an electrolyte or two similar conductors in dissimilar electrolytes. Where the two dissimilar metals are in contact, the resulting action is referred to as “couple action”.

Grain Size- (1) For metals, a measure of the areas or volumes of grains in a polycrystalline material, usually expressed as an average when the individual sizes are fairly uniform. Grain sizes are reported in terms of grains per unit area or volume, average diameter, or as a grain-size number derived from area measurements.

Granular Fracture - A type of irregular surface produced when metal is broken, that is characterized by a rough, grain-like appearance as differentiated from a smooth silky, fibrous, type. It can be sub-classified into transgranular and intergranular forms. This type of fracture is frequently called crystalline fracture, but the inference that the metal has crystallized is not justified.

Graphitizing - Annealing a ferrous alloy in such a way that some or all of the carbon is precipitated as graphite.

Gray Cast Iron - A cast iron that gives a gray fracture due to the presence of flake graphite. Often called gray iron.

Grinding Cracks - Shallow cracks formed in the surface of relatively hard materials because of excessive grinding heat or the high sensitivity of the material.

Gun Drill -A drill, usually with one or more flutes and coolant passages through the drill body, used for deep hale drilling.

Hammer Forging - Forging in which the work is deformed by repeated blows. Compare with press forging.

Hard Chromium - Chromium deposited for engineering purposes, such as increasing the wear resistance of sliding metal surfaces, rather than as a decorative coating. It is usually applied directly to basis metal and customarily thicker than a decorative deposit.

Hardenability - In a ferrous alloy, the property that determines the depth and distribution of hardness induced by quenching.

Hardening - Increasing the hardness by suitable treatment, usually involving heating and cooling.

Heat-Affected Zone-That portion of the base metal which was not melted during brazing, cutting, or welding, but whose microstructure and physical properties were altered by the heat.

Homogenizing - Holding at high temperature to eliminate or decrease chemical segregation by diffusion.

Honing - Removing stock generally on the internal cylindrical surface of a workpiece with an abrasive stick mounted in a holder.

Hot Shortness - Brittleness in metal in the hot forming range.

Hot Top - (1) A reservoir thermally insulated or heated, to hold molten metal on top of a mold to feed the ingot or casting as it contracts on solidifying to avoid having "pipe" or voids.

Immersed Scanning - In ultrasonics, a planned, systematic movement of the beam relative to the abject being inspected, the search unit being coupled to this abject through a column of liquid. In most cases the abject and the search unit are submerged in water.

Impact Energy (Impact Value) - The amount of energy required to fracture a material, usually measured by means of an Izod or Charpy test. The type of specimen and testing conditions affect the values and therefore should be specified.

Impact Test - A test to determine the behaviour of materials when subjected to high rates of loading, usually in bending, tension, or torsion. The quantity measured is the energy absorbed in braking the specimen by a single blow, as in the Charpy or Izod test.

Inclusions - Nonmetallic materials in a solid metallic matrix.

Induction Hardening - Quench hardening in which the heat is generated by electrical induction.

Inert-Gas Shielded-Arc Welding - Arc welding in an inert gas such as argon or helium.

Ingot Iron - Commercially pure open-hearth iron.

Investment Casting - (1) Casting metal into a mold produced by surrounding (investing) an expendable pattern with a refractory slurry that sets at room temperature after which the wax, plastic, or frozen mercury pattern is removed through the use of heat. Also called precision casting, or lost-wax process. (2) A casting made by the process.

Izod Test -A pendulum type of single blow impact test in which the specimen, usually notched, is fixed atone end and broken by a falling pendulum. The energy absorbed, as measured by a subsequent rise of the pendulum, is a measure of impact strength or notch toughness.

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

Kip - A load of 1000 lbs.

Laminations - Metal defects with separation or weakness generally aligned parallel to the worked surface of the metal. May be the result of pipe, blisters, seams, inclusions, or segregation elongated and made directional by working. Lamination defects may also occur in metal-powder compacts.

Lap -A surface defect, appearing as a seam, caused by folding over hot metal, fins, or sharp corners and then rolling or forging them into a surface, but not welding them.

Light Metal- One of the low-density metals such as aluminum, magnesium, titanium, beryllium, or their alloys.

Longitudinal Direction - The principal direction of flow in worked metal.

Low-Hydrogen Electrode -A covered arc welding electrode that provides an atmosphere around the arc and molten weld metal which is low in hydrogen.

Machinability- The relative ease in machining a metal.

Machinability Index - A relative measure of the machinability of an engineering material under specified standard conditions.

Magnetic-Particle Inspection - A nondestructive method of inspection for determining the existence and extent of possible defects in ferromagnetic materials. Finely divided magnetic particles, applied to the magnetized part, are attached to and outline the pattern of any magnetic-leakage fields created by discontinuities.

Martempering - Quenching an austenitized ferrous alloy in a medium at a temperature in the upper part of the martensite range, or slightly above that range, and holding that in the medium until the temperature throughout the alloy is substantially uniform. The alloy is then allowed to cool in the air through the martensite range.

Martensite - (1) In an alloy, a metastable transitional structure intermediate between two allotropic modifications whose abilities to dissolve a given solute differ considerably, the high-temperature phase having the greater solubility. The amount of the high temperature phase transformed to martensite depends to a large extent upon the temperature attained in cooling, there being a rather distinct beginning temperature. (2) A metastable phase of steel, formed by a transformation of austenite below the M,(or Ar") temperature. It is an interstitial supersaturated solid solution of carbon in iron having a body-centered tetragonal lattice. Its microstructure is characterized by an acicular, or needle-like, pattern.

Mechanical Properties - The properties of a material that reveal its elastic and inelastic behaviour where force is applied, thereby indicating its suitability for mechanical applications; for example, modulus of elasticity, tensile strength, elongation, hardness, and fatigue limit.

Modulus of Elasticity - A measure of the rigidity of metal. Ratio of stress, within proportional limit, to corresponding strain. Specifically, the modulus obtained in tension or compression is Young's modulus, stretch modulus or modulus of extensibility; the modulus obtained in torsion or shear is modulus of rigidity, shear modulus or modulus of torsion; the modulus covering the ratio of the mean normal stress to the change in volume per unit volume is the bulk modulus. The tangent modulus and secant modulus are not restricted within the proportional limit; the former is the slope of the stress-strain curve at a specified point; the latter is the slope of a line from the origin to a specified point on the stress-strain curve. Also called "elastic modulus" and "coefficient of elasticity''.

Nitriding - Introducing nitrogen into a solid ferrous alloy by holding at a suitable temperature (below Ac, for ferritic steels) in contact with a nitrogenous material, usually ammonia of molten cyanide of appropriate composition. Quenching is not required to produce a hard case.

Normalizing - Heating a ferrous alloy to a suitable temperature above the transformation range and then cooling in the air to a temperature substantially below the transformation range.

Open-Hearth Furnace -A reverberatory melting furnace with a shallow hearth and a low roof. The flame passes over the charge in the hearth, causing the charge to be heated both by direct flame and radiation from the roof and sidewalls of the furnace. In ferrous industry, the furnace is regenerative.

Orange Peel - A pebble-grain surface which develops in forming of metals having coarse grains.

Overheating - Heating a metal or alloy to such a high temperature that its properties are impaired. When the original properties cannot be restored by further heat treating, by mechanical working, or by combination of working and heat treating, the overheating is know as burning.

Oxygen-Free Copper - Electrolytic copper free from cuprous oxide, produced without the use of residual metallic or metalloidal deoxidizers.

Pancake Forging - A rough forge shape which may be obtained quickly with a minimum of tooling. It usually requires considerable machining to attain the finish size.

Pearlite - A lamellar aggregate of ferrite and cementite, often occurring in steel and case iron.

Peening - Mechanical working of metal by hammer blows or shot impingement.

Physical Properties - The properties, other than mechanical properties, that pertain to the physics of a material; for example, density, electrical conductivity, heat conductivity, thermal expansion.

Pickling - Removing surface oxides from metals by chemical or electrochemical reaction.

Pig Iron - (1) High-carbon iron made by reduction of iron ore in the blast furnace. (2) Cast iron in the form of pigs.

Pipe - (1) The central cavity formed by contraction in metal, especially ingots, during solidification. (2) The defect in wrought or cast products resulting from such a cavity. (3) An extrusion defect due to the oxidized surface of the billet flowing towards the center of the rod at the back end. (4) A tubular metal product, castor wrought.

Pitting - Forming small sharp cavities in a metal surface by nonuniform electro-deposition or by corrosion.

Planishing - Producing a smooth surface finish on metal by rapid succession of blows delivered by highly polished dies or by a hammer designed for the purpose, or by rolling in a planishing mill.

Postheating - Heating weldments immediately after welding, for tempering, for stress relieving, or for providing a controlled rate of cooling to prevent formation of a hard or brittle structure.

Precipitation Hardening - Hardening caused by the precipitation of a constituent from a supersaturated solid solution.

Preheating - Heating before some further thermal or mechanical treatment. For tool steel, heating to an intermediate temperature immediately before austenitizing. For some nonferrous alloys, heating to a high temperature for a long time in order to homogenize the structure before working.

Press Forging - Forging metal, usually hot, between dies in a press.

Primes - Metal products, principally sheet and plate, of the highest quality and free from visible defects.

Process Annealing - In the sheet and wire industries, heating a ferrous alloy to a temperature close to, but below, the lower limit of the transformation range and then cooling in order to soften the alloy for further cold working.

Proof Stress - (1) The stress that will cause a specified small permanent set in a material. (2) A specified stress to be applied to a member or structure to indicate its ability to withstand service loads.

Proportional Limit - The maximum stress at which strain remains directly proportional to stress.

Quench Hardening - Hardening a ferrous alloy by austenitizing and then cooling rapidly enough so that some or all of the austenite transforms to martensite. The austenitizing temperature for hypoeutectoid steels is usually above Ac_3 and for hypereutectoid steels usually between Ac, and Ac,m.

Recrystallization - (1) The change from one crystal structure to another, as occurs on heating or cooling through a critical temperature. (2) The formation of a new, strain-free grain structure from that existing in cold worked metal, usually accomplished by heating.

Recyrstallization Temperature - The approximate minimum temperature at which complete recrystallization of a cold worked metal occurs within a specified time.

Reduction of Area - (1) Commonly, the difference, expressed as a percentage of original area, between the original cross-sectional area of a test tensile specimen and the minimum cross sectional area measured after complete separation. (2) The difference, expressed as a percentage of original area, between original cross-sectional area and that straining the specimen.

Refractory Metal -A metal having an extremely high melting point. In the board sense, it refers to metals having melting points above the range of iron, cobalt, and nickel.

Residual Stress - Stress present in a body that is free of external forces or thermal gradients.

Rimmed Steel - A low-carbon steel containing sufficient iron oxide to give a continuous evolution of carbon monoxide while the ingot is solidifying, resulting in a case or rim of metal virtually free of voids. Sheet and strip products made from the ingot have very good surface quality.

Roller Leveling - Leveling by passing flat stock through a machine having a series of small diameter staggered rolls.

Rough Machining - Machining without regard to finish, usually to be followed by a subsequent operation.

Scab -A defect consisting of a flat volume of metal joined to a casting through a small area. It is usually set in a depression, a flat side being separated from the metal of the casting proper by a thin layer of sand.

Scaling - Forming a thick layer of oxidation products on metals at high temperatures.

Scalped Extrusion Ingot - A cast, solid, or hollow extrusion ingot which has been machined on the outside surface.

Scarfing - Cutting surface areas of metal abjects, ordinarily by using a gas torch. The operation permits surface defects to be cut from ingots, billets, or the edges of plate that is to be beveled for butt welding.

Seam - On the surface of metal, an unwelded fold or lap which appears as a crack, usually resulting from a defect obtained in casting or in working.

Secondary Hardening - Tempering certain alloy steels at certain temperatures so that the resulting hardness is greater than that obtained by tempering the same steel at some lower temperature for the same time.

Segregation - Nonuniform distribution of alloying elements, impurities or microphases.

Semikilled Steel - Steel that is completely deoxided and contains sufficient dissolved oxygen to react with the carbon to form carbon monoxide to offset solidification shrinkage.

Sendzimir Mill -A mill having two work rolls of 1to21/2-in. diam. each, backed up by two rolls twice that diameter and each of these backed up by bearings on a shaft mounted eccentrically so that rotating it increases the pressure between bearings and backup rolls.

Shear Strength - The stress required to produce fracture in the plane of cross section, the conditions of loading being such that the directions of force and of resistance are parallel and opposite although their paths are offset a specified minimum amount.

Shell Molding - Forming a mold from thermosetting resin-bonded sand mixtures brought in contact with preheated (300° to S00°F) metal patterns, resulting in a form shell with a cavity corresponding to the outline of the pattern. Also called “Croning Process”.

Shielded-Arc Welding - Arc welding in which the arc and the weld metal are protected by a gaseous atmosphere, the products of decomposition of the electrode covering, or a blanket of fusible flux.

Shortness - A form of brittleness in metal. It is designed as “cold’; “hot’; and “red’; to indicate the temperature range in which the brittleness occurs.

Siliconing - Diffusing silicon into solid metal, usually steel, at an elevated temperature.

Skelp -A piece or strip of metal produced to a suitable thickness, width, and edge configuration, from which pipe or tubing is made.

Slack Quenching - The process of hardening steel by quenching from the austenitizing temperature at a rate slower that the critical cooling rate for the particular steel resulting in incomplete hardening and the formation of one or more transformation products in addition to or instead of martensite.

Solid Solution -A single solid homogeneous crystalline phase containing two or more chemical species.

Solution Heat Treatment - Heating an alloy to a suitable temperature, holding at that temperature long enough to allow one or more constituents to enter solid solution, and then cooling rapidly enough to hold the constituents in solution. The alloy is left in a supersaturated, unstable state, and may subsequently exhibit quench aging.

Spalling - The cracking and flaking of particles out of a surface.

Spheroidizing - Heating and cooling to produce a spheroidal or globular form of carbide in steel. Spheroidizing methods frequently used are:

1. Prolonged holding at a temperature just below Ae_1.
2. Heating and cooling alternately between temperatures that are just below Ae_1.
3. Heating to a temperature above Ae_1 or Ae_3 and then cooling very slowly in the furnace or holding at a temperature just below Ae_1.
4. Cooling at a suitable rate from the minimum temperature at which ail carbide is dissolved to prevent the reformation of a carbide network, and then reheating in accordance with methods 1 or 2 above. (Applicable to hypereutectoid steel containing a carbide network.)

Spot Welding - Welding of lapped parts in which fusion is confined to a relatively small circular area. It is generally resistance welding, but may also be gas-shielded tungsten-arc, gas-shielded metal-arc, or submerged-arc welding.

Stabilizing Treatment - Any treatment intended to stabilize the structure of an alloy of the dimensions of a part. (1) Heating austenitic stainless steels that contain titanium, columbium, or tantalum to a suitable temperature below that of a full anneal in order to inactivate the maximum amount of carbon by precipitation as a carbide of titanium, columbium, or tantalum. (2) Transforming retained austenite in parts made from tool steel. (3) Precipitating a constituent from a nonferrous solid solution to improve the workability, to decrease the tendency of certain alloys to age harden at room temperature, or to obtain dimensional stability.

Steel -An iron-base alloy, malleable in some temperature range as initially cast, containing manganese, usually carbon, and often other alloying elements. In carbon steel and low-alloy steel, the maximum carbon is about 2.0%; in high-alloy steel, about 2.5%. The dividing line between low-alloy and high-alloy is generally regarded as being at about 5% metallic alloying elements. Steel is to be differentiated from two general classes of"irons": the cast irons, on the high-carbon side, and the relatively pure irons such as ingot iron, carbonyl iron, and electrolytic iron, on the low-carbon side. In some steels containing extremely low carbon, the manganese content is the principal differentiating factor, steel usually containing at least 0.25%; ingot iron contains considerably less.

Sterling Silver -A silver alloy containing at least 95.2% Ag, the remainder being unspecified but usually copper.

Strain - A measure of the change in the size or shape of a body, referred to its original size or shape. "Linear Strain" is the change per unit length of a linear dimension. "True Strain" (or "natural strain") is the natural logarithm of the ratio of the length at the moment of observation to the original gauge length. "Conventional strain" is the linear strain referred to the original gauge length. "Shearing strain" (or"shear strain") is the change in angle (expressed in radians) between two fines originally at right angles. When the term strain is used alone it usually refers to the linear strain in the direction of the applied stress.

Stress - Force per unit area, often thought as force acting through a small area within a plane. It can be divided into components, normal and parallel to the plane, called "normal stress" and "shear stress': respectively. "True stress" denotes the stress where force and area measured at the same time. "Conventional stress", as applied to tension and compression tests, is force divided by the original area. "Nominal stress" is the stress computed by simple elasticity formulas, ignoring stress raisers and disregarding plastic flow; in a notch bond test, for example, it is bending moment divided by minimum section modulus.

Stress-Corrosion Cracking - Failure by cracking under combined action or corrosion and stress, either external (applied) to internal (residual). Cracking may be either intergranular, or transgranular, depends on metal and corrosive medium.

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.

Stress-Rupture Test - A tension test performed at constant temperature, the load being held at such a level as to cause rupture. Also known as "creep-rupture test''.

Stretcher Leveling - Leveling where a piece of metal is gripped at each end and subjected to a stress higher than its yield strength to remove wrap and distortion. Sometimes called patent leveling.

Stretcher Straightening -A process for straightening rod, tubing, and shapes by the application of tension at the ends of the stock. The products are elongated a definite amount to remove warpage.

Stretcher Strains - Elongated markings that appear on the surface of some materials when deformed just past the yield point. These markings lie approximately parallel to the direction of maximum shear stress and the result of localized yielding. Same as Luders lines.

Superalloy - An alloy developed for very high temperature service where relatively high stresses (tensile, thermal, vibratory, and shock) are encountered and where oxidation resistance is frequently required.

Superficial Rockwell Hardness Test - Form of Rockwell hardness test using relatively light loads which produce minimum penetration. Used for determining surface hardness or hardness of thin sections or small parts, or where large hardness impression might be harmful.

Tack Welds - Small scattered welds made to hold parts of a weldment in proper alignment while the final welds are being made.

Temper- (1) In heat treatment, reheating hardened steel or hardened cast iron to some temperature below the eutectoid temperature for the purpose of decreasing the hardness and increasing toughness. The process also is sometimes applied to normalized steel. (2) In tool steels, "temper'' is sometimes used, but inadvisedly, to denote the carbon content. (3) In nonferrous alloys and in some ferrous alloys (steels that cannot be hardened by heat treatment), the hardness and strength produced by mechanical or thermal treatment, or both, and characterized by a certain structure, mechanical properties, or reduction in area during cold working.

Temper Brittleness - Brittleness that results when certain steels are held within, or are cooled slowly, through a certain range of temperature below the transformation range. The brittleness is revealed by notched-bar impact tests at or below room temperature.

Tempering - Reheating a quench-hardened or normalized ferrous alloy to a temperature below the transformation range and then cooling at any rate desired.

Tensile Strength - In tensile testing, the ratio of maximum load to original cross sectional area. Also called ultimate strength.

Torsion - A twisting action resulting in shear stresses and strains.

Toughness - Ability of a metal to adsorb energy and deform plastically before fracturing. It is usually measured by the energy absorbed in a notch impact test, but the area under the stress-strain curve in tensile testing is also a measure of toughness.

Transformation Ranges (Transformation Temperature Ranges) - Those ranges of temperature within which austenite forms during heating and transform during cooling. The two ranges are distinct, sometimes overlapping but never coinciding. The limiting temperatures of the ranges depend on the composition of the alloy and on the rate of change of temperature, particularly during cooling.

Transition Temperature - (1) An arbitrarily defined temperature within the temperature range in which metal fracture characteristics determined usually by notched tests are changing rapidly such as from primarily fibrous (shear) to primarily crystalline (cleavage) fracture. Commonly used definitions are (transition temperature for 50% cleavage fracture'; "10-ft-lb transition temperature'; and "transition temperature for half maximum energy''. (2) Sometimes also used to denote the arbitrarily defined temperature in a range in which the ductility changes rapidly with temperature.

Transverse - Literally, "across'; usually signifying a direction or plane perpendicular to the direction of working.

Trepanning - A type of boring where an annular cut is made into a solid material with the coincidental formation of a plug or solid cylinder.

Ultimate Strength - The maximum conventional stress, tensile, compressive, or shear, that a material can withstand.

Ultrasonic Frequency-A frequency, associated with elastic waves, that is greater than the highest audible frequency, generally regarded as being higher that 15 kc per sec.

Ultrasonic Waves - Waves of ultrasonic frequency. They include longitudinal, transverse, surface, and standing waves.

Universal Mill -A rolling mill in which rolls with a vertical axis roll the edges of the metal stock between some of the passes through the horizontal rolls.

Vacuum Melting - Melting in a vacuum to prevent contamination from air, as well as to remove gases already dissolved in the metal; the solidification may also be carried out in a vacuum or at low pressure.

Wrought Iron -A commercial iron consisting of slag (iron silicate) fibers entrained in a ferrite matrix.

Yield Point - The first stress in a material, usually less than the maximum attainable stress, at which an increase in strain occurs without an increase in stress. Only certain metals exhibit a yield point. If there is a decrease in stress after yielding, a distinction may be made between upper and lower yield points.

Yield Strength - The stress at which a material exhibits a specified deviation from proportionality of stress and strain. An offset of0.2% is used for many metals.

Useful Information

- To find circumference of a circle multiply diameter by 3.1416.
- To find diameter of a circle multiply circumference by .31831.
- To find area of a circle multiply square of diameter by .7854.
- Radius of circle equals half of diameter.
- Area of rectangle. Length multiplied by breadth. Doubling the diameter of a circle increases its area four times.
- To find area of a triangle multiply base by 1/2 perpendicular height.
- Area of ellipse= product of bath diameters X .7854.
- Area of parallelogram = base X altitude.
- To find side of an inscribed square multiply diameter by 0.7071 or multiply circumference by 0.2251 or divide circumference by 4.4428.
- Side of inscribed cube= radius of sphere X 1.1547.
- To find side of an equal square multiply diameter by .8862.
- Square. A side multiplied by 1.4142 equals diameter of its circumscribing circle.
- A side multiplied by 4.443 equals circumference of its circumscribing circle.
- A side multiplied by 1.128 equals diameter of an equal circle.
- A side multiplied by 3.547 equals circumference of an equal circle.
- To find cubic inches in a ball multiply cube of diameter by .5236.
- To find cubic contents of a cane, multiply area of base by 1/3 the altitude.
- Surface of frustum of cane or pyramid = sum of circumference of bath ends X 1/2 slant height plus area of bath ends.
- Contents of frustum of cane or pyramid = multiply area of two ends and get square root. Add the 2 areas and X 1/3 altitude.
- Doubling the diameter of a pipe increases its capacity four times.
- A cubic foot of water contains 7.4805 U.S. (6.2278 Imp.) gallons, 1728 cubic inches, and weighs 62 1/2 lbs.
- To find the pressure in pounds per square inch of a column of water multiply the height of the column in feet by .434.
- Steam rising from water at its boiling point (212 degrees) has a pressure equal to the atmosphere (14.7 lbs. to the square inch).
- A standard horse power: The evaporation of 30lbs. of water per hour from a feed water temperature of 100°F. into steam at 70 lbs. gauge pressure.
- To ascertain heating surface in tubular boilers multiply 2/3 the circumference of boiler by length of boiler in inches and add to the area of ail tubes.
- One metre equals 39.37 inches. See metric tables pages 259 - 260. <will be new numbers>
- To find millimetre equivalent of inch decimals, multiply by 25.4.

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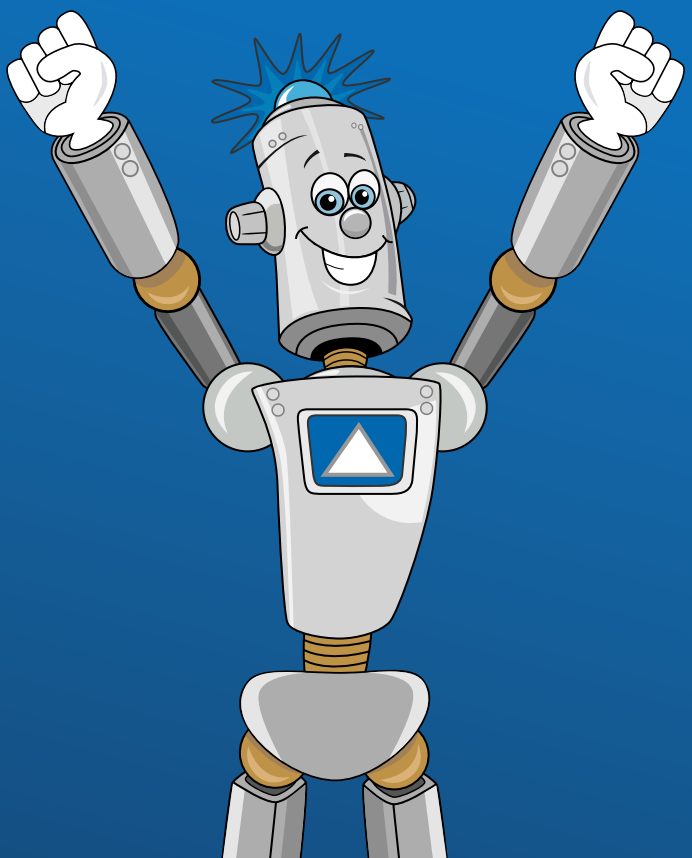

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