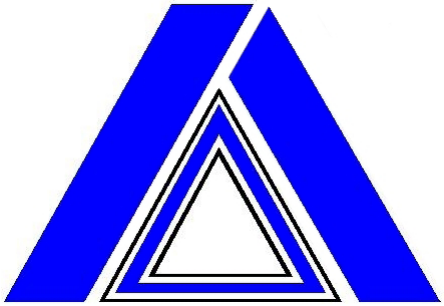
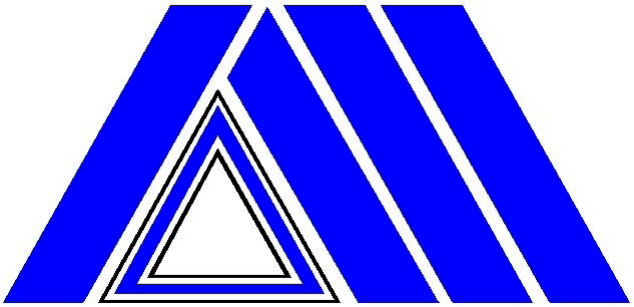


AMERICAN STEEL

LAMPROS STEEL



AMERICAN METALS

SERVICE CENTER BRANCH LOCATIONS

American Metals Corporation is comprised of 11 locations spanning the West Coast including Alaska Steel in Anchorage, Fairbanks, and Kenai, AK; Haskins Steel in Spokane, WA; American Steel in Canby, OR and Kent, WA; Lampros Steel in Portland, OR and Los Angeles, CA; and American Metals in Sacramento and Fresno, CA.

In this handbook, for purposes of clarity “American Metals Corporation” designates all locations.

COMMITTED TO EXCELLENCE

AMERICAN METALS CORPORATION

AMERICAN METALS CORPORATION

ANCHORAGE, AK
Alaska Steel
6180 Electron Drive
Anchorage, AK 99518
(907) 651-1188
Fax (907) 651-2935
(800) 770-0969

FAIRBANKS, AK
Alaska Steel
2800 S Cushman
Fairbanks, AK 99701
(907) 456-2719
Fax (907) 451-0449

KENAI, AK
Alaska Steel
205 Trading Bay Rd.
Kenai, AK 99611
(907) 283-3880
Fax (907) 283-3759

WEST SACRAMENTO, CA
American Metals
1499 Parkway Boulevard
West Sacramento, CA 95691
(916) 371-7700
Fax (916) 371-7760
(800) 852-7075

FRESNO, CA
American Metals
2655 North Weber
Fresno, CA 93705
(559) 266-0881
Fax (559) 266-0892
(800) 366-3825

CANBY, OR
American Steel
525 S Sequoia Parkway
Canby, OR 97013
(503) 651-6700
Fax (503) 651-1525
(800) 547-9032

KENT, WA
American Steel
20826 68th Ave S
Kent, WA 98032
(253) 437-4080
(800) 547-9032

SPOKANE, WA
Haskins Steel
3613 E Main Ave.
Spokane, WA 99202
(509) 535-0657
Fax (509) 535-8167
(800) 541-6354

PORTLAND, OR
Lampros Steel
9040 Burgard Way
Portland, OR 97203
(503) 285-6667
Fax (503) 445-4124
(800) 852-7075

PORTLAND, OR
Plate Sales
9040 Burgard Way
Portland, OR 97203
(503) 286-0039

LOS ANGELES, CA
LSI Plate
8909 Rochester Ave.
Rancho Cucamonga, CA 91730
(877) 877-7528

FOREWORD

Steel Service Centers play an important role in the distribution of steel products to all phases of industry. American Metals Corporation is proud to be a major steel supplier to industry on the west coast with five locations in Canby, Kent, Redding, Sacramento and Fresno. We offer our customers the most knowledgeable, efficient and cooperative personnel in the steel industry to help solve purchasing problems.

American Metals Corporation has an established quality assurance program in each plant to identify all steel products inventoried by heat numbers and mill source. This assures that all products shipped are of the highest quality, meet all specification requirements and are traceable to the mill test report. A copy of our Quality Assurance Manual is available on request.

The technical information published herein is accurate to the best of our knowledge and was established from numerous engineering sources. Applications shown for the various steel grades are made solely to permit the reader to make his own evaluation and decision and to illustrate some of the usages of the various steel grades and products. As there are many different applications and designs for the same type of part, each steel grade and/or heat treatment must be evaluated for its particular use.

$35.00 per copy: American Metals Corporation

525 S. Sequoia Parkway
Canby, Oregon 97013
(503)651-6700

WARRANTY POLICY

American Metals Corporation warrants that the products sold are free from defects of material or workmanship. American's sole liability under such warranty is limited to the repair or replacement of products deemed to be defective by American. No product shall be returned to American for warranty replacement without specific prior written approval by American. Upon prompt notice of nonconformity and confirmation that the products have been properly stored, installed, maintained and operated, American may elect to either repair or replace such products. The foregoing constitutes buyer's sole and exclusive remedy, whether in contract, tort or otherwise. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PURPOSE. IN NO EVENT SHALL AMERICAN BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES NOR FOR ANY OTHER LOSS OR DAMAGE. Merchandise may be returned only with prior permission from American. All returns subject to a 20% restocking charge, and must be accompanied by copy of invoice. Claims, warranty or otherwise must be made within 10 days of invoice date to be valid.

WEIGHTS

All sales are based on theoretical or nominal weights.

PRICING

Quotations are subject to adjustment to reflect our prices in effect at the time of shipment.

DELIVERY

Deliveries are promised subject to unavoidable circumstances such as strikes, fire, accidents, and acts of God.

CAPABILITIES

American Metals Corporation offers the following metal processing capabilities with one goal; assurance to you of top quality and service.

Drilling	4 Kinetic K5000 drill systems
Laser Cutting	2 8,000W fiberoptic laser machines
Shearing	5 shears to 3/4” x 25'
Sawing	18 saws, high speed and mitre cut
Burning	17 electronically controlled flame-cutting installations
Cut-to-length	3 leveling lines to 1/2” x 84” wide
Flat Bar Line	To 3/16” x 12” wide
Cambering	

Vision

American Metals Corporation's vision is to be the most responsive, quality conscious steel service center in the industry.

Our success results from shared goals and values focused on the quality of relationships with each other, our customers, and suppliers.

Beliefs and Principles

Our values provide a foundation for our actions as we consciously change the organizational structures, processes, and methods. These values are displayed in what we do, in the way we treat each other, our customers and our suppliers,in the way we lead and the decisions we make.

- We work to build and maintain trust
- We treat each other with respect, dignity, and consideration
- We hold ourselves to the highest standards of honesty and integrity
- We foster equality and tolerance
- We function with regard for the safety of ourselves and others

The spirit of our people is the key to our advantage; it is what makes us unique.

- We encourage participation and involvement in all aspects of our business
- We provide an environment where all are inspired to think creatively and innovatively
- We recognize the value of continual training and education
- We strive for excellence in our work and accept responsibility and accountability
- We value our uniqueness and diversity

Our business is built on the quality of our relationships. Those who interact with and within our organization are the keystone to the viability and success of our business.

- We continually assess our customers' needs and align our business practices to exceed their expectations
- We seek a win-win partnership with our suppliers
- We interact with our community and with governmental bodies in a non-judgmental, open manner working towards mutually rewarding decisions and actions

Commitment to our future depends on our ability to work together with the same goals and objectives in mind.

- We share knowledge and information openly and honestly
- We see each other as colleagues - not adversaries
- We promote effective communication, share our opinions, actively listen to each other, seek understanding, and are willing to compromise
- We are committed to the continuous improvement of all business practices

TAB INDEX

SECTION 1

PLATE AND PLATE COIL

SECTION 1

PLATE AND PLATE COIL
(Continued)

Kinetic K-5000

Features include:

•CAT 50 taper 48 Hp servo drill that will:
- Drill 4” diameter holes in 8” thick plate
- Bore 8” diameter holes in 8” thick plate
- Tap 1 ¼” diameter holes
- Automatic tool changer with 24 tool holders

•2 Hypertherm HyPerformance HPR400XD plasma torches with production cutting capacities of 2” mild steel, 1 ¾” stainless, and 1 ½” aluminum
•2 Oxyfuel stations for cutting up to 8” plate
•Plasma and oxygen bevel cutting up to 45 degrees
•Marking

PRODUCT DESCRIPTION

Steel plates are produced either as a flat rolled plate or plate coil which is a continuous plate in coil form. Flat rolled plates are run two ways; one, through a continuous set of roll stands which reduces the plate to final thickness or, two, on a reversing mill where the plate slab is run back and forth through one mill to final thickness. Plate coil is continuously rolled through a series of stands on a continuous plate mill which coils the hot plate into large coils. In each case the rolling temperatures along with the chemistry are closely monitored to produce the desired mechanical properties.

Steel plates are produced in many chemical grades and quality levels covered under various ASTM and ASME specifications. Structural grades range from low-yield strengths starting at 30,000 psi to high-yield strengths over 100,000 psi such as A514. Mechanical properties are controlled by chemistry, controlled rolling and heat treatment depending on the steel grade. Some grades such as A537 or ABS grade DH36 are produced for high strength and low temperature applications where Charpy values will exceed 15 ft-lb at -50 F. Other grades with 70,000 and 80,000 psi minimum yields are produced with low inclusion levels. These grades have good resistance to lamellar tearing, minimal differences in mechanical properties in the three dimensions of the plate, and excellent formability.

Pressure Vessel Quality plates (PVQ) are plates used in the fabrication of pressure tanks and boilers and these plates must meet the requirements of the ASME Boiler and Pressure Vessel Code. It is for this reason each plate is tested in the steel mill for its mechanical strength.

Specialty plates such as AR, AR321 and AR360 are produced with special chemistries to increase abrasion resistance. AR321 and AR360 are medium alloy steels with approximately .25% carbon and are heat treated to 321 and 360 Brinell hardness levels. Both these steels will have good abrasion resistance and are totally weldable using proper welding procedures for these grades of steel.

AISI 4140 is a medium carbon, chromium and molybdenum alloy steel used in a wide variety of machinery parts requiring tensile strengths to 250,000 psi. The steel is through hardening up to 5" in thickness and will harden to a Rockwell C hardness range of 38-48. The best toughness range is HRC 38-45.

Brochures and technical data are available for all our plate products.

American Metal’s plate processing equipment includes:

Shearing
Capacities up to 3/8” x 16’

Flame Cutting Equipment
Computer controlled-oxy-propane
Straight track and beveling
Circle burning
VFX modem through telephone network

Plasma Cutting
Two computer-controlled machines with capacities of 1 1/4" up to 85' in length

Cut-to-Length Lines
Coil processed 30 ga through 1/2" up to and including 84" wide

ASTM PLATE GRADES

A 36 - This is the most common grade of structural steel used. It has a minimum yield strength of 36,000 psi and is available in plate, bars and rolled structural shapes. It is used for riveted, bolted or welded structures. In many cases our A36 plates are dual specified with ABS grade A.

A 131 - ABS equivalent specification for structural steels used for ship building. The specification covers plate, bar and structural shapes. There are two categories of steel grades—Ordinary Strength and Higher Strength steels which in some cases are normalized.

A 242 - A high strength low alloy steel used for structural purposes with yield strengths of 42,000 to 50,000 psi minimum yield depending on thickness. It can be used in place of A36 where savings in weight or added durability are important. A 242 has enhanced atmospheric corrosion resistance of approximately two times that of carbon structural steels with copper or four times that of carbon structural steels without copper.

A 514 (T-1 Type) - Quenched and tempered alloy steel plates of structural quality produced in thicknesses up to and including 6”. Specified minimum yield strength is 100,000 psi for thicknesses up to and including 2-1/2”. Each steel mill has their own proprietary chemical analysis. There are eight different chemical grades. Material has good impact properties and welding characteristics.

A 516 - Pressure vessel quality plates for moderate and lower temperature service produced to a fine austenitic grain size. The specification covers four strength levels and is intended for pressure vessels where improved low temperature notch toughness is important. Thicknesses over 1-1/2 are normalized.

A 537 - Heat treated pressure vessel quality plates produced to a fine austenitic grain size. Class 1 is normalized, Class 2 is quenched and tempered. This specification will meet 50,000 psi minimum yield up to 2-1/2” in thickness and 45,000 psi minimum yield over 2-1/2” up to and including 4”

A 572 - Specification A572 defines six grades of high-strength low-alloy steel having specified minimum yield points of 42,000, 45,000, 50,000, 55,000, 60,000, and 65,000 psi. Grades 42, 45, and 50 are intended for riveted, bolted or welded construction of bridges, buildings, and other structures.

A 588 (Corten) - A group of high strength low-alloy steels with four to six times the corrosion resistance of plain carbon structural steels. Produced in thicknesses up to and including 8”, yield strength minimums will be 50,000 psi through 4”; there are five chemical analyses listed in the specification. The enhanced atmospheric corrosion resistance permits the use of this steel in the unpainted condition in many applications

A 656 - A very high strength product with 70,000 and 80,000 psi minimum yield strengths and good Charpy impact test properties to -20° F. Toughness and strength are controlled by a combination of micro-alloying and controlled rolling procedures. In addition this steel grade has good formability in the rolling and transverse direction of the plate. This is accomplished by reducing the inclusion levels and controlling the shape of the sulfide inclusion.

A 786 - Safety Floor Plate rolled to Patterns No. 3 and 4. The product is available in plate and in plate coil in some thicknesses. Grades available are Commercial Quality and A36 depending on size.

ASTM PLATE GRADES (Continued)

PLATE GRADES - CHEMICAL

AISI 1045 Plate is available in thicknesses from 1/4” through 4”. Our plate is ordered to a 1045 chemical analysis instead of 1040 or 1040/1045. The reason being the 1045 analysis will heat treat consistently to higher hardness and strength levels. AISI 1040 with a carbon range of .37 - .44% when melted on the low side of the chemical range can cause heat treating problems. The flame cut edge will have a Rockwell C hardness of approximately 35 - 45.

AISI 4140 Plate—A chromium-molybdenum alloy that will through harden when quench and tempered for maximum strength. Flame cut edges of the plate will have an approximate hardness range of 45-55 Rockwell C. It is recommended these plates be stress relieved annealed prior to machining. It is also standard practice to stress relieve prior to heat treating Standard thickness range is 3/4” to 4”.

PLATE COIL

Physical Quality, PQ36, or 36,000 psi minimum yield plate coil in thicknesses from 3/16” through 1/2” and 48” to 84” wide is produced to meet the requirements of ASTM A36. When ordered, plate coils can be cut on our cut-to-length line to any specific length from 60” to 720” long. Ordering to specified lengths will eliminate costly scrap and reduce fabricating and welding time.
PQ50 or 50,000 psi minimum yield strength plate coil will meet the requirements of ASTM A572 Grade 50 plate. This product is available in thicknesses from 3/16” to 1/2” and widths up to 84”.
PQ70, 80, 100 or 70,000, 80,000, 100,000 psi minimum yield plate coils are available in thicknesses of 3/16” and 1/4”. Similar plate grade is ASTM A656. This product is controlled rolled on the mill and is microalloyed with such elements as columbium, titanium, vanadium or zirconium. The steel has excellent formability with and across the rolling direction and is used for high strength applications such as trailer frames and reinforcing parts.
Temper Rolled Plate Coil is hot rolled plate coil that has been temper rolled or skin passed in the mill after the coils have been cooled to ambient temperatures. The steel has a nice cosmetic appearance with a tight, adherent blue scale that will not flake off in bending The approximate carbon range is .12% - .23% with a manganese range of .40% - .80%. This steel grade will have the same forming and welding characteristics as A36.
Pickled and Oiled hot rolled plate coil is available in 3/16” an 3/8” thicknesses and widths up to 72”. This material will meet all the requirements of A36, but will be free of hot mill scale. Applications for this product would be for stamping work and immediate painting after fabricating.

OTHER GRADES

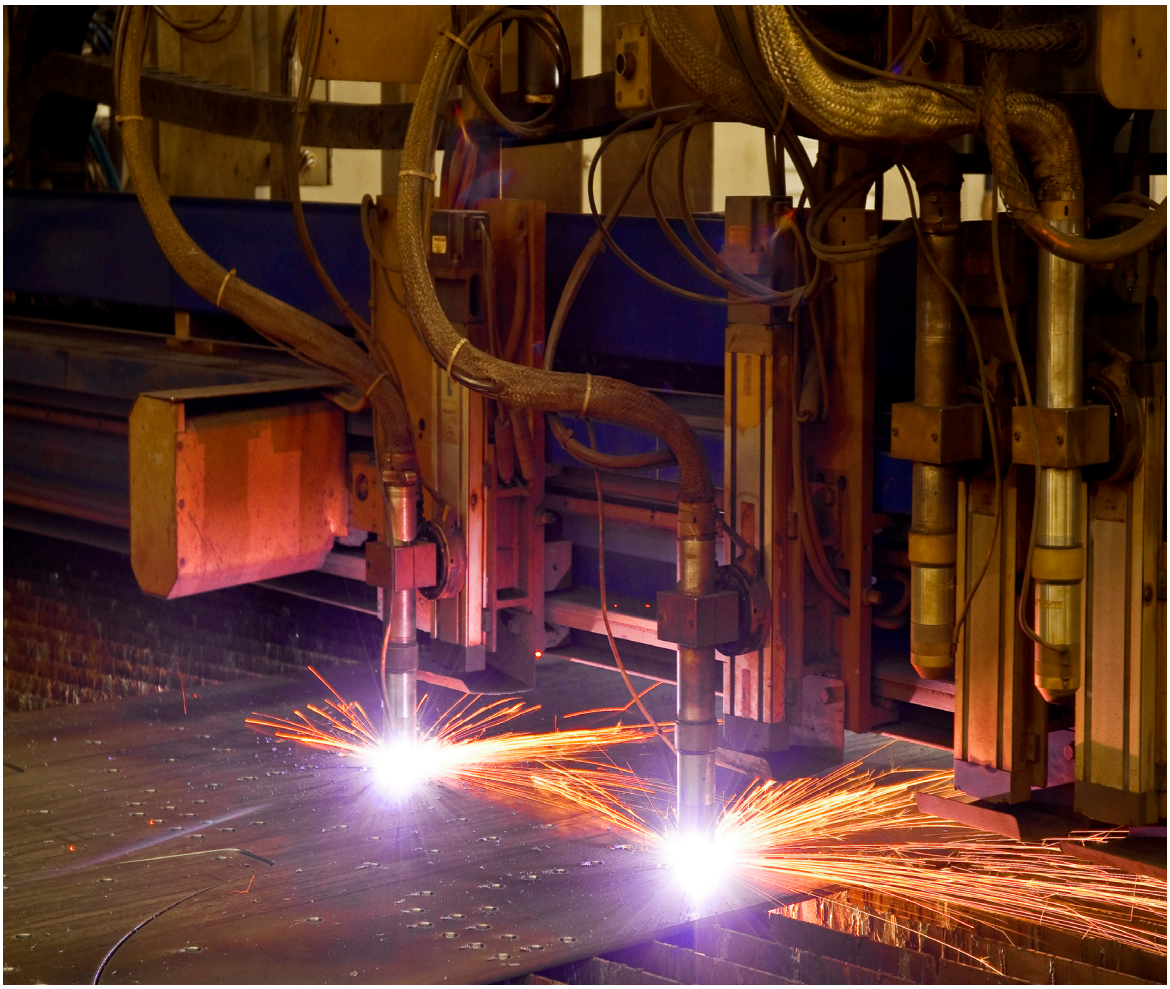
ABS - American Bureau of Shipping. Ordinary-strength grades with 34,000 psi minimum yields and higher-strength grades with 46,000 and 51,000 minimum yields. Grade DH 36 is Charpy Impact tested to meet 25 ft/lb minimum in the transverse direction at -50 F in accordance with an American Bureau of Shipping requirement. Our ABS ordinary-strength grade is also available in coils which are in compliance with the ABS rules. ABS plates are tested and certified at the mill or ABS witnessed in a certified testing laboratory.

AR 235 - An as-rolled abrasion resistant plate with approximately 1.25% manganese and .45% carbon. Brinell hardness is approximately 235, however, since the plate is as-rolled there will be variations of hardness in various locations of the plate. Since these plates have a tendency to have low ductility, caution should be used in press brake forming or bending these plates. Special welding procedures should be used because of a Carbon Equivalent Ratio of approximately .65%. This product is used for sliding abrasion jobs with minimal impact.

ASTM PLATE GRADES (CONTINUED)

AR 321 - Abrasion resistant plate heat treated to a 321 -363 Brinell hardness developed for sliding and impact abrasion type applications. Steel has an A514 chemistry and will have good weldability with proper welding procedures for this type of steel. Applications would be for high impact and sliding abrasion. Plates will have limited formability because of the plate hardness.

AR 360 - Abrasion resistant plate heat treated to a higher level of hardness at 360 to 415 Brinell. Chemical analysis is similar to AR321 for good weldability. Higher plate hardness is obtained by increasing the carbon content and tempering at a lower temperature, Applications would be for higher abrasion and impact problems. These plates will have very limited formability.



American's Plasma Arc Burning Technology

SIZE RANGE/SHEARED & BURNED PLATE

Size	Weight Per Plate	
3/16"	*"7.6579#/Sq. Ft.* (.05318#/Sq. In.)"	
	48 x 96"	245.05
	48 x 120"	306.32
	48 x 144"	367.58
	48 x 240"	612.63
	48 x 288"	735.16
	60 x 96"	306.32
	60 x 120"	382.90
	60 x 144"	459.47
	60 x 192"	612.63
	60 x 240"	765.79
	60 x 288"	918.94
	72 x 96"	367.58
	72 x 120"	459.47
	72 x 144"	551.37
	72 x 192"	735.16
	72 x 240"	918.95
	72 x 288"	1102.74
	72 x 360"	1378.42
	84 x 96"	428.84
	84 x 120"	536.05
	84 x 144"	643.26
	84 x 240"	1072.11
	84 x 288"	1286.53
	84 x 360"	1608.16
	96 x 240"	1225.26
	96 x 288"	1470.32
	96 x 360"	1837.90
1/4”	10.2096#Sq. Ft. (.0709#Sq. In.)”	
	48 x 96”	326.70
	48 x 120”	408.38
	48 x 144”	490.06
	48 x 240”	816.77
	48 x 288”	980.13
	60 x 96”	408.38
	60 x 120”	510.48
	60 x 144”	612.58
	60 x 192”	816.77
	60 x 240”	1020.96
	60 x 288”	1225.15
	60 x 360”	1531.44
	72 x 96”	490.06
	72 x 120”	612.58
	72 x 144”	735.09
	72 x 192”	980.12
	72 x 240”	1225.15
	72 x 288”	1470.18
	72 x 360”	1837.73
	84 x 96”	571.74
	84 x 120”	714.67
	84 x 144”	857.61
	84 x 192”	1143.48
	84 x 240”	1429.34
	84 x 288”	1715.21
	84 x 360”	2144.02
	84 x 480”	2858.69

Size	Weight Per Plate	
1/4” (cont.)	96 x 240”	1633.54
	96 x 288"	1960.24
	96 x 360"	2450.30
	96 x 480"	3267.07
	120 x 360"	3062.88
	120 x 480"	4083.84
5/16”	“12.7627#/Sq. Ft. (.08863#/Sq. In.)”	
	48 x 96"	408.41
	48 x 120"	510.51
	48 x 144"	765.76
	48 x 240"	1021.02
	60 x 96”	510
	60 x 120"	638.14
	60 x 144"	765 76
	60 x 240"	1276.27
	60 x 288"	1531.53
	60 x 360"	1914.41
	72 x 96"	612.61
	72 x 120"	765.76
	72 x 144"	918.92
	72 x 240"	1531.53
	72 x 288”	1837.83
	72 x 360"	2297.29
	84 x 120"	893.39
	84 x 144"	1072.07
	84 x 240"	1786.78
	84 x 288"	2144.14
	84 x 360"	2680.17
	84 x 480”	3573.56
	96 x 240”	2042.04
	96 x 288”	2450.44
	96 x 360”	3063.05
	96 x 480”	4084.07
	120 x 360”	3828.82
3/8”	15.3144#/Sq. Ft. (.10635#/Sq. In)”	
	48 x 96”	490.06
	48 x 120”	612.58
	48 x 144”	735.09
	48 x 240”	1225.15
	48 x 288”	1470.18
	60 x 96”	612.58
	60 x 120”	765.72
	60 x 144”	918.86
	60 x 240”	1531.44
	60 x 288”	1837.73
	72 x 96”	735.09
	72 x 120”	918.86
	72 x 144”	1102.64
	72 x 192”	1470.18
	72 x 240”	1837.73
	72 x 288”	2205.27
	72 x 360”	2756.59
	84 x 96”	857.61
	84 x 120”	1072.01

SIZE RANGE/SHEARED & BURNED PLATE (Continued)

Size		Weight Per Plate
3/8” (cont.)	84 x 144”	1286.41
	84 x 240”	2144.02
	84 x 288”	2572.82
	84 x 360”	3216.02
	84 x 480”	4288.03
	96 x 120”	1225.15
	96 x 240”	2450.30
	96 x 288”	2940.36
	96 x 360”	3675.46
	96 x 488”	4900.61
	120 x 360”	4594.32
	120 x 480”	6125.76
7/16”	17.8675#/Sq. Ft. (.12408#/Sq. In.)	
	84 x 360”	3752.18
	96 x 240”	2858.80
	96 x 360”	4288.20
	96 x 480”	5717.61
1/2”	20.4192#/Sq. Ft. (.1418#/Sq. In.)	
	48 x 96”	653.41
	48 x 120”	816.77
	48 x 144”	980.12
	48 x 240”	1633.54
	60 x 144”	1225.15
	60 x 240”	2041.92
	60 x 288”	2450.30
	72 x 120”	1225.15
	72 x 144”	1470.18
	72 x 240”	2450.36
	72 x 288”	2940.36
	72 x 360”	3675.46
	84 x 120”	1429.34
	84 x 240”	2858.69
	84 x 288”	3430.43
	84 x 360”	4288.03
	84 x 480”	5717.38
	96 x 120”	1633.54
	96 x 240”	3267.07
	96 x 288”	3920.49
	96 x 360”	4900.61
	96 x 480”	6534.14
	120 x 360”	6125.76
	120 x 480”	8167.68
9/16”	22.9723#/Sq. Ft. (.159534#/Sq. In.)	
	60 x 360”	3445.85
	96 x 360”	5513.36
5/8”	25.5244#/Sq. Ft. (.17725#/Sq. In.)	
	48 x 96”	816.77
	48 x 120”	1020.96
	60 x 120”	1276.20
	60 x 240”	2552.40

Size		Weight Per Plate
5/8” (cont.)	72 x 240”	3062.88
	72 x 288”	3675.46
	84 x 240”	3573.36
	84 x 288”	4288.03
	84 x 360”	5360.04
	84 x 480”	7146.72
	96 x 240”	4083.84
	96 x 360”	6125.76
	96 x 480”	8167.68
	120 x 360”	7657.20
	120 x 480”	10209.60
11/16”	28.0771#/Sq. Ft. (.194980#/Sq. In.).	
3/4”	30.6288#/Sq. Ft. (.21270#/Sq. In.)	
	48 x 96”	980.12
	48 x 120”	1225.15
	48 x 240”	2450.30
	60 x 120”	1531.44
	60 x 240”	3062.88
	72 x 240”	3675.46
	72 x 288”	4410.55
	72 x 360”	5513.18
	84 x 240”	4288.03
	84 x 360”	6432.05
	84 x 480”	8576.06
	96 x 240”	4900.61
	96 x 288”	5880.73
	96 x 360”	7350.91
	96 x 480”	9801.22
	120 x 360”	9188.64
	120 x 480”	12251.52
13/16”	33.1819#/Sq. Ft. (.230430#/Sq. In.)	
7/8”	35.736#/Sq. Ft. (.24815#/Sq. In.)	
	72 x 240”	4288.03
	84 x 240”	5002.70
	96 x 240”	5717.38
	96 x 360”	8576.06
15/16”	38.2867#/Sq. Ft. (.26588#/Sq. In.)	
1”	40.8384#/Sq. Ft. (.28360#/Sq. In.)	
	48 x 96”	1306.83
	48 x 120”	1633.54
	60 x 120”	2041.92
	60 x 240”	4083.84
	72 x 240”	4900.61
	72 x 360”	7350.91
	84 x 240”	5717.38
	84 x 288”	6860.85
	84 x 360”	8576.06

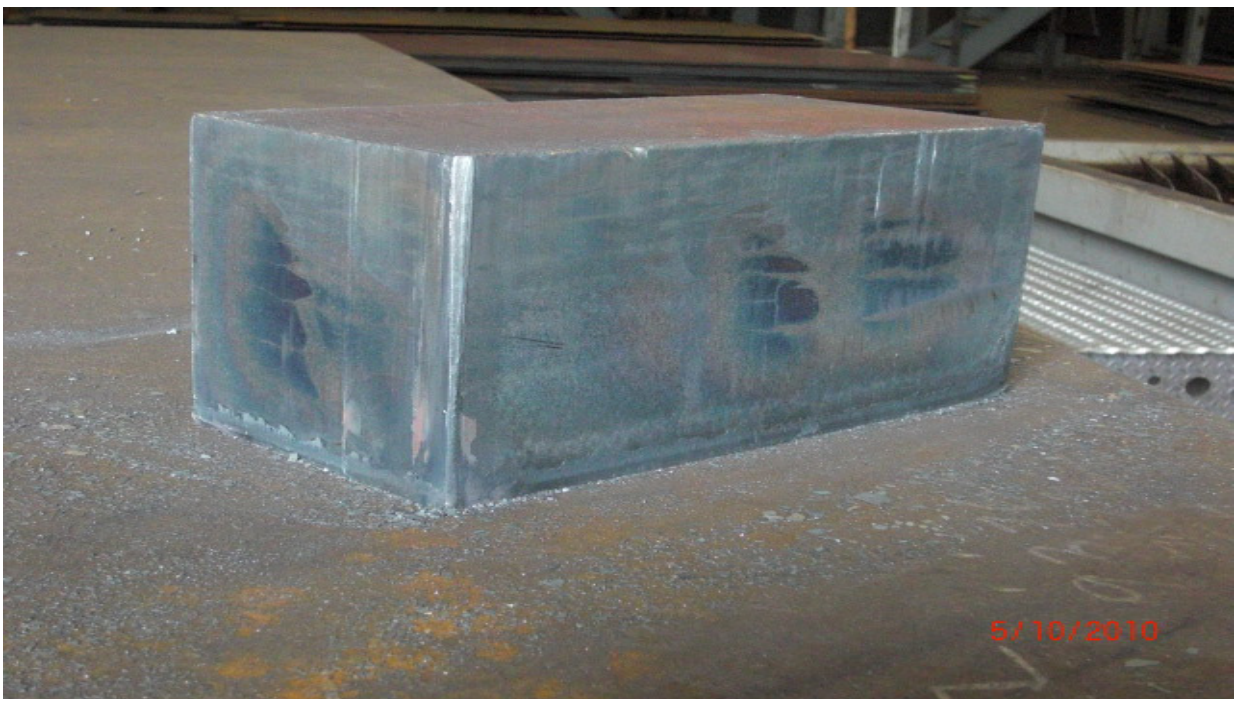
SIZE RANGE/SHEARED & BURNED PLATE (Continued)

Size	Weight Per Plate	
1”	96 x 240”	6534.14
	96 x 288”	7840.97
	96 x 360”	9801.22
	120 x 360”	12251.52
	120 x 480”	15335.36
1 1/8”	45.9432#/Sq. Ft. (.31905#/Sq. In.)	
	96 x 240”	7350.91
	96 x 288”	8821.09
	96 x 360”	11026.37
1 3/16”	48.5956#/Sq. Ft. (.336775#/Sq. In.)	
1 1/4”	51.048#/Sq. Ft. (.3545#/Sq. In.)	
	60 x 240”	5104.80
	72 x 240”	6125.76
	84 x 240”	7146.72
	84 x 288”	8576.06
	84 x 360”	10720.08
	96 x 120”	4083.44
	96 x 240”	8167.68
	96 x 360”	12251.52
1 3/8”	56.1528#/Sq .Ft. (.38995#/Sq. In.)	
	96 x 240”	8984.45
	96 x 360”	13476.67
	96 x 480”	17968.90
1 1/2”	61.2576#/Sq. Ft (.42540#/Sq. In.)	
	64 x 240”	6125.76
	72 x 240”	7350.91
	84 x 240”	8576.06
	84 x 288”	10291.28
	96 x 240”	9801.22
	96 x 360”	14701.82
	120 x 360”	18377.28
1 5/8”	66.3624#/Sq. Ft. (.46085#/Sq. In.)	
	96 x 240”	10617.98
	120 x 360”	19908.72
1 3/4”	71.4672#/Sq. Ft. (.49630#/Sq. In.)	
	84 x 240”	10005.41
	84 x 360”	15008.11
	96 x 240”	11434.75
	96 x 360”	17152.13
1 7/8”	76.5720#/Sq .Ft. (.531750#Sq. In.)	
2”	81.6768#/Sq. Ft. (.5672#/Sq. In.)	
	48 x 288”	7840.97
	60 x 240”	8167.68

Size	Weight Per Plate	
2”	72 x 240”	9801.22
	72 x 288”	11761.46
	84 x 240”	11434.75
	84 x 360”	17152.13
	96 x 240”	13068.29
	96 x 360”	19602.43
2 1/4”	91.8864#/Sq. Ft. (.63810#/Sq. In.)	
	84 x 240”	12864.10
	96 x 240”	14701.82
2 3/8”	96.9912#/Sq. Ft. (.67360#/Sq. In.)	
2 1/2”	102.0960#/Sq. Ft. (.7090#/Sq. In.)	
	72 x 240”	12251.52
	84 x 240”	14293.44
	96 x 240”	16335.36
2 3/4”	112.5152#/Sq. Ft. (.7799#/Sq. In.)	
	96 x 240”	17968.90
3”	122.5152#/Sq. Ft. (.8508#/Sq. In)	
	60 x 240”	12251.52
	72 x 240”	14701.82
	84 x 192”	13721.70
	84 x 240”	17152.13
	96 x 240”	19602.43
3 1/4”	132.7248#/Sq. Ft. (.9217#/Sq. In.)	
	84 x 120”	9290.74
	96 x 192”	16988.77
	96 x 240”	21235.97
3 1/2”	142.9344#/Sq. Ft. (.9926#/Sq. In.)	
	84 x 240”	20010.82
	96 x 120”	11434.75
	96 x 144”	13721.70
	96 x 192”	18295.60
	96 x 240”	22869.50
3 3/4”	153.1440#/Sq. Ft. (.1.0635#Sq. In.)	
	84 x 120”	10720.08
	96 x 192”	19602.43
4”	163.3536#/Sq. Ft. (1.1344#/Sq. In.)	
	84 x 192”	18295.60
	84 x 240”	22869.50
	96 x 120”	13068.29
	96 x 144”	15681.95
	96 x 192”	20909.26
	96 x 240”	26136.58

SIZE RANGE/SHEARED & BURNED PLATE(Continued)

Size	Weight Per Plate	Size	Weight Per Plate
4 1/2”	183.7728#/Sq. Ft. (1.2762#/Sq. In.) 72 x 240” 22052.74 84 x 192” 20582.55 96 x 120” 15294.18	7 1/2”	306.2880#/Sq. Ft. (2.1270#/Sq. In.) 72 x 120” 18377.28
5”	204.1920#/Sq. Ft. (1.4180#/Sq. In.) 60 x 240” 20419.20 96 x 120” 16335.36 96 x 144” 19602.43	8”	326.7072#/Sq. Ft. (2.2688#/Sq. In.) 72 x 120” 19602.43
5 1/2”	224.6112#/Sq. Ft. (1.5598#/Sq. In.) 96 x 120” 17968.90	8 1/2”	347.1264#/Sq. Ft. (2.41060#/Sq. In.)
6”	245.0304#/Sq. Ft. (1.7016#/Sq. In.) 72 x 144” 17642.19 96 x 120” 19602.43	9”	367.5456#/Sq. Ft. (2.5524#/Sq. In.)
6 1/2”	265.4496#/Sq. Ft. (1.8434#/Sq. In.)	9 1/2”	387.9648#/Sq. Ft. (2.6942#/Sq. In.)
7”	285.8688#/Sq. Ft. (1.9852#/Sq. In.) 72 x 120” 17152.13 84 x 120” 20010.82	10”	408.3840#/Sq. Ft. (2.8360#/Sq. In.)
		10 1/2”	428.8032#/Sq. Ft. (2.9778#/Sq. In.)
		11”	449.2224#/Sq. Ft. (3.1196#/Sq. In.)
		12”	490.0608#/Sq. Ft. (3.4032#/Sq. In.)



Oxy Fuel Burning up to 11”

UNIVERSAL MILL PLATES

ASTM A36 20' LENGTHS

Up to 3/16 x 12" , inclusive --- See Hot Rolled Strip

	Size In Inches	Est. Wt. Per Ft. lbs.	Wt. Per 20' Bar lbs.
1/4 x	9	7.65	153.0
	10	8.50	170.0
	12	10.20	204.0
	14	11.90	238.0
	15	12.75	255.0
	16	13.60	272.0
	18	15.30	306.0
	20	17.00	340.0
	22	18.70	374.0
	24	20.40	408.0
5/16 x	9	9.56	191.2
	10	10.63	212.6
	12	12.75	255.0
	14	14.88	297.6
	15	15.94	318.8
	16	17.00	340.0
	18	19.13	382.6
	20	21.25	425.0
	22	23.37	467.4
	24	25.50	510.0
3/16 x	9	11.48	229.6
	10	12.75	255.0
	12	15.30	306.0
	14	17.85	357.0
	15	19.13	382.6
	16	20.40	408.0
	18	22.95	459.0
	20	25.50	510.0
	22	28.05	561.0
	24	30.60	612.0
1/2 x	9	15.30	306.0
	10	17.00	340.0
	12	20.40	408.0
	14	23.80	476.0
	16	27.20	544.0
	18	30.60	612.0
	20	34.00	680.0
	22	37.40	748.0
	24	40.80	816.0
5/8 x	9	19.13	382.6
	10	21.25	425.0
	12	25.50	510.0
	14	29.75	595.0
	16	34.00	680.0
	18	38.25	765.0
	20	42.50	850.0
	22	46.75	935.0
	24	51.00	1020.0
3/4 x	9	22.95	459.0
	10	25.50	510.0
	12	30.60	612.0
	14	35.70	714.0
	16	40.80	816.0
	18	45.90	918.0
	20	51.00	1020.0
	22	56.10	1122.0
	24	61.20	1224.0
7/8 x	10	29.75	595.0
	12	35.70	714.0
	16	47.60	952.0
	24	71.40	1428.0
1 x	9	30.60	612.0
	10	34.00	680.0
	12	40.80	816.0
	14	47.60	952.0
	16	54.40	1088.0
	18	61.20	1224.0
	20	68.00	1360.0
	24	81.60	1632.0
1 1/4 x	10	42.50	850.0
	12	51.00	1020.0
	14	59.30	1186.0
	16	68.00	1360.0
	18	76.50	1530.0
	20	85.00	1700.0
1 1/2 x	10	51.00	1020.0
	12	61.20	1224.0
	14	71.40	1428.0
	16	81.60	1632.0
	18	91.80	1836.0
	20	102.00	2940.0
2 x	12	81.60	1632.0

DIAMOND FLOOR PLATE

Size	Weight Per Sheet	
16 Gauge*	3.00#/Sq. Ft.	
	(.0208#/Sq. In.)	
	36 x 120”	89.86
	36 x 144”	107.83
	48 x 120”	119.81
	48 x 144”	191.69
14 Gauge*	3.75#/Sq. Ft.	
	(.0260#/Sq. In.)	
	36 x 120”	112.32
	36 x 144”	134.78
	48 x 120”	149.76
	48 x 144”	179.71
	48 x 192”	239.62
12 Gage*	5.25#/Sq. Ft	
	(.0365#/Sq. In.)	
	48 x 96”	168.19
	48 x 120”	210.24
	48 x 144”	252.29
	60 x 144”	315.36
1/2”*	6.15#/Sq. Ft.	
	(.0427#/Sq. In.)	
	36 x 96”	147.57
	36 x 120”	184.46
	36 x 144”	221.36
	48 x 96”	196.76
	48 x 120”	245.95
	48 x 144”	295.14
	48 x 192”	393.52
	48 x 240”	491.9
	48 x 288”	590.28
	60 x 96”	245.95
	60 x 120”	307.44
	60 x 144”	368.93
	60 x 240”	614.88
	60 x 288”	737.86
3/16”*	8.71#/Sq. Ft.	
	(.0605#/Sq. In.)	
	48 x 96”	278.78
	48 x 120”	348.48
	48 x 144”	418.18
	48 x 192”	557.57
	48 x 240”	696.96
	48 x 288”	836.35
	60 x 96”	348.48
	60 x 120”	435.60
	60 x 144”	522.72
	60 x 240”	871.20
	60 x 288”	1045.44

Size	Weight Per Sheet	
3/16”*	72 x 96”	418.18
	72 x 120”	522.72
	72 x 144”	627.26
	72 x 240”	1045.44
	72 x 288”	1254.53
1/4"*	11.26#/Sq. Ft.	
	(.0782$/Sq. In.)	
	48 x 96”	360.35
	48 x 120”	450.43
	48 x 144”	540.52
	48 x 240”	900.86
	48 x 288”	1081.04
	60 x 120”	563.04
	60 x 144”	900.86
	60 x 240”	1126.08
	60 x 288”	1351.20
	72 x 96”	540.52
	72 x 120”	675.65
	72 x 144”	810.78
	72 x 240”	1351.30
	72 x 288”	1621.56
	96 x 240”	1801.73
5/16”*	13.81#/Sq. Ft.	
	(.0959#/Sq. In.)	
	60 x 240”	1380.96
	72 x 96”	662.86
	72 x 120”	828.58
	72 x 144”	994.29
	72 x 192”	1325.72
	72 x 240”	1657.15
	96 x 240”	2209.54
3/8”*	16.37#/Sq. Ft.	
	(.1137#/Sq. In.)	
	60 x 144”	368.93
	72 x 240”	1964.74
	72 x 288”	2357.68
	96 x 240”	2619.65
	96 x 288”	3143.58
1/2”*	21.47#/Sq. Ft.	
	(.1491#/Sq. In.)	
	72 x 240”	2576.45
	96 x 240”	3435.26
3/4”	31.65#/Sq. Ft.	
	(.2198#/Sq. In.)	
	96 x 288”	6076.80

***Also available in coil**

TOLERANCES

THICKNESS AND WEIGHT

SHEARED AND UNIVERSAL MILL PLATES

WHEN ORDERED TO THICKNESS 15" AND UNDER

Tolerance over average of lots* for widths given in Inches, expressed in percentages of nominal weights**

Permissible Variations in Thickness for Rectangular Carbon, High-Strength Low Alloy, and Alloy-Steel Plates, 15 in, and Under in Thickness When Ordered to Thickness

Note 1 - Permissible variation under specified thickness. 0.01 in.

Note 2 - Thickness to be measured at 3/8 to 3/4 in. from the longitudinal edge.

Note 3 - For thickness measured at any location other than that specified in Note 2, the permissible maximum over tolerance shall be increased by 75% rounded to the nearest 0.01 in.

Specified Thickness, In.	Tolerance Over Specified Thickness For Widths Given. in.											
	48 and under	Over 48 to 60, excl	60 to 72, excl	72 to 84, excl	84 to 96, excl	96 to 108, excl	108 to 120, excl	120 to 132, excl	132 to 144, excl	144 to 168, excl	168 to 182, excl	182 and over
To 1/4, excl	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	-	-	-
1/4 to 5/16, excl	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	-	-	-
5/16 to 3/8, excl	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.05	-	-
3/8 to 7/16, excl	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.06	-
7/16 to 1/2, excl	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.06	-
1/2 to 5/8, excl	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.07	-
5/8 to 3/4, excl	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.06	0.07	0.07
3/4 to 1, excl	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.07	0.08	0.09
1 to 2, excl	0.06	0.06	0.06	0.06	0.06	0.07	0.08	0.10	0.10	0.11	0.13	0.16
2 to 3, excl	0.09	0.09	0.09	0.10	0.10	0.11	0.12	0.13	0.14	0.15	0.15	-
3 to 4, excl	0.11	0.11	0.11	0.11	0.11	0.13	0.14	0.14	0.14	0.15	0.17	-
4 to 6, excl	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.20	0.20	-
6 to 10, excl	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.27	0.28	-
10 to 12, excl	0.29	0.29	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.35	-
12 to 15, incl	0.29	0.29	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	-

SHEARED, UNIVERSAL MILL AND MILL EDGE PLATES

Sheared - Width and Length Thickness 1 1/2" and Under Mill Edge - Length Only All Thickness

Universal - Length Only Thickness 2 1/2" and Under

Specified Dimension, Inches		Tolerance Over Specified Width and Length for Thickness, Inches or Equivalent Weights, Pounds Per Square Foot							
		To under 3/8		3/8 to under 5/8		5/8 to under 1		1 thru 2*	
Length	Width	To under 15.3		15.3 to under 25.5		25.5 to under 40.8		40.8 thru 81.6	
		Width	Length	Width	Length	Width	Length	Width	Length
To under 120	To under 60	3/8	1/2	7/16	5/8	1/2	3/4	5/8	1
	60 to under 64	7/16	5/8	1/2	11/15	5/8	7/8	3/4	1
	84 to under 108	1/2	3/4	5/8	7/8	3/4	1	1	1 1/8
	10 thru 200	5/8	7/8	3/4	1	7/8	1 1/8	1 1/8	1 1/4
120 to under 240	To under 60	3/8	3/4	1/2	7/8	5/8	1	3/4	1 1/8
	60 to under 64	1/2	3/4	5/8	7/8	3/4	1	7/8	1 1/4
	84 to under 108	9/16	7/8	11/16	15/16	13/16	1 1/8	1	1 3/8
	108 thru 200	5/8	1	3/4	1 1/8	7/8	1 1/4	1 1/8	1 3/8
240 to under 360	To under 60	3/8	1	1/2	1 1/8	5/8	1 1/4	3/4	1 1/2
	60 to under 64	1/2	1	5/8	1 1/8	3/4	1 1/4	7/8	1 1/2
	84 to under 108	9/16	1	11/16	1 1/8	7/8	1 3/8	1	1 1/2
	108 thru 200	11/16	1 1/8	7/8	1 1/4	1	1 3/8	1 1/4	1 3/4

Tolerance under specified width and length, 1/4" *Applicable also to Universal Mill Plates up to 12" wide, thickness over 2" thru 2 1/2"

SHEARED, UNIVERSAL MILL AND MILL EDGE PLATES (Continued)

Sheared - Width and Length Thickness 1 1/2" and Under Mill Edge - Length Only All Thickness

Universal - Length Only Thickness 2 1/2" and Under

Specified Dimensions, Inches		Tolerance Over Specified Width and Length for Thickness, Inches or Equivalent Weights, Pounds Per Square Foot							
		To under 3/8		3/8 to under 5/8		5/8 to under 1		1 thru 2*	
Length	Width	To under 15.3		15.3 to under 25.5		25.5 to under 40.8		40.8 thru 81.6	
		Width	Length	Width	Length	Width	Length	Width	Length
360 to under 480	to under 60	7/16	1 1/8	1/2	1 1/4	5/8	1 3/8	3/4	1 5/8
	60 to under 64	1/2	1 1/4	5/8	1 3/8	3/4	1 1/2	7/8	1 5/8
	84 to under 108	9/16	1 1/4	3/4	1 3/8	7/8	1 1/2	1	1 7/8
	108 thru 200	3/4	1 3/8	7/8	1 1/2	1	1 5/8	1 1/4	1 7/8
480 to under 600	to under 60	7/16	1 1/4	1/2	1 1/2	5/8	1 5/8	3/4	1 7/8
	60 to under 64	1/2	1 3/8	3/8	1 1/2	3/4	1 5/8	7/8	1 7/8
	84 to under 108	5/8	1 3/8	3/4	1 1/2	7/8	1 5/8	1	1 7/8
	108 thru 200	3/4	1 1/2	7/8	1 5/8	1	1 3/4	1 1/4	1 7/8
600 to under 720	to under 60	1/2	1 3/4	5/8	1 7/8	3/4	1 7/8	7/8	2 1/4
	60 to under 64	5/8	1 3/4	3/4	1 7/8	7/8	1 7/8	1	2 1/4
	84 to under 108	5/8	1 3/4	3/4	1 7/8	7/8	1 7/8	1 1/8	2 1/4
	108 thru 200	7/8	1 3/4	1	2	1 1/8	2 1/4	1 1/4	2 1/2
600 to under 720	to under 60	9/16	2	3/4	2 1/8	7/8	2 1/4	1	2 3/4
	60 to under 64	3/4	2	7/8	2 1/8	1	2 1/4	1 1/8	2 3/4
	84 to under 108	3/4	2	7/8	2 1/8	1	2 1/4	1 1/4	2 3/4
	108 thru 200	1	2	1 1/8	2 3/8	1 1/4	2 1/2	1 3/8	3

Tolerance under specified width and length, 1/4" *Applicable also to Universal Mill Plates up to 12" wide, thickness over 2" thru 2 1/2"

TOLERANCES (Continued)

FLATNESS

CARBON GRADES WITH A SPECIFIED MINIMUM TENSILE STRENGTH OF NOT MORE THAN 60,000 PSI (OR RELATED CHEMISTRY OF HARDNESS)

FLATNESS---
For all plate, the longer dimension specified is considered the length, and flatness tolerance along the length should not exceed the amounts indicated below for the specified width and thickness in plate up to 12 ft. in length or in any 12 ft. of longer plate. The flatness variations across the width should not exceed the tabular amount for the specified width. When the longer dimension is under 36", flatness tolerance should not exceed 1/4" for Carbon and 3/8" for High Strength Low Alloy. When the longer dimension is 36" through 72", the flatness variation should not exceed 75% of the tabular amount on the specified width or 1/4". Whichever is the greater.

Specified Thickness Inches		Specified Weight lb/sq. ft.		Flatness Tolerances for Specified Widths---Inches (Maximum deviation from a horizontal flat surface)											
				To under 36	36 to under 48	48 to under 60	60 to under 72	72 to under 84	84 to under 96	96 to under 108	108 to under 120	120 to under 144	144 to under 168	168 thru 200
under	1/4	under	10.2	9/16	3/4	15/16	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	----	----
1/4	to under 3/8	0.2 to under	15.3	1/2	5/8	3/4	15/16	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	----	----
3/8	to under 1/2	15.3 to under	20.4	1/2	9/16	5/8	5/8	3/4	7/8	1	1 1/8	1 1/4	1 7/8	2 1/8
1/2	to under 3/4	20.4 to under	30.6	7/16	1/2	9/16	5/8	5/8	3/4	1	1	1 1/8	1 1/2	2
3/4	to under 1	30.6 to under	40.8	7/16	1/2	9/16	5/8	5/8	5/8	3/4	7/8	1	1 3/8	1 3/4
1	to under 2	40.8 to under	81.6	3/8	1/2	1/2	9/16	9/16	5/8	5/8	5/8	11/16	1 1/8	1 1/2
2	to under 4	81.6 to under	163.2	5/16	3/8	7/16	1/2	1/2	1/2	1/2	9/16	5/8	7/8	1 1/8
4	to under 6	163.2 to under	244.8	3/8	7/16	1/2	1/2	9/16	9/16	5/8	3/4	7/8	7/8	1
6	to under 8	244.8 to under	326.4	7/16	1/2	1/2	5/8	11/16	3/4	7/8	7/8	1	1	1
8	to under 10	326.4 to under	408.0	1/2	1/2	5/8	11/16	3/4	13/16	7/8	15/16	1	1	1
10	to under 12	408.0 to under	489.6	1/2	5/8	3/4	13/16	7/8	15/16	1	1	1	1	1
12	thru 15	489.6 thru	612.0	5/8	3/4	13/16	7/8	15/16	1	1	1	1	1	1

Carbon Grades with a specified minimum tensile strength of not more than 60,000 psi (or related chemistry or hardness)

The above flatness tolerances apply to circles and sketch plate, based on the maximum dimension of the plate.

TOLERANCES (Continued)

FLATNESS

CARBON AND HIGH STRENGTH LOW ALLOY GRADES WITH A SPECIFIED MINIMUM TENSILE STRENGTH IN EXCESS OF 60,000 PSI (OR RELATED CHEMISTRY OF HARDNESS)

FLATNESS---
For all plate, the longer dimension specified is considered the length, and flatness tolerance along the length should not exceed the amounts indicated below for the specified width and thickness in plate up to 12 ft. in length or in any 12 ft. of longer plate. The flatness variations across the width should not exceed the tabular amount for the specified width. When the longer dimension is under 36", flatness tolerance should not exceed 1/4" for Carbon and 3/8" for High Strength Low Alloy. When the longer dimension is 36" through 72", the flatness variation should not exceed 75% of the tabular amount on the specified width or 1/4". Whichever is the greater.

Specified Thickness Inches		Specified Weight lb/sq. ft.	Flatness Tolerances for Specified Widths---Inches (Maximum deviation from a horizontal flat surface)											
			To under 36	36 to under 48	48 to under 60	60 to under 72	72 to under 84	84 to under 96	96 to under 108	108 to under 120	120 to under 144	144 to under 168	168 thru 200
under 1/4		under 10.2	13/16	1 1/8	1 3/8	1 7/8	2	2 1/4	2 3/8	2 5/8	2 3/4	----	----
1/4	to under 3/8	10.2 to under 15.3	3/4	15/16	1 1/8	1 3/8	1 3/4	1 7/8	2	2 1/4	2 3/8	----	----
3/8	to under 1/2	15.3 to under 20.4	3/4	7/8	15/16	15/16	1 1/8	1 5/16	1 1/2	1 5/8	1 7/8	2 3/4	3 1/8
1/2	to under 3/4	20.4 to under 30.6	5/8	3/4	13/16	7/8	1	1 1/8	1 1/4	1 3/8	1 5/8	2 1/4	3
3/4	to under 1	30.6 to under 40.8	5/8	3/4	7/8	7/8	15/16	1	1 1/8	1 5/16	1 1/2	2	2 5/8
1	to under 2	40.8 to under 81.6	9/16	5/8	3/4	13/16	7/8	15/16	1	1	1	1 5/8	2 1/4
2	to under 4	81.6 to under 163.2	1/2	9/16	11/16	3/4	3/4	3/4	3/4	7/8	1	1 1/4	1 5/8
4	to under 6	163.2 to under 244.8	9/16	11/16	3/4	3/4	7/8	7/8	15/16	1 1/8	1 1/4	1 1/4	1 1/2
6	to under 8	244.8 to under 326.4	5/8	3/4	3/4	15/16	1	1 1/8	1 1/4	1 5/16	1 1/2	1 1/2	1 1/2
8	to under 10	326.4 to under 408.0	3/4	13/16	15/16	1	1 1/8	1 1/4	1 5/16	1 3/8	1 1/2	1 1/2	1 1/2
10	to under 12	408.0 to under 489.6	3/4	15/16	1 1/8	1 1/4	1 5/16	1 3/8	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
12	thru 15	489.6 thru 612.0	7/8	1	1 3/16	1 5/16	1 3/8	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2

Carbon and High Strength Low Alloy Grades with a specified minimum tensile strength in excess of 60,000 psi (or related chemistry or hardness)

The above flatness tolerances apply to circles and sketch plate, based on the maximum dimension of the plate.

PERMISSIBLE VARIATIONS IN WAVINESS FOR PLATES

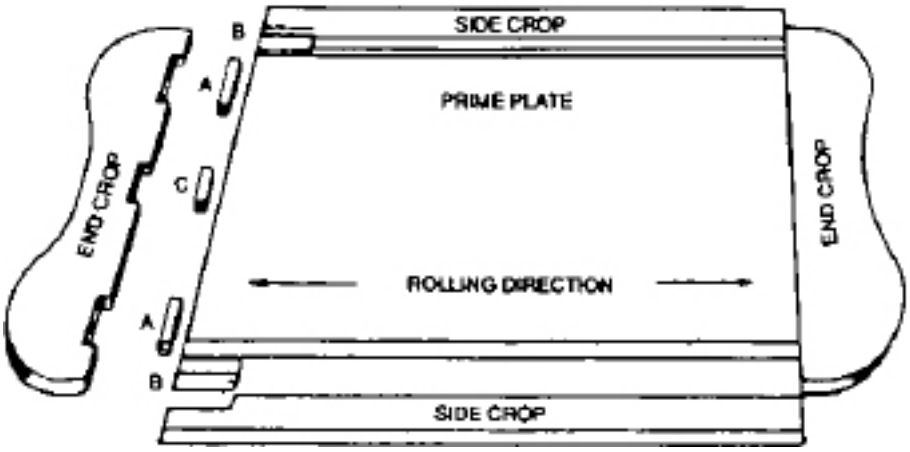
Note—Waviness denotes the maximum deviation of the surface of the plate from a plane parallel to the surface of the point of measurement and contiguous to the surface of the plate at each of the two adjacent wave peaks, when the plate is resting on flat horizontal surface, as measured in an increment of less than 12 ft of length.

The waviness tolerance is a function of the flatness tolerance

Flatness Tolerance, in.	Waviness Tolerance, In., When Number of Waves in 12 ft is						
	1	2	3	4	5	6	7
5/16	5/16	1/4	3/16	1/8	1/8	1/16	1/16
3/8	3/8	5/16	3/16	3/16	1/8	1/16	1/16
7/16	7/16	5/16	1/4	3/16	1/8	1/8	1/16
1/2	1/2	3/8	5/16	3/16	3/16	1/8	1/16
9/16	9/16	7/16	5/16	1/4	3/16	1/8	1/8
5/8	5/8	1/2	3/8	1/4	3/16	1/8	1/8
11/16	11/16	1/2	3/8	5/16	3/16	3/16	1/8
3/4	3/4	9/16	7/16	5/16	1/4	3/16	1/8
13/16	13/16	5/8	7/16	5/16	1/4	3/16	1/8
7/8	7/8	11/16	1/2	3/8	1/4	3/16	1/8
15/16	15/16	11/16	1/2	3/8	5/16	1/4	3/16
1	1	3/4	9/16	7/16	5/16	1/4	3/16
1 1/8	1 1/8	7/8	5/8	1/2	3/8	1/4	3/16
1 1/4	1 1/4	1 5/16	11/16	1/2	3/8	5/16	1/4
1 3/8	1 3/8	1 1/16	3/4	9/16	7/16	5/16	1/4
1 1/2	1 1/2	1 1/8	7/8	5/8	1/2	3/8	1/4
1 5/8	1 5/8	1 1/4	15/16	11/16	1/2	3/8	5/16
1 3/4	1 3/4	1 5/16	1	3/4	9/16	7/16	5/16
1 7/8	1 7/8	1 1/16	1 1/16	9/16	9/16	7/16	5/16
2	2	1 1/2	1 1/8	7/8	5/8	1/2	3/8
2 1/8	2 1/8	1 5/8	1 3/16	7/8	11/16	1/2	3/8
2 1/4	2 1/4	1 11/16	1 1/4	15/16	11/16	9/16	3/8
2 3/8	2 3/8	1 13/16	1 5/16	1	3/4	9/16	7/16
2 1/2	2 1/2	1 7/8	1 7/16	1 1/6	13/16	9/16	7/16
2 5/8	2 5/8	2	1 1/2	1 1/8	13/16	5/8	7/16
2 3/4	2 3/4	2 1/16	1 9/16	1 1/8	7/8	5/8	1/2
2 7/8	2 7/8	2 3/16	1 5/8	1 3/16	15/16	11/16	1/2
3	3	2 1/4	1 11/16	1 1/4	15/16	11/16	9/16
3 1/8	3 1/8	2 3/8	1 3/4	1 5/16	1	3/4	9/16

ASTM TEST SPECIMENS

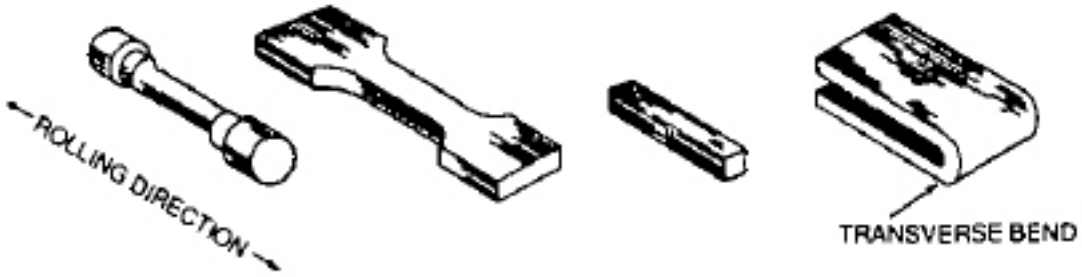
CUSTOMARY LOCATION OF TEST SPECIMENS FOR ASTM AND SIMILAR STEEL PLATE SPECIFICATIONS



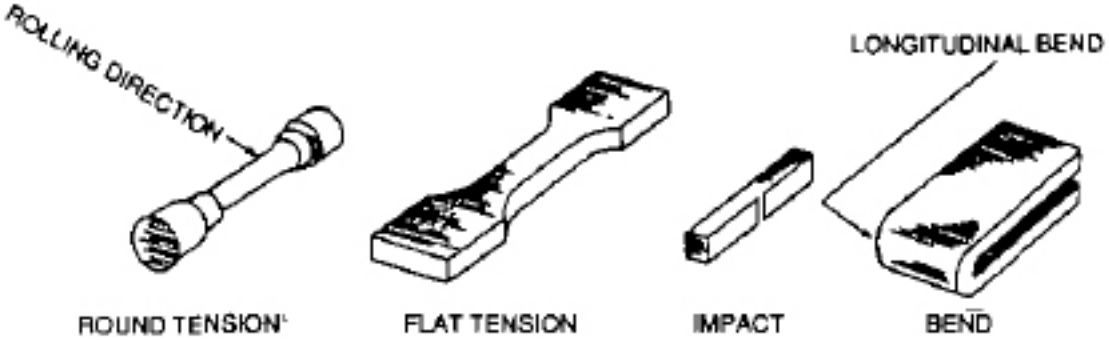
Quality	Tensile	Bend When Specified	Impact
Structural	Width thru 24" B Or B' Width over 24" A Or A'	B Or B' A Or A'*	B Or B' A Or A'*
Pressure Vessel	A or A’	C	B or B’ A or A’

*Transverse specimens
Drillings for Product Analysis can be obtained from broken Tensile Test Specimens.
When an additional Tension Test is specified, specimen will be obtained from a corner at the opposite end of the plate

LONGITUDINAL TEST



TRANSVERSE TEST



FLAME CUT EDGES

Flame cut edges on all grades of steel plate will have higher Rockwell hardnesses than the level of hardness for the steel grade. This is caused by the high flame cutting temperature and the mass cooling effect of the plate on the flame cut edge. The plate acts as a heat sink and actually quenches the flame cut edge similar to quenching steel in oil or water during a heat treating operation The hardness of the edge will also increase with A36 steel. Hardness penetration will be approximately . 100" on the flame cut edge.

Higher carbon plates such as 1045 and alloy grades A514, 4140 and 4340 will have hardnesses ranging from HRC 45-55. These plates will have to be stress relief annealed under the following conditions; when the edge will be machined, if they are to be bent or formed and if the plates or parts are to be heat treated. Usually 1045, 4140 and 4340 are stress relieved at 1250 degrees F at the heat treat shop. The A514 grade is stress relieved at 1100 degrees F which is 100 degrees below the tempering temperature Stress relieving A514 at 1100 degrees will not affect the mechanical strength of the plate as certified by the mill.
It is also possible to flame temper back the hardness of the flame cut edge with the use of a 1000 degree temperature crayon.

CHARPY IMPACT TEST

At times it is important to know the exact toughness of steel for a specific application. These applications would be for parts subjected to high impact or shock loads, for safety considerations, and for parts subjected to very low temperatures.

The Charpy Test is a measurement of steel toughness, and is based on the average of three steel samples in a special testing machine. The samples are three small square bars precision machined and ground with a close tolerance V-notch. The samples are impacted with a swinging pendulum and the energy required to fracture the test bars is measured in ft-lb.

The testing temperature must be specified for Charpy Impact Tests. Test temperatures are usually from ambient to -50F but can be lower. Most steels will exhibit varying degrees of toughness at different temperatures. The transition temperature where plain carbon steels such as A36 change from ductile to brittle or nil toughness is called the transition temperature. This is approximately -10F. Normalized steels such as A537 and AISI 4340 with a high nickel content will have good impact properties at very low temperatures.

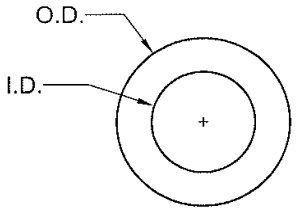
Plate thickness must be at least 1/2" in order to obtain a full size Charpy Test specimen. Smaller sized or sub-sized specimen tests will be converted to full size impact values by the following ASTM A20 specifications. The minimum level of toughness is considered at 12 ft-lb on a full size Charpy Impact specimen.

Charpy V-Notch Test Acceptance Criteria for Various Sub-Size Specimens

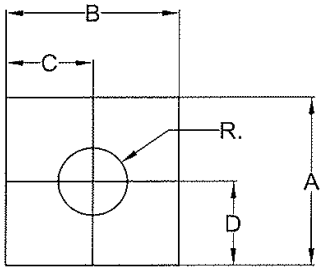
Full Size ft-lb	3/4 Size ft-lb	2/3 Size ft-lb	1/2 Size ft-lb	1/3 Size ft-lb	1/4 Size ft-lb
40	30	27	20	13	10
35	26	23	18	12	9
30	22	20	15	10	8
25	19	17	12	8	6
20	15	13	10	7	5
16	12	11	8	5	4
15	11	10	8	5	4
13	10	9	6	4	3
12	9	8	6	4	3
10	8	7	5	3	2
7	5	5	4	2	2

ORDER METHOD FOR PLATE PATTERN CUTTING

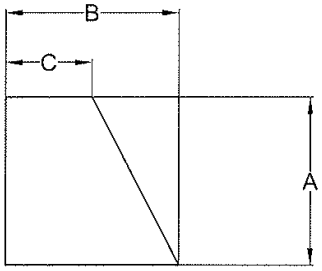
Order By Form With Complete Dimensions



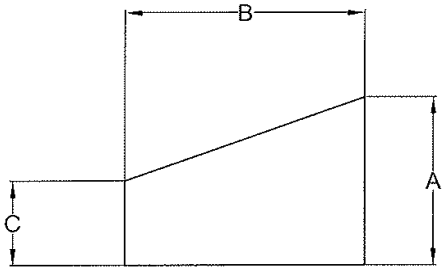
SHAPE - NO. 1



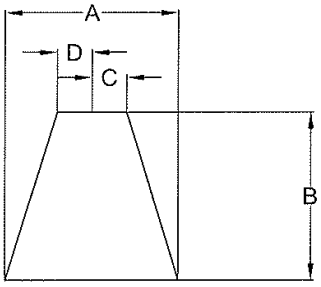
NO. 2



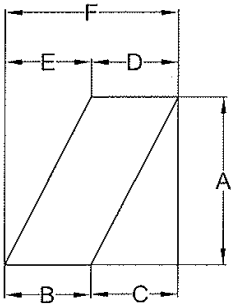
NO. 3



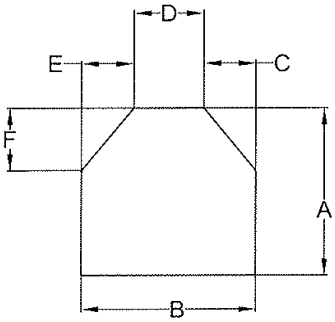
NO. 4



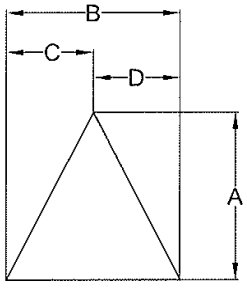
NO. 5



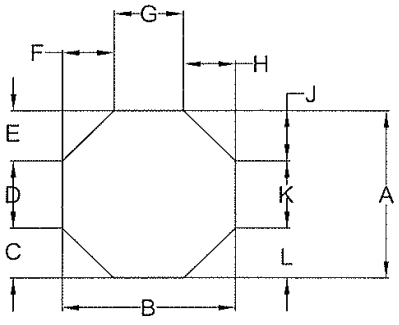
NO. 6



NO. 7



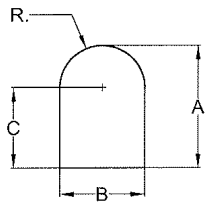
NO. 8



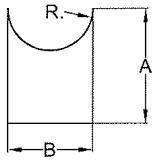
NO. 9

ORDER METHOD FOR PLATE PATTERN CUTTING (Continued)

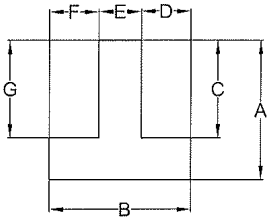
Order By Form Number With Complete Dimensions



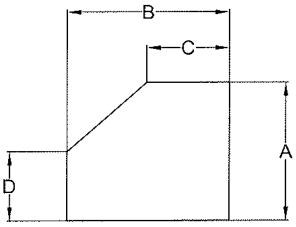
NO. 10



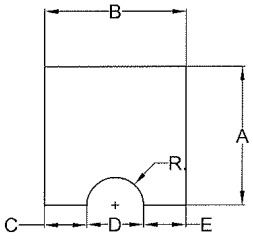
NO. 11



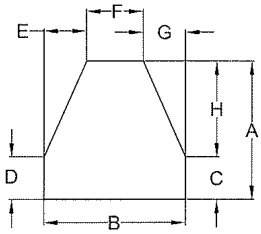
NO. 12



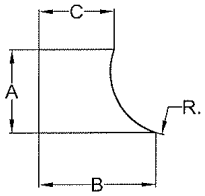
NO. 13



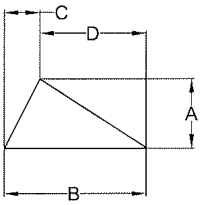
NO. 14



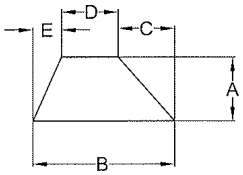
NO. 15



NO. 16

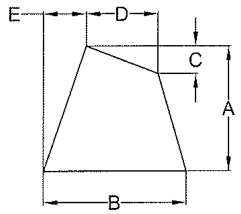


NO. 17

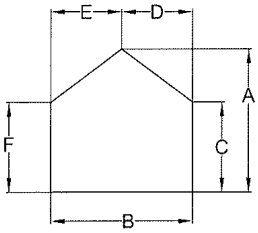


NO. 18

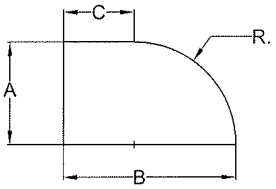
ORDERING GUIDE FOR FORMING



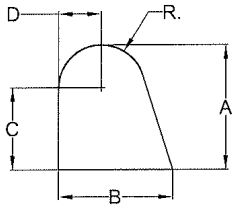
NO. 19



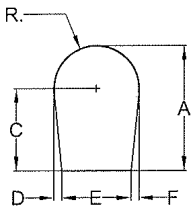
NO. 20



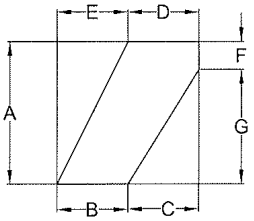
NO. 21



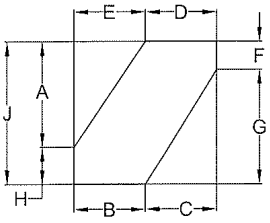
NO. 22



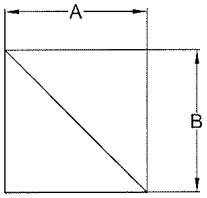
NO. 23



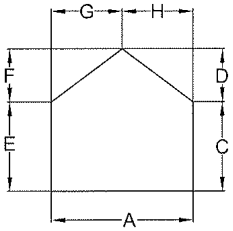
NO. 24



NO. 25



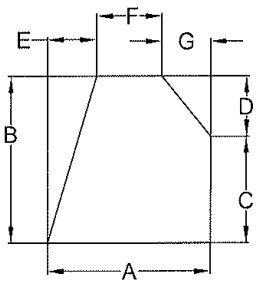
NO. 26



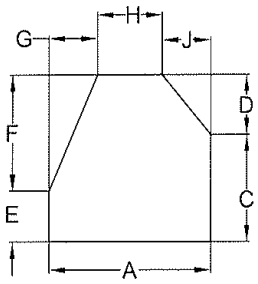
NO. 27

ORDERING GUIDE FOR FORMING

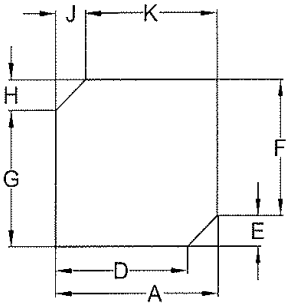
It



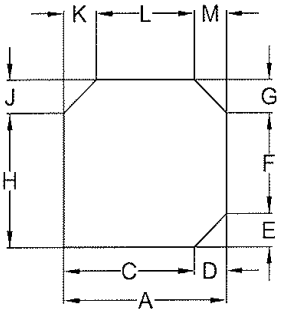
NO. 28



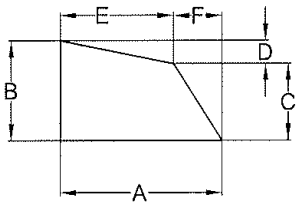
NO. 29



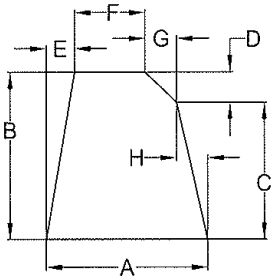
NO. 30



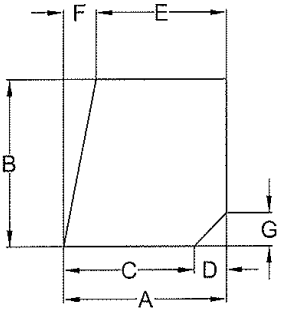
NO. 31



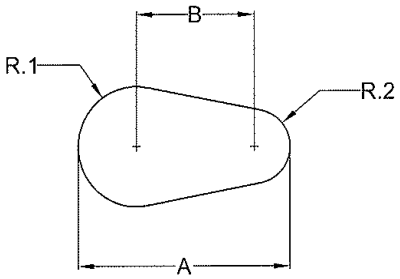
NO. 32



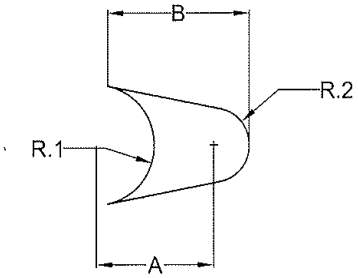
NO. 33



NO. 34

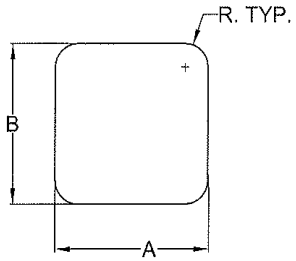


NO. 35

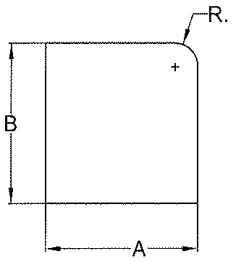


NO. 36

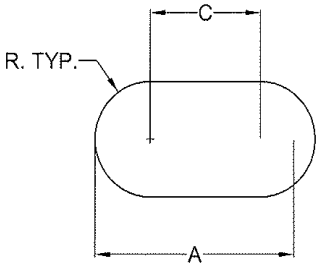
ORDERING GUIDE FOR FORMING



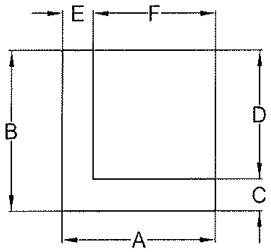
NO. 37



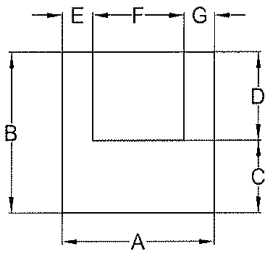
NO. 38



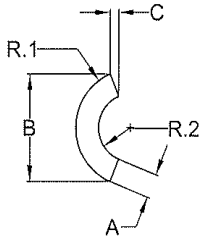
NO. 39



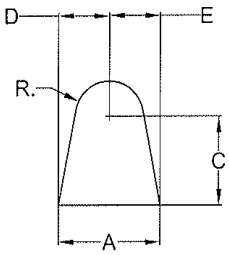
NO. 40



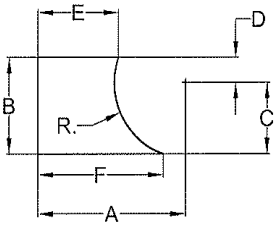
NO. 41



NO. 42



NO. 43



NO. 44

MG2- 2 Torch Plasma with 5-axis Bevel Head

CARBON STEEL PLATE SPECIFICATIONS

Designation	Thickness Range	Mechanical Properties				Chemical Composition - %					
		Yield Point Min. KSI	Tensile Strength KSI	% Elongation Minimum		C Max	MN Range or Max.	P Max.	S Max.	SI	**Other**
				8"	2"						
ASTM-A6-70	General Requirement Specification										
ASTM-A7	Deleted Replaced by ASTM-A36										
ASTM-A36	3/16" to 3/4" incl.	36.0	58.0/80.0	20	23	0.25		0.04	0.05		
	Over 3/4" to 1 1/2" incl.	36.0	58.0/80.0	20	23	0.25	0.80-1.20	0.04	0.05		
	Over 1 1/2" to 2 1/2" incl.	36.0	58.0/80.0	20	23	0.26	0.80-1.20	0.04	0.05	0.15-0.30	
	Over 2 1/2 to 4" incl.	36.0	58.0/80.0	20	23	0.27	0.85-1.20	0.04	0.05	0.15-0.30	
	Over 4"	36.0	58.0/80.0	20	23	0.29	0.85-1.20	0.04	0.05	0.15-0.30	
ASTM A131 (ABS)											
Grade A	To 1/2"	34.0	58-71	21	24	0.26	2.1/2XC	0.50	0.50	-	-
	To 2"	34.0	58-71	21	24	0.23	2.1/2XC	0.50	0.50	-	-
Grade B	To 2"	34.0	58-71	21	24	0.21	.80-1.10	0.40	0.40	.35 max	-
Grade D	To 2"	34.0	58-71	21	24	0.21	.60-1 35	0.40	0.40	10/.35	FGP&N1
Grade E	To 2"	34.0	58-71	21	24	0.18	.60-1.35	0.40	0.40	10/.35	FGP&N
Grade CS	To 2"	34.0	58-71	21	24	0.16	1.00-1.35	0.40	0.40	10/.35	FGP&N
Grade DS	To 2"	34.0	58-71	21	24	0.18	.90-1.60	0.40	0.40	10/.35	FGP&N1
Grade DH36	To 2"	51.0	71-90	21	24	0.18	.90-1.60	0.40	0.40	10/.50	FGP&N

FGP---Fine Grain Practice **[1]Normalized over 1.3/8" thickness**
N-Normalized

HIGH STRENGTH LOW ALLOY CARBON

PLATE SPECIFICATIONS

Designation	Thickness Range	Mechanical Properties				Chemical Composition - %									Other
		Yield Point Min.KSI	Tensile Strength Min. KSI	% Elongation Minimum		C Max	MN Range or Max.	P Max.	S Max.	Si or Max.	Cu	Mo Max.	CR Max.	Nl Max.	
				8"	2"										
ASTM A242	3/16" to 3/4"	50.0	70.0	18		.20	1.35	.04	.05		20 min				Or .50% min. Si & CA
Type 2	Over 3/4" to 1 1/2"	46.0	67.0	18											Instead of Cu
	Over 1 1/2' to 4"	42.0	63.0	18											
ASTM A572															
Grade 50	4" max	50.0	65.0	15	17	23	1.35	.04	.05	.15-40					Type 1.005-05 CB
															Type 2.01-.15 V
															Type 3.05 max,CB + V
ASTM A588															
Type A						19	.80-1.25	.04	.05	.30-65	.25-40		.40-65	.40	.02- 1OV
Type B						20	.75-1.35	.04	.05	.51-50	.20-40		.40-70	.50	.01-1OV
	3/16" to 4"	50.0	70.0	18	21										
	Over 4" to 5"	46.0	67.0		21										
	Over 5" 8"	42.0	63.0		21										
ASTM A656											N				
Grade 70	3/16" to 1"	70.0	80.0	14		18	1.65	025	.035	.60	.020 max				Type 3 .08 max V
Grade 80	3/16" to 3/4"	80.0	90.0	12		18	1.65	025	.035	.60	.020 max				.0005-15 CB
															Type 7.005- 15V
															.005-.10 CB

QUENCH AND TEMPERED HIGH STRENGTH STRUCTURAL

Designation	Thickness Range	Mechanical Properties				Chemical Composition-%								
		Yield Point Min. KSI	Tensile Strength KSI	%Elongation Minimum		C	MN	P	S	SI	CU	MO	CR	NI	Other
				8"	2"										
ASTM A514	To 2 1/2"	100.0	110-130		18	Chemical Analysis will vary depending on the mill manufacture. In general all grades will have .12-21% carbon and various amounts of CR, NI, MO and V. Boron is generally added to increase hardenability.									
	Over 2 1 /2" to 6"	90.0	100-130		16										

PRESSURE VESSEL QUALITY CARBON STEEL PLATE

Designation	Thickness Range	Mechanical Properties				Chemical Composition - %					
		Yield Point Min. KSI	Tensile Strength KSI	% Elongation Minimum		C Max	MN Range or Max.	P Max.	S Max.	SI	Other
				8"	2"						
ASTM-A285 Grade C	To 2"	30.0	55-75	23	27	.28	.90	.035	.040		
ASTM A515 Grade 70	To 1" Over 1" to 2" Over 2" to 4" Over 4" to 8"	38.0	70-90	17	21	.31 .33 35 .35	1.20	.035	.040	.15-40	CGP CGP CGP CGP
ASTM A516 Grade 70	1/4" to 1/2" Over 1/2" to 2" Over 2" to 4" Over 4" to 8"	38.0	70-90	17	21	.27 .28 .30 .31	.85-1.20	.035	.040	.15-40	FGP FGP FGP FGP
ASTM A537 Class I	1/4" to 2 1/2" Over 2 1/2 to 4"	50.0 45.0	70-90 65-85	18	22	.24	.70-1.35 1 1.00-1.60 [2]	. 035	.040	.15-50	FGP&N FGP&N

CGP-Coarse Grain Practice ‘ 1/2” and under *over 1 1/2”

ABRASION RESISTANT AND CHEMICAL GRADES

Designation	Thickness Range	Brinell Hardness Range	Chemical Composition C max.	MN max.	P	S	SI	CR	NI	Mo	Comments
AR235			.35/.50	1.50/2.00	.05	.055	.15/.85	-	-	-	As-Rolled
AR321					ASTM A514 chemical Analysis						Quench & Tempered
AR360		321-341									
		360-402	.14/.30	1.00/1.60	.030	.030	.15/.40	.35/.65	-	.10/.35	Quench & Tempered
					CHEMICAL GRADES						
AISI 1020		111-163	.18/.23	.30/.60	.040	.050	.15/.30				As-Rolled
AISI 1040		150-183	.37/.44	.60/.90	.040	.050	.15/.30				As-Rolled
AISI 1045		156-197	.43/.50	.60/.90	.040	.050	.15/.30				As-Rolled
AISI 4140		197-248	.38/.43	.75/1.00	.035	.040	.15/.30	.80/1.10	-	.15/.25	Annealed

MARINE STEELS

CARBON, HIGH-STRENGTH LOW-ALLOY, STEEL PLATES FOR MARINE CONSTRUCTION

Specification	ABS Grade A A131 Grade A	ABS Grade B A131 Grade B	ABS Grade D A131 Grade D	ABS Grade E A131 Grade E	ABS Grade CS A131 Grade CS
Type of Steel	Carbon Steel, as rolled	Carbon Steel, as rolled	Carbon Steel, normalized	Carbon Steel, normalized	Carbon Steel, normalized
Tensile Strength range psi	58,000-71,000	58,000-71,000	58,000-71,000	58,000-71,000	58,000-71,000
Yield Point/Strength minimum psi	34,000	34,000	34,000	34,000	34,000
Thickness Availability inches	to 2 incl	to 2 incl	to 2 incl	to 2 incl	to 2 incl
Chemical Composition (Ladle analysis_%) carbon (max)	.23**	.23	. 21	.18	.15
Manganese	***	.80 to 1.10*	.70 to 1.40*	.70 to 1.50	1.00 to 1.35
Phosphorous (max)	.05	.04	. 04	.04	.04
Sulfur (max)	.05	.04	.04	.04	.04
Silicon	-	.35 max	.10 to 35	.10 to 35	.10 to 35
Chromium	-	-	-	-	-
Nickel	-	-	-	-	-
Molybdenum	-	-	-	-	-
Copper	-	-	-	-	-
Other Elements	-	-	.02 to .06 Al	.02 TO .06 Al	.02 TO .06 Al
Relative Price Factor	Structural 1.02 Cold Flanging 1.04	Structural 1.03 Cold Flanging 1.05	1.31	1.40	1.23
Remarks *	*Over 1” min yield point 32,000 **1/2” and under 26 max C **Over 1/2” min Mn must be 2.5 times carbon content	* Cold Flanging Quality .60 to 90% Mn allowed Thickness 1”	*1” and under 60 to 1.40% Mn includes CVNL to 30 ft-lbs at-20C (-4F) on Heat lot basis	Includes normalizing and CVNL Tests on each plate top 20 ft-lbs at -40C (-40F)	

MARINE STEELS (Continued)

CARBON, HIGH-STRENGTH LOW-ALLOY, STEEL PLATES FOR MARINE CONSTRUCTION

	ABS Grade DS	ABS & A131 Grades		ABS & A131 Grades		ABS & A131 Grades	
Specification	A131 Grade DS	AH32	AH36	DH32	DH36	EH32	EH36
Type of Steel	Carbon Steel, as rolled	High-Strength Steel, as normalized		High-Strength Steel, as normalized		High-Strength Steel, as normalized	
Tensile Strength minimum psi	58,000	68,000	71,000	68,000	71,000	68,000	71,000
Yield Point/Strength minimum psi	34,000	46,000	51,000	46,000	51,000	46,000	51,000
Thickness Availability inches	to 2 incl	to 2 incl	to 2 incl	to 2 incl	to 2 incl	to 2 incl	to 2 incl
Chemical Composition (ladle analysis*%) Carbon (max)	.16	.18	.18	.18	.18	.18	.18
Manganese	1.00 to 1.35	.90 to 1.60*	.90 to 1.60*	.90 to 1.60	.90 to 1.60	.90 to 1.60	.90 to 1.60
Phosphorus (max)	.04	.04	.04	.04	.04	.04	.04
Sulfur (max)	.04	.04	.04	.04	.04	.04	.04
Silicon	.10 to .35	.10 to .50*	.10 to .50*	.10 to .50	.10 to .50	.10 to .50	.10 to .50
Chromium	-	.25 (max)	.25 (max)	.25 (max)	.25 (max)	.25 (max)	. 25 (max)
Nickel	-	.40 (max)	.40 (max)	.40 (max)	.40 (max)	.40 (max)	.40 (max)
Molybdenum	-	.08 (max)	.08 (max)	.08 (max)	.08 (max)	.08 (max)	.08 (max)
Copper	-	.35 (max)	.35 (max)	.35 (max)	.35 (max)	.35 (max)	.35 (max)
Other elements	.02 to .06 AL or .05 Ca (max) or .10 V (max)	.06 AL (max.) or .05 Ca (max) or .10 V (max)	.06 AL (max.) or .05 Ca (max) or .10 V (max)	.06 AL (max.) or .05 Ca (max) or .10 V (max)	.06 AL (max.) or .05 Ca (max) or .10 V (max)	.06 AL (max.) or .05 Ca (max) or .10 V (max)	.06 AL (max.) or .05 Ca (max) or .10 V (max)
Relative Price Factor	1.10 normalized 1.28	1.13	1.17	1.38	1.40	1.45	1.47
Remarks	*Must be normalized over 1 1/2" thickness	*1/2" and under 70 to 1.50% MN and no min Si under 1/2" Thickness 1"	*1/2" and under 70 to 1 50% MN and no min Si under 1/2" Thickness 1"	Includes normalizing and CVNL to 25 ft-lbs at-20 C (-4 F) on heat lot basis	Includes normalizing and CVNL to 25 ft-lbs at-20 C (-4 F) on heat lot basis	Includes normalizing and CVNL Tests on each plate to 25 ft-lbs at-40C (-40F)	Includes normalizing and CVNL Tests on each plate to 25 ft-lbs at-40C (-40F)

SECTION 2

HOT AND COLD ROLLED SHEET & COIL

PRODUCT DESCRIPTION AND GRADES

Sheet steel products are available in cold rolled, hot rolled and hot rolled pickled and oiled.

Hot Rolled As Rolled or Hot Rolled Black is sheet steel with an as rolled surface finish. The surface is medium blue to purple black in color. The surface consists of a thin layer of iron oxide called scale. Adherence of the scale is generally tight on sheet steel products.

Hot Rolled Pickled & Oiled is the same sheet steel product further processed through a continuous pickling line. The pickling solution is either sulfuric or hydrochloric acid at a concentration of approximately 15%. These acids remove the scale by attacking the steel surface below the scale. After pickling the steel in the same process line it is sprayed with special rust preventative oils. The surface appearance will vary from dull silver to a dark gray color. The surface roughness or profilometer reading will run 50 to 80 RMS.

Cold Rolled Sheet is the same hot rolled pickled product called a hot rolled band which is cold reduced up to 70% of its hot rolled gauge. The product is annealed and skin passed or temper rolled through a rolling mill which continuously irons the steel flat and imparts a matte finish. The color is bright silver and the surface roughness is 20-40 RMS which is smoother than HRP&O.
Cold rolled sheet steel used for exposed and unexposed parts. The surface roughness or profilometer reading is 25 to 40 RMS. The Commercial Quality hardness range is Rockwell B 48 to 60. This product is capable of being bent in any direction through 180° flat on itself without cracking and is suitable for moderate drawing applications.
Panel Flat-Extremely flat cold rolled sheets used on part applications where center buckles or “oil canning” are objectionable. The product can also eliminate the need of surface grinding for flatness. Available in a wide gauge range and sheet size.

Note: When hot rolled and cold rolled sheet steel products are to be plated for highly finished end uses it is important to adequately grind the surface to remove surface imperfections and to produce a bright smooth surface. Sheet steel products unless special ordered from the mill for plating applications could have seams, slivers and pits which should be removed by grinding off at least 2% of the sheet thickness. Special strip steel products can be ordered from the mill to minimize or eliminate surface finishing. These products would be Regular Bright Finish or Best Bright Finish.
Various ASTM quality grades are produced for different applications for ductility or strength. Cold rolled sheet and coil are available in gauge thickness from 28 through 10. Hot rolled sheet products are available from 16 through 10 gauge. American Metals Corporation has the capability of furnishing slit coil or cut to length sheets to your dimensional requirement.

The following ASTM grades are available:

1008 CS TYPE B	Steel Sheet, Carbon, Cold Rolled, Commercial Quality
1011 CS TYPE B	Steel Carbon (0.15 maximum percent), Hot Rolled Sheet and Strip, Commercial Quality
1011 SS	Steel Sheet and Strip, Carbon, Hot Rolled, Structural Quality
1011 HSLAS	Steel Sheet and Strip, High Strength, Low Alloy, Columbium or Vanadium (or both), Hot Rolled and Cold Rolled
1008 DS	Steel Sheet and Strip, Carbon, Drawing Quality, Special Killed, Cold Rolled

PRODUCT DESCRIPTION AND GRADES

(Continued)

1011 CS Type B Hot rolled sheet steel used on forming applications but not drawing applications. This product is furnished black or pickled and oiled.

1011 SS Hot rolled sheet steel manufactured to various strength levels for structural applications The mechanical strength properties are controlled by chemical analysis and steel mill rolling practice. American Metals Corporation can furnish Grades 30, 33, 36 and in some cases grade 40. This product is available as-rolled or pickled and oiled.

1011 HSLAS Grade 50. This product is hot rolled, high strength, low alloy steel with 50,000 psi minimum yield strength and is used for higher strength applications than A570. Approximate Rockwell B hardness will be in the 70 to 80 range.

1008 DS CRDQ This sheet steel product is used for very deep draws requiring elongation values from 36 to 45% The steel is stabilized with aluminum and will not age harden. Rockwell B hardness 60 or less.

FLOOR PLATE COIL

ASTM A786 Diamond pattern. Can be processed on our cut-to-length line to your specific lengths.

COIL INVENTORY

HOT ROLLED SHEET COIL

STOCK WIDTHS

Manufacturers Standard Gauge	Nominal Decimal Thickness	1011 CS Type B	1011-50	1011 P & O	Floor Plate
10	.1345	48, 60, 72, 84	48, 60	48	
11	.1196	48, 60, 72		48	48
12	.1046	48, 60, 72	48	60, 72	48
14	.0747	48, 60, 72		48, 60	
16	.0598	48, 60			

HOT ROLLED STEEL SHEETS

ASTM 1011 CS Type B Commercial Quality .15% max carbon
1011 Type B Pickled and Oiled
1011 Structural Quality
1011-50

Size in Inches	Est. Weight Per Sheer
7 Gauge (.1793")	
7.50 lbs. sq. ft.	
48 x 96	200
120	300
144	330
10 Gauge (.1345")	
5.625 lbs.sq. ft.	
36 x 96	
120	168.8
144	202.5
48 x 96	180.0
120	225.0
144	270.0
192	360.0
240	450.0
60 x 96	225.0
120	281.3
144	337.5
192	450.0
240	562.5
72 x 96	270.0
72 x 120	337.5
144	405.0
240	675.0
84 x 120	393.8
144	472.5
240	787.5
11 Gauge (.1196")	
135.0 5 lbs. sq. ft.	
36 x 96	120
120	150
144	180
48 x 96	160
120	200
144	240
192	320
240	400
60 x 96	200
120	250
144	300
192	400
240	500

HOT ROLLED STEEL SHEETS (Continued)

Size in Inches	Est Weight Per Sheet
72 x 120	300
144	360
192	480
240	600
12 Gauge (.1046")	
4.375 lbs. sq. ft.	
36 x 96	105.0
120	131.3
144	157.5
48 x 96	140.0
120	175.0
144	210.0
192	280.0
240	350.0
60 x 96	175.0
120	218.8
144	262.5
192	350.0
72 x 96	210.0
120	262.5
144	315.0
192	420.0
240	525.0

Size in Inches	Est. Weight Per Sheet
14 Gauge (.0747")	
3.125 lbs. sq. ft.	
36 x 96	75.0
120	93.8
144	112.5
48 x 96	100.0
120	125.0
144	150.0
192	200.0
60 x 96	125.0
120	156.3
144	187.5
240	312.5
72 x 120	187.5
144	225.0
192	300.0
240	375.0
16 Gauge (.0598")	
2.5 lbs. sq. ft.	
36 x 96	60.0
120	75.0
144	90.0
48 x 96	80.0
120	100.0
144	120.0
60 x 96	100.0
120	125.0
144	150.0

COLD ROLLED STEEL SHEETS

1008 CS TYPE B
COMMERCIAL QUALITY

These sheets are produced on continuous sheet mills and can be used for auto body work, furniture, panels, table tops, partitions, locker work; will stand simple forming and moderate drawing.

Commercial Quality — Oiled

Size	Weight Per Sheet
10 Gauge (.1345") 5.625 lbs. sq. ft.	
36 x 120	168.8
48 x 120	225.0
11 Gauge (.1196") 5 lbs. sq. ft.	
48 x 120	200.0
12 Gauge (.1046") 4.375 lbs sq. ft.	
36 x 96	105.0
120	131.3
48 x 120	175.0
60 x 120	218.8
14 Gauge (.0747") 3.125 lbs. sq. ft.	
36 x 96	75.0
120	93.8
48 x 96	100.0
120	125.0
144	150.0
60 x 120	156.3
16 Gauge (.0598") 2.5 lbs. sq. ft.	
36 x 96	60.0
120	75.0
48 x 96	80.0
120	100.0
144	120.0
60 x 120	125.0
18 Gauge (.0478") 2.00 lbs. sq. ft.	
36 x 96	48.0
120	60.0
48 x 96	64.0
120	80.0
144	96.0

Size	Weight Per Sheet
20 Gauge (.0359") 1.5 lbs. sq. ft	
36 x 96	36.0
120	45.0
48 x 96	48.0
120	60.0
144	72.0
22 Gauge (.0299") 1.25 lbs. sq. ft.	
36 x 96	30.0
120	37.5
144	45.0
48 x 96	40.0
120	50.0
24 Gauge (.0239") 1 lbs. sq. ft.	
36 x 96	24.0
120	30.0
48 x 96	32.0
120	40.0
26 Gauge (.0179") .75 lbs. sq. ft	
36 x 96	18.0
120	22.5
48 x 96	24.0
120	30.0
28 Gauge (.0149") .625 lbs. sq. ft.	
36 x 96	15.0
120	18.8

STOCK WIDTHS

COLD ROLLED SHEET COIL

Commercial Quality 1008 CS TYPE B

Manufacturers Standard Gauge	Nominal Decimal Thickness	Width
10	.1345	48
11	.1196	48, 60
12	.1046	48, 60
14	.0747	48, 60
16	.0598	36, 48, 60
18	.0478	36, 48, 60
20	.0359	36, 48, 60
22	.0299	36, 48
24	.0239	36, 48

COILS AND CUT LENGTHS, INCLUDING PICKLED

Specified Width, Inches		Thickness Tolerances Over, Inch No Tolerance Under				
		Specified Minimum thickness, Inch				
	Over .180 to . 230 Incl.	Over .098 to .180	Over .071 to .098 Incl.	Over .057 to .071 Incl.	Over .051 to .057 Incl.	Over .044 to .051 Incl.
To 20 incl.	.010	.010	.009	.009	.008	.008
Over 20 to 40 incl.	.012	.010	.010	.009	.008	.008
Over 40 to 48 incl.	.014	.012	.010	.009	.009	.008
Over 48 to 60 incl.	.015	.012	.010	.010	.009	-
Over 60 to 72 incl.	.016	.012	.012	.010	.010	-
Over 72	.018	.012	.012	-	-	-

Note 1. Thickness is measured at any point across the width not less than 5/8 In. from a cut edge and not less than 1 in. from a mill edge. The above table does not apply to the uncropped ends of mill edge coils.
Note 2. The specified thickness range captions noted above also apply when sheet Is specified to a nominal thickness, and the above tolerances are divided equally, over and under (based upon ASTM A568)

WIDTH TOLERANCES

HOT ROLLED CUT EDGE SHEET

COILS AND CUT LENGTHS NOT RESQUARED INCLUDING PICKLED

(ASTM A568)

Specified Width, Inches	Tolerances Over Specified Width, Inch, No Tolerance Under
Over 12 to 30 incl.	1/8
Over 30 to 48 incl.	3/16
Over 48 to 60 incl.	1/4
Over 60 to 80 incl.	5/16
Over 80	3/8

The above tolerances apply to thicknesses .230 inch and thinner.

HOT ROLLED MILLED EDGE SHEET

COILS AND CUT LENGTHS, INCLUDING PICKLED
(ASTM A568)

Specified Width, Inches	Tolerances Over Specified Width, Inch, No Tolerance Under
Over 12 to 14 incl.	7/16
Over 14 to 17 incl.	1/2
Over 17 to 19 incl.	9/16
Over 19 to 21 incl.	5/8
Over 21 to 24 incl.	11/16
Over 24 to 26 incl.	13/16
Over 26 to 30 incl.	15/16
Over 30 to 50 incl.	1 1/8
Over 50 to 78 incl.	1 1/2
Over 78	1 7/8

The above tolerances do not apply to the uncropped ends of mill edge coils

LENGTH TOLERANCES
HOT ROLLED SHEET

CUT LENGTHS NOT RESQUARED, INCLUDING PICKLED

(ASTM A568)

Specified Width, Inches	Tolerances Over Specified Width, Inch, No Tolerance Under
Over to 15 incl.	1/8
Over 15 to 30 incl.	1/4
Over 30 to 60 incl	1/2
Over 60 to 120 incl.	3/4
Over 120 to 156 incl.	1
Over 156 to 192 incl.	1 1/4
Over 192 to 240 incl.	1 1/2
Over 240	1 3/4

FLATNESS TOLERANCES[A]

HOT ROLLED SHEET
CUT LENGTH NOT SPECIFIED TO STRETCHER LEVEL FLATNESS

STANDARD OF FLATNESS, INCLUDING PICKLED

Specified Minimum Thickness, Inch	Specified Width, Inches	Flatness Tolerances, Inch[b]	
		Specified Yield Point, Min., Psi	
		To 42,000 incl.[d]	45,000 to 50,000 incl.[c8]
Over .044 to .057 incl.	Over 12 to 36 incl.	1/2	3/4
	Over 36 to 60 incl.	3/4	1 1/8
	Over 60	1	1 1/2
Over .057 to .180 incl.	Over 12 to 60 incl.	1/2	3/4
	Over 60 to 72 incl.	3/4	1 1/8
	Over 72	1	1 1/2
Over .180 to .230 incl.	Over 12 to 48 incl.	1/2	3/4

a. The above table also applies to lengths cut from coils by the consumer when adequate flattening operations are performed.
b. Maximum deviation from a horizontal flat surface.
c. There are no established flatness tolerances for sheet with specified minimum yield point in excess of 50.000 psi.
d. Tolerances to 42.000 psi yield point inclusive based upon ASTM A568.
e. Tolerances from 45.000 psi through 50,000 psi yield point inclusive are generally followed by producers.

THICKNESS TOLERANCE
COLD ROLLED SHEET

COIL AND CUT LENGTHS, INCLUDING PICKELED

COILS AND CUT LENGTHS OVER 12 INCHES IN WIDTH

Specified Width, Inches	Thickness Tolerances Over, Inch No Tolerance Under					
	Specified Minimum Thickness, Inch					
	Over .098 to .142 incl.	Over .071 to .098	Over .057 to .071 incl.	Over .039 to .057 incl.	Over .019 to .039 incl.	Over .014 to .019 incl.
To 15 incl	.005	.005	.005	.004	.003	.002
Over 15 to 72 incl	.006	.005	.005	.004	.003	.002
Over 72	.007	.006	.005	.004	.003	-

Note 1 Thickness is measured at any point across the width not less than 1 in. from a side edge.
Note 2 The specified thickness range captions noted above also apply when sheet is specified to a nominal thickness, and the above tolerances are divided equally, over and under (based upon ASTM A568).

WIDTH TOLERANCES

COLD ROLLED SHEET

COILS AND CUT LENGTHS OVER 12 INCHES NOT RESQUARED (ASTM A568)

Specified Width, Inches	Tolerances Over Specified Width, Inch, No Tolerance Under
Over 12 to 30 incl.	1/8
Over 30 to 48 incl.	3/16
Over 48 to 60 incl.	1/4
Over 60 to 80 incl.	5/16
Over 80	3/8

LENGTH TOLERANCES

COLD ROLLED SHEET

CUT LENGTHS OVER 12 INCHES (ASTM A568)

Specified Width, Inches	Tolerances Over Specified Width, Inch, No Tolerance Under
Over 12 to 30 incl.	1/8
Over 30 to 60 incl.	1/4
Over 60 to 96 incl.	1/2
Over 96 to 120 incl.	3/4
Over 120 to 156 incl.	1
Over 156 to 192 incl.	1 1/4
Over 192 to 240 incl.	1 1/2
Over 240	1 3/4

OUT-OF-SQUARE TOLERANCES

COLD ROLLED SHEET

CUT LENGTHS OVER 12 INCHES IN WIDTH NOT RESQUARED (ASTM A568)

Out-of-square is the greatest deviation of an end edge from a straight line at right angle to a side and touching one corner. It is also obtained by measuring the difference between the diagonals of the cut length sheet. The out-of-square deviation is one-half of that difference. The tolerance for all thicknesses and all sizes is 1/16 inch per 6 inches of width or fraction thereof.

FLATNESS TOLERANCES

COLD ROLLED SHEET

CUT LENGTHS OVER 12 INCHES IN WIDTH NOT SPECIFIED TO STRETCHER LEVEL STANDARD OF FLATNESS (ASTM A568)

Specified Minimum Thickness, Inch	Specified Width, inches			Flatness Tolerances (maximum deviation from a horizontal flat surface), Inch
.044 and thinner	To	36	incl.	3/8
	Over	36		5/8
	To	60	incl.	
	Over	60		7/8
Over .044	To	36	incl.	1/4
	Over	36		3/8
	To	60	incl.	
	Over	60		5/8
	To	72	incl.	
	Over	72		7/8

Note 1. The above table applies to lengths cut from coils by the consumer when adequate flattening measure are performed.
Note 2. The above table does not apply when product is ordered.
(a) Full Hard or to a hardness range
(b) Class 2. Annealed last - not skin passed

ASTM SPECIFICATIONS

HOT ROLLED SHEET AND STRIP

ASTM Designation	Product	Thickness Range	Mechanical Properties				Chemical Composition %			Other
			Yield Point Min. KSI	Tensile Strength KSI	%Elongation Minimum		C Max.	Mn Range or Max.	P Max.	S Max.	
					8"	2"					
1011 CS Type B	Commercial Quality	.1196-.0149"	Subject to Bend Test Only				0.15	.60	.030	.035	
1011 SS Grade 30	Structural Quality	.1345-.0972"	30.0	49.0	19	25	.25	.90	.035	.04	
		.0971-.0636"			17	24					
		.0635-.0598"				21					
Grade 33		.1345-.0972"	33.0	52.0	18	23	.25	.90	.035	.04	
		.0971-.0636"			16	22					
		.0635-.0598"				18					
1011 HSLAS	High Strength Low Alloy	.230 -. 097	50.0	65.0		22	.23	1.35	.040	.04	Cb or V
		.097 - .025									
1011 DS	Drawing Quality						.08	.50	.020	.030	
ASTM A622	Drawing Quality Special Killed									Al	

ASTM SPECIFICATIONS (Continued)

COLD ROLLED SHEET AND STRIP

ASTM Designation	Product	Thickness Range	Mechanical Properties			Chemical Composition %					
			Yield Point Min.KSI	Tensile Strength KSI	%Elongation Minimum 8" 2"	C Max	Mn Range or Max	P Max	S Max	Other
1008 CS TYPE B	Commercial Quality	Rockwell B Hardness Range 70 or less				.15	.60	.035	.040	
1008 DS	Drawing Quality	Rockwell B Hardness Range 60 or less				.10	.50	.025	.035	Al

ASTM-AISI

THICKNESS TOLERANCE RANGES*
CARBON STEEL SHEETS
HOT ROLLED • H R P & O • COLD ROLLED

Gage No.	Thickness, inches: Dec. Equiv	Thickness, inches: Toler, Range HR& P&O	Thickness, inches: Toler, Range CR	lbs. per sq.ft. Wt. Equiv.*
4	.2242	.2332 .2152		9.375
5	.2092	.2182 .2002		8.75
6	.1943	.2033 .1853		8.125
7	.1793	.1873 .1713	.1883 .1703	7.5
8	.1644	.1724 .1564	.1734 .1554	6.875
9	.1495	.1575 .1415	.1585 .1405	6.25
10	.1345	.1425 .1265	.1405 .1285	5.625
11	.1196	.1276 .1116	.1256 .1136	5.0
12	.1046	.1126 .0966	.1106 .0986	4.375
13	.0897	.0967 .0827	.0947 .0847	3.75
14	.0747	.0817 .0677	.0797 .0697	3.125
15	.0673	.0733 .0613	.0723 .0623	2.812
16	.0598	.0658 .0538	.0648 .0548	2.5
17	.0538	.0598 .0478	.0548 .0498	2.25
18	.0478	.0528 .0428	.0518 .0438	2.0

Gage No.	Thickness, inches: Dec Equiv	Thickness, inches: Toler Range CR	lbs. per sq. ft. Wt. Equiv.*
19	.0418	.0458 .0378	1.75
20	.0359	.0389 .0329	1.5
21	.0329	.0359 .0299	1.375
22	.0299	.0329 .0269	1.25
23	.0269	.0299 .0239	1.125
24	.0239	.0269 .0209	1.0
25	.0209	.0239 .0179	.875
26	.0179	.0199 .0159	.75
27	.0164	.0184 .0144	.688
28	.0149	.0169 .0129	.625
29	.0135	.0155 .0115	.562
30	.0120	.0130 .0110	.50

CR* - Gauges 4 thru 10 - Tolerances shown for widths over 48” to 72” inclusive.
All other gauges - Tolerances shown for widths over 15” to 72” inclusive.
HR* - Gages 4 thru 18 - Tolerances shown for widths over 40” to 48” inclusive.
P & O
* Based on density of .2904 lb. per cubic inch

Slit Coil Inventory

SECTION 3

COATED SHEET AND COIL

PRODUCT DESCRIPTION

Coated steel products are generally cold rolled sheet steel hot dipped with either zinc or aluminum, electro-plated with zinc and/or nickel, or painted. The purpose of the coating is to isolate the base metal from corrosion and eliminate individual part plating or painting. Hot dipped sheet steel with either zinc or aluminum will have a heavier coating thickness than electroplated steels and therefore will have better corrosion resistance. While galvanized sheet steel has been highly recognized for solving many corrosion problems, aluminum coated sheet will have better corrosion resistance in sea water environments and for high temperature exposure up to 1200° F and many other applications.

Our electrolytically plated zinc coated products are used for many indoor or protected environments where corrosion protection is important. The zinc plated products are mill treated with a phosphate coating and if required can be painted without further preparation except for normal cleaning procedures. Both the electro zinc plated and our electro zinc-nickel product which still has better corrosion resistance is widely used in the electronics industry for chassis and cabinets.

These products are available with a variety of coating weights, surface finishes, and mechanical properties designed to meet your particular requirements.

ASTM A653CQ	Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process, Commercial Quality
ASTM A653LFQ	Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process, Lock-Forming Quality
ASTM A463	Steel Sheet, Cold Rolled, Aluminum Coated, Type 1 and Type 2
ASTM A879	Steel Sheet, Cold Rolled, Electrolytic Zinc Coated
ASTM A653 Galvanneal	Steel Sheet, Zinc-Iron (Alloyed) Coated by the Hot Dipped Process
ASTM A792 Galvalume	Steel Sheet, Aluminum-Zinc Coated by the Hot Dipped Process
A653CQ	Galvanized sheet steel, hot dip process, commercial quality with a G90 coating weight which is .90 oz/sq. ft. of zinc total both sides. Material of this quality is intended primarily for bending and moderate drawing applications.
A653LFQ	This specification covers galvanized sheet steel of lock forming quality. The standard coating weight for this produce is G90, however, other coating weights are available. Material of this quality is intended primarily for use in fabrication where it is to be subjected to machine lock forming. The high speed forming of the machines impose requirements on both the base metal and the coating which are In excess of the formability requirements of commercial quality.
A463	This specification is for aluminum coated sheet steel and would be used where higher corrosion resistance applications are involved or for higher temperature applications. Aluminum coated sheet steel has excellent high temperature oxidation resistance up to 950° F without discoloration.
A879	Electrolytically zinc plated sheet steel with a coating weight of either .030 oz/sq. ft. or .060 oz/sq ft. total amount both sides with phosphate treatment. This product is dull gray in appearance and can be readily painted. It is generally used for interior part applications where corrosion is a consideration and should be painted as soon as possible after parts are fabricated. Other coating weights are available.

PRODUCT DESCRIPTION (Continued)

Galvannealed (Alloyed) A653	Coil or sheets are coated with zinc by the continuous hot dip process similar to galvanized sheet steel. The rate of solidification of the zinc coating is controlled by heating so that the entire coating is converted to a zinc-iron alloy which eliminates the spangles. The product has an A60 coating of .60 oz/sq. ft. and is not chemically treated so that it can be readily painted. This product is used for interior and exterior applications. Since the coating thickness is less than that of standard galvanized sheet steel, galvannealed sheet steel should be painted as soon as possible when exposed to the weather. Refer to page 66 under "Corrosion Protection."
Zincalume ASTM A792	Aluminum-zinc alloy coated steel sheet produced with a small bright spangle. This product has better salt water and industrial atmospheric corrosion resistance than galvanized sheets.

We also inventory stucco embossed, pre-painted steels, cabinet white and gutter coils In a variety of widths.

GALVANIZED SHEETS

ASTM A653 Commercial Quality

Size	Weight per Sheet
10 ga. (.1382") 5.781#sq. ft	
36 x 120	173.4
48 x 96	185.0
48 x 120	231.2
48 x 144	277.5
12 ga. (1084") 4.531#/sq ft	
36 x 96	108.8
36 x 120	135.9
48 x 96	145.0
48 x 120	181.2
48 x 144	217.5
60 x 96	181.24
60 x 120	226.6
14 ga. (0785") 3.281#/sq. ft.	
36 x 96	78.8
36 x 120	98.4
48 x 96	105.0
48 x 120	131.2
48 x 144	157.5
60 x 96	131.24
60 x 120	164.05
60 x 144	196.9
16 ga. (0635") 2.658#/sq. ft.	
36 x 96	63.8
36 x 120	79.7
48 x 96	85.0
48 x 120	106.2
48 x 144	127.5
60 x 96	106.24
60 x 120	132.8
60 x 144	159.36
18 ga. (0516") 2.156#/sq ft	
36 x 96	51.8
36 x 120	64.7
48 x 96	69.0
48 x 120	86.2
48 x 144	103.5
60 x 96	86.24
60 x 120	107.8
60 x 144	129.36

ASTM A653 Lock Forming Quality

Size	Weight per Sheet
20 ga. (.0396") 1.656#/sq ft	
36 x 96	39.8
36 x 120	49.7
48 x 96	53.0
48 x 120	66.2
60 x 96	66.24
60 x 120	82.6
60 x 144	99.36
22 ga. (0336") 1.406#/sq ft.	
36 x 96	33.8
36 x 120	42.2
46 x 96	45.0
48 x 120	58.2
60 x 96	58.24
60 x 120	70.3
60 x 144	84.36
24 ga. (0276") 1.156#/sq. ft	
36 x 96	27.8
36 x 120	34.7
48 x 96	37.0
48 x 120	46.2
60 x 96	46.24
60 x 120	57.8
60 x 144	69.36
26 ga. (0217") 0.906#/sq ft.	
36 x 96	21.8
36 x 120	27.2
48 x 96	29.0
48 x 120	36.2
28 ga. (0187") 0.781#/sq ft.	
36 x 96	18.8
36 x 120	23.4
30 ga. (0157") 0.656#/sq ft.	
30 x 96	13.1
30 x 96	13.1
30 x 120	16.4
36 x 96	15.8
36 x 120	19.7

G**alvannealed sheets available in above sizes.**

GALVANIZED AND ZINC COATED COIL STOCK WIDTHS

STOCK WIDTHS

Manufacturers Standard Gauge	Nominal Thickness	A653 CQ A653 Lock Forming	A591 Electrolythic Zinc	Galvannealed A653-A60-LFQ
10	.1382	48"		
11	.1233	48"		
12	.1064	48"	36, 48	
14	.0785	36, 48, 60"	36, 48	
16	.0635	36, 48, 60"	36, 48	
18	.0516	36, 48, 60"	36, 48	48
20	.0396	36, 48, 60"	36, 48	48
22	.0336	36, 48, 60"	36, 48	48
24	.0276	36, 48, 60"	36, 48	48
26	.0217	36, 48, 60"		
28	.0187	36, 48		
30	.0157	30, 36		

*Commercial quality only

ELECTROLYTIC ZINC COATED STEEL SHEET

PHOSPHATE COATED - COMMERCIAL QUALITY ASTM 879

Electrolytic Zinc Coated Steel Sheets are produced from flat rolled low carbon steel which has been electrolytically plated with zinc, and then phosphate coated for better paint adherence. The zinc phosphate treatment is optional, although normally specified. This product offers the best combination of good corrosion resistance coupled with low cost.

Surface finish is smooth in texture and has a medium gray color

Electrolytic Zinc Coated Steel Sheets can be roller leveled from coil and cut to length to exact specifications

Thickness	Lb./Sq. Ft.	Width and Length	Estimated Wt. Lbs. Per Sheet
12 Ga.	4.375	48 x 120	175.0
14 Ga.	3.125	48 x 120	125.0
16 Ga.	2.500	48 x 96	80.0
16 Ga.	2.500	48 x 120	100.0
18 Ga.	2.000	48 x 96	64.0
18 Ga.	2.000	48 x 120	80.0
20 Ga.	1.500	48 x 96	48.0
20 Ga.	1.500	48 x 120	60.0
20 Ga.	1.500	48 x 144	72.0
22 Ga.	1.250	36 x 120	37.5
22 Ga.	1.250	48 x 96	40.0
22 Ga.	1.250	48 x 120	50.0
24 Ga.	1.000	36 x 120	30.0
24 Ga.	1.000	48 x 96	32.0
24 Ga.	1.000	48 x 120	40.0
24 Ga.	1.000	48 x 144	48.0
26 Ga.	0.750	48 x 120	30.0

Galvannealed sheets available in above sizes.

ALUMINIZED SHEET & COIL

ASTM 463-TYPE 1

Aluminized Steel is sheet steel hot dip coated on both sides with aluminum-silicon alloy by the continuous method. It provides the best qualities of aluminum and steel by resisting corrosion and providing strength at a low cost. The weight of aluminum coating applied to both sides of the sheet is approximately 0.40 oz. per sq. ft., providing a coating of about 0.001 inches of aluminum per side. Resists destructive heat at 1200 o (degree) F, reflects as much as 80% of radiant heat up to 900 o(degree) F, and has excellent resistance to combinations of heat and corrosion Will withstand bending at room temperature through 180^{o} (degree) over a diameter equal to twice its thickness without peeling or flaking. Applications include crop dryers, dry kiln fan walls, dryers, Incinerators, mufflers, oven and space heater components.

ALUMINIZED SHEET & COIL (Continued)

Gauge & Thickness	Weight Per Sq. Foot (lbs.)	Weight Per Sheet (lbs.)
14 ga. (.0785")	3.238	
48 x 96		103.6
48 x 120		129.5
16 ga. (.0635”)	2.613	
48 x 96		83.6
48 x 120		104.5
18 ga. (0.516”)	2.113	
48 x 96		67.6
48 x 120		84.5
20 ga. (.0396”)	1.613	
48 x 96		51.6
48 x 120		64.5
22 ga. (.0336”)	1.363	
48 x 96		43.6
48 x 120		54.5
24 ga. (.0276”)	1.113	
48 x 120		44.5
26 ga. (.0217”)	0.863	34.5
48 x 120		

ZINCALUME SHEET & COIL

ASTM A 792

Zincalume ® is 45% Zinc/55% Aluminum alloy applied by a continuous hot dip coating process. It combines the strength of steel with the corrosion resistance of aluminum. Zincalume ® is a registered trade mark of BHP Coated Steel Corporation.

Gauge & Thickness	Std AZ50 Wt. per Sq. Ft. (lbs.)	Weight Per Sheet (lbs.)
20 ga. (.0396")	1.5405	
48 x 120		61.62
22 ga. (.0336")	1.3365	
48 x 120		53.46
24 ga. (.0276")	1.0918	
48 x 120		43.67
26 ga. (.0217")	0.8511	
48 x 120		34.04
28 ga. (.0187")	0.7288	
48 x 120		29.15
30 ga. (.0157")	0.6063	
48 x 120		24.25

THICKNESS TOLERANCES
GALVANIZED HOT DIPPED - ASTM A924

COILS AND CUT LENGTHS

	Thickness Tolerances Over, Inch No Tolerances Under					
	Specified Minimum Thickness, Inch					
	Over .101 to .187 incl.	Over .075 to .101 incl.	Over .061 to .101 incl.	Over .043 to .061 incl.	Over .023 to .043 incl.	.023 and thinner
To 32 incl.	.012	.010	.006	.005	.004	.003
Over 32 to 40 incl.	.012	.012	.006	.005	.004	.003
Over 40 to 60 incl.	.014	.012	.006	.005	.004	.003
Over 60 to 72 incl.	.014	.014	.006	.005	.004	.003

Note 1- Thickness is measure at any point across the width not less than 1 in. from a side edge.

Note 2- The specified thickness range captions noted above also apply when sheet is specified to a nominal thickness and the above tolerances are divided equally, over and under (based upon ASTM A924).

WIDTH TOLERANCES

HOT DIPPED GALVANIZED SHEET

COILS AND CUT LENGTHS OVER 12 INCHES IN WIDTH NOT RE-SQUARED

(ASTM A924)

Specified Width, Inches	Tolerances Over Specified Length, Inch No Tolerance Under
Over 12 to 30 incl.	1/8
Over 30 to 48 incl.	3/16
Over 48 to 60 incl.	1/4
Over 60 to 72 incl.	5/16

LENGTH TOLERANCES

HOT DIPPED GALVANIZED SHEET

CUT LENGTHS OVER 12 INCHES IN WIDTH NOT RE-SQUARED

(ASTM A924)

Specified Width, Inches	Tolerances Over Specified Length, Inch No Tolerance Under
Over 12 to 30 incl.	1/8
Over 30 to 60 incl.	1/4
Over 60 to 96 incl.	1/2
Over 96 to 120 incl.	3/4
Over 120 to 156 incl.	1
Over 156 to 192 incl.	1 1/4
Over 192 to 240 incl.	1 1/2
Over 240	1 3/4

FLATNESS TOLERANCES

HOT DIPPED GALVANIZED SHEET

CUT LENGTHS OVER 12 INCHES IN WIDTH

NOT SPECIFIED TO STRETCHER LEVEL STANDARD OF FLATNESS (ASTM A924)

Specified Minimum Thickness (Inches)	Specified Width (Inches)	Flatness Tolerances (maximum deviation from a horizontal flat surface) (Inches)
.048 and thinner	To 36 incl.	3/8
	Over 36 To 60 incl.	5/8
	Over 60 To 72 incl.	7/8
Over .048	To 36 incl.	1/4
	Over 36 To 60 incl.	3/8
	Over 60 To 72 incl.	5/8

Note 1. The above table does not apply when product is ordered Full Hard or to a hardness range.

Note 2. The above table also applies to lengths cut from coils by the consumer when adequate flattening measures are performed.

OUT-OF-SQUARE TOLERANCES

HOT DIPPED GALVANIZED SHEET

CUT LENGTHS OVER 12 INCHES IN WIDTH

NOT SPECIFIED TO STRETCHER LEVEL STANDARD OF FLATNESS (ASTM A924)

Out-of-square is the greatest deviation of an end edge from a straight line at right angle to a side and touching one corner. It is also obtained by measuring the difference between the diagonals of the cut length sheet. The out-of-square deviation is one-half of that difference. The tolerance for all thicknesses and all sizes is 1/16 inch per 6 inches of width or fraction thereof.

COATING THICKNESS DESIGNATIONS

TEST LIMITS

(ASTM A924)

Type	Coating Designation	Previous Coating Class oz. per sq. ft.	Minimum Check Limit Triple Spot Test oz. per sq. ft.	Minimum Check Limit Single Spot Test oz. per sq. ft.
Regular	G235	2.75	2.35	2.00
Regular	G210	2.50	2.10	1.80
Regular	G185	2.25	1.85	1.60
Regular	G165	2.00	1.65	1.40
Regular	G140	1.75	1.40	1.20
Regular	G115	1.50	1.15	1.00
Regular	G90	1.25 Commercial	0.90	0.80
Regular	G60	Light Commercial	0.60	0.50
Regular	G01		No Minimum	No Minimum
Alloyed	A60		0.60	0.50
Alloyed	A40		0.40	0.30
Alloyed	A01		No Minimum	No Minimum

The weight of coating in oz. per sq. ft. refers to the total coating on both surfaces. The coating designation number is the term by which this product is specified.

Plate Coil Inventory

GALVANIZED SHEET STEEL

GENERAL DESCRIPTION

Galvanized sheet steel is produced from coils that are continuously coated with molten zinc through a Continuous Hot-Dip Galvanizing Line. This large process line produces both the bright spangled galvanized sheet and the dull gray galvannealed product. The coating thickness or weight of the zinc is controlled out of the zinc pot by wiper rolls. The most used coating thickness for galvanize is .90 oz/sq. ft. which is the total coating weight on both sides and is designated as G-90. The coating weight for Galvannealed sheets is A-60 which is .60 oz/sq. ft. The dull gray or matte finish appearance of the galvannealed product is produced by reheating the zinc surface which converts the zinc crystals or spangles into a zinc iron alloy.

CORROSION PROTECTION

The zinc coating protects the sheet against corrosion in two ways. The zinc coating insulates the steel from atmospheric corrosion so that the steel does not oxidize in air or water. If the zinc surface is broken through to the steel base the zinc through galvanic action will deplete itself and protect the steel. The length of time galvanized sheets are protected is directly proportional to the weight of their zinc coating. Therefore galvanize sheet with a G-90 coating thickness will outlast Galvannealed with an A-60 coating weight, it is recommended that Galvannealed material be immediately painted after fabrication. Iron oxide spotting from the zinc-iron alloy will occur rapidly when the material is exposed to the atmosphere. Very thinly coated zinc coated sheets such as electrogalvanized are not recommended for outdoor service.

STORAGE

G-90 galvanized sheets are surface treated with chemicals for resistance to wet storage stain or white rust. The chemical treatment in the steel mill will minimize the problem, but in cases of poor storage or unprotected sheets in transportation white rust can still occur. White rust is a white crusty deposit made up of zinc oxide and zinc carbonate. It is caused by water trapped between the galvanized sheets and the local depletion of oxygen. Very rapid attack can occur in as little as 24 hours.

Galvanized sheets that are in lifts should be stored inside in constant temperature conditions and not in areas of high humidity Bundles of galvanized exposed to water or high humidity conditions will have water drawn between the sheets by capillary action. Do not use plastic wrapping to shroud bundles. Plastic prevents a free flow of air and tends to trap moisture. For more information on storing galvanize sheet steel contact your American Metals Corporation sales representative.

Galvannealed sheets are not chemically treated.

FABRICATION

The zinc coating produced by the continuous hot dip method flows and stretches with the base metal. Galvanized steel sheets can be roll or brake formed, deep drawn, spun or lock seamed without flaking, peeling or powdering of the zinc coating. In general the degree of fabrication possible with galvanized steel sheets is limited only by the quality of the base metal, i.e., Commercial Quality, Drawing Quality or Drawing Quality Special Killed. Lock Forming Quality will have superior ductility in comparison to Commercial Quality because of the severity of the lock forming operation and 180 degree bends.

GALVANIZED SHEET STEEL (Continued)

PAINTING

Galvanized sheet steel has a very smooth surface and because of this special surface treatments or paints must be used for good adhesion. Satisfactory results can be obtained with zinc dust paints, portland cement in-oil paints and some latex or other specially formulated paints specially developed for galvanized sheet steel. Conventional metallic zinc-dust paints perform the best on galvanized steel sheets; the zinc-rich type paints are not required. There are also specially developed paint pre-treatments for use on production facilities. Some of these would be a chromate conversion coating; an amorphous film of complex oxides; and a wash primer which is a basic zinc chromate vinyl butral wash-coat. American Metals Corporation can furnish more information on painting galvanize sheet steel.

Galvannealed sheets have a dull gray zinc-iron-alloy surface which provides a rough textured surface for good paintability. The steel can be painted with many paints without any special treatment. Oil, grease or fingerprints can be cleaned with mineral spirits, paint thinner or naptha.

WELDING AND SOLDERING

Electric Resistance Welding: Welding conditions for galvanized sheets will differ somewhat from those used for welding uncoated sheets. Higher electrode pressures and welding current and shorter welding times are required to produce the same diameter fused zone in galvanized sheets as that in uncoated steel. The shorter weld time is required to minimize electrode pickup of zinc The following are recommended precautions that should be observed:

1. Electrodes should be kept as cool as possible by water cooling.
2. The use of copper alloy, truncated cone shaped is preferred.
3. Dome-type electrodes 1 1/2-3 inches in radius can also be used.

Metallic Arc: Shielded arc welding procedures, including choice of electrode types, are about the same for galvanized and uncoated steel sheets except for the position of the electrode. In welding galvanized sheets, the electrode should be directed slightly ahead of the welding pool and held high enough to allow the fumes to escape and avoid absorption of the zinc vapor by the deposited metal. It is important that welding be done in a veil ventilated area.

Oxyacetylene. Brazing flux is needed to promote fusion of the steel. Filler rods such as 60 copper and 40 zinc are available already fluxed. A neutral flame should be directly applied to the filler rod.

Soldering: Tin-lead solders can be successfully used for joining together light gauge material. The solder produces a corrosion resistant joint and unlike the welding operation, the zinc coating is not affected. Oxides and fluxes that were developed during either the soldering or brazing operation should be removed by wire brushing.

RESTORATION OF WELD AREAS

Spot and arc welding will burn and vaporize the zinc coating creating an area for corrosion attack. There are two methods used for restoring the corrosion resistance and cosmetic appearance of the welded areas. One method is zinc repair sticks which are 99.99% zinc. The stick is heated to approximately 525 degrees F and rubbed on the damaged area. There are also many proprietary zinc-rich paints which can be applied either by brush or out of aerosol cans.

ASTM-AISI

THICKNESS TOLERANCE RANGES

GALVANIZED STEEL SHEETS

	Thickness, Inches		lbs. per sq. ft.
Gage No.	Dec. Equiv.	Toler Range	Weight Equiv.*
10	.1382	.1452 .1312	5.78125
11	.1233	.1303 .1163	5.15625
12	.1084	.1154 .1014	4.53125
13	.0934	.0994 .0874	3.90625
14	.0785	.0845 .0725	3.28125
15	.0710	.074 .068	2.96875
16	.0635	.0665 .0605	2.65625
17	.0575	.060 .055	2.40625
18	.0516	.0541 .0491	2.15625
19	.0456	.0481 .0431	1.90625
20	.0396	.0416 .0376	1.65625

	Thickness, Inches		lbs. per sq. ft.
Gage No.	Dec. Equiv.	Toler Range	Weight Equiv.*
21	.0366	.0386 .0346	1.53125
22	.0336	.0356 .0316	1.40625
23	.0306	.0326 .0286	1.28125
24	.0276	.0296 .0256	1.15625
25	.0247	.0267 .0227	1.03125
26	.0217	.0232 .0202	.90625
27	.0202	.0217 .0187	.84375
28	.0187	.0202 .0172	.78125
29	.0172	.0187 .0157	.71875
30	.0157	.0172 .0142	.65625

*Gauges 10-11-12--- Tolerances shown for widths over 40” to 60” inclusive.

All other gauges --- Tolerances shown for widths over 32 to 60” inclusive.

SECTION 4

ANGELS, CHANNELS AND BEAMS

PRODUCT DESCRIPTION

ANGELS BEAMS CHANNELS

American Metals Corporation stocks a wide range of sizes of angels, beams and channels which meet the requirements of ASTM A36. These structurals are available in either 20 or 40 foot lengths and can be ordered wheelabrated and prime painted.

The following is the letter designation for each type of structural

L Angles Equal & Unequal Legs

C American Standard Channels

MC Miscellaneous Channels

S American Standard Beams

ST Structural Tees

W Wide Flange Shapes

ASTM A36 STRUCTURAL SHAPES CHEMICAL ANALYSIS

C	Mn*	P	S	CU[1]
.26 max	___	.040 max.	.050 max	.20 min %

[1]When copper steel is specified

*manganese content of .85-1.35% and silicon content of .15-.40% is required for shapes over 426 lb/ft.

TENSILE REQUIREMENTS[A]

Plates, Shapes[B], and Bars	
Tensile strength, ksi	58-80
Yield point, min ksi	36[C]
Plates and Bars [E,F]	
Elongation in 8 in. min, %	20[D]
Elongation in 2 in. min, %	23
Shapes:	
Elongation in 8 in. min, %	20[D]
Elongation in 2 in. min, %	21[B]

[A]For plates wider than 24 in, the test specimen is taken in the transverse direction. See 11.2 of Specification A 6.

[B]For wide flange shapes over 426 lb/ft tensile strength minimum of 58 ksi only and elongation in 2 in. of 19% minimum applies.

[C]Yield point 32 ksi for plates over 8 in. in thickness.

[D]See 8.3.

[E]Elongation not required to be determined for floor plate.

[F]For plates wider than 24 in the elongation requirement is reduced two percentage points.

Shapes less than 1 in. in cross section and bars, other than flats, less than 1/2 in. in thickness or diameter need not be subjected to tension tests by the manufacturer. For material under 5/16 in. in thickness or diameter, a deduction from the percentage of elongation in 8 in. specified in Table 3, of 1.25% shall be made for each decrease of 1/32 in. of the specified thickness or diameter below 5/16 in.

STEEL ANGLES L

BAR SIZE
ASTM A36

Size in Inches	Weight Per Ft. Pounds	Wt. per 20' Bar Pounds
1/2 x 1/2 x		
1/8	.38	7.6
3/4 x 3/4 x		
1/8	.59	11.8
1 x 1 x		
1/8	.80	16.0
3/16	1.16	23.2
1/4	1.49	29.8
1 1/4 x 1 1/4 x		
1/8	1.01	20.2
3/16	1.48	29.6
1/4	1.92	38.4
1 1/2 x 1 1/2 x		
1/8	1.23	24.6
3/16	1.80	36.0
1/4	2.34	46.8
5/16	2.86	57.2
3/8	3.35	67.0
1 3/4 x 1 3/4 x		
1/8	1.44	28.8
3/16	2.12	42.4
1/4	2.77	55.4
2 x 1 1/2 x		
1/8	1.44	28.8
3/16	2.12	42.4
1/4	2.77	55.4
2 x 2 x		
1/8	1.65	33.0
3/16	2.44	48.8
1/4	3.19	63.8
5/16	3.92	78.4
3/8	4.70	94.0
2 1/2 x 1 1/2 x		
3/16	2.44	48.8
1/4	3.19	63.8
5/16	3.92	78.4
2 1/2 x 2 x		
3/16	2.75	55.0
1/4	3.62	72.4
5/16	4.50	90.0
3/8	5.30	106.0
2 1/2 x 2 1/2 x		
3/16	3.07	61.4
1/4	4.10	82.0
5/16	5.00	100.0
3/8	5.90	118.0
1/2	7.70	154.0

STEEL ANGLES (Continued) L

STRUCTURAL
ASTM A36

Size In Inches	Weight Per Ft. Pounds	Wt. per 20' Bar Pounds	Wt. per 40' Bar Pounds
3 x 2 x			
3/16	3.07	61.4	123.0
1/4	4.10	82.0	164.0
5/16	5.00	100.0	200.0
3/8	5.90	118.0	236.0
1/2	7.70	154.0	308.0
3 x 2 1/2 x			
1/4	4.50	90.0	180.0
5/16	5.60	112.0	224.0
3/8	6.60	132.0	264.0
1/2	8.50	170.0	340.0
3 x 3 x			
3/16	3.71	74.2	148.4
1/4	4.90	98.0	196.0
5/16	6.10	122.0	244.0
3/8	7.20	144.0	288.0
7/16	8.30	166.0	332.0
1/2	9.40	188.0	376.0
3 1/2 x 2 1/2 x			
1/4	4.90	98.0	196.0
5/16	6.10	122.0	244.0
3/8	7.20	144.0	288.0
1/2	9.40	188.0	376.0
3 1/2 x 3 x			
1/4	5.40	108.0	216.0
5/16	6.60	132.0	264.0
3/8	7.90	158.0	316.0
1/2	10.20	204.0	408.0
3 1/2 x 3 1/2 x			
1/4	5.80	116.0	232.0
5/16	7.20	144.0	288.0
3/8	8.50	170.0	340.0
1/2	11.10	222.0	444.0
4 x 3 x			
1/4	5.80	116.0	232.0
5/16	7.20	144.0	288.0
3/8	8.50	170.0	340.0
1/2	11.10	222.0	444.0
5/8	13.60	272.0	544.0
4 x 3 1/2 x			
1/4	6.20	124.0	248.0
5/16	7.70	154.0	308.0
3/8	9.10	182.0	364.0
1/2	11.90	238.0	476.0
4 x 4 x			
1/4	6.60	132.0	264.0
5/16	8.20	164.0	328.0
3/8	9.80	196.0	392.0
1/2	12.80	256.0	512.0
5/8	15.70	314.0	628.0
3/4	18.50	370.0	740.0

STEEL ANGLES (Continued) L

Size In Inches	Weight Per. Ft. Pounds	Wt. per 20' Bar Pounds	Wt. per 40' Bar Pounds
5 x 3 x			
1/4	6.60	132.0	264.0
5/16	8.20	164.0	328.0
3/8	9.80	196.0	392.0
1/2	12.80	256.0	512.0
5 x 3 1/2 x			
1/4	7.00	140.0	280.0
5/16	8.70	174.0	348.0
3/8	10.40	208.0	416.0
1/2	13.60	272.0	544.0
5/8	16.80	336.0	672.0
3/4	19.80	396.0	792.0
5 x 5 x			
5/16	10.30	206.0	412.0
3/8	12.30	246.0	492.0
1/2	16.20	324.0	648.0
5/8	20.00	400.0	800.0
3/4	23.60	472.0	944.0
6 x 3 1/2 x			
1/4	7.90	158.0	316.0
5/16	9.80	196.0	392.0
3/8	11.70	234.0	468.0
1/2	15.30	306.0	612.0
6 x 4 x			
5/16	10.30	206.0	412.0
3/8	12.30	246.0	492.0
1/2	16.20	324.0	648.0
5/8	20.00	400.0	800.0
3/4	23.60	472.0	944.0
7/8	27.20	544.0	1088.0
6 x 6 x			
5/16	12.40	248.0	496.0
3/8	14.90	298.0	596.0
1/2	19.60	392.0	784.0
5/8	24.20	484.0	968.0
3/4	28.76	574.0	1148.0
7/8	33.10	662.0	1324.0
1	37.40	748.0	1496.0
7 x 4 x			
3/8	13.60	272.0	544.0
1/2	17.90	358.0	716.0
3/4	26.20	524.0	1048.0
8 x 4 x			
1/2	19.60	392.0	784.0
5/8	24.20	484.0	968.0
3/4	28.70	574.0	1148.0
8 x 6 x			
1/2	23.00	460.0	920.0
5/8	28.50	570.0	1140.0
8 x 8 x			
1/2	26.40	528.0	1056.0
5/8	32.70	654.0	1308.0
3/4	38.90	778.0	1556.0
1	51.00	1020.0	2040.0

Any of the above sizes can be furnished galvanized to order.

STRUCTUAL TEES ST

BAR SIZE
ASTM A36

Flange Inches	Stem Inches	Stem Thickness Inches	Wt. Per Ft.	Weight Lbs. of 20' Bar
1	1	1/8	.85	17.00
		3/16	1.20	24.00
1 1/4	1 1/4	1/8	1.09	21.80
		3/16	1.55	31.00
1 1/2	1 1/2	3/16	1.90	38.00
		1/4	2.43	48.60
2	2	1/4	3.56	71.20
		5/16	4.40	88.00
2 1/2	2 1/2	1/4	4.60	92.00
		3/8	6.40	128.00

STRUCTURAL
STOCK LENGTHS 20, 40 FT.
ASTM A36

Flange Inches	Stem Inches	Stem Thickness Inches	Wt Per Ft.	Weight Lbs. of 20' Bar
3	3	3/8	7.80	156
4	4	1/2	13.50	270

Other sizes of structural tees can be produced by splitting Standard Beams, Junior Beams or Wide Flange Beams.

CHANNELS C

BAR SIZE
ASTM A36

Size In Inches	Weight Per Ft. Pounds	Wt. Per 20' Bar Pounds
3/4 x 3/8 x 1/8	.56	11.2
1 x 1/2 x 1/8	.83	16.6
1 1/4 x 1/2 x 1/8	1.01	20.2
1 1/2 x 1/2 x 1/8	1.12	22.4
1 1/2 x 9/16 x 3/16	1.44	28.8
1 1/2 x 3/4 x 1/8	1.17	23.4
1 3/4 x 1/2 x 3/16	1.55	31.0
2 x 1/2 x 1/8	1.33	26.6
2 x 9/16 x 3/16	1.76	35.2
2 x 1 x 1/8	1.78	35.6
2 x 1 x 3/16	2.57	51.4
2 1/2 x 5/8 x 3/16	2.27	45.4

CHANNELS "C" SHAPES C

STANDARD
ASTM A36

Depth Channel Inches	Weight Per Ft. Pounds	A Thickness of Web	B Width of Flange Inches	Wt. Per. 20' Bar
3	4.10	0.170	1.410	82
	5.00	0.258	1.498	100
	6.00	0.356	1.596	120
4	5.40	0.180	1.580	108
	6.25	0.247	1.647	125
	7.25	0.320	1.720	145
5	6.70	0.190	1.750	134
	9.00	0.325	1.885	180
6	8.20	0.200	1.920	164
	10.50	0.314	2.034	210
	13.00	0.437	2.157	260
7	9.80	0.210	2.090	196
	12.25	0.314	2.194	245
	14.75	0.419	2.229	295
8	11.50	0.220	2.260	230
	13.75	0.303	2.343	275
	18.75	0.487	2.527	375
9	13.40	0.230	2.430	268
	15.00	0.285	2.485	300
	20.00	0.448	2.648	400
10	15.30	0.240	2.600	306
	20.00	0.379	2.739	400
	25.00	0.526	2.886	500
	30.00	0.673	3.033	600
12	20.70	0.280	2.940	414
	25.00	0.387	3.047	500
	30.00	0.510	3.170	600
15	33.90	0.400	3.400	678
	40.00	0.520	3.520	800
	50.00	0.716	3.716	1000

JUNIOR
ASTM A36

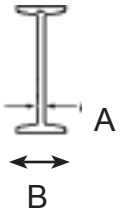
Depth Channel Inches	**Weight Per Ft. Pounds**	**Thickness of Web**	**Width of Flange Inches**	**Wt .Per 20' Bar**
8"	8.5	.180	1 7/8	170
10"	6.5	.150	1 1/8	130
10"	8.4	.170	1 1/2	168
12"	10.6	.190	1 1/2	212

MISCELLANEOUS
ASTM A36

Size	Weight Per Ft. Pounds	Thickness of Web Inches	Width Of Flange Inches	Wt. Per 20' Bar Pounds
3	7.1	0.313	1.938	142
	9.0	0.500	2.122	180
4	13.8	0.500	2.500	276
6	12.0	0.313	2.500	240
	15.1	0.313	2.938	302
	15.3	0.340	3.500	306
	16.3	0.375	3.000	326
	18.0	0.375	3.500	360
7	17.6	0.375	3.000	352
	19.1	0.350	3.450	382
	22.7	0.500	3.600	454
8	18.7	0.350	2.975	374
	20.0	0.400	3.025	400
	21.4	0.375	3.450	428
	22.8	0.425	3.500	456
9	23.9	0.400	3.450	478
	25.4	0.450	3.500	508
10	22.0	0.290	3.320	440
	24.9	0.377	3.402	498
	25.3	0.425	3.550	506
	28.3	0.475	3.500	566
	28.5	0.425	3.950	570
	33.6	0.575	4.100	672
12	30.9	0.450	3.450	618
	32.9	0.500	3.500	658
	35.0	0.467	3.767	500
	37.0	0.600	3.600	740
	40.0	0.590	3.890	800
	45.0	0.712	4.012	900
	50.0	0.835	4.135	1000
13	31.8	0.375	4.000	636
	35.0	0.447	4.072	700
	40.0	0.560	4.185	800
	50.0	0.787	4.412	1000
18	42.7	0.450	3.950	854
	45.8	0.500	4.000	916
	51.9	0.600	4.100	1038
	58.0	0.700	4.200	1160

BEAMS “S” SHAPES S

STANDARD
ASTM A36



Size In Inches	Weight Per Ft. Pounds	A Thickness of Web	B Width of Flange	Wt. Per 20’ Bar Pounds
3	5.7	0.170	2.230	114
	7.5	0.349	2.509	150
4	7.7	0.190	2.660	154
	9.5	0.326	2.796	190
5	10.0	0.210	3.000	200
	14.75	0.494	3.284	295
6	12.5	0.230	3.330	250
	17.25	0.465	3.565	345
7	15.3	0.250	3.660	306
8	18.4	0.270	4.000	368
	23.0	0.441	4.171	460
10	25.4	0.310	4.660	508
	35.0	0.594	4.944	700
12	31.8	0.350	5.000	636
	35.0	0.428	5.078	700
	40.8	0.460	5.250	816
	50.0	0.687	5.477	1000
15	42.9	0.410	5.500	858
	50.0	0.550	5.640	1000
18	54.7	0.460	6.000	1094
20	65.4	0.500	6.250	1308
24	79.9	0.500	7.000	1598
	100.0	0.747	7.247	2000

JUNIOR
ASTM A36

Size In Inches	Weight Per Ft. Pounds	A Thickness of Web	Width of Flange	Wt. Per 20’ Bar Pounds
6	4.4	.114	1.84	88
8	6.5	.135	2.281	130
10	9.0	.155	2.688	180
12	11.8	.175	3.063	236
14	17.2	.210	4.00	344

WIDE FLANGE SHAPES

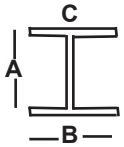
ASTM A36

Theoretical Dimensions and Properties for Designing

AISI Designation	A Depth in Inches	B Flange Width Inches	C Web Thick Inches
W4 x 13#	4.16	4.060	.280
W5 x 16#	5.01	5.000	.240
W5 x 19#	5.15	5.030	.270
W6 x 9#	5.90	3.940	.170
W6 x 12#	6.03	4.000	.230
W6 x 16#	6.28	4.030	.260
W6 x 15#	5.99	5.990	.230
W6 x 20#	6.20	6.020	.260
W6 x 25#	6.38	6.080	.320
W8 x 10#	7.89	3.940	.170
W8 x 13#	7.99	4.000	.230
W8 x 15#	8.11	4.015	.245
W8 x 18#	8.14	5.250	.230
W8 x 21#	8.28	5.270	.250
W8 x 24#	7.93	6.495	.245
W8 x 28#	8.06	6.535	.285
W8 x 31#	8.00	7.995	.285
W8 x 35#	8.12	8.020	.310
W8 x 40#	8.25	8.070	.360
W8 x 48#	8.50	8.110	.400
W8 x 58#	8.75	8.220	.510
W8 x 67#	9.00	8.280	.570
W10 x 12#	9.87	3.960	.190
W10 x 15#	9.99	4.000	.230
W10 x 17#	10.11	4.010	.240
W10 x 19#	10.24	4.020	.250
W10 x 22#	10.17	5.750	.240
W10 x 26#	10.35	5.770	.260
W10 x 30#	10.47	5.810	.300
W10 x 33#	9.73	7.960	.290
W10 x 39#	9.92	7.985	.315
W10 x 45#	10.10	8.020	.350
W10 x 49#	9.98	10.000	.340
W10 x 54#	10.09	10.030	.370
W10 x 60#	10.22	10.080	.420
W10 x 68#	10.40	10.130	.470
W10 x 77#	10.60	10.190	.530
W10 x 90#	10.84	10.265	.605
W10 x 100#	11.10	10.340	.680
W10 x 112#	11.36	10.415	.755

AISI Designation	A Depth in Inches	B Flange Width Inches	C Web Thick Inches
W12 x 14#	11.91	3.970	.200
W12 x 16#	11.99	3.990	.220
W12 x 19#	12.16	4.005	.235
W12 x 22#	12.31	4.030	.260
W12 x 26#	12.22	6.490	.230
W12 x 30#	12.34	6.520	.260
W12 x 35#	12.50	6.560	.300
W12 x 40#	11.94	8.005	.295
W12 x 45#	12.06	8.045	.335
W12 x 50#	12.19	8.080	.375
W12 x 53#	12.06	9.995	.345
W12 x 58#	12.19	10.010	.360
W12 x 65#	12.12	12.000	.390
W12 x 72#	12.25	12.040	.430
W12 x 79#	12.38	12.080	.470
W12 x 87#	12.53	12.125	.515
W12 x 96#	12.71	12.160	.550
W12 x 106#	12.89	12.220	.610
W12 x 120#	13.12	12.320	.710
W12 x 136#	13.41	12.400	.790
W12 x 152#	13.71	12.480	.870
W12 x 170#	14.03	12.570	.960
W12 x 190#	14.38	12.670	1.060
W14 x 22#	13.74	5.000	.230
W14 x 26#	13.91	5.025	.255
W14 x 30#	13.34	6.730	.270
W14 x 34#	13.98	6.745	.285
W14 x 38#	14.10	6.770	.310
W14 x 43#	13.66	7.995	.305
W14 x 48#	13.79	8.030	.340
W14 x 53#	13.92	8.060	.370
W14 x 61#	13.89	9.995	.375
W14 x 68#	14.04	10.035	.415
W14 x 74#	14.17	10.070	.450
W14 x 82#	14.31	10.130	.510
W14 x 90#	14.02	14.452	.440
W14 x 99#	14.16	14.565	.485
W14 x 109#	14.32	14.605	.525
W14 x 120#	14.48	14.670	.590
W14 x 132#	14.66	14.725	.645
W14 x 145#	14.78	15.500	.680

WIDE FLANGE SHAPES (Continued) W



ASTM A36

Theoretical Dimensions and Properties for Designing

AISI Designation	A Depth in Inches	B Flange Width Inches	C Web Thick Inches
W14 x 159#	14.98	15.565	.745
W14 x 176#	15.22	15.650	.830
W14 x 193#	15.48	15.710	.890
W14 x 211#	15.72	15.800	.980
W14 x 233#	16.04	15.890	1.070
W14 x 257#	16.38	15.995	1.175
W14 x 283#	16.74	16.110	1.290
W14 x 311#	17.12	16.230	1.410
W14 x 342#	17.54	16.360	1.540
W14 x 370#	17.92	16.475	1.655
W14 x 398#	18.29	16.590	1.770
W14 x 426#	18.67	16.695	1.875
W16 x 26#	15.69	5.500	.250
W16 x 31#	15.88	5.525	.275
W16 x 36#	15.86	6.985	.295
W16 x 40#	16.01	6.995	.305
W16 x 45#	16.13	7.035	.345
W16 x 50#	16.26	7.070	.380
W16 x 57#	16.43	7.120	.430
W16 x 67#	16.33	10.235	.395
W16 x 77#	16.52	10.295	.455
W16 x 89#	16.75	10.365	.525
W16 x 100#	16.97	10.425	.585
W18 x 35#	17.70	6.000	.300
W18 x 40#	17.90	6.015	.315
W18 x 46#	18.06	6.060	.360
W18 x 50#	17.99	7.495	.355
W18 x 55#	18.11	7.530	.390
W18 x 60#	18.24	7.555	.415
W18 x 65#	18.35	7.590	.450
W18 x 71#	18.47	7.635	.495
W18 x 76#	18.21	11.035	.425
W18 x 86#	18.39	11.090	.480
W18 x 97#	18.59	11.145	.535
W18 x 106#	18.73	11.200	.590
W18 x 119#	18.97	11.265	.655
W21 x 44#	20.66	6.500	.350
W21 x 50#	20.83	6.530	.380
W21 x 57#	21.06	6.555	.405
W21 x 62#	20.99	8.240	.400
W21 x 68#	21.13	8.270	.430
W21 x 73#	21.24	8.295	.455
W21 x 83#	21.43	8.355	.575
W21 x 93#	21.62	8.420	.580
W21 x 101#	21.36	12.290	.500

AISI Designation	A Depth in Inches	B Flange Width Inches	C Web Thick Inches
W21 x 111#	21.51	12.340	.550
W21 x 122#	21.68	12.390	.600
W21 x 132#	21.83	12.450	.650
W21 x 147#	22.06	12.510	.720
W24 x 55#	23.57	7.000	.395
W24 x 62#	23.74	7.040	.430
W24 x 68#	23.73	8.965	.415
W24 x 76#	23.92	8.990	.440
W24 x 84#	24.10	9.020	.470
W24 x 94#	24.31	9.065	.515
W24 x 104#	24.06	12.750	.500
W24 x 117#	24.26	12.800	.550
W24 x 131#	24.48	12.855	.605
W24 x 146#	24.74	12.900	.650
W24 x 162#	25.00	12.955	.705
W27 x 84#	26.71	9.960	.460
W27 x 94#	26.92	9.990	.490
W27 x 102#	27.09	10.015	.515
W27 x 114#	27.29	10.070	.570
W27 x 146#	27.38	13.965	.605
W27 x 161#	27.59	14.020	.660
W27 x 178#	27.81	14.085	.725
W30 x 99#	29.65	10.450	.520
W30 x 108#	29.83	10.475	.545
W30 x 116#	30.01	10.405	.565
W30 x 124#	30.17	10.515	.585
W30 x 132#	30.31	10.545	.615
W30 x 173#	30.44	14.985	.655
W30 x 191#	30.68	15.040	.710
W30 x 211#	30.94	15.105	.775
W33 x 118#	32.86	11.480	.550
W33 x 130#	33.09	11.510	.580
W33 x 141#	33.30	11.535	.605
W33 x 152#	33.49	11.565	.635
W33 x 201#	33.68	15.745	.715
W33 x 221#	33.93	15.805	.775
W33 x 241#	34.18	15.860	.830
W36 x 135#	35.55	11.950	.600
W36 x 150#	38.85	11.975	.625
W36 x 160#	36.01	12.000	.650
W36 x 170#	36.17	12.030	.680
W36 x 182#	36.33	12.075	.725
W36 x 194#	36.49	12.115	.765
W36 x 210#	36.69	12.180	.830

TOLERANCES

BAR SIZE SHAPES

Depth of section, Width of Flange Thickness of Web and Out-of-Square Tolerances

Specified Size of Channel-Inches	Size Tolerances Over and Under-Inches				Out-of square of either flange-Inches per Inch of flange width
	Depth of Section	Width of Flanges	Thickness of Web for Thickness Given		
			To 3/16 Incl.	Over 3/16	
3/4 to 1 1/2 incl.	1/32	1/32	.010	.015	1/32
Over 1 1/2 to 2 incl	1/16	1/16	.015	.020	1/32

[1]For Channels 5/8 in. and under in depth, the out-of-square tolerance is 3/64 in. per inch of depth.
Measurements for depth of section and width of flanges are overall.

Permissible Variations in Dimensions for Hot-Wrought Bar Size Channels of Carbon Steel

Specified Size of Channel, In.	Permissible Variations In Size Over and Under, in.				Out-of square if either flange in./in. of flange width
	Depth Section[A]	Width Flanges[B]	Thickness of Web for Thickness Given		
			To 3/16, Incl.	Over 3/16	
To 1 1/2 Incl.	1/32	1/32	.010	.015	1/32
Over 1 1/2 to 3 excl.	1/16	1/16	.015	.020	1/32

[A]Measurements for depth of section and width of flanges are over-all.
[B]For channels 5/8 in. and under in depth, the out-of-square tolerance is 3/64 in./in. of depth.

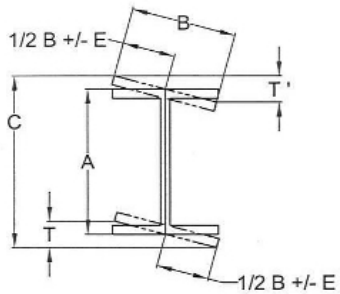
Permissible Variations In Thickness, Length and Out-of-Square for Hot-Wrought Bar Size Angles of Carbon Steel

Specified Length of leg. In.[A]	Permissible Variations in Thickness for Thickness Given Over and Under, In.			Permissible Variations for Length of Leg. Over and Under, In.
	to 3/16, Incl	Over 3/16 to 3/8, Incl.	Over 3/8	
To 1, incl.	0.008	0.010	-	1/32
Over 1 to 2, incl.	0.010	0.010	0.012	3/64
Over 2 to 3, incl.	0.012	0.015	0.015	1/16

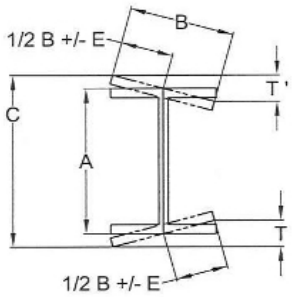
[A]The longer leg of an unequal angel determines the size for tolerance The out-of- square tolerance in either direction is 1 1/2°.

TOLERANCES (Continued)

WIDE FLANGE



WIDE FLANGE



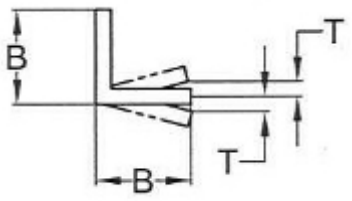
WIDE FLANGE

ROLLING TOLERANCES, INCHES

Section Nominal Size	A Depth		B Flange Width		T+T' Flanges Out-of-Square	E Web Off Center	C Max. Depth at Any Cross Section
	Over Theor	Under Theor	Over Theor	Under Theor			Over Theor Depth
Up to 12 incl.	1/8	1/8	1/4	3/16	1/4 max.	3/16 max.	1/4
Over 12	1/8	1/8	1/4	3/16	5/16 max	3/16 max.[2]	1/4

(A) is measured at center line of web. (B) is measured parallel to flange.
(C) is measured parallel to web.

[Z]Variation of 5/16 in. max., for sections over 426 lb. per ft.



ANGLES

Nominal Size	B Length of Leg		T Out-of Square Per In. of B In.
	Over	Under	
3 to 4 Incl.	1/8	3/32	1 1/2 deg.
Over 4 to 6 Incl.	1/8	1/8	1 1/2 deg.
Over 6	3/16	1/8	1 1/2 deg.

For unequal leg angles longer leg determines classification.

Variation in weight: ± 2.5%
Straightness: Camber or sweep =

$$1/8'' \times \frac{\text{No. of feet of total length}}{5}$$

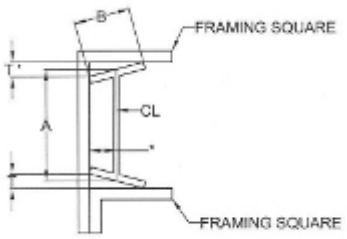
TOLERANCES (Continued)

AMERICAN STANDARD SHAPES

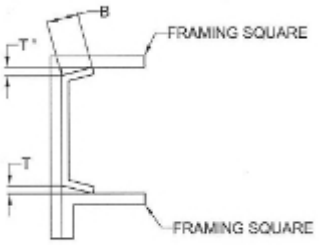
Out of square and center line of web to be parallel when measuring out-of-square."

CHANNELS

T + T' applies when flanges of channels are toed in or out.



STANDARD SHAPES



CHANNELS

ROLLING TOLERANCES, INCHES

Section	Nominal Depth	A Depth		B Flange Width		T+ T' Out-Of-Square Per In. of B In.
		Over Theor	Under Theor	Over Theor	Under Theor	
American Standard Shapes	3 to 7 Incl.	3/32	1/16	1/8	1/8	1/32
	Over 7 to 14 Incl.	1/8	3/32	5/32	5/32	1/32
	Over 14 to 24 Incl.	3/16	1/8	3/16	3/16	1/32
Channels	3 to 7 Incl.	3/32	1/16	1/8	1/8	1/32
	Over 7 to 14 Incl.	1/8	3/32	1/8	5/32	1/32
	Over 14	3/16	1/8	1/8	3/16	1/32

(A) is measured at center line of web for beams; and at back of web for channels.

Variation in weight: ± 2 5%
Straightness: Camber or sweep =

$$1/8 \times \frac{\text{No. of feet of total length}}{5}$$

*ID when flange width is more than 6 in.

ORDERING GUIDE FOR FORMED ROLLED SHAPES

TEES

STEM OUT
Specify inside diameter

STEM IN
Specify outside diameter

STEM UP
Specify diameter of stem C/L

CHANNELS

EZ WAY, FLANGES OUT
Specify inside diameter

EZ WAY, FLANGES IN
Specify outside diameter

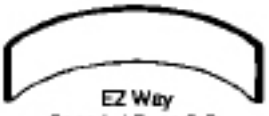
HARD WAY OF WEB
Specify I.D. or O.D

BEAMS

EZ Way
Specify diameter of web C/L

HARD WAY
Specify I.D. or O.D.

BARS



EZ Way
Specify I.D or O.D.

HARD WAY
Specify I D or O D.

ANGLES

LEG OUT
Specify inside diameter and if unequal which leg is out

LEG IN
Specify outside diameter and if unequal which leg is in

HEEL OUT
Specify outside diameter

HEEL IN
Specify inside diameter

LEG OUT

LEG IN

BOTH LEGS OUT

BOTH LEGS IN

SECTION 5

HOT ROLLED CARBON BARS

PRODUCT DESCRIPTION

ASTM A36
AISI 1045
PROCESSED BARS

Hot rolled carbon steel bars are available in A36 rounds, flats and squares and AISI 1045 round bars.

Our low carbon bars are A36 steel instead of AISI 1020. By ordering A36 steel, test reports will show the strength level of the bar and chemical analysis rather than only chemical analysis with AISI 1020 steel. In some cases the A36 chemical analysis will also match AISI 1020 chemical analysis.

AISI 1045 steel is a medium carbon steel grade that will have higher strength levels in the as-rolled condition than A36 steel. The yield and tensile strengths will approximate that of normalized 1045 steel. Larger bars will have lower yields and tensiles because of the mass cooling effect than smaller diameter bars. This steel grade can be heat treated by quenching in oil or water and tempering to various levels of hardness and strength. AISI 1045 steel is considered a shallow hardening steel in comparison to alloy steels which are through hardening.

Chemical Analysis

Steel Grade	Size	C	Mn	P	S	Si
A36	to 3/4 incl	.26 max	-	.040 max	.050 max	-
	over 3/4 to 1.5	.27	.60-.90	.040	.050	-
	over 1.5 to 4	.28	.60-.90	.040	.050	-
	over 4	.29	.60-.90	.040	.050	-
1045	All	.43-.50	.60-.90	.040	.050	.15-.35

Mechanical Properties

Steel Grade	Size	Tensile	Yield	% Elong	Brinell
A36	All	58-80,000 psi	36,000 psi min	21	116-167
1045	1	98,000	60,000	24	201
1045	2	95,000	55,000	24	197
1045	4	92,000	52,000	24	187

Note: 1045 steels are approximate values.

HOT ROLLED ROUNDS

ASTM A36
AISI 1045

Diameter In Inches	Est. Wt. Per Ft. Pounds	Wt. Per 20' Bar Pounds
3/16	.094	1.88
1/4	.167	3.34
5/16	.261	5.22
3/8	.376	7.52
7/16	.511	10.22
31/64	.627	12.54
1/2	.668	13.36
9/16	.845	16.90
39/64	.992	19.84
5/8	1.043	20.86
47/64	1.440	28.80
3/4	1.502	30.04
55/64	1.970	39.40
7/8	2.044	40.88
1	2.670	53.40
1 1/8	3.380	67.60
1 1/4	4.172	83.44
1 3/8	5.050	101.00
1 1/2	6.010	120.20
1 5/8	7.050	141.00
1 3/4	8.180	163.60
1 7/8	9.390	187.80
2	10.680	213.60
2 1/8	12.060	241.20
2 1/4	13.520	270.40
2 3/8	15.060	301.20
2 1/2	16.690	333.80
2 5/8	18.40	368.00
2 3/4	20.20	404.00
2 7/8	22.07	441.40

HOT ROLLED ROUNDS (Continued)

Diameter in Inches	Est.Wt. Per Ft Pounds	Wt.Per 20' Bar Pounds
3	24.03	480.60
3 1/4	28.21	564.20
3 1/2	32.71	654.20
3 3/4	37.55	751.00
4	42.73	854.60
4 1/4	48.23	964.60
4 1/2	54.08	1081.60
4 3/4	60.25	1205.00
5	66.76	1335.20
5 1/4	73.60	1472.00
5 1/2	80.78	1615.60
5 3/4	88.29	1765.80
6	96.13	1922.60
6 1/2	112.82	2256.40
7	130.85	2617.00
7 1/2	150.21	3004.20
8	170.90	3418.00
8 1/2	192.93	3858.60
9	216.30	4326.00
9 1/2	241.00	4820.00
10	267.04	5340.80

Note: In larger diameters bars will run oversize and weight will be calculated accordingly. Bars 3" and over "Special Quality."

HOT ROLLED SQUARE BARS

20' LENGTHS **ASTM A-36**

Size In Inches	Est. Wt. Per Ft. Pounds	Wt. Per 20' Bar, Pounds	Size In Inches	Est. Wt. Per Ft. Pounds	Wt. Per 20' Bar, Pounds
1/4	.213	4.26	1 1/4	5.313	106.26
5/16	.332	6.64	1 1/2	7.65	153.00
3/8	.478	9.56	1 5/8	8.98	179.60
7/8	.651	13.02	1 3/4	10.41	208.20
1/2	.850	17.00	2	13.60	272.00
9/16	1.080	21.60	2 1/4	17.21	344.20
5/8	1.330	26.60	2 1/2	21.25	425.00
3/4	1.910	38.20	2 3/4	25.71	514.20
7/8	2.603	52.06	3	30.60	612.00
1	3.400	68.00	3 1/2	41.65	833.00

HOT ROLLED STRIP

A 36 20' LENGTHS

Size in Inches	Est. Wt. Per Ft. Pounds	Wt. Per 20' Bar, Pounds	Size in Inches	Est. Wt. Per Ft. Pounds	Wt. Per 20' Bar, Pounds
1/8 x 1/2	.213	4.26	3/16 x 1/2	.319	6.38
5/8	.266	5.32	5/8	.398	7.96
3/4	.319	6.38	3/4	.478	9.56
7/8	.372	7.44	7/8	.558	11.16
1	.425	8.50	1	.638	12.76
1 1/4	.531	10.62	1 1/4	.797	15.94
1 1/2	.638	12.76	1 1/2	.956	19.12
1 3/4	.744	14.88	1 3/4	1.120	22.40
2	.850	17.00	2	1.280	25.60
2 1/4	.956	19.12	2 1/4	1.430	28.60
2 1/2	1.063	21.26	2 1/2	1.594	31.88
2 3/4	1.169	23.38	2 3/4	1.753	35.06
3	1.275	25.50	3	1.913	38.26
3 1/2	1.488	29.76	3 1/2	2.230	44.60
4	1.700	34.00	4	2.550	51.00
4 1/2	1.913	38.26	5	3.188	63.76
5	2.125	42.50	6	3.825	76.50
6	2.550	51.00	8	5.100	102.00
8	3.400	68.00	10	6.375	127.50
10	4.250	85.00	12	7.650	153.00
12	5.100	102.00			
16	6.800	136.00			

TOLERANCES

Width	Over or Under In Width	Over on Length
To 2", Incl.	1/32	3/4
Over 2" to 5", incl.	3/64	3/4
5" to 10"	1/16	1 1/4

STRAIGHTNESS

Up to & incl. 1 1/2" width - 1/4 inch in any 5 ft.
Over 1 1/2" width - 1/8 inch in any 5 ft.

FLAT STEEL BARS
ASTM A36 (1/4 IN. AND THICKER) 20' LENGTHS

Size in Inches	Est. Wt. Per Ft. Pounds	Wt. Per 20' Bar, Pounds
1/4 X 1/2	0.425	8.50
5/8	0.531	10.62
3/4	0.638	12.76
7/8	0.744	14.88
1	0.850	17.00
1 1/4	1.06	21.20
1 1/2	1.28	25.60
1 3/4	1.49	29.80
2	1.70	34.00
2 1/4	1.91	38.20
2 1/2	2.13	42.60
2 3/4	2.340	46.80
3	2.550	51.00
3 1/4	2.760	55.20
3 1/2	2.980	59.60
3 3/4	3.190	63.80
4	3.400	68.00
4 1/2	3.830	76.00
5	4.250	85.00
6	5.100	102.00
7	5.950	119.00
8	6 800	136.00
5/16 X 1/2	0.531	10.62
3/4	0.797	15.94
1	1.060	21.20
1 1/4	1.330	26.60
1 1/2	1.590	31.80
1 3/4	1.860	37.20
2	2.130	42.60
2 1/4	2.390	47.80
2 1/2	2.660	53.20
2 3/4	2.920	58.40
3	3.190	63.80
4	4.250	85.00
5	5.310	106.20
6	6.380	127.60
7	7.440	148.50
8	8.500	170.00
3/8 X 1/2	0.638	12.76
3/4	0.956	19.12
1	1.280	25.60
1 1/4	1.590	31 80
1 1/2	1.910	38.20
13/4	2.230	44.60
2	2 550	51.00
2 1/4	2.870	57.40
2 1/2	3.190	63.80
2 3/4	3 510	70.20
3	3.830	76.60
3 1/2	4.460	89.20
4	5.100	102.00
4 1/2	5.740	114.80
5	6.380	127.60
6	7.650	153.00
7	8.930	178.90
8	10.200	204.00

Size in Inches	Est. Wt. Per Ft. Pounds	Wt. Per 20' Bar, Pounds
1/2 X 3/4	1.28	25.60
7/8	1.49	29.80
1	1.70	34.00
1 1/4	2.13	42.50
1 1/2	2.55	51.00
1 3/4	2.98	59.50
2	3.40	68.00
2 1/4	3.83	76.50
2 1/2	4.25	85.00
2 3/4	4.68	93.60
3	5.10	102.00
3 1/2	5.95	119.00
4	6.80	136.00
4 1/2	7.65	153.00
5	8.50	170.00
6	10.20	204.00
7	11.90	238.00
8	13.60	272.00
5/8 X 1	2.13	42.50
1 1/4	2.66	53.13
1 1/2	3.19	63.76
2	4.25	85.00
2 1/4	4.78	95.60
2 1/2	5.31	106.26
3	6.38	127.50
3 1/2	7.44	148.76
4	8.50	170.00
5	10.63	212.50
6	12.75	255.00
7	14.88	297.60
8	17.00	340.00
3/4 X 1	2.55	51.00
1 1/4	3.19	63.75
1 1/2	3.83	76.50
2	5 10	102.00
2 1/4	5.74	114.80
2 1/2	6.38	127.50
3	7 65	153.00
3 1/2	8 93	178.50
4	10 20	204.00
5	12.75	255.00
6	15 30	306.00
7	17.85	357.00
8	20.40	408.00
7/8 X 1 1/4	3.72	74.40
1 1/2	4.46	89.20
2	5.95	119.00
2 1/4	6.69	133 80
7/8 X 2 1/2	7.44	148.76
3	8 93	178.50
3 1/2	10 41	208.26
4	11.90	238.00
5	14.88	297.50
6	17.85	357.00
7	20.83	416.60
8	23.80	476.00

FLAT STEEL BARS (Continued)

Size in Inches	Est. Wt. Per Ft. Pounds	Wt. Per 20' Bar, Pounds
1 x 1 1/2	5.10	102.00
2	6.80	136.00
2 1/2	8.50	170.00
3	10.20	204.00
3 1/2	11.90	238.00
4	13.60	272.00
4 1/2	15.30	306.00
5	17.00	340.00
6	20.40	408.00
7	23.80	476.00
8	27.20	544.00
1 1/2 x 2	7.65	153.00
2 1/2	9.56	191.20
3	11.48	229.60
4	15.30	306.00
5	19.13	382.00
6	22.95	459.00
1 1/4 x 2	8.50	170.00
2 1/2	10.63	212.50
3	12.75	255.00
4	17.00	340.00
5	21.25	425.00
6	25.50	510.00
7	29.75	595.00
8	34.00	680.00
1 1/2 x 2	10.20	204.00
2 1/2	12.75	255.00
3	15.30	306 00
4	20.40	408.00
5	25.50	510.00
6	30.60	612.00
7	35.70	714.00
8	40 80	816.00
1 3/4 x 4	23.80	476.00
4 1/2	26.77	535.40
5	29.75	595.00
6	35.70	714.00
7	41.65	833.00
8	47.60	952.00
2 x 2 1/2	17.00	340.00
3	20.40	408.00
4	27.20	544.00
5	34.00	680.00
6	40.80	816.00
7	47.60	952.00
8	54.40	1088.00

REINFORCING STEEL BARS

ASTM A615 DEFORMED STEEL BARS FOR CONCRETE REINFORCEMENT

Size#	Grade	Diameter In Inches	Area Square In	Weight Per Foot	Wt Per 20' Bar
3	40	3/8	.11	.376	7.52
4	40	1/2	.20	.668	13.36
5	40	5/8	.31	1.043	20.86
6	40	3/4	.44	1.502	30.04
7	60	7/8	.60	2.044	40.88
8	60	1	.79	2.670	53.40

Note: Grade 60 also available in all sizes. .

TENSILE REQUIREMENTS

	Grade 40[A]	Grade 60
Tensile strength, min. psi	70.000	90.000
Yield strength, min. psi	40.000	60.000
Elongation in 8 in., min. %:		
Bar No. 3	11	9
4,5,6	12	9
7,8	…	8
9,10	…	7
11,14,18	..	7

[A] Grade 40 bars are furnished only in sizes 3 through 6

PROCESSED BARS

American Metals Corporation can be your source for A36, A36 P&O and A572 Gr50 bars in non-standard width and lengths. The processed bars start out as slit coil and are uncoiled and run through a bar mill which is equipped with horizontal and vertical rolls. The vertical or edging rolls will produce a smooth edged bar. The bars can be cut to any length to eliminate wastage.

Capacity - 3/16” to 3/8” thickness and from
3” to 12” wide depending on thickness
up to 40’ lengths

MACHINING ALLOWANCES - HOT ROLLED BARS

When ordering bars it is advisable to make adequate allowances for machining and to specify sizes accordingly.

These allowances require consideration of the manufacturing process, the length and size of bars, straightness, size tolerance and out-or-round tolerance.

In order to obtain a clean surface, free from any defects, and uniform surface hardness after heat treatment, it is advisable that the allowances made be adequate to permit an actual stock removal per side of not less than the amounts shown as follows:

Nominal Diameter of Bars in Inches	Minimum Stock Removal Per Side in Inches Carbon Bars
Up to 5/8 incl.	.025
Over 5/8 to 7/8 incl	.025
Over 7/8 to 1 incl.	.028
Over 1 to 1 1/8 incl.	.031
Over 1 1/8 to 1 1/4 incl.	.034
Over 1 1/4 to 1 3/8 incl.	.037
Over 1 3/8 to 1 1/2 incl.	.040
Over 1 1/2 to 2 incl.	.053
Over 2 to 2 1/2 incl.	.065
Over 2 1/2 to 3 1/2 incl.	.090
Over 3 1/2 to 4 1/2 incl.	.115
Over 4 1/2 to 5 1/2 Incl.	.140
Over 5 1/2 to 6 1/2 incl.	.165
Over 6 1/2 to 8 1/4 incl	.209
Over 8 1/4 to 9 1/2 incl	.240
Over 9 1/2 to 10 incl.	.253

TOLERANCES FOR SIZE AND OUT-OF-ROUND OR OUT-OR SQUARE

HOT ROLLED CARBON STEEL BARS ROUND, SQUARE, AND ROUND-CORNERED SQUARE-CORNERED SQUARE BARS

Specified Sizes, in.	Size Tolerances, inch		Out-or-Round or Out-or-Square Section, in.
	Over	Under	
Up to 5/16 incl	0.005	0.005	0.008
Over 5/16 to 7/16 incl.	0.006	0.006	0.009
Over 7/16 to 5/8 incl.	0.007	0.007	0.010
Over 5/8 to 7/8 incl.	0.008	0.008	0.012
Over 7/8 to 1 incl.	0.009	0.009	0.013
Over 1 to 1 1/8 incl.	0.010	0.010	0.015
Over 1 1/8 to 1 1/4 incl.	0.011	0.011	0 016
Over 1 1/4 to 1 3/8 incl.	0.012	0.012	0.018
Over 1 3/8 to 1 1/2 incl.	0.014	0.014	0.021
Over 1 1/2 to 2 incl.	1/64	1/64	0.023
Over 2 to 2 1/2 incl.	1/32	0	0.023
Over 2 1/2 to 3 1/2 incl.	3/64	0	0.035
Over 3 1/2 to 4 1/2 incl.	1/16	0	0.046
Over 4 1/2 to 5 1/2 incl.	5/64	0	0.058
Over 5 1/2 to 6 1/2 incl.	1/8	0	0.070
Over 6 1/2 to 8 1/4 incl.	5/32	0	0.085
Over 8 1/4 to 9 1/2 incl.	3/16	0	0.100
Over 9 1/2 to 10 incl.	1/4	0	0.120

Note: Out-or-round is the difference between the maximum and minimum diameters of the bar, measured at the same cross section. Out-of-square section is the difference in the two dimensions at the same cross section of a square bar between opposite faces.

STRAIGHTNESS TOLERANCES

ALL BARS AND SMALL SHAPES

Standard Straightness: 1/4-in, in any 5ft. Or 1/4-in. x number of ft of length divided by 5. Special Straightness: 1/8-in. in any 5-ft. or 1/8-in. x number of ft. of length divided by 5.

Because of warpage, Standard and Special straightness tolerances do not apply to bars if any subsequent heating operation has been performed after straightening.

For specifications to ASTM-A36 see Structural shapes Section. Special quality specifications inquire.

TOLERANCES FOR THICKNESS AND WIDTH

HOT ROLLED CARBON STEEL BARS SQUARE-EDGE AND ROUND EDGE BARS

Specified Widths, inches	Thlckness Tolerances, for Thickness Given, Over and Under, In.							Width tolerances, inches	
	.203 to .230 excl.	.203 to 1/4 excl.	1/4 to 1/2 incl.	Over 1/2 to 1, incl.	Over 1 to 2, incl.	Over 2 to 3 incl.	Over 3	Over	Under
To 1 incl.	0.007	0.007	0.008	0.010	-	-	-	1/64	1/64
Over 1 to 2 incl.	0.007	0.007	0.012	0.015	1/32	-	-	1/32	1/32
Over 2 to 4 incl.	0.008	0.008	0.015	0.020	1/32	3/64	3/64	1/16	1/32
Over 4 to 6 incl.	0.009	0.009	0.015	0.020	1/32	3/64	3/63	3/32	1/16
Over 6 to 8 incl.	*	0.015	0.016	0.025	1/32	3/64	-	1/8**	3/32**

* Flats Over 6” to 8”, incl. In width are not available as hot rolled carbon steel bars in thickness under 0.230.

**For flats over 6” to 8”, incl. in width, and to 3” incl., in thickness

Extensive hot rolled flat bar inventory

SECTION 6

COLD FINISHED CARBON BARS

PRODUCT DESCRIPTION

AISI 1018 COLD FINISHED BARS

AISI 1018 Cold Finished Bars have a bright smooth finish produced either by cold drawing through a die or cold rolling in the case of large flats and squares. In comparison to hot rolled bars, these bars will have closer tolerances, better straightness, and the cold drawn and cold rolled bars will have better machinability.

The mechanical properties listed for cold drawn bars were developed from the American Iron and Steel Institute's "Cold Finished Steel Bar Handbook." These mechanical properties can vary depending on chemical variation, hardness of the hot rolled bars and cold drawing reduction. When more accurate tensile properties are required on a particular mill shipment, the bars should be tensile tested.

CHEMICAL ANALYSIS

Carbon	Manganese	Phosphorous	Sulphur
.15/.20	.60/.90	.040 max	.050 max

MECHANICAL PROPERTIES

(EXPECTED MINIMUMS)

Size	Tensile	Yield	%Elong	BHN
5/8" to 7/8"	70,000 psi	60,000 psi	18	143
15/16" to 1 1/4"	65,000	55,000	16	131
1 5/16" to 2"	60,000	50,000	15	121
1 1/16" to 3"	55,000	45,000	15	111

MACHINABILITY

Cold Drawn 1018 Bars have a machinability rating of 66% based on the machinability of AISI 1212 Steel at 100%.

APPLICATIONS

Suitable for low strength level machinery parts in light sections and for rigid machinery parts in heavier sections. This steel grade cannot be quench and tempered heat treated since the chemical analysis is below .30% carbon content. It is also for this reason CD 1018 Bars will have good welding characteristics.

Cold Drawn 1018 Bars are not recommended for carburizing for two reasons:
1) unless the bars are machined, the drawing lubricant on the bars insulates the surface from the carburizing salt, carburizing compounds or carburizing atmosphere in controlled carburizing furnaces; and 2) low carbon-low manganese steels do not carburize uniformly.

In most cases Cold Drawn and Cold Rolled Bars will have high yields close to tensile strengths, low elongations and will have poor ductability. It is for this reason cold forming or bending of Cold Drawn 1018 Bars is not recommended.

PRODUCT DESCRIPTION (Continued)

AISI 1045 TURNED GROUND & POLISHED BARS

ASTM A108, STEEL BARS, CARBON, COLD FINISHED, STANDARD QUALITY

This product is machine turned, ground and polished for close dimensional tolerances and is available in roller and ball bearing diameters. This precision shafting represents the highest degree of overall accuracy, concentricity, straightness and surface perfection attainable in commercial practice. The surface roughness rating of these bars is approximately 12 RMS, which is measured with a profilometer. These bars are produced from hot rolled bars and therefore will have mechanical properties of hot rolled 1045 steel off the bar mill. Yield, tensile and elongations will vary depending on chemical variation, bar diameter and rate of cooling off the bar mill. When more accurate tensile properties are required, the bars should be tensile tested.

CHEMICAL ANALYSIS

Carbon	Manganese	Silicon	Phosphorous	Sulphur
.43-.50%	.60-.90	.15-.35	.040 max	.050 max

MECHANICAL PROPERTIES (APPROXIMATE)

Size	Tensile	Yield	% Elong	BHN
1”	97,000 psi	58,100	24	197
2”	95,250	55,600	24	197
4”	91,750	52,600	24	197

MACHINABILITY

Turned, Ground and Polished AISI 1045 bars have a machinability rating of 55% based on the machinability rating of AISI 1212 at 100%.

APPLICATIONS

This precision shafting is used for motor shafts and similar applications where higher strength levels than AISI 1018 are required and where a minimum amount of machining is involved. These bars are decarb free and can be induction hardened to a Rockwell C hardness of 54-57 for needle bearing and wear surfaces.

AISI 1045 Steel can be readily welded with good welds providing special precautions are used such as preheating, postheating and low hydrogen welding rods are used.

PRODUCT DESCRIPTION (Continued)

COLD DRAWN FREE MACHINING STEELS

AISI 12L14
AISI 1215

These steels are also called screw machine steels and are used for long production runs on high production machining equipment The chemical composition plus the cold drawn properties produce a steel grade that will machine at increased surface feet per minute, produce a smooth surface and increase tool life. The high sulfur content of the steel improves machinability by causing formation of a broken chip instead of a stringer or long curl. The addition of lead in 12L14 acts as a built-in lubricant that reduces frictional heat build-up on the cutting tool.

AISI 1215 is a lower carbon-free machining steel than 12L14 and is rated as the fastest non-leaded free machining steel. This steel will also machine with a good surface finish. The product would be used in place of leaded steels when lead is considered a contaminant for ecological reasons.

CHEMICAL ANALYSIS

Grade	Carbon	Manganese	Sulfur	Phosphorous	Lead
12L14	.15 max	.85-1.15	.26-.35	.04-.09	.15-.35
1215	.09	.75-1.05	.26-.35	.04-.09	___

MECHANICAL PROPERTIES

Grade	Tensile	Yield	% Elong	Approx. Rockwell B
12L14	70-90,000	60-80,000	10 - 18	75-90
1215	70-80,000	60-70,000	10 - 18	70-85

WELDABILITY

High sulfur and leaded steels present gas problems in welding and will promote porous welds. Both products can be satisfactorily brazed.

APPLICATIONS

These steels would be used where strength requirements are not a major factor. The chemical analysis of both grades will prevent them from having uniform case hardening properties .

PRODUCT DESCRIPTION (Continued)

COLD FINISHED BARS

STRESSPROOF AISI 1144

Stressproof bars are cold drawn, free machining bars produced with a minimum yield strength of 100,000 psi. This steel product can eliminate heat treating or the use of heat treated bars on parts requiring a hardness range of HRC 23-27 when an alloy steel is not required. The AISI 1144 modified steel as nitrogen added to increase yield and tensile strengths. Stressproof, which is a LaSalle Steel product, is made by a patented process which consists of drawing a bar through a special die under heavy draft and stress relieving the bars in heat treating furnaces. The uniform hardness plus stress relieving of the bars will produce machined parts with a minimum amount of distortion and warpage. Stressproof bars are available in either an ebonized finish or ground and polished.

CHEMICAL ANALYSIS

Carbon	Manganese	Phosphorous	Sulphur	Silicon	Nitrogen
.40/.48	1.35/1.65	.040 max	.24	.15/.30	.006/.009

MECHANICAL PROPERTIES

Tensile	Yield	% Elong	BHN
132,300 psi (mean)	100,000 psi (min)	12	269

MACHINABILITY

Stressproof has a rating of 83% when compared to AISI 1212 at 100%

APPLICATIONS

Stressproof can be used on many applications now requiring heat treating to a hardness rating of Rockwell C23 to 27. Some of these parts would include motor and pump shafts, boring bars, lead screw, light duty gears, etc. It is important to remember Stressproof is a resulphurized steel and could be notch sensitive under certain circumstances of high torque and product design.

This steel grade can also be induction hardened to a Rockwell C54-57 for bearing and wear surfaces.

The welding characteristics of Stressproof will be poor, which is typical of any resulphurized steel product.

COLD FINISHED CARBON STEEL ROUNDS

AISI 1018, AISI 1045, AISI 12L14, AISI 1215 STRESSPROOF

Sizes in Stock	Weight Per Foot	Weight Per 12' Bar	Weight Per 20' Bar	Sizes in Stock	Weight Per Foot	Weight Per 12' Bar	Weight Per 20' Bar
1/8"	.042		.84	2 13/16	21.120		422.40
3/16	.094		1.88	2 7/8	22.070		441.40
1/4	.167	2.00	3.34	2 15/16	23.040		460.80
5/16	.261	3.13	5.22	3"	24.030	288.36	480.60
3/8	.376	4.51	7.52	3 1/16	25.050		501.00
7/16	.511	6.13	10.22	3 1/8	26.080		521.60
1/2	.668	8.02	13.36	3 3/16	27.130		542.60
9/16	.845	10.14	16.90	3 1/4	28.210	338.52	564.20
5/8	1.043	12.52	20.86	3 5/16	29.300		586.00
11/16	1.262	15.12	25.24	3 3/8	30.420		608.40
3/4	1.502	18.00	30.04	3 7/16	31.550		631.00
13/16	1.763	21.12	35.26	3 1/2	32.710	392.52	654.20
7/8	2.044	24.43	40.88	3 9/16	33.890		677.80
15/16	2.347	28.20	46.94	3 5/8	35.090		701.80
1"	2.670	32.04	53.40	3 11/16	36.310		726.20
1 1/16	3.014	36.24	60.28	3 3/4	37.550	450.60	751.00
1 1/8	3.379	40.56	67.58	3 7/8	40.100		802.00
1 3/16	3.766	50.04	75.32	3 15/16	41.400		808.00
1 1/4	4.173	55.20	83.46	4"	42.730	512.76	854.60
1 5/16	4.600		92.00	4 1/8	45.440		908.80
1 3/8	5.049	60.60	101.00	4 3/16	46.830		936.60
1 7/16	5.518	66.24	110.40	4 1/4	48.230		964.60
1 1/2	6.008	72.12	120.20	4 5/16	49.660		993.20
1 9/16	6.520		130.40	4 3/8	51.110		1,022.00
1 5/8	7.051	84.60	141.00	4 7/16	52.580		1,052.00
1 11/16	7.604		152.10	4 1/2	54.080		1,082.00
1 3/4	8.178	98.16	163.60	4 5/8	57.120		1,142.00
1 13/16	8.773	105.24	175.50	4 3/4	60.250		1,205.00
1 7/8	9.388	112.68	187.80	4 7/8	63.460		1,269.00
1 15/16	10.020		200.40	4 15/16	65.100		1,302.00
2"	10.680	128.16	213.60	5"	66.760		1,335.00
2 1/16	11.360		227.20	5 1/8	70.140		1,403.00
2 1/8	12.060		241.20	5 1/4	73.600		1,472.00
2 3/16	12.780		255.60	5 7/16	78.950		1,579.00
2 1/4	13.520	162.24	270.40	5 1/2	80.780		1,616.00
2 5/16	14.280		285.60	5 5/8	84.490		1,690.00
2 3/8	15.060		301.20	5 3/4	88.290		1,766.00
2 7/16	15.870		317.40	5 15/16	94.140		1,883.00
2 1/2	16.690	200.20	333.80	6"	96.130		1,923.00
2 9/16	17.530		350.60	6 1/4	104.300		2,086.00
2 5/8	18.400		368.00	6 7/16	110.700		2,214.00
2 11/16	19.290		385.80	6 1/2	112.800		2,256.00
2 3/4	20.200	242.28	404.00				

COLD FINISHED FLATS

C-1018 12' LENGTHS

Sizes in Stock	Weight Per Lin. Ft	Weight Per 12' Bar
1/8 x 1/4"	.106	1.27
5/16	. 133	1.59
3/8	.159	1.91
1/2	.213	2.55
5/8	.266	3.19
3/4	.319	3.83
7/8	.372	4.46
1	.425	5.10
1 1/8	.478	5.74
1 1/4	.531	6.37
1 1/2	.638	7.66
1 3/4	.744	8.93
2	.850	10.20
2 1/4	.956	11.47
2 1/2	1.063	12.76
2 3/4	1.169	14.03
3	1.275	15.30
3 1/2	1.488	17.86
4	1.700	20.40
4 1/2	1.913	22.96
5	2.125	25.50
6	2.550	30.60
3/16 x 1/4"	.160	1.92
5/16	.199	2.39
3/8	.239	2.87
7/16	.279	3.35
1/2	.319	3.83
5/8	.398	4.78
3/4	.478	5.74
7/8	.558	6.69
1	.638	7.65
1 1/8	.717	8.60
1 1/4	.797	9.56
1 1/2	.956	11.47
1 3/4	1.116	13.39
2	1.275	15.30
2 1/4	1.434	17.21
2 1/2	1.594	19.13
2 3/4	1.753	21.04
3	1.913	22.96
3 1/2	2.231	26.77
4	2.550	30.60
4 1/2	2.869	34.43
5	3.188	38.26
6	3.825	45.90

Sizes in Stock	Weight Per Lin. Ft.	Weight Per 12' Bar
1/4 x 5/16"	.266	3.19
3/8	.319	3.83
1/2	.425	5.10
9/16	.478	5.74
5/8	.531	6.37
3/4	.638	7.65
7/8	.744	8.93
1	.850	10.20
1 1/8	.956	11.47
1 1/4	1.063	12.76
1 1/2	1.275	15.30
1 5/8	1.381	16.57
1 3/4	1.488	17.86
2	1.700	20.40
2 1/4	1.913	22.96
2 1/2	2.125	25.50
2 3/4	2.338	28.06
3	2.550	30.60
3 1/4	2.763	33.16
3 1/2	2.975	35.70
4	3.400	40.80
4 1/2	3.825	45.90
5	4.250	51.00
5 1/2	4.675	56.10
6	5.100	61.20
8	6.800	81.60
10	8.500	102.00
12	10.200	122.40
5/16 X 3/8"	.398	4.78
1/2	.531	6.37
5/8	.664	7.97
3/4	.797	9.56
7/8	.930	11.16
1	1.063	12.76
1 1/8	1.195	14.34
1 1/4	1.328	15.94
1 1/2	1.594	19.13
1 3/4	1.859	22.31
2	2.125	25.50
2 1/4	2.391	28.69
2 1/2	2.656	31.87
2 3/4	2.922	35.06
3	3.188	38.26
3 1/2	3.719	44.63
4	4.250	51.00

COLD FINISHED FLATS (Continued)

Sizes In Stock	Weight Per Lin. Ft.	Weight Per 12' Bar
5/16 x 4 1/2	4.781	57.37
5	5.313	63.76
6	6.375	76.50
8	8.500	102.00
10	10.630	127.50
12	12.750	153.00
3/8 x 7/16	.588	6.70
1/2	.636	7.65
5/8	.797	9.56
3/4	.956	11.47
7/8	1.116	13.39
1	1.275	15.30
1 1/8	1.434	17.21
1 1/4	1.594	19.13
1 3/8	1.753	21.04
1 1/2	1.913	22.96
1 5/8	2.072	24.86
1 3/4	2.231	26.77
2	2.550	30.60
2 1/4	2.869	34.43
2 1/2	3.188	38.26
2 3/4	3.506	42.07
3	3.825	45.90
3 1/4	4.144	49.73
3 3/8	4.303	51.64
3 1/2	4.463	53 56
4	5.100	61.20
4 1/2	5.738	68.86
5	6.375	76.50
5 1/2	7.013	84.16
6	7.650	91.80
8	10.200	122.40
10	12.750	153.00
12	15.300	183.60
7/16 x 1/2	.744	8 93
5/8	.930	11.16
3/4	.116	13.39
1	1.488	17.86
1 1/4	1.859	22.31
1 1/2	2.231	26.77
1 3/4	2.603	31.24
2	2.975	35.70
2 1/2	3.719	44.63
3	4.463	53.56
3 1/2	5.206	62.47
4	5.950	71.40
5	7.438	89.26

Sizes in Stock	Weight Per Lin. Ft.	Weight Per 12' Bar
1/2 x 9/16	.970	11.64
5/8	1.063	12.76
3/4	1.275	15.30
7/8	1.488	17.86
1	1.700	20.40
1 1/8	1.913	22.96
1 1/4	2.125	25.50
1 1/2	2.550	30.60
1 3/4	2.975	35.70
2	3.400	40.80
2 1/4	3.825	45.90
2 1/2	4.250	51.00
2 3/4	4.675	56.10
3	5.100	61.20
3 1/4	5.525	66.30
3 1/2	5.950	71.40
4	6.800	81.60
4 1/4	7.224	86.69
4 1/2	7.650	91.80
5	8.500	102.00
5 1/2	9.350	112.20
6	10.200	122.40
8	13.600	163.20
10	17.000	204.00
12	20.400	244.80
5/8 x 3/4	1.594	19.13
7/8	1.859	22.31
1	2.125	25.50
1 1/8	2.391	28.69
1 1/4	2.656	31.87
1 1/2	3.188	38.26
1 3/4	3.719	44.63
2	4.250	51.00
2 1/4	4.781	57.37
2 1/2	5.313	63.76
2 3/4	5.844	70.13
3	6.375	76.50
3 1/4	6.906	82.87
3 1/2	7.438	89.26
4	8.500	102.00
4 1/2	9.563	114.80
5	10.630	127.60
5 1/2	11.690	140.36
6	12.750	153.00
8	17.000	204.00
10	21.250	255.00
12	25.500	306.00

COLD FINISHED FLATS(Continued)

C-1018 12' LENGTHS

Sizes in Stock	Weight Per Lin. Ft.	Weight Per 12' Bar
3/4 x 7/8	2.231	26.77
1	2.550	30.60
1 1/8	2.869	34.43
1 1/4	3.188	38.26
1 1/2	3.825	45.90
1 3/4	4.463	53.56
2	5.100	61.20
2 1/4	5.738	68.86
2 1/2	6.375	76.50
3	7.650	91.80
3 1/4	8.288	99.46
3 1/2	8.925	107.10
4	10.200	122.40
4 1/2	11.480	137.80
5	12.750	153.00
6	15.300	183.60
8	20.400	244.80
10	25.500	306.00
12	30.600	367.20
7/8 x 1	2.975	35.70
1 1/8	3.347	40.16
1 1/4	3.719	44.63
1 1/2	4.463	53.56
1 3/4	5.206	62.47
2	5.950	71.40
2 1/4	6.694	80.33
2 1/2	7.438	89.26
3	8.925	107.10
3 1/2	10.410	124.90
4	11.900	142.80
4 1/2	13.390	160.70
5	14.880	178.60
6	17.850	214.20
8	23.800	285.60
12	35.700	428.40
1 x 1 1/8	3.825	45.90
1 1/4	4.250	51.00
1 1/2	5.100	61.20
1 3/4	5.950	71.40
2	6.800	81.60
2 1/4	7.650	91.80
2 1/2	8.500	102.00
2 3/4	9.350	112.20
3	10.200	122.40
3 1/4	11.050	132.60
3 1/2	11.900	142.80
4	13.600	163.20

Sizes In Stock	Weight Per Lin.Ft.	Weight Per 12' Bar
1 x 4 1/2	15.300	183.60
5	17.000	204.00
6	20.400	244.80
8	27.200	326.40
10	34.000	408.00
12	40.800	489.60
1 1/8 x 1 1/4	4.781	57.37
1 1/2	5.738	68.86
2	7.650	91.80
2 1/2	9.562	114.74
3	11.470	137.64
1 1/4 x 1 1/2	6.375	76.50
1 3/4	7.438	89.26
2	8.500	102.00
2 1/4	9.563	114.80
2 1/2	10.630	127.60
2 3/4	11.690	140.30
3	12.750	153.00
3 1/2	14.880	178.60
4	17.000	204.00
4 1/2	19.130	229.60
5	21.250	255.00
6	25.500	306.00
8	34.000	408.00
10	42.500	510.00
12	51.000	612.00
1 1/2 x 1 3/4	8.925	107.10
2	10.200	122.40
2 1/4	11.480	137.80
2 1/2	12.750	153.00
3	15.300	183.60
3 1/2	17.850	214.20
4	20.400	244.80
4 1/2	22.950	275.40
5	25.500	306.00
6	30.600	367.20
8	40.800	489.60
10	51.000	612.00
12	61.200	734.40
1 3/4 x 2"	11.900	142.80
2 1/4	13.390	160.70
2 1/2	14.880	178.60
3	17.850	214.20
3 1/2	20.830	250.00
4	23.800	285.60

COLD FINISHED FLATS(Continued)

Sizes In Stock	Weight Per Lin. Ft.	Weight Per 12' Bar
1 3/4 x 4 1/2	26.780	321.40
5	29.750	357.00
6	35.700	428.40
2 x 2 1/4	15.300	183.60
2 1/2	17.000	204.00
3	20.400	244.80
3 1/2	23.800	285.60
4	27.200	326.40
4 1/2	30.600	367.20
5	34.000	408.00
6	40.800	489.60
8	54.400	652.80
12	81.600	979.20

Sizes in Stock	Weight Per Lin. Ft	Weight Per 12' Bar
2 1/2 x 3"	25.500	306.00
3 1/2	29.750	357.00
4	34.000	408.00
4 1/2	38.250	459.00
5	42.500	510.00
6	51.000	612.00
3 x 4"	40.800	489.60
4 1/2	45.900	550.80
5	51.000	612.00
6	61.200	734.40

COLD DRAWN SQUARES

C1018

Sizes In Stock	Weight Per Foot	Weight Per 12' Bar
1/8"	.053	.64
5/32	.083	1.00
3/16	.120	1.44
7/32	.163	1.96
1/4	.213	2.56
9/32	.269	3.24
5/16	.332	3.98
3/8	.478	5.74
7/16	.651	7.81
1/2	.850	10.20
9/16	1.076	12.91
5/8	1.328	15.94
11/16	1.607	19.28
3/4	1.912	22.94
13/16	2.244	26.93
7/8	2.603	31.24
15/16	2.988	35.86
1	3.400	40.80
1 1/16	3.838	46.06

Sizes in Stock	Weight Per Lin. Ft	Weight Per 12' Bar
1 1/8	4.303	51.64
1 3/16	4.795	57.54
1 1/4	5.313	63.76
1 5/16	5.857	70.28
1 3/8	6.428	77.16
1 7/16	7.026	84.31
1 1/2	7.650	91.80
1 5/8	8.978	107.74
1 3/4	10.410	124.92
1 7/8	11.960	143.52
2	13.600	163.20
2 1/4	17.210	206.52
2 1/2	21.250	255.00
2 3/4	25.710	308.52
2 7/8	28.100	337.20
3	30.600	367.20
3 1/2	41.650	499.80
3 3/4	47.810	573.70
4	54.400	652.80

SIZE TOLERANCES FOR COLD DRAWN CARBON STEEL BARS

Size in Inches	Maximum of Carbon Range 0.28% or Less	Maximum of Carbon Range Over 0.28% to 0.55% incl	Maximum of Carbon Range to 0.55% incl. Stress Relieved or Annealed After Cold Finishing	Maximum of Carbon Range Over 0.55% of All Grades Quenched and Tempered or Normalized Before Cold Finishing
	All tolerances are In inch and are minus			
		ROUNDS		
To 1 1/2 incl.	0.002	0.003	0.004	0.005
Over 1 1/2 to 2 1/2 incl.	0.003	0.004	0.005	0.006
Over 2 1/2 to 4 incl.	0.004	0.005	0.006	0.007
		HEXAGONS		
To 3/4 incl.	0.002	0.003	0.004	0.006
Over 3/4 to 1 1/2 incl.	0.003	0.004	0.005	0.007
Over 1 1/2 to 2 1/2 incl	0.004	0.005	0.006	0.008
Over 2 1/2 to 3 1/8 incl.	0.006	0.006	0.007	0.009
		SQUARES		
To 3/4 incl.	0.002	0.004	0.005	0.007
Over 3/4 to 1 1/2 incl.	0.003	0.005	0.006	0.008
Over 1 1/2 to 2 1/2 incl	0.004	0.006	0.007	0.009
Over 2 1/2 to 4 incl.	0.006	0.008	0.009	0.011
Width, In Inches				
		FLATS		
To 3/4 incl.	0.003	0.004	0.006	0.008
Over 3/4 to 1 1/2 incl.	0.004	0.005	0.008	0.010
Over 1 1/2 to 3 incl	0.005	0.006	0.010	0.012
Over 3 to 4 incl.	0.006	0.008	0.011	0.016
Over 4 to 6 incl	0.008	0.010	0.012	0.020
Over 6	0.013	0.015	--	--

SIZE TOLERANCES FOR TURNED AND POLISHED ROUND CARBON STEEL BARS

To 1 1/2 incl.	0.002	0.003	0.004	0.005
Over 1 1/2 to 2 1/2 incl.	0.003	0.004	0.005	0.006
Over 2 1/2 to 4 incl.	0.004	0.005	0.006	0.007
Over 4 to 6 incl.	0.005	0.006	0.007	0.008
Over 6 to 8 incl	0.006	0.007	0.008	0.009
Over 8 to 9 incl	0.007	0.008	0.009	0.010
Over 9	0.008	0.009	0.010	0.011

Note 1. The tolerances for flats apply to thickness as well as width for both cold drawn and rolled flats.

Note 2. Width governs the tolerances for both width and thickness of flats. For example: When the maximum of the carbon range is 0.28 percent or less, for a flat 2 in. wide and1 in. thick, the width tolerance is 0.006 in. and the thickness tolerance is the same, namely, 0.006 in.

Note 3. The size of a hexagon is the distance between opposite sides.

SIZE TOLERANCES* FOR TURNED, GROUNDED AND POLISHED ROUND CARBON STEEL BARS

Diameter, In Inches	Size Tolerance
	All tolerances are in inch and are minus
To 1 1/2 incl.	0.001
Over 1 1/2 to 2 1/2 excl.	0.0015
2 1/2 to 3 incl.	0.002
Over 3 to 4 incl.	0.003
Over 4 to 6 incl.	0.004*
Over 6	0.005*

*For nonresulfurized steels (steels specified to maximum sulfur limits under 0.08 percent) or for steels thermally treated, the tolerance is increased by 0.001 in.

STRAIGHTNESS TOLERANCES FOR COLD FINISHED BARS [A,B]

ASTM A29

Note: All grades quenched and tempered or normalized and tempered to Brinell 302 max before cold finishing; and all grades stress relieved or annealed after cold finishing. Straightness tolerances are not applicable to bars having Brinell hardness exceeding 302.

Size, in.	Length, ft.	Straightness Tolerances, in. (Maximum Deviation) from Straightness in any 10-ft. Portion of the Bar			
		Maximum of Carbon Range, 0.28% or Less"		Maximum of Carbon Range Over 0.28% and All Grades Thermally Treated	
		Rounds	Squares, Hexagons, & Octagons	Rounds	Squares, Hexagons, & Octagons
Less than 5/8	Less than 15	1/8	3/16	3/16	1/4
Less than 5/8	15 and over	1/8	5/16	5/16	3/8
5/8 and over	Less than 15	1/16	1/8	1/8	3/16
5/8 and over	15 and over	1/8	3/16	3/16	1/4

[A] The foregoing tolerance are based on the following method of measuring straightness: Departure from straightness is measured by placing the bar on a level table so that the arc or departure from straightness is horizontal, and the depth of the arc is measured with a feeler gauge and straightedge.

[B] It should be recognized that straightness is a perishable quality and may be altered by mishandling. The preservation of straightness in cold-finished bars requires the utmost care in subsequent handling. Specific straightness tolerances are sometimes required for carbon and alloy steels in which case the purchaser should inform the manufacturer of the straightness tolerances and the methods to be used in checking the straightness.

There are no published straightness tolerances for cold drawn flat bars.

TURNED GROUND AND POLISHED BARS

Turned ground and polished bars are the highest quality cold finished bars produced. There are no published straightness tolerances and each steel mill producer works to their own standards. An average straightness tolerances from these mills would be .004” maximum out-of-straight in 12” or .048” in any ten feet.

MACHINING ALLOWANCES

COLD DRAWN BARS

Cold drawn bars are produced from Special Bar Quality hot rolled bar which has a minimum of surface imperfections in comparison to Merchant Quality Bars. However, at times these bars can also have light seams, pits, small laps and slivers which cannot be eliminated then the hot rolled bars are cold drawn. Machining allowances have been established for minimum stock removal to produce a machined part with good surface quality. These allowances should be taken into consideration when ordering cold drawn bars. The machining allowances are set up for two steel categories: 1) plain carbon steels such as AISI 1018, 1045, etc., and 2) Resulfurized grades such as 12L14,1215,1144, etc. Resulfurized grades have high levels of iron-manganese-sulfide inclusions which promote good machinability. However, these steels will also have more seams and it is for this reason the machining allowance is greater for resulfurized steels.

SIZE RANGE (in)	MATERIAL	
	NON RESULFURIZED GRADES (in)	RESULFURIZED GRADES (in)
	Maximum Clean Up Cut	Maximum Clean Up Cut
Thru 5/8	.010 Per Side	.015 Per Side
Over 5/8	.001 Per Side for Each 1/16 of Diameter	.0015 Per Side for Each 1/16 of Diameter

CHROMEROD

DESCRIPTION

American Metals Corporation inventories precision ground chrome plated bars in a wide variety of grades and sizes. Chromerod eliminates the need for high cost piece by piece custom plating after machining. The main application for this product is hydraulic/pneumatic cylinder piston rods where a smooth surface and protection from rust is important. The corrosion resistance is greatly increased with the application of Corr-Guard* which is a compound applied to the surface of the hard chrome plated steel bars.
American Metals Corporation stocks various sizes in two strength levels and two plating thicknesses. All bars are packed in protective fiber tubes. Stock lengths are 20' and 24' with special lengths available for production runs. The two basic grades are chrome plated only and induction hardened chrome plated.
*™ LaSalle Steel, US Patent #4755191

SPECIFICATIONS

Symbol	Steel Grade	Min Yield Strength	Plating Thickness	Color Code
240	1045	CD properties	.0005/.0007"	green
300	1045/1050	100 KSI	.0005/.0007"	gold
450	1045/1050	100 KSI	.0010/.0015"	blue

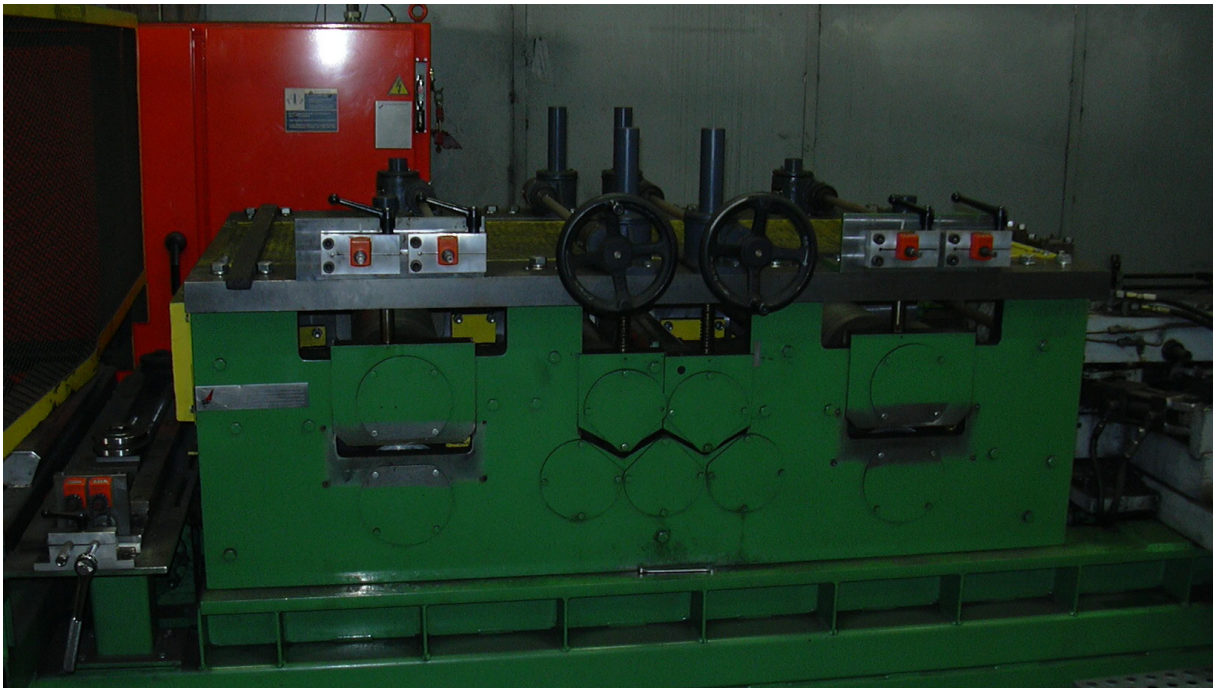
TOLERANCES

1 1/2 and under	.001
Over 1 1/2 to under 2 1/2	.0015
2 1/2 to 3	.002
Over 3 to 4	.003
Over 4	.005

INVENTORY

Size	Length	240 Green	300 Gold	450 Blue
1	20	x		
1 1/4	20	x		
1 1/2	20	x		
1 3/4	20	x		
2	20	x		
2 1/4	20		x	
2 1/2	24	x		x
3	20	x		x
3 1/2	20	x		
4	20	x		x

Ornamental & Structural Tubing



Custom sizes and lengths available from our bar mill

SECTION 7

ALLOY BARS

PRODUCT DESCRIPTION

AISI 4140[1]

HOT ROLLED ANNEALED
HOT ROLLED & HEAT TREATED
TURNED, GROUND & POLISHED

CHEMICAL ANALYSIS

C	Mn	Max P	Max S	Si	Cr	Mo
.38/.43	.75/1.00	.035	.040	.15/.30	.80/1.10	.15/.25

AISI 4140 steel is a medium carbon, chromium, molybdenum alloy steel widely used for machinery parts and shafting where higher mechanical strength levels are required that are not available in carbon steels. The annealed bars conform to ASTM A322, the hot rolled heat treated bars are in accordance to ASTM A434. Smaller diameters are available to ASTM A-193 Grade B7. Turned, ground and polished 4140 bars are produced at the mill to a 269-321 Brinell hardness range. These bars have a minus tolerance for bearings. It is possible to induction harden certain areas of the bar to an HRC 55-58 for needle bearings and bushings.

[1]4140 Annealed and 4140 Heat Treated are also available in some sizes as a rough turned and burnished bar free of surface defects and decarburization.

4340 ANNEALED
8620 AS ROLLED

CHEMICAL ANALYSIS

Grade	C	Mn	P	Max S	Max Si
4340	.37/.44	.55/.90	.035	.040	.15/.30
8620	.18/.23	.70/.90	.035	.040	.15/.30

Grade	Cr	Ni	Mo
4340	.65/.95	1.55/2.00	.20/.30
8620	.40/.60	.40/.70	.15/.25

AISI 4340 steel is considered an exceptionally tough alloy with high impact and torque strength. This chromium, nickel, molybdenum alloy is used on parts requiring maximum strength and toughness and has a working hardness range of 363-461 Brinell. Charpy V notch values are also high at temperatures to -150 degrees F.

AISI 8620 steel is the most widely used case hardening or carburizing alloy. The chromium, nickel, molybdenum alloying elements promote good control in heat treating to produce a case hardness of HRC 59-62 with a tough core for such applications as gears, cams and sliding machinery parts.

4340 annealed and 8620 also available in some sizes as a burnished bar which has a smooth rough turned surface free of surface defects and decarburization.

SIZE RANGE/ALLOY BARS

Sizes in Stock	Weight Per Foot	Weight Per 20' Bar	Sizes in Stock	Weight Per Foot	Weight Per 20' Bar
3/8"	.376	7.52	3"	24.030	480.60
7/16"	.511	10.22	3 1/8"	26.080	521.60
1/2"	.668	13.36	3 3/16"	27.130	542.60
9/16"	.845	16.90	3 1/4"	28.210	564.20
5/8"	1.043	20.86	3 3/8"	30.420	608.40
3/4"	1.502	30.04	3 7/16"	31.550	631.00
7/8"	2.044	40.88	3 1/2"	32.710	654.20
1 5/16"	2.347	46.94	3 5/8"	35.090	701.80
1"	2.670	53.40	3 3/4"	37.550	751.00
1 1/16"	3.015	60.30	3 7/8"	40.100	802.00
1 1/8"	3.379	67.58	3 15/16"	41.400	828.00
1 3/16"	3.766	75.32	4"	42.730	854.60
1 1/4"	4.172	83.44	4 1/4"	48.230	964.60
1 5/16"	4.600	92.00	4 7/16"	52.580	1,051.60
1 3/8"	5.049	100.98	4 1/2"	54.080	1,081.60
1 7/16"	5.518	110.36	4 3/4"	60.250	1,205.00
1 1/2"	6.008	120.16	4 7/8"	63.460	1,269.00
1 9/16"	6.519	130.38	4 15/16"	65.100	1,302.00
1 5/8"	7.051	141.02	5"	66.760	1,335.20
1 11/16"	7.604	152.08	5 1/4"	73.600	1,472.00
1 3/4"	8.178	163.56	5 1/2"	80.780	1,615.60
1 13/16"	8.772	175 44	5 3/4"	88.290	1,765.80
1 7/8"	9.388	187.76	6"	96.130	1,922.60
1 15/16"	10.020	200.40	6 1/4"	104.300	2,086.00
2"	10.680	213.60	6 1/2"	112.800	2,256.00
2 1/16"	11.360	227.20	6 3/4"	121.700	2,434 00
2 1/8"	12.060	241.20	7"	130.900	2,618.00
2 3/16"	12.780	255.60	7 1/4"	140.400	2,808.00
2 1/4"	13.520	270.40	7 1/2"	150 200	3,004 00
2 5/16"	14.280	285.60	7 3/4"	160.400	3,208.00
2 3/8"	15.060	301.20	8"	170.900	3,418.00
2 7/16"	15.870	317.40	8 1/4"	181.800	3,636.00
2 1/2"	16.690	333.80	8 1/2"	192.900	3,858.00
2 5/8"	18.400	368.00	9"	216.300	4,326.00
2 11/16"	19.290	385.80	9 1/2"	241.000	4,820.00
2 3/4"	20.190	403 80	10"	267.300	5,346.00
2 7/8"	22.070	441.40	11"	323.400	6,468.00
2 15/16	23.040	460.80	12"	387.900	7,698.00

ALLOWANCES FOR MACHINING ALLOY STEEL BARS

MACHINING ALLOWANCES

When ordering bars it is advisable to make adequate allowances for machining and to specify sizes accordingly.

These allowances require consideration of the manufacturing process, the length and size of bars, straightness, size tolerance and out-of-round tolerance.

In order to obtain a clean surface, free from any defects, and uniform surface hardness after heat treatment, it is advisable that the allowances made be adequate to permit an actual stock removal of not less than the amounts shown below:

HOT ROLLED BARS

Nominal Diameter of Bars in Inches	Minimum Stock Per Side Removal in Inches Alloy Bars
Up to 5/8 Incl.	.016
Over 5/8 to 7/8 Incl.	.021
Over 7/8 to 1 incl.	.023
Over 1 to 1 1/8 incl	.025
Over 1 1/8 to 1 1/4 incl.	.028
Over 1 1/4 to 1 3/8 incl.	.030
Over 1 3/8 to 1 1/2 incl.	.033
Over 1 1/2 to 2 incl.	.042
Over 2 to 2 1/2 incl.	.052
Over 2 1/2 to 3 1/2 incl.	.072
Over 3 1/2 to 4 1/2 incl.	.090
Over 4 1/2 to 5 1/2 incl.	.110
Over 5 1/2 to 6 1/2 incl.	.125
Over 6 1/2 to 8 1/4 incl.	.155
Over 8 1/4 to 9 1/2 incl.	.203

HOT ROLLED AND COLD DRAWN ALLOY BARS
SUBJECT TO MAGNETIC PARTICLE (MAGNAFLUX) INSPECTION

HOT ROLLED Nominal Diameter of Bars in inches	MINIMUM STOCK Removal From Surface in Inches	COLD DRAWN Nominal Diameter of Bars in Inches
Up to 1/2 incl.	.030	Up to 7/16 incl.
Over 1/2 to 3/4 incl.	.045	Over 7/16 to 11/16 incl.
Over 3/4 to 1 incl.	.060	Over 11/16 to 15/16 incl.
Over 1 to 1 1/2 incl.	.075	Over 15/16 to 17/16 incl.
Over 1 1/2 to 2 incl.	.090	Over 1 7/16 to 1 15/16 incl.
Over 2 to 2 1/2 incl.	.125	Over 1 15/16 to 2 7/16 incl.
Over 2 1/2 to 3 1/2 incl.	.156	Over 2 7/16 to 3 3/8 incl.
Over 3 1/2 to 4 1/2 incl.	.187	Over 3 3/8 to 4 3/8 incl.
Over 4 1/2 to 6 incl.	.250	-

TOLERANCES

HOT ROLLED ALLOY BARS, ROUNDS

Specified Sizes, in.	Size Tolerances, Inch		Out-of-Round Section, in.
	Over	Under	
To 5/16 incl.	0.005	0.005	0.008
Over 5/16 to 7/16 incl.	0.006	0.006	0.009
Over 7/16 to 5/8 incl.	0.007	0.007	0.010
Over 5/8 to 7/8 incl.	0.008	0.008	0.012
Over 7/8 to 1 incl.	0.009	0.009	0.013
Over 1 to 1 1/8 incl.	0.010	0.010	0.015
Over 1 1/8 to 1 1/4 incl.	0.011	0.011	0.016
Over 1 1/4 to 1 3/8 incl.	0.012	0.012	0.018
Over 1 3/8 to 1 1/2 incl.	0.014	0.014	0.021
Over 1 1/2 to 2 incl.	1/64	1/64	0.023
Over 2 to 2 1/2 incl.	1/32	0	0.023
Over 2 1/2 to 3 1/2 incl	3/64	0	0.035
Over 3 1/2 to 4 1/2 incl.	1/16	0	0.046
Over 4 1/2 to 5 1/2 incl.	5/64	0	0.058
Over 5 1/2 to 6 1/2 incl.	1/8	0	0.070
Over 6 1/2 to 8 1/4 incl.	5/32	0	0.085
Over 8 1/4 to 9 1/2 incl.	3/16	0	0.100

Out-of-round is the difference between the maximum and minimum diameters of the bar, measured at the same cross section.

Out-of-square is the difference in the two dimensions at the same cross section of a square bar, each dimension being the distance between opposite sides.

Straightness tolerance 1/4" in 5'.

ALLOY STEEL BARS

TURNED, GROUND AND POLISHED

DIAMETER TOLERANCES

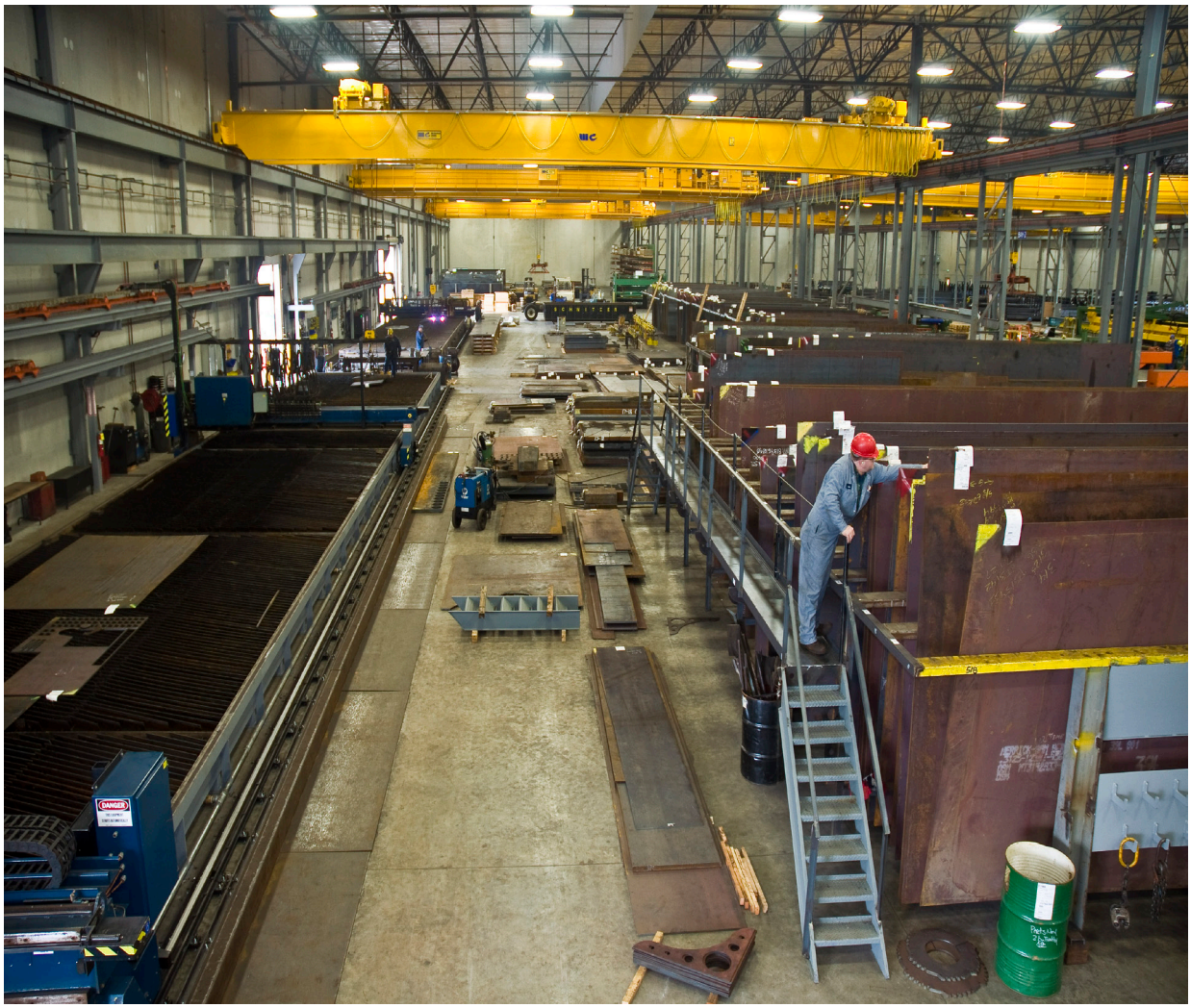
Diameter range In Inches	Not heat treated, all carbons	Heat treated*, all carbons
To 1 1/2 incl.	0 001	0.001
Over 1 1/2 to 2 1/2 excl.	0.0015	0.0015
Over 2 1/2 3 to incl.	0.002	0.002
Over 3 to 4 incl.	0.003	0.003
Over 4 to 6 incl.	0.004	0.005
Over 6	0.005	0.006

*Applies to quenched and tempered (heat treated), normalized and tempered, or any similar double treatment prior to turning.

STRAIGHTNESS TOLERANCES

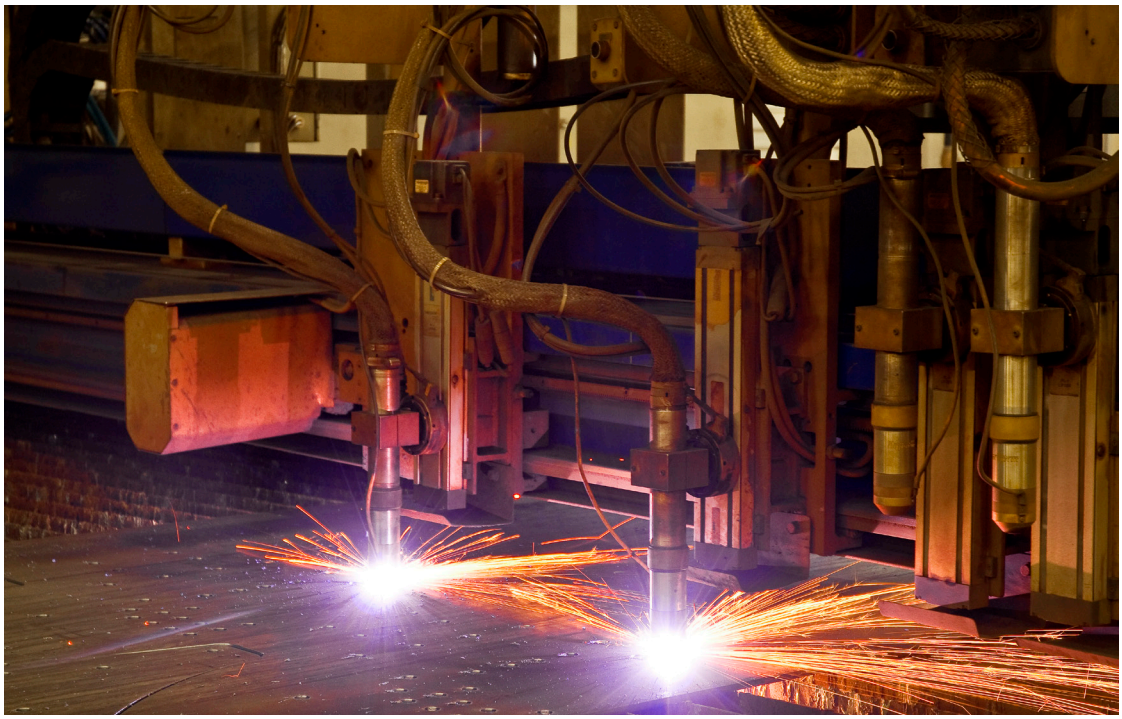
TURNED GROUND AND POLISHED BARS

Turned ground and polished bars are the highest quality cold finished bars produced. There are no published straightness tolerances and each steel mill producer works to their own standards. An average straightness tolerance from these mills would be .004" maximum out-of-straight in 12" or .048" in any ten feet.



Canby Plate Burning Facility

Plate Coil Processing Center



One of several MG burning machines with plasma capabilities

SECTION 8

TUBING AND PIPE

PRODUCT DESCRIPTION

Tubular products are variously designated as pipe, tubes and tubing and are used for conveying gases, liquids and solids and for a diversity of mechanical and structural purposes. The product descriptions are used interchangeably and there are no easy rules for distinguishing between the usages of the general terms pipe, tubes and tubing. Therefore it is possible to use the word tubing for seamless tubing and welded tubing. Basically the process or processes employed in the production of steel pipe are the same as those used in producing round tubes. Pipe, as distinguished from tubes, is commonly produced in greater quantities and in relatively few standard sizes. Tubing is generally made in smaller quantities to more exacting specifications for dimensions, finish, chemical composition and mechanical properties as required by specific end users.

Some ASTM specifications for the various products are as follows:

ASTM A53
PIPE, STEEL, BLACK AND HOT-DIPPED, ZINC-COATED WELDED AND SEAMLESS

This specification covers seamless and welded black and hot dipped galvanized steel pipe in NPS 1/8 to 26. NPS designates nominal pipe size and is substituted in place of nominal diameter, size and nominal size. Type E pipe is electric resistance welded available in Grades A and B. Pipe ordered under this specification is suitable for welding and suitable for forming operations involving coiling, bending and flanging. This pipe is hydrostatic tested.

ASTM A135
ELECTRIC RESISTANCE STEEL PIPE

This specification covers electric resistance welded carbon and alloy steel tubing intended for conveying liquid, gas, or vapor. The tubing can be produced from hot rolled or cold rolled steel. This pipe is hydrostatic tested.

ASTM A 500
COLD-FORMED WELDED AND SEAMLESS STRUCTURAL TUBING ROUNDS AND SHAPES

This specification covers cold-formed welded and seamless carbon steel round, square, rectangular and special shape structural tubing for welded, riveted or bolted construction of bridges and buildings for general structural purposes. This product is available in Grade B with guaranteed mechanical properties.

ASTM A513
ELECTRIC-RESISTANCE-WELDED CARBON AND ALLOY STEEL MECHANICAL TUBING

This specification covers electric resistance welded carbon and alloy steel tubing for use as mechanical tubing. The tubing can be produced from hot rolled or cold rolled sheet steel and is produced in round, square, rectangular, and special shape tubing. The product is produced either as-welded or drawn over mandrel.

PRODUCT DESCRIPTION (Continued)
ASTM A519

SEAMLESS CARBON AND ALLOY STEEL MECHANICAL TUBING

Covers carbon and alloy steel mechanical tube manufactured by the seamless process by hot piercing and extruding a steel billet and finish rolling to size on specialized steel mill equipment. Seamless tubing is available as hot rolled, cold drawn or honed.

COMMONLY USED PIPE AND TUBE CODES

AWCS	As- Welded from Cold Rolled Steel
AWHR	As- Welded from Hot Rolled Steel
CDS	Cold Drawn Seamless
DOM	Drawn Over Mandrel also MD
EW	Nominal Pipe Size
NPS	Nominal Pipe Size
STD*	Standard Strength for Pipe
XS*	Extra Strength for Pipe
XXS*	Double Extra Strength for Pipe
Sched No.	Wall thickness or weight per foot

*weight classes

Production sawing

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING

SPECIFICATIONS:

ASTM A-519 CDS 1018/1026

ASTM A-513 DOM 1020/1026

ASTM A-513 ERW LOW CARBON

Size	Wall	Theor. I.D.	Type	Wt. per Ft.
1/8" O.D.	.020	.085	CDS	.022
	.028	.069	CDS	.029
	.035	.055	CDS	.033
5/32" O.D.	.028	.100	CDS	.033
3/16" O.D.	.022	.144	CDS	.039
	.028	.131	CDS	.047
	.035	.188	CDS	.057
	.049	.090	CDS	.072
	.065	.058	CDS	.086
1/4" O. D.	.028	.194	CDS	.066
	.035	.180	CDS	.080
	.035	.180	EW	.080
	.049	.152	CDS	.105
	.049	.152	EW	.105
	.058	.134	CDS	.118
	.065	.120	CDS	.128
	.065	.120	EW	.128
	.083	.084	CDS	.148
	.095	.060	CDS	.157
5/16" O. D.	.028	.257	CDS	.085
	.035	.243	CDS	.103
	.049	.214	CDS	.138
	.058	.196	CDS	.158
	.065	.182	CDS	.172
	.083	.147	CDS	.203
	.095	.122	CDS	.221
	.109	.095	CDS	.237
	.120	.072	CDS	.247
3/8" O. D.	.028	.319	CDS	.103
	.028	.319	EW	.103
	.035	.305	CDS	.127
	.035	.305	EW	.127
	.049	.277	CDS	.170
	.049	.277	EW	.170
	.058	.259	CDS	.196
	.065	.245	CDS	.215
	.065	.245	EW	.215
	.083	.209	CDS	.258
	.083	.209	EW	.258
	.095	.185	CDS	.284
	.109	.157	CDS	.309
	.120	.135	CDS	.327

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D.	Type	Wt. per Ft.
7/16" O. D.	.028	.381	CDS	.122
	.035	.367	CDS	.150
	.049	.340	CDS	.203
	.058	.322	CDS	.235
	.065	.307	CDS	.258
	.083	.272	CDS	.314
	.095	.248	CDS	.348
	.120	.197	CDS	.407
1/2" O. D.	.028	.444	CDS	.141
	.035	.430	CDS	.173
	.035	.430	EW	.173
	.049	.402	CDS	.236
	.049	.402	EW	.236
	.058	.384	CDS	.273
	.065	.370	CDS	.302
	.065	.370	EW	.302
	.083	.334	CDS	.369
	.083	.334	EW	.369
	.095	.310	CDS	.410
	.109	.282	CDS	.455
	.120	.260	CDS	.487
	.134	.232	CDS	.523
	.156	.187	CDS	.572
	.188	.124	CDS	.626
9/16" O. D.	.028	.506	CDS	.160
	.035	.493	CDS	.197
	.049	.269	CDS	.269
	.058	.447	CDS	.310
	.065	.432	CDS	.345
	.083	.397	CDS	.425
	.095	.374	CDS	.474
	.109	.344	CDS	.528
	.120	.323	CDS	.567
	.156	.251	CDS	.678
5/8" O. D.	.028	.569	CDS	.178
	.035	.555	CDS	.220
	.035	.555	EW	.220
	.049	.527	CDS	.301
	.049	.527	EW	.301
	.058	.509	CDS	.351
	.065	.495	CDS	.388
	.065	.495	EW	.388
	.083	.459	CDS	.480
	.083	.459	EW	.480
	.095	.435	CDS	.537
	.095	.435	EW	.537
	.109	.407	CDS	.600
	.120	.385	CDS	.647
	.134	.357	CDS	.702
	.156	.312	CDS	.781
	.188	.250	CDS	.877

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D.	Type	Wt. per Ft.
11/16" O. D.	.035	.618	CDS	.264
	.049	.589	CDS	.334
	.065	.557	CDS	.432
	.083	.521	CDS	.536
	.095	.497	CDS	.601
	.109	.456	CDS	.674
	.120	.447	CDS	.727
	.156	.375	CDS	.886
	.188	.312	CDS	1.004
3/4" O. D.	.035	.680	CDS	.267
	.035	.680	EW	.267
	.049	.652	CDS	.366
	.049	.652	EW	.366
	.058	.634	CDS	.428
	.065	.620	CDS	.475
	.065	.620	EW	.475
	.083	.584	CDS	.591
	.083	.584	EW	.591
	.095	.560	CDS	.664
	.095	.560	EW	.664
	.109	.532	CDS	.746
	.109	.532	EW	.746
	.120	.510	CDS	.807
	.120	.510	EW	.807
	.134	.482	CDS	.881
	.156	.437	CDS	.989
	.188	.375	CDS	1.128
	.219	.312	CDS	1.242
	.250	.250	CDS	1.335
13/16" O. D.	.035	.745	CDS	.290
	.049	.714	CDS	.399
	.065	.683	CDS	.519
	.083	.646	CDS	.677
	.095	.622	CDS	.728
	.120	.572	CDS	.888
	.156	.500	CDS	1.095
	.188	.437	CDS	1.225
7/8" O. D.	.028	.819	CDS	.253
	.035	.805	CDS	.314
	.035	.805	EW	.314
	.049	.777	CDS	.432
	.049	.777	EW	.432
	.058	.759	CDS	.506
	.065	.745	CDS	.562
	.065	.745	EW	.562
	.083	.709	CDS	.702
	.083	.709	EW	.702
	.095	.685	CDS	.791
	.095	.685	EW	.791
	.109	.657	CDS	.891
	.109	.657	EW	.891

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I. D.	Type	Wt. per Ft.
7/8" O. D.	.120	.635	CDS	.967
	.120	.635	EW	.967
	.134	.607	CDS	1.060
	.134	.607	EW	1.060
	.156	.562	CDS	1.198
	.188	.500	CDS	1.379
	.219	.437	CDS	1.534
	.250	.375	CDS	1.669
	.281	.313	CDS	1.783
	.313	.250	CDS	1.879
15/16" O. D.	.035	.868	CDS	.338
	.049	.840	CDS	.465
	.065	.808	CDS	.606
	.083	.772	CDS	.758
	.095	.748	CDS	.855
	.120	.697	CDS	1.085
	.134	.670	CDS	1.151
	.156	.625	CDS	1.303
1" O. D.	.028	.944	CDS	.290
	.035	.930	CDS	.360
	.035	.930	EW	360
	.049	.902	CDS	.497
	.049	.902	EW	.497
	.058	.884	CDS	.583
	.065	.870	CDS	.649
	.065	.870	EW	.649
	.072	.856	EW	.713
	.083	.834	CDS	.812
	.083	.834	EW	.812
	.095	.810	CDS	.918
	.095	.810	EW	.918
	.109	.782	CDS	1.037
	.109	.782	EW	1.037
	.120	.760	CDS	1.128
	.120	.760	EW	1.128
	.134	.732	CDS	1.239
	.134	.732	EW	1.239
	.156	.687	CDS	1.406
	.188	.625	CDS	1.630
	.219	.562	CDS	1.827
	.250	.500	CDS	2.003
	.281	.438	CDS	2.158
	.313	.375	CDS	2.297
	.375	.250	CDS	2.503
1 1/16" O. D.	.035	.992	CDS	.384
	.065	.932	CDS	.692
	.065	.932	EW	.692
	.083	.897	CDS	.868
	.095	.872	CDS	.982
	.120	.823	CDS	1.209
	.188	.687	CDS	1.757

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I. D.	Type	Wt. per Ft.
1 1/16" O. D.	.219	.625	CDS	1.974
	.250	.562	CDS	2.171
1 1/8" O. D.	.035	1.055	CDS	.407
	.035	1.055	EW	.407
	.049	1.027	CDS	.563
	.049	1.027	EW	.563
	.058	1.009	CDS	.660
	.065	.995	CDS	.735
	.065	.995	EW	.735
	.083	.959	CDS	.923
	.083	.959	EW	.923
	.095	.935	CDS	1.045
	.095	.935	EW	1.045
	.109	.907	CDS	1.183
	.109	.907	EW	1.183
	.120	.885	CDS	1.288
	.120	.885	EW	1.288
	.134	.857	EW	1.418
	.156	.812	CDS	1.614
	.188	.750	CDS	1.881
	.219	.688	CDS	2.119
	.250	.625	CDS	2.336
	.281	.563	CDS	2.533
	.313	.500	CDS	2.714
	.375	.375	CDS	3.004
1 3/16" O. D.	.065	1.057	CDS	.779
	.083	1.022	CDS	.979
	.095	.997	CDS	1.109
	.120	.947	CDS	1.368
	.156	.876	CDS	1.719
	.188	.812	CDS	2.008
	.250	.687	CDS	2.504
	.313	.562	CDS	2.925
1 1/4" O. D.	.035	1.180	CDS	.454
	035	1.180	EW	.454
	.049	1.152	CDS	.628
	.049	1.152	EW	.628
	.065	1.120	CDS	.822
	.065	1.120	EW	.822
	.083	1.084	CDS	1.034
	.083	1.084	EW	1.034
	.095	1.060	CDS	1.172
	.095	1.060	EW	1.172
	.109	1.032	CDS	1.328
	.109	1.032	EW	1.328
	.120	1.010	CDS	1.448
	.120	1.010	EW	1.448
	.134	.982	EW	1.597
	.156	.937	CDS	1.823
	.188	.875	CDS	2.132
	.219	.812	CDS	2.411

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I. D.	Type	Wt. per Ft.
1 1 /4" O. D.	.250	.750	CDS	2.670
	.281	.687	CDS	2.908
	.313	.625	CDS	3.132
	.375	.500	CDS	3.504
	.438	.375	CDS	3.798
1 5/16" O. D.	.065	1.182	CDS	.866
	.065	1.182	EW	.866
	.095	1.123	CDS	1.236
	.095	1.123	EW	1.236
	.120	1.072	CDS	1.529
	.134	1.072	CDS	1.928
	.156	1.000	CDS	1.928
	.188	.938	CDS	2.259
	.219	.875	CDS	2.259
	.250	.813	CDS	2.839
	.281	.750	CDS	3.097
	.313	.688	CDS	3.343
	.375	.562	CDS	3.757
1 3/8" O. D.	.035	1.305	CDS	.500
	.049	1.277	EW	.693
	.065	1.245	CDS	.909
	.065	1.245	EW	.909
	.083	1.209	CDS	1.145
	.083	1.209	EW	1.145
	.095	1.185	CDS	1.299
	.095	1.185	EW	1.299
	.109	1.157	CDS	1.473
	.120	1.135	CDS	1.608
	.120	1.135	EW	1.608
	.134	1.107	CDS	1.776
1 3/8" O. D.	.134	1.107	EW	1.776
	.156	1.062	CDS	2.031
	.188	1.000	CDS	2.383
	.188	1.000	EW	2.383
	.219	.938	CDS	2.704
	.250	.875	CDS	3.004
	.281	.813	CDS	3.283
	.313	.750	CDS	3.550
	.375	.625	CDS	4.005
1 7/16" O. D.	.065	1.307	CDS	.953
	.120	1.198	CDS	1.689
	.156	1.125	CDS	2.136
	.188	1.062	CDS	2.510
	.219	1.000	CDS	2.851
	.250	.938	CDS	3.172
1 1/2" O. D.	.028	1.444	CDS	.440
	.035	1.430	CDS	.547
	.035	1.430	EW	.547
	.049	1.402	CDS	.759
	.049	1.402	EW	.759
	.065	1.370	EW	.996

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I. D.	Type	Wt. per Ft.
1 1/2" O. D.	.083	1.334	CDS	1.256
	.083	1.334	EW	1.256
	.095	1.310	CDS	1.426
	.095	1.310	EW	1.426
	.109	1.282	CDS	1.619
	.109	1.282	EW	1.619
	.120	1.260	CDS	1.769
	.120	1.260	EW	1.769
	.134	1.232	CDS	1.955
	.134	1.232	EW	1.955
	.156	1.188	CDS	2.239
	.188	1.125	CDS	2.634
	.188	1.125	EW	2.634
	.219	1.062	CDS	2.996
	.250	1.000	CDS	3.338
	.281	.938	CDS	3.658
	.313	.875	CDS	3.968
	.375	.750	CDS	4.506
	.438	.625	CDS	4.928
	.500	.500	CDS	5.340
1 9/16" O. D.	.035	1.493	CDS	.571
	.095	1.373	CDS	1.489
	.120	1.323	CDS	1.849
	.156	1.250	CDS	2.344
	.188	1.187	CDS	2.716
	.250	1.062	CDS	3.506
	.313	.936	CDS	4.179
1 5/8" O. D.	.035	1.555	EW	.593
	.049	1.527	EW	.824
	.065	1.495	CDS	1.083
	.065	1.495	EW	1.083
	.095	1.435	CDS	1.552
	.095	1.435	EW	1.552
	.120	1.385	CDS	1.929
	.120	1.385	EW	1.929
	.134	1.385	CDS	2.132
	.134	1.385	EW	2.132
	.156	1.313	CDS	2.447
	.188	1.250	CDS	2.885
	.188	1.250	EW	2.885
	.219	1.187	CDS	3.289
	.250	1.125	CDS	3.671
	.281	1.063	CDS	4.033
	.313	1.000	CDS	4.386
	.375	.875	CDS	5.006
	.438	.750	CDS	5.553
	.500	.625	CDS	6.008
1 3/4" O. D.	.035	1.680	EW	.641
	.049	1.625	EW	.890
	.065	1.620	CDS	1.170
	.065	1.620	EW	1.170

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I. D.	Type	Wt. per Ft.
1 3/4" O. D.	.083	1.584	CDS	1.478
	.083	1.584	EW	1.478
	.095	1.560	CDS	1.679
	.095	1.560	EW	1.679
	.120	1.510	CDS	2.089
	.120	1.510	EW	2.089
	.134	1.482	CDS	2.313
	.156	1.438	CDS	2.656
	.188	1.375	CDS	3.136
	.188	1.375	EW	3.136
	.219	1.312	CDS	3.581
	.250	1.250	CDS	4.005
	.281	1.188	CDS	4.409
	.313	1.125	CDS	4.804
	.375	1.000	CDS	5.510
	.438	.875	CDS	6.137
	.500	.750	CDS	6.675
	.563	.624	CDS	7.137
1 7/8" O. D.	.035	1.805	EW	.687
	.049	1.777	EW	.955
	.065	1.745	CDS	1.257
	.065	1.745	EW	1.257
	.095	1.685	CDS	1.806
	.120	1.635	CDS	2.249
	.120	1.635	EW	2.249
	.156	1.563	CDS	2.864
	.188	1.500	CDS	3.387
	.188	1.500	EW	3.387
	.219	1.438	CDS	3.873
	.250	1.375	CDS	4.339
1 7/8" O. D.	.281	1.313	CDS	4.784
	.313	1.250	CDS	5.222
	.375	1.125	CDS	6.008
	.438	1.000	CDS	6.722
	.500	.875	CDS	7.343
2" O. D.	.035	1.930	EW	.734
	.049	1.902	CDS	1.021
	.049	1.902	EW	1.021
	.065	1.870	CDS	1.343
	.065	1.870	EW	1.343
	.083	1.834	CDS	1.699
	.083	1.834	EW	1.699
	.095	1.810	CDS	1.933
	.095	1.810	EW	1.933
	.109	1.782	CDS	2.201
	.109	1.782	EW	2.201
	.120	1.760	CDS	2.409
	.120	1.760	EW	2.409
	.134	1.732	CDS	2.670
	.134	1.732	EW	2.670
	.156	1.687	CDS	3.072

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D.	Type	Wt. per Ft.
2” O.D.	.188	1.625	CDS	3.638
	.188	1.625	EW	3.638
	.219	1.562	CDS	4.166
	.250	1.500	CDS	4.673
	.281	1.438	CDS	5.159
	.313	1.375	CDS	5.639
	.375	1.250	CDS	6.508
	.438	1.125	CDS	7.307
	.500	1.000	CDS	8.010
	.563	.874	CDS	8.649
	.625	.750	CDS	9.178
	.750	.500	CDS	10.010
2 1/8” O.D.	.049	2.027	DOM	1.086
	.065	1.995	DOM	1.430
	.065	1.995	EW	1.430
	.095	1.935	DOM	2.060
	.125	1.875	DOM	2.670
	.156	1.813	DOM	3.281
	.188	1.750	DOM	3.889
	.219	1.687	DOM	4.458
	.250	1.625	DOM	5.006
	.281	1.563	DOM	5.534
	.313	1.500	DOM	6.057
	.375	1.375	CDS	7.009
	.438	1.250	CDS	7.892
	.500	1.125	CDS	8.678
	.563	1.000	CDS	9.392
	.625	.875	CDS	10.010
2 1/4” O.D.	.035	2.180	DOM	.828
	.049	2.152	EW	1.152
	.065	2.120	DOM	1.517
	.065	2.120	EW	1.517
	.083	2.084	DOM	1.921
	.095	2.060	DOM	2.186
	.095	2.060	EW	2.186
	.120	2.010	EW	2.730
	.125	2.000	DOM	2.837
	.156	1.937	DOM	3.489
	.188	1.875	DOM	4.140
	.219	1.813	DOM	4.750
	.250	1.750	DOM	5.340
	.313	1.625	DOM	6.475
	.375	1.500	CDS	7.509
	.438	1.375	CDS	8.476
	.500	1.250	CDS	9.345
	.563	1.125	CDS	10.140
	.625	1.000	CDS	10.850
	.750	.750	CDS	12.020

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D.	Type	Wt. per Ft.
2 3/8" O.D.	.120	2.135	EW	2.890
	.156	2.063	DOM	3.697
	.188	2.000	DOM	4.391
	.219	1.938	DOM	5.043
	.250	1.875	DOM	5.674
	.281	1.813	CDS	6.284
	.313	1.750	DOM	6.893
	.375	1.625	CDS	8.010
	.438	1.500	CDS	9.061
	.500	1.375	CDS	10.010
	.563	1.249	CDS	10.900
	.625	1.125	CDS	11.680
2 1/2" O.D.	.035	2.430	EW	.922
	.049	2.402	EW	1.283
	.065	2.370	DOM	1.690
	.065	2.370	EW	1.690
	.083	2.334	DOM	2.143
	.083	2.334	EW	2.143
	.095	2.310	EW	2.440
	.095	2.310	DOM	2.440
	.120	2.260	EW	3.050
	.125	2.250	DOM	3.171
	.134	2.250	DOM	3.385
	.156	2.187	DOM	3.905
	.188	2.125	DOM	4.642
	.219	2.062	DOM	5.335
	.250	2.000	DOM	6.008
	.313	1.875	DOM	7.311
	.375	1.750	DOM	8.511
	.438	1.625	CDS	9.646
	.500	1.500	CDS	10.680
	.563	1.375	CDS	11.650
	.625	1.250	CDS	12.520
	.750	1.000	CDS	14.020
2 5/8" O.D.	.065	2.495	EW	1.777
	.065	2.495	DOM	1.777
	.095	2.435	DOM	2.567
	.095	2.435	EW	2.567
	.125	2.375	DOM	3.338
	.156	2.313	DOM	4.114
	.188	2.250	DOM	4.893
	.219	2.187	DOM	5.627
	.250	2.125	DOM	6.341
	.281	2.063	DOM	7.035
	.313	2.000	DOM	7.729
	.375	1.875	CDS	9.011
	.438	1.751	CDS	10.230
	.500	1.625	CDS	11.350
	.625	1.375	CDS	13.350
	.750	1.750	CDS	15.018

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D.	Type	Wt. per Ft
2 3/4" O.D.	.049	2.652	EW	1.413
	.065	2.620	DOM	1.864
	.065	2.620	EW	1.864
	.083	2.584	DOM	2.364
	.083	2.584	EW	2.364
	.095	2.560	EW	2.699
	.095	2.560	DOM	2.699
	.120	2.510	EW	3.371
	.125	2.500	DOM	3.504
	.156	2.438	DOM	4.322
	.188	2.375	DOM	5.144
	.219	2.312	DOM	5.920
	.250	2.250	DOM	6.675
	.313	2.125	DOM	8.147
	.375	2.000	CDS	9.512
	.438	1.875	CDS	10.820
	.500	1.750	CDS	12.020
	.563	1.625	CDS	13.150
	.625	1.500	CDS	14.180
	.750	1.250	CDS	16.020
	.875	1.000	CDS	17.521
2 7/8" O.D.	.065	2.745	DOM	1.951
	.065	2.745	EW	1.951
	.120	2.635	EW	3.671
	.125	2.625	DOM	3.671
	.156	2.563	DOM	4.530
	.188	2.500	DOM	5.395
	.219	2.437	DOM	6.212
	.250	2.375	DOM	7.009
	.281	2.313	CDS	7.785
	.313	2.250	CDS	8.564
	.375	2.125	CDS	10.010
	.438	2.000	CDS	11.400
	.500	1.875	CDS	12.680
	.563	1.751	CDS	13.900
	.625	1.625	CDS	15.020
	.750	1.375	CDS	17.020
3" O.D.	.049	2.902	DOM	1.544
	.049	2.902	EW	1.544
	.065	2.870	DOM	2.037
	.065	2.870	EW	2.037
	.075	2.850	EW	2.342
	.083	2.834	EW	2.586
	.083	2.834	DOM	2.586
	.095	2.810	DOM	2.947
	.095	2.810	EW	2.947
	.109	2.782	EW	3.365
	.120	2.760	CDS	3.691
	.120	2.760	EW	3.691
	.125	2.750	DOM	3.838

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D.	Type	Wt. per Ft.
3” O.D.	.134	2.732	DOM	4.102
	.134	2.732	EW	4.102
	.156	2.688	DOM	4.739
	.188	2.625	DOM	5.646
	.219	2.562	DOM	6.505
	.250	2.500	DOM	7.342
	.250	2.500	EW	7.342
	.281	2.437	DOM	8.160
	.313	2.375	DOM	8.982
	.375	2.250	DOM	10.510
	.438	2.125	CDS	11.980
	.500	2.000	CDS	13.350
	.563	1.875	CDS	14.650
	.625	1.750	CDS	15.850
	.750	1.500	CDS	18.020
	.875	1.250	CDS	19.860
	1.000	1.000	CDS	21.360
3 1/8” O.D.	.065	2.995	DOM	2.124
	.095	2.935	DOM	3.074
	.125	2.875	DOM	4.008
	.188	2.750	DOM	5.897
	.219	2.687	DOM	6.797
	.250	2.625	DOM	7.676
	.281	2.563	DOM	8.535
	.313	2.499	DOM	9.400
	.375	2.375	DOM	11.010
	.438	2.250	CDS	12.570
	.500	2.125	CDS	14.020
	.563	1.999	CDS	15.400
	.625	1.875	CDS	16.690
3 1/4” O.D.	.065	3.120	DOM	2.211
	.065	3.120	EW	2.211
	.095	3.060	DOM	3.201
	.125	3.000	DOM	4.172
	.156	2.938	DOM	5.155
	.188	2.875	DOM	6.148
	.219	2.813	DOM	7.089
	.250	2.750	DOM	8.010
	.313	2.615	DOM	9.818
	.375	2.500	DOM	11.510
	.438	2.374	CDS	13.150
	.500	2.250	CDS	14.690
	.563	2.125	CDS	16.160
	.625	2.000	CDS	17.520
	.750	1.750	CDS	20.030
	.875	1.500	CDS	22.190
	1.000	1.250	CDS	24.030
3 3/8” O.D.	.188	3.000	DOM	6.399
	.250	2.875	DOM	8.344
	.313	.750	DOM	10.240
	.375	2.625	DOM	12.020

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D.	Type	Wt. per Ft.
3 3/8" O.D.	.438	2.500	CDS	13.740
	.500	2.375	CDS	15.350
	.625	2.125	CDS	18.360
	.750	1.875	CDS	21.030
3 1/2" O.D.	.049	3.402	EW	1.806
	.065	3.370	DOM	2.385
	.065	3.370	EW	2.385
	.075	3.350	EW	2.742
	.083	3.334	DOM	3.029
	.083	3.334	EW	3.029
	.095	3.310	DOM	3.455
	.095	3.310	EW	3.455
	.109	3.282	EW	3.947
	.120	3.260	EW	4.332
	.125	3.250	DOM	4.332
	.134	3.232	DOM	4.817
	.134	3.232	EW	4.817
	.156	3.188	DOM	5.571
	.188	3.124	DOM	6.650
	.219	3.062	DOM	7.674
	.250	3.000	DOM	8.678
	.281	2.938	DOM	9.660
	.313	2.875	DOM	10.650
	.375	2.750	DOM	12.520
	.438	2.625	CDS	14.320
	.500	2.500	CDS	16.020
	.563	2.375	CDS	17.660
	.625	2.250	CDS	19.190
	.750	2.000	CDS	22.030
	.875	1.750	CDS	24.530
	1.000	1.500	CDS	26.700
3 5/8" O.D.	.188	3.200	DOM	6.901
	.250	3.125	DOM	9.011
	.281	3.063	DOM	10.040
	.313	3.000	DOM	11.070
	.375	2.875	DOM	13.020
	.438	2.750	CDS	14.910
	.500	2.625	CDS	16.690
	.625	2.375	CDS	20.030
	.750	2.125	CDS	23.030
3 3/4" O.D.	.065	3.620	EW	2.558
	.095	3.560	DOM	3.708
	.120	3.510	EW	4.652
	.125	3.500	DOM	4.839
	.156	3.438	DOM	5.988
	.188	3.375	DOM	7.152
	.188	3.375	EW	7.152
	.250	3.250	DOM	9.345
	.281	3.188	DOM	10.410
	.313	3.125	DOM	11.490
	.375	3.000	DOM	13.520
	.438	2.875	CDS	15.490

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D.	Type	Wt. per Ft.
3 3/4" O.D.	.500	2.750	CDS	17.360
	.563	2.624	CDS	19.160
	.625	2.500	CDS	20.860
	.750	2.250	CDS	24.030
	.875	2.000	CDS	26.870
	1.000	1.750	CDS	29.370
3 7/8" O.D.	.125	3.625	DOM	5.006
	.188	3.500	DOM	7.403
	.250	3.375	DOM	9.678
	.313	3.249	DOM	11.910
	.375	3.125	DOM	14.020
	.438	3.000	CDS	16.080
	.500	2.875	CDS	18.020
	.563	2.750	CDS	19.910
	.750	2.375	CDS	25.030
4" O.D.	.065	3.870	DOM	2.732
	.065	3.870	EW	2.732
	.075	3.850	EW	3.143
	.083	3.834	DOM	3.472
	.083	3.834	EW	3.472
	.095	3.810	DOM	3.962
	.095	3.810	EW	3.962
	.109	3.782	EW	4.530
	.120	3.760	EW	4.973
	.125	3.750	DOM	4.973
	.134	3.732	DOM	5.533
	.134	3.732	EW	5.533
	.156	3.688	DOM	6.404
	.188	3.625	DOM	7.654
	.188	3.640	EW	7.344
	.219	3.563	DOM	8.843
	.250	3.500	DOM	10.010
	.281	3.438	DOM	11.160
	.313	3.375	DOM	12.330
	.375	3.250	DOM	14.520
	.438	3.125	DOM	16.660
	.500	3.000	DOM	18.690
	.563	2.875	CDS	20.670
	.625	2.750	CDS	22.530
	.750	2.500	CDS	26.030
	.875	2.250	CDS	29.200
	1.000	2.000	CDS	32.040
	1.250	1.500	CDS	36.710
4 1/8" O.D.	.120	3.885	DOM	5.133
	.188	3.749	DOM	7.905
	.250	3.625	DOM	10.690
	.313	3.500	DOM	12.740
	.375	3.375	DOM	15.020
	.438	3.249	DOM	17.250
	.500	3.125	DOM	19.360

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D.	Type	Wt. per Ft.
4 1/8" O.D.	.563	2.999	CDS	21.420
	.625	2.875	CDS	23.360
	.750	2.625	CDS	27.030
	1.000	2.125	CDS	33.380
4 1/4" O.D.	.065	4.120	EW	2.905
	.083	3.959	EW	3.694
	.095	4.060	DOM	4.216
	.120	4.010	EW	5.293
	.125	4.000	DOM	5.507
	.156	3.937	DOM	6.821
	.188	3.875	EW	8.156
	.188	3.875	DOM	8.156
	.250	3.750	DOM	10.680
	.313	3.625	DOM	13.160
	.375	3.500	DOM	15.520
	.438	3.375	DOM	17.830
	.500	3.250	DOM	20.030
	.563	3.124	DOM	24.000
	.625	3.000	DOM	24.200
	.750	2.750	CDS	28.040
	.875	2.500	CDS	31.540
	1.000	2.250	CDS	34.710
	1.250	1.750	CDS	40.050
4 3/8" O.D.	.188	4.000	DOM	8.407
	.313	3.749	DOM	13.580
	.375	3.625	DOM	16.020
	.438	3.500	DOM	18.420
	.500	3.375	DOM	20.690
	.625	3.125	DOM	25.030
	.750	2.875	CDS	29.040
4 1/2" O.D.	.065	4.370	EW	3.079
	.075	4.350	EW	3.574
	.083	4.334	EW	3.915
	.095	4.310	DOM	4.216
	.109	4.282	EW	5.111
	.120	4.260	EW	5.613
	.125	4.250	DOM	5.841
	.134	4.232	DOM	6.248
	.156	4.188	DOM	7.237
	.188	4.125	DOM	8.658
	.219	4.062	DOM	10.010
	.250	4.000	DOM	11.350
	.313	3.875	DOM	14.000
	.375	3.750	DOM	16.520
	.438	3.625	DOM	19.000
	.500	3.500	DOM	21.360
	.563	3.375	DOM	23.670
	.625	3.250	DOM	25.870
	.750	3.000	CDS	30.040
	.875	2.750	CDS	33.880

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D.	Type	Wt. per Ft.
4 1/2" O.D.	1.000	2.500	CDS	37.380
	1.125	2.250	CDS	40.550
	1.250	2.000	CDS	43.390
4 5/8" O.D.	.188	4.250	DOM	8.908
	.250	4.125	DOM	11.680
	.313	4.000	DOM	14.410
	.375	3.875	DOM	17.020
	.438	3.750	DOM	19.590
	.500	3.625	DOM	22.030
	.625	3.375	DOM	26.100
	.875	2.875	CDS	35.040
	1.000	2.625	CDS	38.720
4 3/4" O.D.	.125	4.500	DOM	6.174
	.188	4.374	DOM	9.160
	.250	4.250	DOM	12.020
	.313	4.125	DOM	14.830
	.375	4.000	DOM	17.520
	.438	3.874	DOM	20.170
	.500	3.750	DOM	22.700
	.625	3.500	DOM	27.530
	.750	3.250	CDS	32.040
	.875	3.000	CDS	36.210
	1.000	2.750	CDS	40.050
	1.250	2.250	CDS	46.730
4 7/8" O.D.	.313	4.250	DOM	15.180
	.438	4.000	DOM	20.760
	.500	3.625	DOM	23.360
	.750	3.375	CDS	33.040
5" O.D.	.065	4.870	EW	3.426
	.075	4.850	EW	3.444
	.083	4.834	EW	4.359
	.095	4.810	DOM	4.977
	.109	4.782	EW	5.663
	.120	4.760	EW	6.254
	.125	4.750	DOM	6.254
	.134	4.732	EW	6.963
	.188	4.625	DOM	9.662
	.188	4.625	EW	9.662
	.250	4.500	DOM	12.680
	.313	4.375	DOM	15.670
	.375	4.250	DOM	18.520
	.438	4.125	DOM	21.340
	.500	4.000	DOM	24.030
	.563	3.875	DOM	26.680
	.625	3.750	DOM	29.200
	.750	3.500	CDS	34.040
	.875	3.250	CDS	38.550
	1.000	3.000	CDS	42.720
	1.125	2.750	CDS	46.560
	1.250	2.500	CDS	50.060
	1.500	2.000	CDS	56.070

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D.	Type	Wt. per Ft.
5 1/4" O.D.	.125	5.000	DOM	6.842
	.188	4.875	DOM	10.160
	.250	4.750	DOM	13.350
	.313	4.625	DOM	16.500
	.375	4.500	DOM	19.520
	.500	4.250	DOM	25.370
	.625	4.000	DOM	30.870
	.750	3.750	CDS	36.050
	.875	3.500	CDS	40.880
	1.000	3.250	CDS	45.390
	1.125	3.000	CDS	49.560
	1.250	2.750	CDS	53.400
5 3/8" O.D.	.188	5.000	DOM	10.410
	.250	4.875	DOM	13.680
5 1/2" O.D.	.065	5.370	EW	3.773
	.120	5.260	EW	6.895
	.125	5.250	DOM	7.176
	.180	5.140	EW	10.230
	.188	5.125	DOM	10.670
	.250	5.000	DOM	14.020
	.313	4.875	DOM	17.340
	.375	4.750	DOM	20.530
	.438	4.624	CDS	23.680
	.500	4.500	DOM	26.700
	.625	4.250	DOM	32.540
	.750	4.000	CDS	38.050
	.875	3.750	CDS	43.220
	1.000	3.500	CDS	48.060
	1.250	3.000	CDS	56.740
	1.375	2.750	CDS	60.566
	1.500	2.500	CDS	64.080
5 3/4" O.D.	.125	5.500	DOM	7.509
	.188	5.375	DOM	11.170
	.250	5.250	DOM	14.690
	.313	5.125	DOM	18.180
	.375	5.000	DOM	21.530
	.500	4.750	DOM	28.040
	.625	4.500	DOM	34.210
	.750	4.250	CDS	40.050
	.875	4.000	CDS	45.560
	1.000	3.750	CDS	50.730
	1.250	3.250	CDS	60.080
	1.500	2.750	CDS	68.900
6" O.D.	.065	5.870	EW	4.120
	.075	5.850	EW	4.745
	.083	5.834	EW	5.245
	.109	5.782	EW	6.857
	.120	5.760	EW	7.536
	.125	5.750	DOM	7.843
	.134	5.732	EW	8.395
	.188	5.625	DOM	11.670

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D.	Type	Wt. per Ft.
6" O.D.	.250	5.500	DOM	15.350
	.313	5.375	DOM	19.010
	.375	5.250	DOM	22.530
	.438	5.125	DOM	26.020
	.500	5.000	DOM	29.370
	.625	4.750	DOM	35.880
	.750	4.500	CDS	42.050
	.875	4.250	CDS	47.890
	1.000	4.000	CDS	53.400
	1.125	3.750	CDS	58.570
	1.250	3.500	CDS	63.410
	1.500	3.000	CDS	72.090
6 1/4" O.D.	.125	6.000	DOM	8.177
	.188	5.875	DOM	12.170
	.250	5.750	DOM	16.020
	.375	5.500	DOM	25.350
	.500	5.250	DOM	30.710
	.625	5.000	DOM	37.550
	.750	4.750	CDS	44.060
	1.000	4.250	CDS	56.070
	1.250	3.750	CDS	66.750
6 1/2" O.D.	.188	6.125	DOM	12.670
	.250	6.000	DOM	16.690
	.375	5.750	DOM	24.530
	.500	5.500	DOM	32.040
	.625	5.250	DOM	39.220
	.750	5.000	CDS	46.060
	.875	4.750	CDS	52.570
	1.000	4.500	CDS	58.740
	1.250	4.000	CDS	70.090
	1.500	3.500	CDS	80.100
6 3/4" O.D.	.188	6.375	DOM	13.180
	.250	6.250	DOM	17.360
	.375	6.000	DOM	25.530
	.500	5.750	DOM	33.380
	.625	5.500	DOM	40.880
	.750	5.250	CDS	48.060
	.875	5.000	CDS	54.900
	1.000	4.750	CDS	61.410
7" O.D.	.188	6.625	DOM	13.680
	.250	6.500	DOM	18.020
	.375	6.250	DOM	26.530
	.500	6.000	DOM	34.710
	.625	5.750	DOM	42.550
	.750	5.500	CDS	50.060
	1.000	5.000	CDS	64.080
	1.250	4.500	CDS	76.760
	1.500	4.000	CDS	88.110
7 1/4" O.D.	.188	6.875	DOM	14.180
	.250	6.750	DOM	18.690
	.375	6.500	DOM	27.530

DOM, SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor .I.D	Type	Wt. per Ft.
7 1/4" O.D.	.500	6.250	DOM	36.050
	.625	6.000	CDS	44.220
	.750	5.750	CDS	52.070
	1.000	5.250	CDS	66.750
	1.500	4.250	CDS	92.120
7 1/2" O.D.	.188	7.125	DOM	14.680
	.250	7.000	DOM	19.360
	.375	6.750	DOM	28.540
	.500	6.500	DOM	37.380
	.625	6.250	DOM	45.890
	.750	6.000	CDS	54.070
	1.000	5.500	CDS	69.420
	1.250	5.000	CDS	83.440
	1.500	4.500	CDS	96.120
7 3/4" O.D.	.250	7.250	DOM	20.030
	.375	7.000	DOM	29.540
	.500	6.750	DOM	38.720
	.625	6.500	DOM	46.560
	.750	6.250	CDS	56.070
	1.000	5.750	CDS	72.090
8" O.D.	.075	7.850	EW	6.347
	.083	7.834	EW	7.018
	.109	7.782	EW	9.186
	.134	7.730	EW	11.580
	.188	7.625	DOM	15.690
	.250	7.500	DOM	20.690
	.375	7.250	DOM	30.540
	.500	7.000	DOM	40.050
	.625	6.750	DOM	49.230
	.750	6.500	CDS	58.070
	1.000	6.000	CDS	74.760
	1.250	5.500	CDS	90.110
	1.500	5.000	CDS	104.100
8 1/4" O.D.	.250	7.750	DOM	21.360
	.375	7.500	DOM	31.540
	.500	7.250	DOM	41.390
	.750	6.750	CDS	60.080
	1.000	6.250	CDS	77.430
8 1/2"O.D.	.250	8.000	DOM	22.030
	.375	7.750	DOM	32.540
	.500	7.500	DOM	42.720
	.750	7.000	CDS	62.080
	.875	6.750	CDS	71.260
	1.000	6.500	CDS	80.100
	1.250	6.000	CDS	96.790
	1.500	5.500	CDS	112.100
8 3/4" O.D.	.250	8.250	DOM	22.700
	.375	8.000	DOM	33.540
	.500	7.750	DOM	44.060
	.750	7.250	CDS	64.080
	1.000	6.750	CDS	82.770

DOM SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D	Type	Wt. per ft.
9" O.D.	.250	8.500	DOM	23.360
	.375	8.250	DOM	34.540
	.500	8.000	DOM	45.390
	.625	7.750	DOM	55.900
	.750	7.500	CDS	66.080
	1.000	7.000	CDS	85.440
	1.250	6.500	CDS	103.460
	1.500	6.000	CDS	120.200
9 1/4"O.D.	.250	8.750	DOM	24.030
	.500	8.250	DOM	46.730
	.750	7.750	CDS	68.090
	1.000	7.250	CDS	88.110
9 1/2" O.D.	.250	9.000	DOM	24.700
	.375	8.750	DOM	36.550
	.500	8.500	DOM	48.060
	.625	8.250	DOM	59.240
	.750	8.000	CDS	70.090
	1.000	7.500	CDS	90.780
	1.250	7.000	CDS	110.100
9 3/4" O.D.	.375	9.000	DOM	37.550
	.500	8.750	DOM	49.400
	.750	8.250	CDS	72.090
	1.000	7.750	CDS	93.450
10" O.D. .	109	9.782	EW	11.510
	.134	9.730	EW	14.520
	.250	9.500	DOM	26.030
	.375	9.250	DOM	38.550
	.500	9.000	DOM	50.730
	.625	8.750	DOM	62.580
	.750	8.500	CDS	74.090
	1.000	8.000	CDS	96.120
	1.250	7.500	CDS	116.812
	1.500	7.000	CDS	136.200
10 1/4" O.D.	.250	9.750	CDS	26.700
	.375	9.500	DOM	39.550
	.500	9.000	DOM	64.250
	.625	9.000	DOM	64.250
	.750	8.750	CDS	76.090
	1.000	7.250	CDS	140.200
10 1/2"O.D	.250	10.000	CDS	27.370
	.375	9.750	DOM	40.550
	.500	9.500	DOM	53.400
	.750	9.000	CDS	78.100
	1.000	8.500	CDS	101.500
	1.500	7.500	CDS	144.200
10 3/4"O.D	.135	10.480	EW	15.250
	.375	10.000	DOM	41.550
	.500	9.750	DOM	54.740
	.750	9.250	CDS	80.100
	1.000	8.750	CDS	104.100

DOM SEAMLESS MECHANICAL & HREW CARBON TUBING (Continued)

Size	Wall	Theor. I.D	Type	Wt. per ft.
10 3/4"O.D	1.250	8.250	CDS	126.800
	1.500	7.750	CDS	148.200
11"O.D.	.375	10.250	DOM	42.550
	.500	10.000	DOM	56.070
	.750	9.500	CDS	82.100
	1.000	9.000	CDS	106.800
	1.500	8.000	CDS	152.190
11 1/2"O.D.	.250	11.000	CDS	30.040
	.375	10.750	DOM	44.560
	.500	10.500	DOM	58.740
	.750	10.000	CDS	86.110
	1.000	9.500	CDS	112.100
11 3/4"O.D	.375	11.000	DOM	45.560
	.500	10.750	DOM	60.800
	.750	10.250	CDS	88.110
	1.000	9.750	CDS	114.800
12" O.D.	.109	11.782	EW	13.840
	.134	11.732	EW	16.980
	.250	11.500	CDS	31.370
	.375	11.250	DOM	46.560
	.500	11.000	DOM	61.410
	.750	10.500	CDS	90.110
	1.000	10.000	CDS	117.500
14" O.D.	.134	13.732	EW	19.840
16" O.D.	.134	15.732	EW	22.700
20" O.D.	.250	19.500	EW	52.730

STEEL TUBING
MECHANICAL SQUARE WELDED

ELECTRIC- RESISTANCE-WELDED
ASTM A513

Nominal Size In.	Wall In.	Lbs. per Foot
1/2 x 1/2”	.049	.28
	.065	.38
5/8 x 5/8”	.049	.36
	.065	.49
	.072	.54
	.083	.61
3/4 x 3/4”	.049	.46
	.065	.59
	.072	.68
	.083	.75
	.095	.84
	.120	1.23
1 x 1”	.049	.63
	.065	.83
	.072	.91
	.083	1.04
	.095	1.17
	.120	1.44
1 1/4 x 1 1/4”	.049	.81
	.065	1.06
	.072	1.15
	.083	1.33
	.095	1.52
	.109	1.69
	.120	1.84

Nominal Size In.	Wall In.	Lbs. per Foot
1 1/2 x 1 1/2”	.049	.96
	.065	1.26
	.072	1.39
	.083	1.59
	.095	1.81
	.109	2.06
	.120	2.25
	.188	3.54
	.250	4.11
1 3/4 x 1 3/4”	.065	1.49
	.072	1.69
	.083	1.88
	.095	2.14
	.109	2.43
	.120	2.65
2 x 2”	.065	1.69
	.072	1.94
	.083	2.15
	.095	2.46
	.109	2.78

STEEL TUBING
MECHANICAL RECTANGULAR WELDED
ELECTRIC RESISTANCE WELDED
ASTM A513

Nominal Size In.	Wall In.	Lbs. per Foot
1 x 1/2”	.049	.45
	.065	.61
1 x 3/4”	.083	.61
1 1/2 x 3/4”	.049	.72
	.065	.94
	.072	1.03
	.083	1.18
	.095	1.33
	.109	1.51
	.120	1.64
1 1/2 x 1”	.049	.81
	.065	1.05
	.072	1.15
	.083	1.34
	.095	1.52
	.109	1.73
	.120	1.88
2 x 1”	.049	.96
	.065	1.29
	.072	1.39
	.083	1.59
	.095	1.82
	.109	2.06
	.120	2.25
2 x 1 1/4”	.065	1.38
	.072	1.50
	.083	1.74
	.095	1.98
	.109	2.25
	.120	2.46
2 x 1 1/2”	.065	1.49
	.072	1.64
	.083	1.88
	.095	2.14
	.109	2.43
	.120	2.66
2 1/2 x 1”	.065	1.49
	.072	1.64
	.083	1.88
	.095	2.14
	.109	2.43
	.120	2.66
2 1/2 x 1 1/4”	.083	2.02

Nominal Size In.	Wall In.	Lbs.per Foot
2 1/2 x 1 1/2”	.065	1.69
	.072	1.89
	.083	2.16
	.095	2.44
	.109	2.80
	.120	3.05
3 x 1”	.065	1.71
	.072	1.89
	.083	2.16
	.095	2.46
	.109	2.80
	.120	3.07
3 x 1 1/2”	.065	1.93
	.072	2.19
	.083	2.45
	.095	2.78
	.109	3.17
	.120	3.48
3 x 2”	.065	2.17
	.072	2.38
	.083	2.75
	.095	3.14
	.109	3.59

STEEL TUBING
SQUARE STRUCTURAL WELDED
ELECTRIC RESISTANCE WELDED
ASTM A500 Gr.B

Nominal Size In.	Wall In.	Lbs. per Foot
2 x 2”	.120	3.05
	.188	4.32
	.250	5.41
2 1/4 x 2 1/4”	.120	3.48
	.188	4.90
	.250	6.26
2 1/2 x 2 1/2”	.120	3.90
	.188	5.59
	.238	5.98
	.250	7.11
3 x 3”	.120	4.75
	.188	6.86
	.250	8.81
	.313	10.58
	.375	12.17
3 1/2 x 3 1/2”	.120	5.61
	.188	8.15
	.250	10.51
	.313	12.70
	.375	14.72
4 x 4”	.120	6.46
	.188	9.42
	.250	12.21
	.313	14.83
	.375	17.27
	.500	21.63
4 1/2 x 4 1/2”	.188	10.70
	.250	13.91
5 x 5”	.120	8.20
	.188	11.97
	.250	15.62
	.313	19.08
	.375	22.37
	.500	28.43

Nominal Size In.	Wall In.	Lbs.per Foot
6 x 6”	.188	14.53
	.250	19.02
	.313	23.34
	.375	27.48
	.500	35.24
7 x 7”	.188	17.08
	.250	22.42
	.313	27.59
	.375	32.58
	.500	42.05
8 x 8”	.188	19.63
	.250	25.82
	.313	31.84
	.375	37.69
	.500	48.85
10 x 10”	.188	24.73
	.250	32.63
	.313	40.35
	.375	47.90
	.500	62.46
12 x 12”	.250	39.43
	.313	48.86
	.375	58.10
	.500	76.07
14 x 14”	.313	57.36
	.375	68.31
	.500	89.68
16 x 16”	.313	65.87
	.375	78.52
	.500	103.39

STEEL TUBING
MECHANICAL RECTANGULAR WELDED
ELECTRIC RESISTANCE WELDED
ASTM A500 GR. B

Nominal Size In.	Wall In.	Lbs. per Foot
3 x 1 1/2”	.188	5.07
3 x 2”	.120	3.93
	.188	5.59
	.250	7.11
3 1/2 x 1 1/2”	.120	3.93
	.188	5.59
	.250	7.41
3 1/2 x 2 1/2”	.120	4.75
	.188	6.87
	.250	8.81
4 x 1 1/2”	.120	4.33
	.188	6.29
4 x 2”	.120	4.75
	.188	7.04
	.250	8.81
	.313	10.58
4 x 3”	.120	5.61
	.188	8.15
	.250	10.51
	.313	12.70
5 x 2”	.120	5.61
	.188	8.15
	.250	10.51
	.313	12.70
5 x 3”	.120	6.46
	.188	9.42
	.250	12.21
	.313	14.83
	.375	17.27
	.500	21.63
5 x 4”	.188	10.70
	.250	13.91
	.313	16.96
	.375	19.82
6 x 2”	.120	6.46
	.188	9.42
	.250	12.21
	.313	14.83
	.375	17.27
6 x 3”	.120	7.31
	.188	10.70
	.250	13.91
	.313	16.96
	.375	19.82
6 x 4”	.120	8.16
	.188	11.97
	.250	15.62
	.313	19.08
	.375	22.37
	.500	28.43
7 x 3”	.188	11.97
	.250	15.62
	.313	19.08
	.375	22.37
	.500	28.43
7 x 4”	.188	13.25
	.250	17.32
	.313	21.21
	.375	24.93
	.500	31.84
7 x 5”	.188	14.53
	.250	19.02
	.313	23.34
	.375	27.48
	.500	35.24
8 x 2”	.188	11.97
	.250	15.62
	.313	19.08
	.375	22.37
8 x 3”	.188	13.25
	.250	17.32
	.313	21.21
	.375	24.93
	.500	31.84
8 x 4”	.188	14.53
	.250	19.02
	.313	23.34
	.375	27.48
	.500	35.24
8 x 6”	.188	17.08
	.250	22.42
	.313	27.59
	.375	32.58
	.500	42.05
9 x 7”	.188	19.63
	.250	25.82
10 x 2”	.188	14.65
	.250	19.02

STEEL TUBING
RECTANGULAR STRUCTURAL WELDED(Continued)

ELECTRIC RESISTANCE WELDED
ASTM A500 GR.B

Nominal Size In.	Wall In.	Lbs. per Foot
10 X 3”	.188	15.80
	.250	20.72
10 X 4”	.188	170.80
	.250	22.42
	.313	27.59
	.375	32.58
	.500	42.05
10 X 6”	.188	19.63
	.250	25.82
	.313	31.84
	.375	37.69
	.500	48.85
10 X 8”	.188	22.18
	.250	29.23
	.313	36.10
	.375	42.79
	.500	55.66
12 X 2”	.188	17.08
	.250	22.42
12 X 3”	.188	18.35
	.250	24.12
12 X 4”	.188	19.63
	.250	25.82
	.313	31.84
	.375	37.69
	.500	48.85
12 X 6”	.188	22.18
	.250	29.23
	.313	36.10
	.375	42.79
	.500	55.66
12 X 8”	.188	24.73
	.250	32.63
	.313	40.35
	.375	47.90
	.500	62.46

Nominal Size In.	Wall In.	Lbs. per Foot
14 X 4”	.250	29.23
	.313	36.10
	.375	42.79
	.500	55.66
14 X 6”	.250	32.63
	.313	40.35
	.375	47.90
	.500	62.46
14 X 10”	.313	48.86
	.375	58.10
	.500	76.07
16 X 4”	.313	40.35
	.375	47.50
	.500	62.46
16 X 8”	.313	48.86
	.375	58.10
	.500	76.07
16 X 12”	.313	57.36
	.375	68.31
	.500	89.68
18 X 6”	.313	48.86
	.375	58.10
	.500	76.07
20 X 4”	.313	48.86
	.375	58.10
	.500	76.07
20 X 8”	.313	57.36
	.375	68.31
	.500	89.68
20 X 12”	.313	65.87
	.375	78.52
	.500	103.30

Note: Available in pre-painted tubing in sizes starting from 3 x 2 through 10 x 4”.

TELESCOPING TUBING

Nominal Size In.	Wall In.	Wt. Per Ft. Lb.
2 X 2”	.203	4.96
2 1/2” X 2 1/2”	.203	6.34
3 X 3	.203	7.72
3 1/2 X 3 1/2”	.203	9.10
Flash controlled to .010”		

Full line of structural products

BLACK OR GALVANIZED STEEL PIPE

GRADES A-53-A-120

Nominal Size	Actual O.D. Inches	Average Wall, Inches	Theoretical I.D. Inches	Weight, lb./ft.	Schedule or Weight	
					Reg.	Wgt.
1/8	0.405	0.049	.307	.1863		
		0.068	.269	.2447	40	Std
		0.095	.215	.3145	80	XS
1/4	0.540	0.065	.410	.3297		
		0.088	.364	.4248	40	Std
		0.119	.302	.5351	80	XS
3/8	0.675	0.065	.545	.4235		
		0.091	.493	.5676	40	Std
		0.126	.423	.7388	80	XS
1/2	0.840	0.065	.710	.5380		
		0.083	.674	.6710		
		0.109	.622	.8510	40	Std
		0.147	.546	1.088	80	XS
		0.188	.464	1.309	160	
		0.294	.252	1.714		XXS
3/4	1.055	0.065	.920	.6838		
		0.083	.884	.8572		
		0.113	.824	1.131	40	Std
		0.154	.742	1.474	80	XS
		0.219	.612	1.944	160	
		0.308	.434	2.441		XXS
1	1.315	0.065	1.185	.8678		
		0.109	1.097	1.404		
		0.133	1.049	1.679	40	Std
		0.179	.957	2.172	80	XS
		0.250	.815	2.844	160	
		0.358	.599	3.659		XXS
1 1/4	1.660	0.065	1.530	1.107		
		0.109	1.442	1.806		
		0.140	1.380	2.273	40	Std
		0.191	1.278	2.997	80	XS
		0.250	1.160	3.765	160	
		0.382	.896	5.214		XXS

BLACK OR GALVANIZED STEEL PIPE (Continued)

GRADES A- 53 -- A-120

Nominal Size	Actual O.D. Inches	Average Wall Inches	Theoretical I.D Inches	Weight lb./ft.	Schedule or Weight	
					Reg.	Wgt.
1 1/2	1.900	0.065	1.770	1.274		
		0.109	1.682	2.085		
		0.145	1.610	2.718	40	Std.
		0.200	1.500	3.631	80	XS
		0.281	1.338	4.859	160	
		0.400	1.100	6.408		XXS
2	2.375	0.065	2.245	1.604		
		0.109	2.157	2.638		
		0.154	2.067	3.653	40	Std.
		0.218	1.939	5.022	80	XS
		0.344	1.687	7.462	160	
		0.436	1.503	9.029		XXS
2 1/2	2.875	0.083	2.709	2.475		
		0.120	2.635	3.531		
		0.203	2.469	5.793	40	Std.
		0.276	2.323	7.661	80	XS
		0.375	2.125	10.01	160	
		0.552	1.771	13.69		XXS
3	3.500	0.083	3.334	3.029		
		0.120	3.260	4.332		
		0.216	3.068	7.576	40	Std.
		0.300	2.900	10.25	80	XS
		0.438	2.624	14.32	160	
		0.600	2.300	18.58		XXS
3 1/2	4.000	0.083	3.834	3.472		
		0.120	3.760	4.973		
		0.226	3.548	9.109	40	Std.
		0.318	3.364	12.50	80	XS
4	4.500	0.083	4.334	3.915		
		0.120	4.260	5.613		
		0.237	4.026	10.79	40	Std.
		0.337	3.826	14.98	80	XS
		0.438	3.624	19.00	120	
		0.531	3.438	22.51	160	
		0.674	3.152	27.54		XXS
5	5.563	0.109	5.345	6.349		
		0.134	5.295	7.770		
		0.258	5.047	14.62	40	Std.
		0.375	4.813	20.78	80	XS
		0.500	4.563	27.04	120	
		0.625	4.313	32.96	160	
		0.750	4.063	38.55		XXS

BLACK OR GALVANIZED STEEL PIPE (Continued)

GRADES A- 53 -- A-120

Nominal Size	Actual O.D. Inches	Average Wall Inches	Theoretical I.D Inches	Weight lb./ft.	Schedule or Weight	
					Reg.	Wgt.
6	6.625	0.109	6.407	7.585		
		0.134	6.357	9.289		
		0.280	6.065	18.97	40	Std.
		0.432	5.761	28.57	80	XS
		0.562	5.501	36.39	120	
		0.719	5.187	45.35	160	
		0.864	4.897	53.16		XXS
8	8.625	0.109	8.407	9.914		
		0.148	8.329	13.40		
		0.250	8.125	22.36	20	Std.
		0.277	8.071	24.70	30	
		0.322	7.981	28.55	40	Std.
		0.406	7.813	35.64	60	
		0.500	7.625	43.39	80	XS
		0.594	7.437	50.95	100	
		0.719	7.187	60.71	120	
		0.812	7.001	67.76	140	
		0.875	6.875	72.42		XXS
		0.906	6.813	74.69	160	
10	10.750	0.134	10.482	15.19		
		0.165	10.420	18.65		
		0.250	10.250	28.04	20	
		0.307	10.136	34.24	30	
		0.365	10.020	40.48	40	Std.
		0.500	9.750	54.74	60	XS
		0.594	9.562	64.43	80	
		0.719	9.312	77.03	100	
		0.844	9.062	89.29	120	
		1.000	8.750	104.1	140	XXS
		1.125	8.500	115.6	160	
12	12.750	0.156	12.438	20.98		
		0.180	12.390	24.16		
		0.279	12.250	33.38	20	
		0.330	12.090	43.77	30	
		0.375	12.000	49.56		Std.
		0.406	11.938	53.52	40	
		0.500	11.750	65.42		XS
		0.562	11.626	73.15	60	
		0.688	11.374	88.63	80	
		0.844	11.062	107.3	100	
		1.000	10.750	125.5	120	XXS
		1.125	10.500	139.7	140	
		1.312	10.126	160.3	160	

DOM TUBING
OD & ID TOLERANCES

OD Size Range	Wall, Percent of OD	OD, Inches Over	OD, Inches Under	ID, Inches Over	ID, Inches Under
Up to 0.500	All	.004	.000		
0.500-1.699	All	.005	.000	.000	.005
1.700-2.099	All	.006	.000	.000	.006
2.100-2.499	All	.007	.000	.000	.007
2.500-2.899	All	.008	.000	.000	.008
2.900-3.299	All	.009	.000	.000	.009
3.300-3.699	All	.010	.000	.000	.010
3.700-4.099	All	.011	.000	.000	.011
4.100-4.499	All	.012	.000	.000	.012
4.500-4.899	All	.013	.000	.000	.013
4.900-5.299	All	.014	.000	.000	.014
5.300-5.549	All	.015	.000	.000	.015
5.550-5.999	Under 6	.010	.010	.010	.010
	6 & Over	.009	.009	.009	.009
6.000-6.499	Under 6	.013	.013	.013	.013
	6 & Over	.010	.010	.010	.010
6.500-6.999	Under 6	.015	.015	.015	.015
	6 & Over	.012	.012	.012	.012
7.000-7.499	Under 6	.018	.018	.018	.018
	6 & Over	.013	.013	.013	.013
7.550-7.999	Under 6	.020	.020	.020	.020
	6 & Over	.015	.015	.015	.015
8.000-8.499	Under 6	.023	.023	.023	.023
	6 & Over	.016	.016	.016	.016
8.500-8.999	Under 6	.025	.025	.025	.025
	6 & Over	.017	.017	.017	.017
9.000-9.499	Under 6	.028	.028	.028	.028
	6 & Over	.019	.019	.019	.019
9.550-9.999	Under 6	.030	.030	.030	.030
	6 & Over	.020	.020	.020	.020
10.000-10.999	Under 6	.034	.034	.034	.034
	6 & Over	.022	.022	.022	.022
11.000-11.999	Under 6	.035	.035	.035	.035
	6 & Over	.025	.025	.025	.025
12.000-12.999	All	.037	.037	.037	.037

DOM TUBING
OD & ID TOLERANCES (Continued)

The ovality shall be within the above tolerance except when the wall thickness is less than 3% of the OD. In such cases the additional ovallty shall be as follows, but the mean diameter shall be within the specified tolerance:

	OD, Inches		Additional Ovallty Tolerance, Inch
Up to	2.000		.010
Over	2.000-3.000	Incl.	.015
“	3.000-4.000	“	.020
“	4.000-5.000	“	.025
“	5.000-6.000	“	.030
“	6.000-7.000	“	.035
“	7.000-8.000	“	.040
“	8.000-9.000	“	.045
“	9.000-10.000	“	.050
“	10.000-11.000	“	.065
“	11.000-12.000	“	.060
“	12.000-12.500	“	.065

WALL TOLERANCES

DOM TUBING

Wall Thickness Inch	TUBE OD .375 to .875	Over .875 to 1.875	Over 1.875 to 3.750	Over 3.750 to 12.500
.028	+.002 -.002	+.002 -.002	+.002 -.002	
.035	+.002 -.002	+.002 -.002	+.002 -.002	
.049	+.002 -.002	+.002 -.003	+.002 -.003	
.065	+.002 -.002	+.002 -.003	+.002 -.003	+.004 -.004
.083	+.002 -.002	+.002 -.003	+.003 -.003	+.004 -.005
.095	+.002 -.002	+.002 -.003	+.003 -.003	+.004 -.005
.109	+.002 -.003	+.002 -.004	+.003 -.003	+.005 -.005
.120	+.003 -.003	+.002 -.004	+.003 -.003	+.005 -.005
.134		+.002 -.004	+.003 -.003	+.005 -.005
.148		+.002 -.004	+.003 -.003	+.005 -.005
.165		+.003 -.004	+.003 -.004	+.005 -.006
.180		+.004 -.004	+.003 -.005	+.006 -.006
.203		+.004 -.005	+.004 -.005	+.006 -.007
.220		+.004 -.006	+.004 -.006	+.007 -.007
.238		+.005 -.006	+.005 -.006	+.007 -.007
.259		+.005 -.006	+.005 -.006	+.007 -.007
.284		+.005 -.006	+.005 -.006	+.007 -.007
.300		+.006 -.006	+.006 -.006	+.008 -.008
.320		+.007 -.007	+.007 -.007	+.008 -.008
.344		+.008 -.008	+.008 -.008	+.009 -.009

WALL TOLERANCES (Continued)

Wall Thickness Inch	TUBE OD .375 to .875	Over .875 to 1.875	Over 1.875 to 3.750	Over 3.750 to 12.500
.375			+.009 -.009	+.009 -.009
.400			+.010 -.010	+.010 -.010
.438			+.011 -.011	+.011 -.011
.480			+.012 -.012	+.012 -.012
.531			+.013 -.013	+.013 -.013
.563				+.013 -.013
.580				+.014 -.014

For Intermediate wall : Use the tolerance for the nearest listed wall. If the intermediate wall falls equally between two listed walls, use the greater tolerance.

MACHINING ALLOWANCES

MINIMUM OD AND ID CLEAN-UP ALLOWANCES FOR MACHINING DOM TUBES

Finished OD Inch	Finished Wall thickness, Inch				
	.187 and Under	OVER .187 to .230 Incl.	OVER .230 to .360 Incl.	OVER .360 to .460 Incl.	OVER .460 to .580 Incl.
Up to 1.500 Incl.	.015	.020	.025	.025	
Over 1.500 to 3.000 Incl.	.020	.025	.030	.030	
Over 3.000 to 4.750 Incl.	.025	.030	.035	.035	.040
Over 4.750 to 6.000 Incl.	.030	.035	.040	.040	.045
Over 6.000 to 7.000 Incl.	.035	.040	.045	.045	.050
Over 7.000 to 8.000 Incl.			.048	.048	.053
Over 8.000 to 10.000 Incl.			.050	.050	.055
Over 10.500 to 12.500 Incl.			.055	.055	.060

Camber : For every 12” or traction thereof over 12” add .010” for camber.
For sizes over 71/2” O.D. add .020” for camber

These allowances are based on conventional chucking procedures

HONING

DOM TUBING

MINIMUM ID STOCK ALLOWANCE FOR THE REMOVAL OF INSIDE SURFACE IMPERFECTIONS BY A HONING OPERATION

Finished OD Inch	Finished Wall thickness, Inch						
	.065 and Under	OVER .065 to .125 Incl.	OVER .125 to .180 Incl.	OVER .180 to .230 Incl.	OVER .230 to .360 Incl.	OVER .360 to .460 Incl.	OVER .460 to .563 Incl.
Up to 1.500 Incl.	.010	.011	.013	.015			
Over 1.500 to 3.000 Incl.	.010	.012	.014	.016	.018		
Over 3.000 to 4.000 Incl.	.011	.013	.015	.017	.019	.021	.023
Over 4.000 to 4.750 Incl.		.014	.016	.018	.020	.022	.024
Over 4.750 to 6.000 Incl.		.015	.017	.019	.021	.023	.025
Over 6.000 to 8.000 Incl.		.016	.018	.020	.022	.024	.026
Over 8.000 to 10.500 Incl.					.023	.025	.027
Over 10.500 to 12.500 Incl.					.024	.026	.028

SEAMLESS MECHANICAL STEEL TUBING

OD & ID TOLERANCE
ROUND COLD DRAWN

O.D. Size Range, Inches	Wall: Percent of O.D.	Unannealed or Stress Relief Annealed <1200F				Soft Annealed or Normalized			
		O.D. Inch.		I.D. Inch		O.D. Inch.		I.D. Inch	
		+	-	+	-	+	-	+	-
Up to 0.499	All	.004	.000	-	-	.005	.002	-	-
0.500/ 1.699	All	.005	.000	.000	.005	.007	.002	.002	.007
1.700/ 2.099	All	.006	.000	.000	.006	.006	.005	.005	.006
2.100/ 2.499	All	.007	.000	.000	.007	.008	.005	.005	.008
2.500/ 2.899	All	.008	.000	.000	.008	.009	.005	.005	.009
2.900/ 3.299	All	.009	.000	.000	.009	.011	.005	.005	.011
3.300/ 3.699	All	.010	.000	.000	.010	.013	.005	.005	.013
3.700/ 4.099	All	.011	.000	.000	.011	.013	.007	.010	.010
4.100/ 4.499	All	.012	.000	.000	.012	.014	.007	.011	.011
4.500/ 4.899	All	.013	.000	.000	.013	.016	.007	.012	.012
4.900/ 5.299	All	.014	.000	.000	.014	.018	.007	.013	.013
5.300/ 5.549	All	.015	.000	.000	.015	.020	.007	.014	.014
5.550/ 5.999	Under 6	.010	.010	.010	.010	.018	.018	.018	.018
	6 to 7 1/2	.009	.009	.009	.009	.016	.016	.016	.016
	Over 7 1/2	.018	.000	.009	.009	.017	.015	.016	.016
6.000/ 6.499	Under 6	.013	.013	.013	.013	.023	.023	.023	.023
	6 to 7 1/2	.010	.010	.010	.010	.018	.018	.018	.018
	Over 7 1/2	.020	.000	.010	.010	.020	.015	.018	.018
6.500/ 6.999	Under 6	.015	.015	.015	.015	.027	.027	.027	.027
	6 to 7 1/2	.012	.012	.012	.012	.021	.021	.021	.021
	Over 7 1/2	.023	.000	.012	.012	.026	.015	.021	.021
7.000/ 7.499	Under 6	.018	.018	.018	.018	.032	.032	.032	.032
	6 to 7 1/2	.013	.013	.013	.013	.023	.023	.023	.023
	Over 7 1/2	.026	.000	.013	.013	.031	.015	.023.	.023
7.500/ 7.999	Under 6	.020	.020	.020	.020	.035	.035	.035	.035
	6 to 7 1/2	.015	.015	.015	.015	.026	.026	.026	.026
	Over 7 1/2	.029	.000	.015	.015	.036	.015	.026	.026
8.000/ 8.499	Under 6	.023	.023	.023	.023	.041	.041	.041	.041
	6 to 7 1/2	.016	.016	.016	.016	.028	.028	.028	.028
	Over 7 1/2	.031	.000	.015	.016	.033	.022	.028	.028
8.500/ 8.999	Under 6	.025	.025	.025	.025	.044	.044	.044	.044
	6 to 7 1/2	.017	.017	.017	.017	.030	.030	.030	.030
	Over 7 1/2	.034	.000	.015	.019	.038	.022	.030	.030
9.000/ 9.400	Under 6	.028	.028	.028	.028	.045	.045	.049	.049
	6 to 7 1/2	.019	.019	.019	.019	.033	.033	.033	.033
	Over 7 1/2	.037	.000	.015	.022	.043	.022	.033	.033
9.500/ 9.999	Under 6	.030	.030	.030	.030	.045	.045	.053	.053
	6 to 7 1/2	.020	.020	.020	.020	.035	.035	.035	.035
	Over 7 1/2	.040	.000	.015	.025	.048	.022	.035	.035
10.000/ 10.750	Under 6	.034	.034	.034	.034	.045	.045	.060	.060
	6 to 7 1/2	.022	.022	.022	.022	.039	.039	.039	.039
	Over 7 1/2	.044	.000	.015	.029	.055	.022	.039	.039

*I.D. Tolerances apply to dimensions 0.625” and over when I.D. is at least half the O.D.

STRAIGHTNESS TOLERANCES (Inches)

COLD DRAWN SEAMLESS AND DOM TUBING

Outside Diameter Size range, Inches	Maximum Deviation from Straight			
	Wall % of Outside Diameter	Total Inches in any 3 Feet	Total in Entire length Inches per foot of length	
			Length 3 to 22 Feet	Length Under 3 and Over 22 Feet
Up to 5.000”	3% OD & Over	.030”	.007”	.010”
5.001 / 8.000”	4% OD & Over	.045”	.010”	.015”
8.001 / 10.750”	4% OD & Over	.060”	.015”	.020”

NOTE : Out-of-straightness is ordinarily checked at points of maximum deviation (as determined by line-of-sight observation) by means of a three-front straightedge and feeler gauges. When overall straightness in entire length is of concern, the tube is rolled on a surface-plate and maximum deviation-from-straight is determined by means of feeler gauges inserted between the tube and plate at point of maximum departure. If rotational methods such as chucking the tube at its ends or supporting the ends on rollers and rotating under a dial indicator are used, extreme care in interpreting results must be employed because readings are influenced by OD dimensional variation in addition to deviation-from-straight.

WALL TOLERANCES

SEAMLESS MECHANICAL TUBING

Max % Over and Under Nominal Wall

Wall Thickness Percent of OD	ID Under .500”	ID .500” and Over
Under 10%	± 10%	± 7.5%
10 to 25%	± 10%	± 6%
Over 25%	± 12.5%	± 7.5%

CARBON MECHANICAL

STEEL TUBING

TYPICAL PROPERTIES

SEAMLESS CARBON AND D.O.M

Chemical composition, percent (Ladle) 1018

C	MN	P	S
0.15 / 0.20	0.60 / 0.90	0.040 max	0.050 max.

Chemical compositions, percent (Ladle) 1026

C	MN	P	S
0.22 / 0.28	0.60 / 0.90	0.040 max.	0.050 max.

MECHANICAL PROPERTIES (APPROXIMATE)

Condition	Yield Strength Psi	Tensile Strength Psi	Elongation In 2 in. min, %
Hot-rolled	35000 47000	60000 70000	30 28
Normalized	38000 50000	58000 67000	35 33
Soft-Annealed[1]	33000 36000	50000 60000	40 35
Medium-Annealed[2]	45000 52000	67000 72000	30 22
Finish-Annealed	60000 65000	80000 82000	15 15
Hard-Drawn	70000 72000	85000 87000	10 10

[1]**Spheroidize Annealed**
[2]**Stress relief Annealed**

WELDED CARBON TUBING

Chemical composition, percent (Ladle) 1010

C	MN	P	S
0.05 / 0.15	0.30 / 0.60	0.040 max.	0.050 max.

Chemical composition, percent (Ladle) 1020

C	MN	P	S
0.15 / 0.25	0.30 / 0.60	0.040 max.	0.050 max

MECHANICAL PROPERTIES (APPROXIMATE)

Condition	Yield Strength Psi	Tensile Strength Psi	Elongation In 2 in. min, %
As-Welded	32000 38000	45000 52000	15 12
Normalized	25000 35000	40000 50000	30 25
Sink-Drawn	40000 50000	50000 60000	8 8
Mandrel-Drawn	50000 60000	60000 70000	5 5
Mandrel-Drawn Stress-Relieved	45000 55000	55000 65000	12 10

Designation	Form Available	Size Range	Mechanical Properties			Chemical Composition - %			
			Yield Point Min.KSI	Tensile Strength KSI	% Elongation Min 2"	C (Max.)	Mn. Range or Max.	P (Max.)	S (Max.)
ASTM-A53-07									
Type F-Furnance -	Welded	1/8" thru 26"							
Butt Welded (CW)	Seamless:		25.0	45.0				0.08	0.06
Type E - ERW Grade A	Black and		30.0	48.0		0.25	0.95	0.05	0.06
Grade B	Galvanized		35.0	60.0		0.30	1.20	0.05	0.06
Type S-Seamless									
Grade A			30.0	48.0		0.25	0.95	0.05	0.06
Grade B			35.0	60.0		0.30	1.20	0.05	0.06
ASTM-A135-06	Electric								
ERW - Grade A	Resistance	2 3/8" thru 22"	30.0	48.0				0.05	0.06
Grade B	Welded		35.0	60.0					
	Steel Pipe								
ASTM-A500-07									
Grade A	Round and		33.0	45.0	25	0.26	-	0.04	0.05
	Shaped	Maximum Periphery	39.0	45.0		0.26	-		
Grade B	Round and	32"	42.0	58.0	23	0.26	-		
	Shaped		46.0	58.0	23	0.26	-	0.04	0.05
ASTM-A513	Round	3/4 thru 15"							
as Welded			32.0	45.0	23	0.20	.60-.90	0.04	0.05
Mandreall Drawn			50.0	60.0	5	0.20	.60-.90	0.04	0.05
ASTM-A519	Round	thru 12 3/4"				22-28	.60-.90	0.04	0.05
Hot Rolled			35.0	55.0	35				
Cold Drawn			65.0	75.0	5				

Note: ASTM-A513 and A519 mechanical properties are listed as typical values

SECTION 9

EXPANDED METAL AND GRATING

PRODUCT DESCRIPTION

Expanded Metal is sheet metal that has been slit and expanded. The formation of the diamond-shaped patterns adds to the strength and rigidity of the sheet.

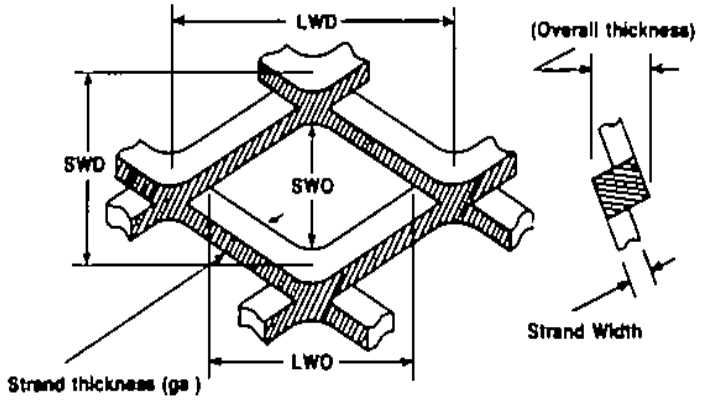
Expanded Metal is available in the “standard” pattern when the strands and bonds are set at a sharp angle to the plane of the sheet. It is also available in the “flattened” pattern when the material has been cold-rolled to bring the strands and bonds into the same plane. Flattened Expanded Metal is especially suited to welding because of its flat surface.

Expanded Metal has strength and rigidity, as well as a skid-resistant surface. It is free from any roughness or burr formed in the strands during the expanding process.

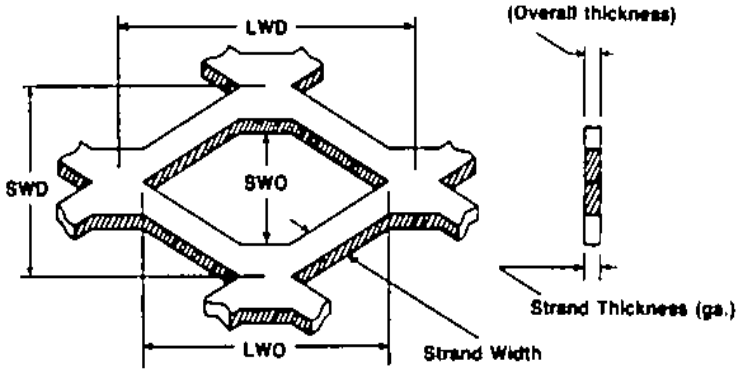
This material has the advantages of savings in weight and metal, free passage of light and air, and a decorative or ornamental effect. Structural applications include door panels, open partitions, window guards, enclosures; decorative applications include grilles, screens, panels, backgrounds, etc.

The width of the sheet is measured in the directions of the short dimension of the diamond. The length of the sheet is measured in the direction of the long dimension of the diamond.

STANDARD



FLATTENED



LEGEND

SWD -- "Short way of diamond"
LWD -- "Long way of diamond"
SWO -- "Short way of opening"
LWO -- "Long way of opening"
Strand Thickness - Equal to the thickness of the sheet of metal used.
Stand Width - Amount of metal of a given thickness in one strand.

EXPANDED METALS

GRATE-X

Style Designation (Wt.Per Sq.Ft.)	Standard Sheet Size S.W.D	x	L.W.D.	Diamond Size Inches	Opening Size Inches	Strand Inches	Overall Thickness Inches	Percent Open Area
3.0 lb.	4' & 6'		8' & 10'	1.33 x 5.33	.95 x 3.50	.264 x 3.50	9/16	60
3.14 lb.	6'		10'	2.00 x 6.00	1.63 x 4.88	.312 x .250	5/8	69
4.0 lb.	4' , 5' & 6'		8' & 10'	1.33 x 5.33	.83 x 3.30	.300 x .215	5/8	62
4.27 lb.	6'		8'	1.41 x 4.00	1.00 x 2.88	.300 x 2.50	5/8	58
5.0 lb	4' & 5' 6'		8' & 10' 10'	1.33 x 5.33	.76 x 3.20	.331 x .250	11/16	57
6.25 lb.	4'		8'	1.41 x 5.33	.75 x 3.10	.350 x .312	3/4	53
7.0 lb.	4'		8' & 8'4"	1.41 x 5.33	.69 x 3.05	.391 x .312	3/4	49

EXPANDED METALS (Continued)

EXPAND-X STANDARD PATTERN

Style	Standard Sheet Size Width	Lgth.	Percent Open Area	Opening Size	Overall Thick-ness	Wt. Lbs. C Sq. Ft.
1/4 No. 18	4'	8'	40	.125 x .687	.125	144
1/2 No. 18	4' & 6'	8'	65	.375 x .950	.161	70
	4'	10'				
1/2 No. 16	4' & 6'	8'	65	.375 x .890	.159	86
	4'	10'				
1/2 No. 13	4' & 6'	8'	61	.350 x .900	.199	147
3/4 No. 16	4' & 6'	8'	76	.700 x 1.640	.183	54
	4'	10'				
3/4 No. 13	4' & 6'	8'	76	.734 x 1.640	.185	80
	4'	10’				
3/4 No. 10	4'	8'	69	.675 x 1.563	.277	120
3/4 No. 9	4' & 6'	8'	68	.600 x 1.45	.290	180
1 1/2 No. 13	4' & 6'	8'	85	1.200 x 2.688	.213	60
1 1/2 No. 9	4' & 6'	8'	76	1.140 x 2.43	.289	119
	4'	10'				
1 1/2 No. 6	4'	8'	70	1.000 x 2.312	.410	250
	6'	12'				

EXPAND-X FLATTENED PATTERN

Style	Standard Sheet Size Width	Lgth.	Percent Open Area	Opening Size	Wt. Lbs. C Sq. Ft.
1/4 No. 18	3' & 4'	8'	34	.088 x .70	111
1/2 No. 18	3' & 4'	8'	58	.289 x 1.0	66
1/2 No. 18	4'	10'	58	.289 x 1.0	66
1/2 No. 16	3' & 4'	8'	60	.301 x 1.0	82
1/2 No. 16	4'	10'	60	.301 x 1.0	82
1/2 No. 13	4'	8'	52	.259 x .970	138
3/4 No. 16	3' & 4'	8' & 10'	74	.650 x 1.75	51
3/4 No. 13	4'	8' & 10'	73	.642 x 1.75	76
3/4 No. 9	4'	8' & 10'	62	.529 x 1.63	171
1 No. 16	3' & 4'	8'	78	.780 x 2.06	45
1 1/2 No. 16	3' & 4'	8'	85	1.14 x 2.71	29
1 1/2 No. 13	4'	8' & 10'	80	1.07 x 2.88	57
1 1/2 No. 9	4'	8' & 10'	74	1.00 x 2.62	113

Available in Stainless Steel, Aluminum and Decorative Expanded Metals

EXPANDED METALS (Continued)

BAR GRATING

STANDARD PANELS

Style	Bearing Bar Size	Weight Per Sq. Ft.
S-1	3/4" x 1/8"	4.1
S-2	1" x 1/8"	5.2
S-3	1 1/4" x 1/8"	6.3
S-4	1 1/2" x 1/8"	7.4
S-5	3/4" x 3/16"	5.7
S-6	1" x 3/16"	7.4
S-7	1 1/4" x 3/16"	9.1
S-8	1 1/2" x 3/16"	10.8
S-9	1 3/4" x 3/16"	12.5
S-10	2" x 3/16"	14.1
S-11	2 1/4" x 3/16"	15.7
S-12	2 1/2" x 3/16"	17.4

Available in 3' and 4' widths x 20' and 24' lengths.

EXPANDED METALS (Continued)

DIAMOND GRIP GRATING

Diamond Grip Grating is a one piece metal grating widely used by industry for work platforms, mezzanines, catwalks, stair treads and wherever safe footing is important; especially around machinery and all wet and oily areas where accidents frequently occur. Some of the design advantage of Diamond Grip are anti-skid, self cleaning, excellent load carrying capacity while still being lightweight and easy to handle and install. Our Diamond Grip is unique in that all diamonds have radiused ends, eliminating the metal tearing at the stress points.

Diamond Grip standard sized are manufactured from ASTM A525, G-90 preglavanized 12 and 14 gauge as well as 5050 H32 aluminum .080 thick to 12" wide, 18 3/4 wide. 100 thick and type 316 2B stainless steel 14 gauge to 11 3/4 wide.

		Width in Inches					
Material	Channel Height	4 3/4	7	9 1/2	11 3/4	18 3/4	24
Steel 14 Gauge Galvanized ASTM 525 G90	1 1/2” 2’” 2 1/2”	D2154 D2204 D2254	D3154 D3204 D3254	D4154 D4204 D4254	D5154 D5204 D5254	D8154 D8204 D8254	D10154 D10204 D10254
Steel 12 Gauge Galvanized ASTM G90	1 1/2" 2" 2 1/2" 3"	D2152 D2202 D2252	D3152 D3202 D3252 D3302	D4152 D4202 D4252 D4302	D5152 D5202 D5252 D5302	D8152 D8202 D8252 D8302	D10152 D10202 D10252 D10302
Aluminum 800 5050-H32	2"	D2202A	D3202A	D4202A	D5202A		
.100 5052-H32	2"					D8208A	
Stainless Steel 14 Guage 316 2B	2"	D2204S	D3204S	D4204S	D5204S		

DIMENSIONAL TOLERANCES:

Width: +1/16
Length: 10 ft + 1 1/2 - 1/4
12 ft + 1/2 - 1/4
Height: + 1/16

ASTM A569 HR P & O 12 & 14 gauge available on special order. Type 304 2B Stainless Steel 16 gauge to 11 3/4" wide on special order.

CORROSION RESISTANT FIBERGLASS REINFORCED GRATING

Fibergrate grating provides easy drain, corrosion resistant flooring for chemically aggressive environments. Other important Fibergrate properties are low flame spread and excellent fire resistance, impact resistance, non-skid, and ability to maintain long term stiffness under sustained heavy traffic in corrosive environments. All types of Fibergrate grating afford optimum performance under adverse conditions such as waste treatment facilities, metal finishing, mining, shipbuilding, and the chemical processing industries. Where corrosion is a problem, Fibergrate grating is an excellent alternative to steel grating.

Fiberglass grating is offered in isophalis resin for general corrosion splash and spill and hetro resin Class I flame spread for more severe chemical problems in the following panel sizes:

Grating Size	Panel Size	Panel Weight
Rectangular Mesh Grating 1" x 1" x 4"	4' x 8'	86 #'s
	3' x 10'	81 #'s
Square Mesh Grating 1 1/2" x 1 1/2” Square	3' x 10'	115 #'s
	4' x 8'	123 #'s
	5' x 10'	192 #'s
	4' x 12'	184 #'s

Fibergrate offers both square mesh and rectangular mesh grating. Square mesh is usually recommended where much greater stiffness is required with only a slight increase in weight.

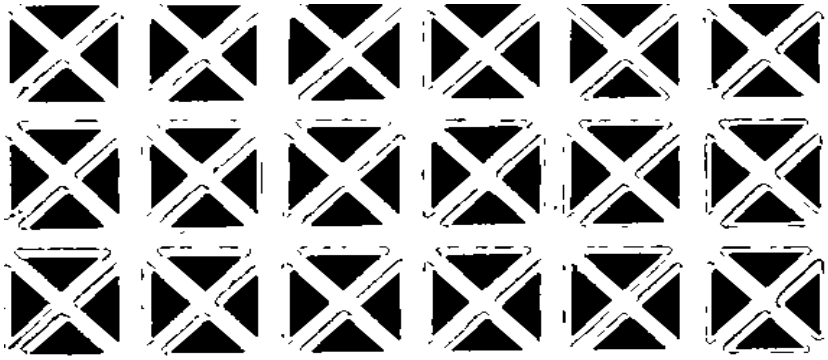
End panel attachments, hold down attachments, clips and fasteners are carried in stock.

EXPANDED METALS (Continued)

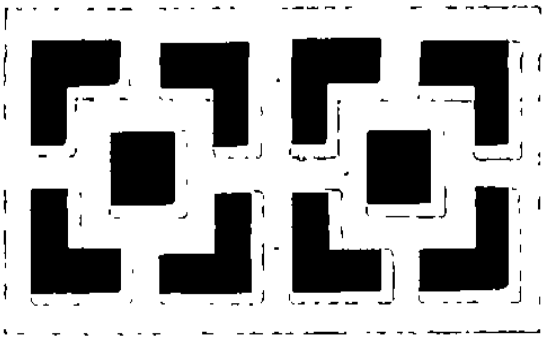
ORNAMENTAL GRILLE SHEETS

TRIPLEX
50% OPEN

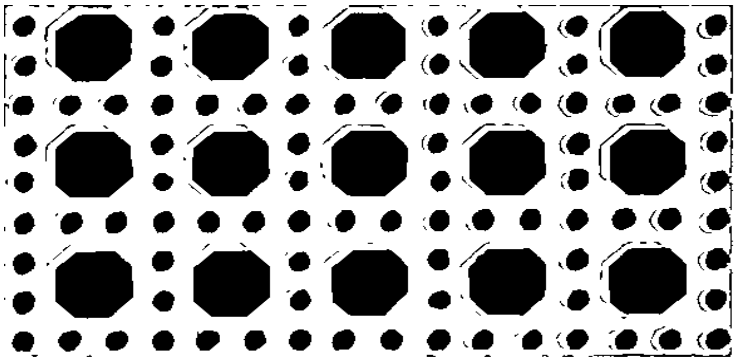
PERFEX
40% OPEN



STYLE A-1
45% OPEN



CANE DESIGN
NO. 41
41% OPEN



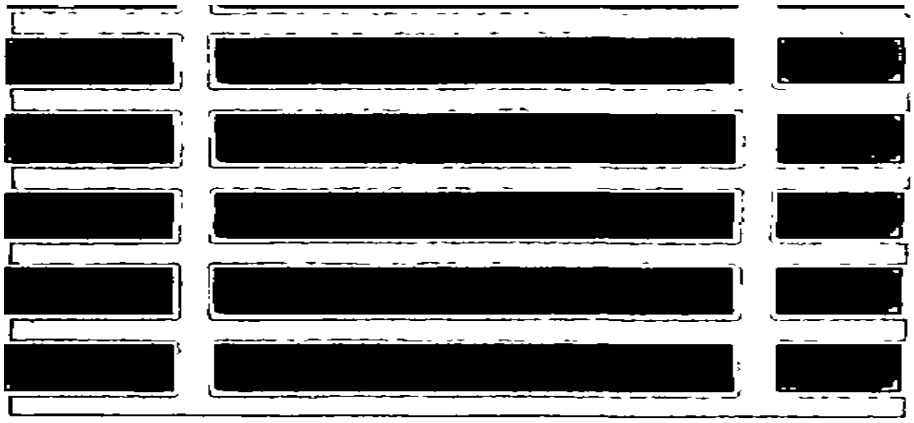
Sheet size 36 x 120 - 22 gauge. Above designs are shown full size.

EXPANDED METALS (Continued)

ORNAMENTAL GRILLE SHEETS

9/32" x 1 27/32" SLOT 65% Open

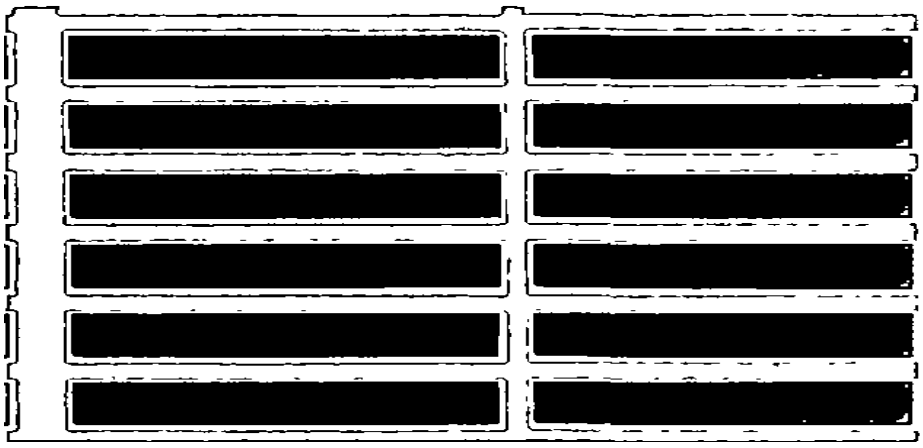
18 GAUGE 36 X 120



1/4" X 1 1/2" SLOT 67% OPEN

16 GAUGE 36 X 120

SLOT RUNS SHORT WAY OF SHEET.



Above designs are shown full size.

Special sizes of grilles can be made up from stock sheets, thereby saving time and expense required for factory shipment of special grilles to order.

Special Grille Catalog, showing all designs that can be furnished by the factory, will be sent upon request.

Grilles made to special size and order, with blank margins, any gauge, also in bronze and aluminum or stainless steel furnished from factory.

SECTION 10

ALUMINUM

ALUMINUM

The versatility of aluminum wrought alloy products is continually demonstrated by their capacity to serve satisfactorily as a material of construction in such diverse engineering and commercial applications as aircraft structures, extruded architectural structures and food processing equipment. The unique combination of properties make it an indispensable family of alloys for a myriad of applications. Among these properties are: low specific gravity; excellent corrosion resistance; the ease with which it can be formed, joined and machined; the broad range of mechanical properties; the high thermal and electrical conductivities; the non-magnetic and non-sparking characteristics; and the high reflectivity through a broad spectral range. One of aluminum's most valued properties is the high strength-to-weight ratio which results from its low density and relatively high mechanical properties, whether by precipitation (age) hardening the heat treatable alloys or work-hardening the non-heat treatable alloys. Many of aluminums best properties are present in both classes of materials and to achieve optimum performance in service before selecting the material consideration should be given to both the capabilities and limitations of each alloy and temper and the processing operations necessary to produce the finished article.

WROUGHT ALUMINUM

The Aluminum Association has established a system of classification of aluminum wrought alloys based on the chemical composition and the temper. The principal alloying elements that impact specific properties to the alloys are copper, manganese, magnesium, silicon and zinc. Depending on the elements added, the resulting alloys may be strengthened by heat treatment or may depend solely on cold-working (strain-hardening) of development of higher tensile properties.
The alloy identification entails four-digit numbers, the first digit identities the primary alloying elements that are effective in developing the mechanical properties by subsequent processing. The level of strength of the alloy is indicated by a letter and number(s) and results from the specific sequence of processing operations.

Alloy Designations

Alloy Number	Major Alloying Element
1xxx — Non-Heat Treatable	None (99.0% mm aluminum)
2xxx — Heat Treatable	Copper
3xxx — Non-Heat Treatable	Manganese
4xxx — Non-Heat Treatable	Silicon
5xxx — Non-Heat Treatable	Magnesium
6xxx — Heat Treatable	Magnesium and Silicon
7xxx — Heat Treatable	Zinc

ALUMINUM TEMPER DESIGNATIONS

The temper designation system is used for all forms of wrought and cast aluminum and aluminum alloys except ingot. It is based on the sequences of basic treatments used to produce the different tempers. The alloy designation is followed by the temper designation, being separated by a dash. Basic temper designations consist of letters. One or more digits following the letter indicates a subdivision of the basic temper. These designate specific sequences of basic treatments, but only when operations significantly influencing the characteristics of the product are indicated. Should another variation of the same sequence of basic operations be applied to the same alloy, then additional digits are added to the designation.

NON-HEAT TREATABLE ALLOYS

—F As fabricated. Applies to the products of shaping processes in which no special control over thermal conditions or strain hardening is employed.
—O Annealed. Applies to wrought products which are fully annealed to obtain the lowest strength condition.
—H Strain hardened. Applies where the strength is increased by strain hardening, with or without supplementary thermal treatments to produce some reduction in strength.

The H is always followed by two or more digits. The first digit following the H indicates the specific combination of operations, as follows:

—H1 strain hardened only.
—H2 strain hardened and partially annealed.
—H3 strain hardened and stabilized.

The second digit indicates the temper, as follows:

2	1/4 hard	8	fullhard
4	1/2 hard	9	extrahard
6	3/4 hard		

Added digits indicate modifications of standard practice.

HEAT TREATABLE ALLOYS

—F As fabricated. Applies to the products of shaping processes in which no special control over thermal conditions or strain hardening is employed.
—O Annealed. Applies to wrought products which are fully annealed to obtain the lowest strength condition.
—W Solution heat treated. An unstable temper applicable only to alloys which spontaneously age at room temperature, after solution heat treatment this designation is specific only when the period of natural aging is indicated
—T Thermally treated to produce stable tempers other than F, 0, or H.

The T is always followed by one or more digits. Numerals 1 through 10 following the T indicates specific sequences of basic treatments, as follows:

—T1 Cooled from an elevated temperature shaping process and naturally aged to a substantially stable condition.
—T2 Annealed to improve ductility and dimensional stability.
—T3 Solution heat treated and then cold worked.
—T4 Solution heat treated and naturally aged to a substantially stable condition.
—T5 Cooled from elevated temperature shaping process and then artificially aged.
—T6 Solution heat treated and then artificially aged.
—T7 Solution heat treated and then stabilized.
—T8 Solution heat treated, cold worked, and then artificially aged.
—T9 Solution heat treated, artificially aged, and then cold worked.
—T10 Cooled from an elevated temperature shaping process, artificially aged and then cold worked.

Additional digits may be added to designations T1 through T10 to indicate a variation in treatment which alters the characteristics of the product. The added digit cannot be zero.

3003 ALUMINUM COIL & SHEET

COILED SHEET
Not Identified, Not Interleaved; Spec QQ-A-250/2

3003-0 Mill Finish

Thick Inch	Width Inches	Est. Lbs. Sq. Ft.	Per Lin. Ft	Thick Inch	Width Inches	Est. Lbs. Sq. Ft.	Per Lin. Ft
.025	36	.356	1.068	.050	48	.711	2.844
.032	48	.455	1.820	.063	48	. 896	3.584
.040	48	.569	2.276				

3003-H14 MIll Finish

Thick Inch	Width Inches	Est. Lbs. Sq. Ft.	Per Lin. Ft	Thick Inch	Width Inches	Est. Lbs. Sq. Ft.	Per Lin. Ft
.016	36	.227	.68	.063	60	.896	4.480
.020	36	.285	.855	.080	36	1.140	3.420
.020	48	.285	1.140	.080	48	1.140	4.560
.025	36	.356	1.068	.080	60	1 140	5.700
.025	48	.356	1.424	.090	36	1.280	3.840
. 032	36	.455	1.365	.090	48	1.280	5.120
.032	48	.455	1 820	.090	60	1.280	6.400
.040	36	.569	1.707	.100	36	1.430	4.290
.040	48	.569	2.276	.100	48	1 430	5.720
.040	60	.569	2.845	.125	36	1.780	5.340
.050	36	.711	2 133	.125	48	1.780	7 120
.050	48	.711	2.644	.125	60	1.780	8.900
.050	60	.711	3.555	.190	36	2.710	8.130
.063	36	.896	2.688	.190	48	2.71	10.840
.063	48	.896	3.584				

FLAT SHEETS
Not Identified, Not Interleaved; Spec QQ-A-250/2

3003-0 Mill Finish

Thick Inch	Size Inches	Est. Lbs. Sq. Ft.	Per Lin. Ft	Thick Inch	Size Inches	Est. Lbs. Sq. Ft.	Per Lin. Ft
.025	36 x 120	.356	10.68	.063	48 x 144	.896	43.01
.032	48 x 144	.455	21.84	.080	48 x 144	1.14	54.72
.040	48 x 144	.569	27.31	.090	48 x 144	1.28	61.44
.050	48 x 144	.711	34.13	.125	48 x 144	1.78	85.44

3003-H14 Mill Finish

. .016	36 x 120	.227	6.81	.040	60 x 96	.569	22.760
.020	36 x 96	.285	6.84		60 x 120	.569	28.450
	36 x 120	.285	8.55		60 x 144	.569	34.140
	36 x 144	.285	10.26	.050	36 x 96	.711	17.06
	48 x 120	.285	11.40		36 x 120	.711	21.33
	48 x 144	.285	13.68		48 x 96	.711	22.75
.025	36 x 120	.356	10.68		48 x 120	.711	28 44
	36 x 144	.356	12.82		48 x 144	.711	34.13
	48 x 120	.356	14.24		60 x 96	.711	28.440
	48 x 144	.356	17.09		60 x 120	.711	35.550
.032	36 x 96	.455	10.92		60 x 144	.711	42.660
	36 x 120	.455	13.65	.063	36 x 96	.896	21.50
	48 x 96	.455	14.56		36 x 120	.896	26.88
	48 x 120	.455	18.20		36 x 144	.896	32.26
	48 x 144	.455	21.84		48 x 96	.896	28.67
.040	36 x 96	.569	13.65		48 x 120	.896	35.84
	36 x 120	.569	17.07		48 x 144	.896	43.01
	36 x 144	.569	20.48	.080	36 x 96	1.14	27.360
	48 x 96	.569	18.21		36 x 120	1.14	34.200
	48 x 120	.569	22.76		36 x 144	1.14	41.040
	48 x 144	.569	27.31		48 x 120	1.14	45.60
					48 x 144	1.14	54.72

5052 ALUMINUM COIL & SHEET

COILED SHEET

Not Identified, Not Interleaved; Spec QQ-A-250/8

5052-O Mill Finish

Thick Inch	Width Inches	Est. Lbs. Per Sq. Ft.	Lin. Ft	Thick Inch	Width Inches	Est. Lbs. Per Sq. Ft.	Lin. Ft
.032	48	.446	1.784	.050	48	.696	2.784
. 040	48	.557	2.228	.063	48	.877	3.508

5052-H32 Mill Finish

.025	36	.348	1.044	.063	48	.877	3.808
.025	48	.348	1.392		60	.877	4.385
.032	36	.446	1.338	.080	36	1.11	3.330
	48	.446	1.784		48	1.11	4.440
.040	36	.557	1.671	.090	36	1.28	5.120
	48	.557	2.228		48	1.28	5.120
.050	36	.696	2.088		60	1.28	6.400
	48	.696	2.784	.125	36	1.78	7.120
.063	36	.877	2.931		48	1.78	7.120
					60	1.78	8.900

5052-H34 MIll Finish

.020	36	.278	.834	.040	36	.557	1.671
.025	36	.348	1.044		48	.557	2.228
.032	48	.446	1.784	.050	48	.696	2.784
				.063	36	.877	2.931
					48	.877	3.508

FLAT SHEETS

Not Identified, Not Interleaved; Spec QQ-A-250/8

5052-O Mill Finish

Thick Inch	Size Inches	Est. Lbs. Per Sq. Ft.	Sheet	Thick Inch	Size Inches	Est. Lbs. Per Sq. Ft.	Lin. Ft
.020	48 x 144	.278	13.34	.063	48 x 144	.877	42.10
.032	48 x 144	.446	21.41	.080	48 x 144	1.11	53.28
.040	48 x 144	.557	26.74	.090	48 x 144	1.26	60.48
.050	48 x 144	.696	33.41	.125	48 x 144	1.74	83.52

5052-H32 Mill Finish

.025	36 X 144	.348	12.53	.063	48 X 96	.877	28.06
	48 X 144	.348	16.704		48 X 120	.877	35.08
.032	36 X 96	.446	10.70		48 X 144	.877	42.10
	48 X 96	.446	14.27	.080	36 X 120	1.11	33.30
	48 X 144	.446	21.41		36 X 144	1.11	39.96
.040	36 X 96	.557	13.37		36 X 96	1.11	26.64
	48 X 96	.557	17.82		48 X 96	1.11	35.52
	48 X 120	.557	22.28		48 X 144	1.11	53.28
	48 X 144	.557	26.74	.090	36 X 96	1.26	30.24
.050	36 X 96	.696	16.70		36 X 120	1.26	37.80
	36 X 120	.696	20.88		36 X 144	1.26	45.36
	48 X 96	.696	22.27		48 X 96	1.26	40.32
	48 X 120	.696	27.84		48 X 144	1.26	60.48
	48 X 144	.696	33.41		60 X 144	1.26	75.60
.063	36 X 96	.877	21.05	.100	48 X 144	1.39	66.72
	36 X 120	.877	26.31	.125	36 X 96	1.74	41.76
	36 X 144	.877	31.57		36 X 120	1.74	52.20
.063	60 X 96	.877	35.08		36 X 144	1.74	62.64
	60 X 120	.877	43.85		48 X 96	1.74	55.68
	60 X 144	.877	52.62		48 X 120	1.74	69.60
					48 X 144	1.74	83.52
					60 X 144	1.74	104.4
				.190	48 X 144	2.65	127.3

5052 ALUMINUM SHEET AND PLATE

FLAT SHEETS

Not Identified, Not Interleaved; Spec QO-A-250/8
5052-H32 Electronic Panel Quality

Thick Inch	Size Inches	Est. Lbs. Per Sq. Ft.	Sheet
.025	36 X 120	.348	10.44
.040	48 X 144	.557	26.74
.050	48 X 144	.696	33.41
.063	48 X 96	.877	28.06
	48 X 144	.877	42.10
	60 X 144	.877	52.62
.080	48 X 144	1.11	53.28
.090	36 X 96	1.26	30.24
	48 X 96	1.26	40.32
	48 X 144	1.26	60.48
.100	48 X 144	1.39	66.72
.125	36 X 96	1.74	41.76
	48 X 96	1.74	55.68
	48 X 144	1.74	83.52
	60 X 144	1.74	104.4
.190	36 X 96	2.65	63.60
	48 X 96	2.65	84.80
	48 X 144	2.65	127.2

5052-H34 Mill Finish

Thick Inch	Size Inches	Est. Lbs. Per Sq. Ft.	Sheet
.020	36 x 96	.278	6.67
.025	36 x 96	.348	8.35
.032	48 x 144	.446	21.41
.040	36 x 96	.557	13.37
	48 x 144	.557	26.74
.050	48 x 120	.696	27.84
	48 x 144	.696	33.41
.063	36 x 96	.877	21.05
	36 x 120	.877	26.31
	48 x 96	.877	28.06
	48 x 120	.877	35.08
	48 x 144	.877	42.10
.080	48 x 144	1.11	53.28
.090	48 x 144	1.26	50.48
.125	48 x 144	1.74	83.52
.190	48 x 144	2.65	127.2

5052-H321 Electronic Cabinet
Identified, Not Interleaved; Spec QQ-A-250/8

Thick Inch	Size Inches	Est. Lbs. Per Sq. Ft.	Sheet
.050	48 x 144	.696	33.41
.063	48 x 144	.877	42.10
.080	48 x 144	1.11	53.28
.090	48 x 144	1.26	60.48
.100	48 x 144	1.39	66.72
.125	48 x 144	1.74	83.52

PLATE

Not Interleaved, Not Identified; Spec QQ-A-250/8

5052-H32 Mill Finish

Thick Inch	Width Inches	Est.. Lbs. Per Sq. Ft	Lin. Ft.
1/4	48 x 144	3.48	139
	48 x 144	3.48	167
3/8	48 x 144	5.22	251

6061 ALUMINUM COIL & SHEET

COILED SHEET

Spec QQ-A-250/11
6061-O Bare — Mill Finish

Thick Inch	Width Inches	Est. Lbs. Sq. Ft	Per Lin. Ft.	Thick Inch	Width Inches	Est. Lbs. Sq. Ft	Per Lin. Ft
.032	48	.452	1.808	.071	48	.999	3.996
.040	48	.565	2.260	.080	48	1.13	4.520
.050	48	.706	2.824	.090	48	1.27	5.080
.063	48	.889	3.556	.125	48	1.764	7.056
				.160	48	2.258	9.032
				.190	48	2.680	10.720

FLAT SHEETS—MILL FINISH

Identified and Interleaved; Spec QQ-A-250/11
6061-0 Bare

Thick Inch	Size Inches	Est. Lbs. Sq. Ft.	Per Sheet	Thick Inch	Size Inches	Est Lbs. Sq. Ft.	Per Sheet
.025	36 X 144	.353	12.71	.071	48 X 144	.999	47.95
.032	48 X 144	.452	21.70	.080	48 X 144	1.13	54.24
.040	48 X 144	.565	27.12	.090	48 X 144	1.27	60.96
.050	48 X 144	.706	33.89	.100	48 X 144	1.41	67.68
	60 X 144	.706	42.36	.125	48 X 144	1.76	84.48
.063	48 X 144	.889	42.67	.160	48 X 144	2.258	108.38
				.190	48 X 144	2.68	128.6

COILED SHEET; Spec QQ-A-250/11

6061-T4 Bare

.032	48	.452	1.508	.050	48	.706	2.824
.040	48	.565	2.260	.063	48	.859	3.556

6061-T4 Bare

.025	48 X 144	.353	16.94	.080	48 X 144	1.13	54.24
.032	48 X 144	.452	21.70	.090	48 X 144	1.27	60.96
.040	48 X 144	.565	27.12	.100	48 X 144	1.41	67.68
.050	48 X 144	.706	33.89	.125	48 X 144	1.76	84.48
.063	48 X 144	.889	42.67	.190	48 X 144	2.68	128.6

6061-T6 Bare

.012	48 X 144	.170	8.16	.080	60 X 144	1.13	67.80
.016	48 X 144	.225	10.8	.090	48 X 144	1.27	60.96
.020	48 X 144	.282	13.54		60 X 144	1.27	76.20
.025	36 X 144	.353	12.71	.100	48 X 144	1.41	67.98
	48 X 144	.353	16.94	.112	48 X 144	1.58	75.84
.032	48 X 144	.452	21.70	.125	36 X 96	1.76	42.24
.040	48 X 96	.565	18.08		36 X 144	1.76	63.36
	48 X 144	.565	27.12		48 X 96	1.76	56.32
.050	48 X 144	.706	33.89		48 X 144	1.76	84.48
	60 X 144	.706	42.36		60 X 144	1.76	105.6
.063	36 X 96	.889	21.34	.160	48 X 144	2.25	108.0
	48 X 144	.889	42.67	.190	48 X 144	2.68	128.6
	60 X 144	.889	53.34		60 X 144	2.68	160.8
.071	48 X 144	.999	47.95		72 X 144	2.68	193.0
.080	48 X 144	1.13	54.24				

6061 ALUMINUM PLATE

6061-T651 Plate

Wrought Tooling Plate
Identified and Interleaved; QQ-A-250/11

Thick Inch	Size Inches	Est. Lbs. Per Sq. Ft.	Plate	Thick Inch	Size Inches	Est Lbs. Per Sq. Ft	Plate
1/4	36.5 x 96.5	3.52	86	1 1/4	36.5 x 96.5	17.6	430
	48.5 x 144 5	3.52	171		48.5 x 144.5	17.6	857
	60.5 x 144.5	3.52	214	1 1/2	36.5 x 96.5	21.1	516
	72.5 x 144 5	3.52	256		48.5 x 144.5	21.1	1027
5/16	48.5 x 144.5	4.39	214		60.5 x 144.5	21.1	1281
	60.5 x 144.5	4.39	267	1 3/4	36.5 x 96.5	24.6	602
3/8	36.5 x 96.5	5.28	129		48.5 x 144.5	24.6	1197
	48.5 x 144.5	5.28	257	2	36.5 x 96.5	28.1	687
	60.5 x 144.5	5.28	321		48.5 x 144.5	28.1	1368
1/2	36.5 x 96.5	7.04	172		60.5 x 144.5	28.1	1706
	48.5 x 144.5	7.04	343	2 1/4	48.5 x 144.5	31.7	1543
	60.5 x 144.5	7.04	428	2 1/2	48.5 x 144.5	35.2	1713
5/8	36.5 x 96.5	8.79	215		60.5 x 144.5	35.2	2137
	48.5 x 144.5	8.79	428	2 3/4	48.5 x 144.5	38.8	1863
	60.5 x 144.5	8.79	534	3	36.5 x 96.5	42.2	1032
3/4	36.5 x 96.5	10.6	259		48.5 x 144.5	42.2	2054
	48.5 x 144.5	10.6	516	3 1/4	48.5 x 144.5	49.2	2394
	60.5 x 144.5	10.6	644	4	48.5 x 144.5	56.3	2740
1/8	48.5 x 144.5	12.3	599	4 1/2	48.5 x 144.5	63.3	3081
1	36.5 x 96.5	14.1	345	5	48.5 x 144.5	70.3	3421
	48 5 x 144.5	14.1	686	6	48 5 x 144.5	84.4	4108
	60.5 x 144.5	14.1	856				

6061 Plate—Mill Finish

Identified and Interleaved; Spec QQ-A-250/11

6061-0 Bare				6061-T451 Bare			
1/4	48 x 144	3.52	169	5/16	48.5 x 144.5	4.51	219
1/4	48 x 144	3.52	169	3/8	48.5 x 144.5	5.29	257

6061-T6 Tread Plate No.C102

(Unidentified, not Interleaved)

1/8	48 x 144	1.90	91	1/4	48 x 192	3.70	237
	48 x 192	1.90	122		60 x 192	3.70	296
	60 x 192	1.90	152	3/8	48 x 192	5.50	352
3/16	48 x 144	2.80	134		60 x 192	5.50	440
	48 x 192	2.80	179	1/2	48 x 192	7.30	467
	60 x 192	2.80	224		60 x 192	7.30	584
1/4	30 x 192	3.70	148				
	48 x 144	3.70	178				
.100	48 x 192	1.55	99				

3003 Tread Bright

.100	48 x 144	1.55	74	.188	48 x 144	2.79	134
	48 x 192	1.55	99		48 x 192	2.78	179
.125	48 x 144	1.90	91		60 x 192	2.79	223
	48 x 192	1.90	122				
	60 x 192	1.90	152				

STANDARD ALUMINIUM TOLERANCES

WIDTH-SHEARED FLAT SHEET AND PLANT[1]

Specified Width--In.

SPECIFIED THICKNESS	Up thru 6	Over 6 thru 24	Over 24 thru 60	Over 60 thru 96	Over 96 thru 132	Over 132 thru 168
in.				Tolerance[2]-In.		
0.006-0.124	± 1/16	±3/32	±1/8	±1/2	±5/32	-
0.125-0.249	±3/32	±3/32	±1/8	±5/32	±3/16	-
0.250-0.499	+1/4	+3/16	+3/8	+3/8	+7/16	+1/2

LENGTH-SHEARED FLAT SHEET AND PLANT[1]

Specified Width--In.

SPECIFIED THICKNESS In	Up thru 30	Over 30 thru 60	Over 60 thru 120	Over 120 thru 240	Over 240 thru 360	Over 360 thru 480	Over 480 thru 600	Over 600 thru 720
				Tolerance[2]-In.				
0.006-0.124	±1/16	±3/32	±1/8	±5/32	±3/16	±7/32	±9/32	-
0.125-0.249	±3/32	±3/32	±1/8	±5/32	±7/32	±1/4	±5/16	-
0.250-0.499	+1/4	+3/8	+7/16	+1/2	+9/16	+3/8	+11/16	+3/4

WIDTH AND LENGTH TOLERANCES- SAWED FLAT SHEET AND PLATE

Specified Width--In.

SPECIFIED THICKNESS In	Up thru 30	Over 30 thru 60	Over 60 thru 120	Over 120 thru 240	Over 240 thru 360	Over 360 thru 480	Over 480 thru 600	Over 600 thru 720
					Tolerance[2]-In.			
0.080-0.249	±1/8	±1/8	±3/16	±1/2	±1/4	±3/16	±3/8	±7/16
0.0250-6.000	+1/4	+5/16	+3/8	+1/2	+9/16	+5/8	+3/4	+7/8

WIDTH AND LENGTH -- SAWED PLATE
Specified Width or Length,Inches

SPECIFIED THICKNESS In	Up thru 18	Over 18 thru 48	Over 48 thru 120	Over 120 thru 144	Over 144 thru 180	Over 180 thru 240	Over 240 thru 540	Over 540 thru 720
					Tolerance,[1] Inches			
.250-6.000	+1/4	+5/16	+3/8	+7/16	+1/2	+9/16	+5/8	+3/4

WIDTH-SLIT COILED SHEET
Specified Width--In.

SPECIFIED THICKNESS	Up thru 6	Over 6 thru 12	Over 12 thru 24	Over 24 thru 48	Over 48 thru 60	Over 60 thru 90
Inches			Tolerance,[2] InCHES PLUS AND MINUS			
.006-.125	.010	0.016	1/32	3/64	1/16	1/8

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

[2] Tolerance applicable at ambient mill temperatures. A change in dimension of 0.013 In per 100 in. per10F(6C) must be recognized.

STANDARD ALUMINIUM TOLERANCES(Continued)

LATERAL BOW (CAMBER)[2] -FLAT SHEET AND PLATE

Allowable deviation of a side edge from a straight line

Specified Thickness Inches	Specified Width Inches	Up thru 30	Over 30 thru 60	Over 60 thru 90	Over 90 thru 120	Over 120 thru 150	Over 150 thru 180	Over 180 thru 210	Over 210 thru 240
		Tolerance, Inches[1]							
Flat Sheet									
.006-.125	Up thru 4	1/16	1/4	1/2	1	1 1/2	2	3	4
.006-.249	Over 4-35	1/32	1/16	3/32	1/8	3/16	1	1/1/2	2
.006-.249	Over 35-90	1/32	1/16	3/32	1/8	3/16	5/16	7/16	9/16
Plate									
.250-6.000	Up thru 10	1/16	1/4	1/2	1	1 1/2	2	3	4
.250-6.000	Over 10-18	1/32	1/16	1/8	1/4	13/32	19/32	25/32	1
.250-6.000	Over 18	1/32	1/16	3/32	1/8	3/16	5/16	7/16	

LATERAL BOW -COILED SHEET

Specified Thickness, Inches	Tolerance -- Inches In Specified Width, Inches	6ft. Allowable Deviation of a Side Edge from a straight line
.006-.064	1/2 thru 1	3/4
	Over 1-2	9/16
.065-.125	Over 2-4	3/8
	Over 4-10	1/4
	Over 10	3/16

SQUARENESS-FLAT SHEET AND PLATE

Length specified, feet	3 feet & under	Over 3 feet
	Maximum allowable difference in length diagonals of either square or rectangular sheet or plate,Inches(1)	
12 feet & under	3/32 x width, feet(2)	5/64 x width, feet (2)
Over 12 feet	9/64 x width, feet(2)	7/64 x width, feet (2)

1) Round calculated results to nearest 1/16"
2) If specified width is other than an exact multiple of 12 inches, tolerance is determined by using the next largest multiple.

STANDARD ALUMINUM TOLERANCES(Continued)

FLATNESS-SAWED OR SHEARED PLATS

Longitudinal Flatness

Specified Thickness, Inches	Tolerance[1] -TX51 tampers[2]	Inches Allowable Deviation from Flat Other than -Tx51 tampers[2]
250-3.000	3/16 in. any 6 ft.[2]	1/4 in. any 6 ft. or less
3.001-6.000	1/8 in. any 6 ft. or less	1/4 in. any 6 ft. or less

Transverse Flatness[5]

	Tolerance[1] Inches Allowable from Flat				
	Widths over 4 ft. thru 6 ft		Widths over 2 ft. thru 4 ft.		Widths 2ft. And less
Specified thickness, Inches	-TXS1 tempers[2]	Other than -TX51 tempers[2]	-TX51 tempers[2]	Other than -TX51 tempers[2]	All Tempers
.250-.624	3/8	1/2	5/16	3/8	
.625-1.500	5/16	3/8	3/16	1/4	Only short-cycle
1.501-3.00	3/16	1/4	3/16	3/16	flatness tolerance
3.001-6.00	1/8	1/4	1/8	3/16	applies

Short-Cycle Flatness

Specified Thickness, Inches	Tolenrance[4] Inches Allowable Deviation from Flat -TX51 tempers[2]	Other than-TX51 tempers[2]
.250-.624	.100	.125
.625-.6000	.075	.090

[1] As measured with plate resting on a flat surface concave side upward, using a straight edge and a feeler gauge, dial gauge or scale.
[2] -TX51 is a general designation for the following stress-relieved Tempers: -T351, -T451, -T651, -T851.
[3] For lengths under 6ft, the tolerance is 1/8 In.
[4] For widths over 6-ft., these tolerances apply tor any 6 ft. of total width.
[5] Short-cycle flatness is the flatness over any 2-ft. span in any direction.
[6] As measured with the plate resting on a flat surface, and by use of a frame with rollers mounted on 2-ft. centers and a depth gauge in the center.

FLATNESS—SHEARED FLAT SHEET[1]

Alloys	Thickness, Inches, Inclusive	Longitudinal or Transverse Frequency, Feet[2] Center to Center of Buckles of Edge Waves: Up thru 2	Over 2 thru 3	Over 3 thru 4	Over 4 thru 6	Over 6
		Tolerance, Inches,[3,4,5]				
1100,3003	**.020-.064**	1/8	3/16	3/16	5/16	3/8
5005,5050	**.065-.249**	1/8	3/16	5/16	3/8	1/2
5052,5083,5086	**.020-.064**	3/16	3/16	5/16	3/8	1/2
All Heat-Treatable Alloys	**.065-.249**	3/16	5/16	3/8	1/2	9/16

[1] Non applicable to cut-to-length sheet, panel flat sheet, coiled sheet, or sheet over 60 inches wide.
[2] Also applicable to overall width and length of sheet if only one longitudinal and/or transverse buckle or edge wave is present.
[3] Allowable deviation from flat with sheet positioned on flat horizontal surface to minimize deviation.
[4] Not applicable to F temper heat-treatable alloys or O H112 and HX8 tempers all alloys.
[5] Not applicable to end or comer turn-up.

SECTION 11

STAINLESS STEEL

STAINLESS STEEL

Stainless steels, by definition, are iron-base alloys containing 11.5% minimum chromium as the major alloying constituent. A continuous film of chromium oxide on the surface of the metal makes the material “stainless”; removal of this film by any means diminishes its capability to resist the initiation of corrosion which is usually progressive.

The addition and/or restriction of certain select materials in specific ranges has resulted in a group of alloys having remarkable versatility in their suitability for service over a wide range of temperatures in various environments. These alloying additions may have one or more beneficial effects in enhancing the tensile strength, toughness, corrosion resistance, scaling resistance at high temperature, machinability and formability. The ultimate selection of the proper stainless steel will require consideration of the end use, the strength requirements the nature and intensity of the corrosive media that it must endure and the fabrication techniques employed to get it into its final form.

The stainless steel family of alloys are classified as Chromium types and Chromium- Nickel types. The former are divided into two sub-classifications and the latter into three. Standard stock items are:

CHROMIUM TYPES:

Martensitic—Heat treatable; magnetic in all tempera 410, 416 and 440C
Ferritic—Non-heat treatable; magnetic: 430

CHROMIUM-NICKELTYPES:

Austenitic —Non-heat treatable; non-magnetic in the annealed condition but they progressively increase in magnetism with increasing cold-work: 301, 302, 303S, 304, 304L, 316, 316L, 321 and 347
Semi-austenitic —Precipitation Hardenable; mildly magnetic in the annealed condition and strongly magnetic in the hardened tempera: 17-7PH
Martensitic—Precipitation Hardenable, strongly magnetic in all tempers: 15-5PH and17-4PH

The user should review the alloy discussions and tabulated data to follow and note the properties of each grade before making the final selection for the application. These properties include corrosion resistance, formability, response to thermal treatments, joining methods and machinability.

TYPE 301

Type 301 responds to work-hardening rapidly, which permits production of sheet products with moderately high tensile strength with sufficient residual ductility to enable the fabricator to perform light forming operations, particularly with the quarter- and half-hard temper sheets it can be welded by inert-gas electric-arc methods without annealing although some loss of the temper is sacrificed in the weldment. It is used in those application that require moderate corrosion resistance and strength without heat treatment.

CHEMICAL COMPOSITION LIMITS (Maximums unless range shown):

C	Mn	P	S	Si	Cr	Ni	Mo	Cu
.15*	2.00	.045	.030	1.00	16.0/18.0	6.0/8.0	.50	.50

*.12% maximum permissible for aircraft applications per QQ-S-766

MECHANICAL PROPERTIES:

Product/Temper	Tensile strength, psl	Yield strength, psl	Elongation In 2", %	Hardness
Sheet				
1/4 Hard	125,000*	75,000*	25*	Rockwell C25
1/2 Hard	150,000*	110,000*	18*	Rockwell C32
Full Hard	185,000*	140,000*	9*	Rockwell C41

*Minimum

STAINLESS STEEL TYPES 302, 304, AND 304L

Type 302, the original "18-8 stainless," set the standard for corrosion resistance to which all other stainless sheets are compared. It work hardens to extraordinarily high tensile strengths. Such as the Spring Temper (condition B) Hinge Pin wire. It is widely used in other coldworking operations, such as deep drawn and spun parts from sheet. Types 304 and 304L are modifications of Type 302 with lowered carbon contents and increased chromium limits. Type 304 is the work-horse of the 300-series stainless steels and is used interchangeably with most Type 302 applications where moderate tensile properties and good corrosion resistance are required. Both grades may be welded in sections sufficiently thin to permit rapid dissipation of the heat that precludes diminishing the characteristic corrosion resistance of the material. In thicker welded sections Type 304L is usually recommended.

Types 304 and 304L are the most frequently specified stainless steels for applications due to their versatility. Applications include cold formed parts, food processing equipment, nuclear reactor components, oil refinery equipment, architectural trim, moderately stressed structural components, valve and pump parts.

CHEMICAL COMPOSITION LIMITS (Maximums unless range shown):

	C	Mn	P	S	Si	Cr	Ni	Mo	Cu	N
302	.15	2.04	.045	.030	1.00	17.00/19.00	8.00/10.00	-	-	-
304	.08	2.00	.040	.030	1.00	18.00/20.00	8.00/11.00	.75	.75	.10
304L	.03	2.00	.040	.030	1.00	18.00/20.00	8.00/11.00	.75	.75	.75

TYPICAL MECHANICAL PROPERTIES:

Product Temper	**Tensile strength psi**	**Yield strength psi**	**Elongation In 2"%**	**Reduction of Area**	**Hardness**
T302 Hinge Pin Wire Spring Temper	185/280,000	-	-	-	-
T302/304/304L Sheet & Plate Annealed	85,000	40,000	55	-	Rockwell B80
T304 Bar & Shapes Annealed	85,000	35,000	60	70	Brinell 150

TYPE 303 S

Type 303S is the free-machining grade that is nominally Type 302, with specific limits of sulfur added to facilitate machining. The corrosion resistance approaches that of Type 302. Typical applications include screw machine parts, bolts, nuts and shafts. Welding is not recommended.

CHEMICAL COMPOSITION LIMITS (Maximums unless range shown):

C	Mn	P	S	Si	Cr	Nl	Md	Cu
.15	2.00	.15	.15/.40	1.00	17.00/19.00	8.00/10.00	.75	.75

TYPICAL MECHANICAL PROPERTIES:

Product Temper	Tensile strength, psi	Yield strength. psi	Elongation IN 2", %	Reduction of Area	Hardness
Bar & Wire Annealed, & cold drawn	100,00	60,000	40	53	Brinell 228
Annealed, centerless, ground	90,000	35,000	50	55	Brinell 160

STAINLESS STEEL

TYPES 316 AND 316L

Types 316 and 316L are other modifications of the basic Type 302 composition that have molybdenum added to improve the strength properties. More importantly, the molybdenum increases the resistance to general corrosion and particularly diminishes the susceptibility to pitting corrosion. Sheets can be cold worked by most conventional methods such as spinning, drawing and bending. Thin sections may be welded without final annealing but sections over 1/4" should use the Type 316L grade to prevent the precipitation of chromium carbides. These grades are specified when the improved corrosion resistance coupled with excellent formability and weldability are required. These include the pharmaceutical and food processing industries, photographic equipment, nuclear reactor components and marine environment applications.

CHEMICAL COMPOSITION LIMITS (Maximums unless range shown):

	C	Mn	P	S	Si	Cr	Ni	Mo	Cu	N
316	.08	2.00	.040	.030	1.00	16.00/18.00	10.00/14.00	2.00/3.00	.75	.10
316L	.03	2.00	.040	.030	1.00	16.00/18.00	10.00/14.00	2.00/3 00	.75	.10

TYPICAL MECHANICAL PROPERTIES:

Product Temper	Tensile Strength psi	Yield Strength psi	Elongation In 2", %	Reduction of Area	Hardness
Sheet annealed	84,000	42,000	50	—	Rockwell B80
Plate annealed	82,000	36,000	55	—	Brinell 149
Bar & Shapes, annealed	80,000	35,000	60	70%	Brinell 149

TYPES 321 AND 347

Types 321 and 347 are variations of the basic 18-8 composition stabilized by alloy addition to improve weldability and high temperature service. The nickel content has been increased from a nominal 8% to 10% and titanium has been added to Type 321 and columbium and tantalum have been added to Type 347 to eradicate the possibility of chromium carbide precipitation which would result in a decrease in corrosion resistance. This allows prolonged service at 1600 degrees F without impairment of the general corrosion resistance and also permits welding without postannealing although a stress relief treatment at 400 to 750 degrees F is recommended. The corrosion resistant properties and the response to cold working are comparable to Types 302 and 304 Applications include oil-refinery equipment, aircraft components, exhaust systems such as aircraft engine manifolds and high-temperature furnace fixtures.

CHEMICAL COMPOSITION LIMITS (Maximums unless range shown):

	C	Mn	P	S	Si	Cr	Ni	Ma	Cu	Ti	Cb & Ta
321	.08	2.00	.040	.030	1.00	17.00/19.00	8.00/12.00	.75	.50	5XC/.70	-
347	.08	2.00	.040	.030	1.00	17.00/19.00	9.00/12.00	.75	.50	-	10XC/1.10

TYPICAL MECHANICAL PROPERTIES:

Product Temper	Tensile Strength psi	Yield Strength psi	Elongation In 2" %	Reduction of Area	Hardness
Sheet, annealed	90,000	35,000	45	—	Rockwell B80
Plate, annealed	85,000	35,000	55	—	Rockwell B89
Bars, annealed	85,000	35,000	55	65%	Brinell 150

TYPE 301 STAINLESS SHEET

QQ-S-766; MIL-S-5059

Type 301, 1/4 Hard, No, 2B Finish

Thickness Dec Inch	Size Inches	Est Lbs Per Sq Ft	Est Lbs Per Sheet	Thickness Dec In Ga	Size Inches	Est Lbs Per Sq Ft	Est Lbs Per Sheet
.0161 (19)	36 x 120	.676	20.28	.040	36 x 120	1.68	50.40
.020 (26)	36 x 120	.840	25.20	.050	36 x 120	2.10	63.00
.025	36 x 120	1.05	31.50	.063	36 x 120	2.65	79.50
.0321	36 x 120	1.35	40.50	.071	36 x 120	2.98	89.40
.036	36 x 120	1.51	45.30	.080	36 x 120	3.36	10.08
				.090	36 x 120	3.78	11.34
				.125	36 x 120	5.25	157.5

Type 301, 1/2 Hard, No. 2B Finish

.0161	36 x 120	.676	20.28	.050	36 x 120	2.10	63.00
.020	36 x 120	.840	25.20	.063	36 x 120	2.65	79.50
.025	36 x 120	1.05	31.50	.080	36 x 120	3.36	10.08
.0321	36 x 120	1.35	40.50	.090	36 x 120	3.76	113.4
.036	36 x 120	1.51	45.30	.125	36 x 120	5.25	157.5
.040	36 x 120	1.68	50.40				

Type 301, Full Hard, No. 2B Finish

Thickness Dec In Ga	Size Inches	Est Lbs Per Sq Ft	Est Lbs Per Sheet	Thickness Dec In Ga	Size Inches	Est Lbs Per Sq Ft	Est Lbs Per Sheet
.0161	36 x 120	.676	20.28	.040	36 x 120	1.68	50.40
.020	36 x 120	.840	25.20	.050	36 x 120	2.10	63.00
.025	36 x 120	1.05	31.50	.063	36 x 120	2.65	79.50
.0321	36 x 120	1.35	40.50	.080	36 x 120	3.36	100.8
				.090	36 x 120	3.75	113.4

TYPE 302-304 STAINLESS SHEET

Condition A

ASTM-A240; ASME-SA240; QQ-S-766; MIL-S-5059; AMS-5513

T304 Sheet, No. 2B Finish, Condition A

Thickness Dec In Ga	Size Inches	Est Lbs Per Sq Ft	Est Lbs Per Sheet	Thickness Dec In Ga	Size Inches	Est Lbs Per Sq Ft	Est Lbs Per Sheet
.0161 (27)	36 x 120	.676	20.28	.040 (19)	36 x 120	1.68	50.40
.018 (26)	36 x 96	.756	18.14		48 x 120	1.68	67.20
	36 x 120	.756	22.68	.048 (18)	36 x 96	2.02	48.48
	48 x 120	.756	30.24		36 x 120	2.02	60.60
.020 (25)	36 x 96	.840	20.16		36 x 144	2.02	72.72
	36 x 120	.840	25.20		48 x 96	2.02	64.64
	48 x 120	.840	33.60		48 x 120	2.02	80.80
.024 (24)	36 x 96	1.01	24.24		48 x 144	2.02	96.96
	36 x 120	1.01	30.30		60 x 120	2.02	100.8
	48 x 96	1.01	32.32		60 x 144	2.02	121.0
	48 x 120	1.01	40.40	.060 (16)	36 x 96	2.52	60.48
	48 x 144	1.01	48.48		36 x 120	2.52	75.60
.030 (22)	36 x 96	1.26	30.24		36 x 144	2.52	90.72
	36 x 120	1.26	37.80		48 x 96	2.52	80.64
	36 x 144	1.26	45.36		48 x 120	2.52	100.8
	48 x 96	1.26	40.32		48 x 144	2.52	121.0
	48 x 120	1.26	50.40		60 x 120	2.52	126.0
	48 x 144	1.26	60.48		60 x 144	2.52	151.2
.0351 (20)	36 x 96	1.47	35.28				
	36 x 120	1.47	44.10				
	36 x 144	1.47	52.92				
	48 x 96	1.47	47.04				
	48 x 120	1.47	58.80				
	48 x 144	1.47	70.56				

TYPE 302-304 STAINLESS SHEET

T302-304 Sheet, No. 2B Finish, Condition A

Thickness Dec In Ga	Size Inches	Est Lbs Per Sq Ft	Est Lbs Per Sheet	Thickness Dec In Ga	Size Inches	Est Lbs Per Sq Ft	Est Lbs Per Sheet
.075 (14)	36 X 96	3.15	75.60	.120 (11)	36 X 96	5.04	121.0
	36 X 120	3.15	94.50		36 X 120	5.04	151.2
	36 X 144	3.15	113.4		48 X 96	5.04	161.3
	48 X 96	3.15	100.8		48 X 120	5.04	201.6
	48 X 120	3.15	126.0		48 X 144	5.04	241.9
	48 X 144	3.15	151.2		60 X 120	5.04	252.0
	60 X 120	3.15	157.5		60 X 144	5.04	302.4
	60 X 144	3.15	189.0	.135 (10)	36 X 120	5.67	170.1
	72 X 120	3.15	189.0		48 X 96	5.67	181.4
.090 (13)	36 X 120	3.78	113.4		48 X 120	5.67	226.8
	48 X 120	3.78	151.2		48 X 144	5.67	272.2
.105 (12)	36 X 96	4.41	105.8		60 X 120	5.67	283.5
	36 X 120	4.41	132.3		60 X 144	5.67	340.2
	36 X 144	4.41	158.8	.165 (8)	36 X 120	6.93	207.9
	48 X 98	4.41	141.1		48 X 120	6.93	277.2
	48 X 120	4.41	176.4		48 X 144	6.93	332.6
	48 X 144	4.41	211.7	.180 (7)	48 X 120	7.53	301.2
	60 X 120	4.41	220.5				
	60 X 144	4.41	264.6				

T302-304 Sheet, No. 2D Finish, Condition A

.075 (14)	60 X 120	3.15	157.5	.120 (11)	60 X 120	5.04	252.0
	72 X 120	3.15	189.0		60 X 144	5.04	302.4
	72 X 144	3.15	226.8		72 X 120	5.04	302.4
.105 (12)	60 X 120	4.14	220.5	.135 (10)	60 X 120	5.67	283.5
	60 X 144	4.14	264.6		60 X 144	5.67	340.2
	72 X 120	4.14	248.4		72 X 120	5.67	340.2
	72 X 144	4.14	317.5				

T302-304 Sheet, No. 3 Finish, Condition A

Thickness Dec In Ga	Size Inches	Est Lbs Per Sq Ft	Est Lbs Per Sheet	Thickness Dec In Ga	Size Inches	Est Lbs Per Sq Ft	Est Lbs Per Sheet
.018 (26)	36 X 120	.756	22.68	.060 (16)	36 X 120	2.52	75.60
.024 (24)	36 X 120	1.01	30.30		46 X 120	2.52	100.8
.032 (22)	36 X 120	1.35	40.50	.075 (14)	36 X 144	3.15	113.4
	48 X 120	1.35	54.00		42 X 120	3.15	110.3
.351 (20)	30 X 120	1.47	36.75		48 X 120	3.15	126.0
	36 X 120	1.47	44.10	.109 (12)	48 X 120	4.58	183.2
	48 X 120	1.47	58.80				
.048 (18)	48 X 96	2.02	67.20				
	48 X 120	2.02	80.80				

T302-304 Sheet, No. 3 Finish, One Side P.V.C., Condition A

.024 (24)	48 X 120	1.01	40.40	.060 (16)	36 X 120	2.52	75.60
.0351 (20)	36 X 120	1.47	44.10		48 X 120	2.52	100.8
	48 X 120	1.47	58.80	.075 (14)	36 X 120	3.15	94.50
.048 (18)	36 X 120	2.02	60.60		48 X 120	3.15	126.0
	36 X 144	2.02	72.72				
	48 X 120	2.02	80.80				

TYPE 302-304 STAINLESS SHEET

T302-304 Sheet (No. 4 Finish One Side)

Thickness Dec In Ga		Size Inches	Est Lbs Per Sq. Ft	Sheet
.020	(25)	36 x 86	.840	20.16
		36 x 120	.840	25.20
		48 x 120	.840	33.60
.024	(24)	36 x 96	1.01	24.24
		36 x 120	1.01	30.30
		48 x 96	1.01	32.32
		48 x 120	1.01	40.40
		48 x 144	1.01	48.48
.030	(22)	36 x 96	1.26	30.24
		36 x 120	1.26	37.80
		48 x 96	1.26	40.32
		48 x 120	1.28	50.40
		48 x 144	1.26	60.48
.0351	(20)	36 x 96	1.47	35.28
		36 x 120	1.47	44.10
		6 x 144	1.47	52.92
		48 x 96	1.47	47.04
		48 x 120	1.47	58.80
		48 x 144	1.47	70.56
.040	(19)	36 x 120	1.68	50.40
		48 x 120	1.68	67.20
.048	(18)	36 x 96	2.02	48.40
		36 x 120	2.02	60.50
		36 x 144	2.02	72.72
		48 x 96	2.02	64.50
		48 x 120	2.02	80.60
		48 x 144	2.02	97.00
		60 x 120	2.02	101.0
		60 x 144	2.02	121.0
.060	(16)	36 x 96	2.52	60.48
		36 x 120	2.52	75.60
		36 x 144	2.52	90.72
		48 x 96	2.52	80.64
		48 x 120	2.52	100.8
		48 x 144	2.52	121.0
		60 x 120	2.52	126.0
		60 x 144	2.52	151 2
.075	(14)	36 x 120	3.15	94.50
		36 x 144	3.15	113.4
		48 x 96	3.15	100.8
		48 x 120	3.15	126.0
		48 x 144	3.15	151.2
		60 x 144	3.15	189.0
.090	(13)	36 x 120	3.78	113.4
		48 x 120	3.78	151.2
.105	(12)	36 x 120	4.41	132.3
		48 x 120	4.41	176.4
		48 x 144	4.41	211.7
		60 x 120	4.41	220.5
		60 x 144	4.41	264.6
.120	(11)	36 x 120	5.04	151.2
		48 x 120	5.04	201.6
.135	(10)	36 x 120	5.67	170.1
		48 x 120	5.67	226.8

T302-304 Sheet, No. 4 Finish, One Side P.V.C., Condition A

.024	(24)	48 x 120	1.01	40.40
.030	(22)	48 x 120	1.26	50.40
.0351	(20)	36 x 120	1.47	44.10
		48 x 120	1.47	58.80
.048	(18)	36 x 120	2.02	60.60
		36 x 144	2.02	72.72
		48 x 120	2.02	80.80
		60 x 120	2.02	101.0
0.60	(16)	36 x 120	2.52	75.60
		48 x 120	2.52	100.8
		48 x 144	2.52	121.0
		60 x 120	2.52	126.0
		60 x 144	2.52	151.2
.075	(14)	48 x 120	3.15	126.0
		60 x 120	3.15	157.5
		60 x 144	3.15	189.0
.105	(12)	36 x 120	4.41	132.3
		48 x 120	4.41	176.4
.120	(11)	48 x 120	5.04	201.6
.135	(10)	48 x 120	5.67	226.8

Our stainless steel sheet inventory is being expanded continually. If the material you require is not listed in this section, please contact us for information on availability.

TYPE 302-304 STAINLESS COIL & PLATE

T304 Coil, No. 2B Finish, Condition A

Dec Inch Thick	Coil Width Inch	Est. Lbs. Per Sq. Ft.	Dec Inch Thick	Coil Width Inch	Est. Lbs. Per Sq. Ft.
.0161	36	.676	.060	36	2.52
.018	36	.756		48	2.52
	48	.756		60	2.52
.020	36	.840	.075	36	3.15
	48	.840		48	3.15
.024	36	1.01		60	3.15
	48	1.01	.090	36	3.78
.030	36	1.26		48	3.78
	48	1.26	.105	36	4.41
.0351	36	1.47		48	4.41
	48	1.47		60	4.41
.040	36	1.68	.120	36	5.04
	48	1.68		48	5.04
.048	36	2.02	.135	36	5.67
	48	2.02		48	5.67
	60	2.02			

T-302-304 Coll, No. 3 Finish, Condition A

Dec Inch Thick	Coil Width Inch	Est. Lbs. Per Sq. Ft.	Dec Inch Thick	Coil Width Inch	Est. Lbs. Per Sq. Ft.
.0351	30	1.47	.048	36	2.02
	48	1.47		48	2.02

T304 Plate, Hot Rolled, Annealed and Pickled

Thickness Inch	Plate Size Inches	Est Lbs Per Sq. Ft.	Plate	Thickness Inch	Plate Size Inches	Est Lbs Per Sq. Ft.	Plate
3/16	48 x 86	8.58	274.6	1/2	60 x 240	21.66	2166
	48 x 120	8.58	487.6		72 x 240	21.66	2599
	60 x 120	8.58	429.0		72 x 360	21.66	3899
	60 x 144	8.58	514.8		96 x 240	21.66	3465
	60 x 240	8.58	858.0	5/8	60 x 120	26.83	1342
	72 x 240	8.58	1029		72 x 240	26.83	3219
	96 x 240	8.58	1372		84 x 240	26.83	3756
1/4	48 x 96	11.16	357.1		96 x 240	26.83	4292
	48 x 120	11.16	446.4	3/4	48 x 120	32.12	1285
	48 x 240	11.16	892.8		72 x 240	32.12	3854
	60 x 120	11.16	558.0		96 x 240	32.12	5139
	60 x 240	11.16	1116	7/8	96 x 240	37.28	5966
	72 x 240	11.16	1339		48 x 96	42.67	1365
	72 x 360	11.16	2008		72 x 240	42.67	5120
	96 x 240	11.16	1785		96 x 240	42.67	6827
5/16	48 x 120	13.75	550.0	11/4	96 x 240	53.00	8480
	60 x 120	13.75	687.5	11/2	96 x 240	63.34	10134
	72 x 240	13.75	1650	13/4	92 x 240	73.67	11787
	96 x 240	13.75	2200	2	96 x 240	84.01	13441
3/8	60 x 240	16.50	1650	21/2	96 x 240	105.1	16817
	72 x 240	16.50	1980	3	84 x 144	126.3	10609
	96 x 240	16.50	2640				

TYPE 303S BARS

Squares-Annealed, Cold Drawn

Size	Foot	Est. Lbs. Per 12 Foot	Size	Foot	Est. Lbs. Per 12 Foot
3/16	.120	1.44	5/8	1.33	15.0
1/4	.210	2.52	3/4	1.91	23.0
5/16	.330	3.96	1	3.40	40.8
3/8	.480	5.76	11/2	7.65	91.8
1/2	.850	10.2	13/4	10.4	125

T304 BARS AND SHAPES

ASTM-A580; ASTM-4479; ASME-SA479;
QQ-S-763; MIL-S-7720; AMS-5639
Rounds - Annealed, Cold Drawn

Size	Foot	Est. Lbs. Per 12 Foot	Size	Foot	Est. Lbs. Per 12 Foot
1/8	.04	.480	3/8	.38	4.56
3/16	.09	1.08	7/16	.51	6.12
1/4	.17	2.04	1/2	.67	8.04
5/16	.26	3.12			

Rounds - Annealed, Centerless, Ground

9/16	.85	10.2	2	10.68	128
5/8	1.04	12.5	2 1/4	13.52	162
1 1/16	1.26	15.2	2 3/8	15.06	181
3/4	1.50	18.0	2 1/2	16.69	200
1 3/16	1.76	21.1	2 5/8	16.40	221
7/8	2.04	24.5	2 3/4	20.20	242
1	2.67	32.0	3	24.30	288
1 1/8	3.38	40.6	3 1/4	28.21	339
1 3/16	3.77	45.2	3 5/8	35.09	421
1 1/4	4.17	50.0	3 3/4	37.55	451
1 3/8	5.05	60.6	4	42.73	513
1 1/2	6.01	72.1	4 1/2	54.07	649
1 5/8	7.051	84.6	5	66.78	801
1 3/4	8.18	98.2			
1 7/8	9.39	113			

Rounds - Hot Rolled Annealed, Rough Turned

3	24.30	288	4 1/2	54.07	649
3 1/4	28.21	339	4 3/4	60.25	723
3 1/2	32.71	392	5	66.76	801
3 5/8	35.09	421	5 1/2	80.77	969
3 3/4	37.56	451	5 5/8	84.49	1014
4	42.73	513	6	96.12	1153
4 1/4	48.23	579	7	130.8	1570
4 3/8	51.11	613	8	179.9	2051

T304 BARS AND SHAPES

Flats - Hot Rolled Annealed and Pickled

Size	Foot	Est. Lbs. Per 12 Foot	Size	Foot	Est. Lbs. Per 12 Foot
1/8 x 1/2	.210	2.52	3/8 x 1/2	.640	7.68
5/8	.266	3.19	3/4	.960	11.5
3/4	.320	3.84	1	1.28	15.4
1	.430	5.16	1 1/4	1.59	19.1
1 1/4	.530	6.36	1 1/2	1.91	22.9
1 1/2	.640	7.68	2	2.55	30.6
2	.850	10.2	2 1/2	3.19	38.3
2 1/2	1.06	12.7	3	3.83	46.0
3	1.28	15.4	4	5.10	61.2
3/16 x 1/2	.320	3.84	1/2 x 1	1.70	20.4
3/4	.480	5.76	1 1/4	2.13	25.6
1	.640	7.66	1 1/2	2.55	30.6
1 1/4	.800	9.60	2	3.40	40.8
1 1/2	.960	11.5	2 1/2	4.25	51.0
2	1.28	15.4	3	5.10	61.2
2 1/2	1.60	19.2	4	6.80	81.6
3	1.91	22.9	6	10.2	122
1/4 x 1/2	.430	5.16	5/8 x 2	4.25	51.0
3/4	.640	7.68	3/4 x 1	2.65	30.6
1	.850	10.2	1 1/2	3.83	46.0
1 1/4	1.06	12.7	2	5.10	61.2
1 1/2	1.28	15.4	3	7.65	91.8
1 3/4	1.49	17.9	4	10.2	122
2	1.70	20.4	1 x 2	6.80	81.6
2 1/2	2.13	25.6	3	10.2	122
3	2.55	30.6	4	13.6	163
4	3.40	40.8			

Square- Hot Rolled, Annealed and Pickled

1/4	.210	2.52	3/4	1.91	23.0
3/8	.480	5.76	1	3.40	40.8
1/2	.850	10.2	1 1/4	5.30	63.7
5/8	1.33	16.0	1 1/2	7.65	91.8

Half-rounds-Annealed, Cold Drawn

5/8 x 5/16	.522	10.44	3/4 x 3/8	751	15.02

Angles-Hot Rolled, Annealed and Pickled

Size	Foot	Est. Lbs. Per 20 Ft.	Size	Foot	Est. Lbs. Per 20 Ft.
3/4 x 3/4 x 1/8	5.90	11.8	2 x 2 x 1/8	1.65	33.0
1 x 1 x 1/8	.800	16.0	3/16	2.44	48.8
3/16	1.16	23.2	1/4	3.19	63.8
1/4	1.49	29.8	2 1/2 x 2 1/2 x 3/16	3.07	61.4
1 1/4 x 1 1/4 x 1/8	1.01	20.2	1/4	4.10	82.0
1/4	1.92	38.4	3 x 3 x 1/4	4.90	98.0
1 1/2 x 1 1/2 x 1/8	1.23	24.6	3/8	7.20	144
3/8	1.80	36.0			
1/4	2.34	46.8			

STANDARD PERMISSIBLE TOLERANCE VARIATIONS

FOR DIMENSIONS OF STAINLESS STEEL BARS

Round Bars-Cold Drawn and Centerless Ground

Size, Inches	Plus	Minus
Under 5/16	.0010	.0010
5/16 thru 1/4	.0015	.0015
1 7/32 thru 3 1/32	.0020	.0020
1 thru 1 7/16	.0025	.0025
1 1/2 thru 4	.0030	.0030
4 1/8 thru 4 1/2	.0050	.0050

Square and Hexagon Bars-Cold Drawn

Under 5/16	.0000	.0020
3/16 thru 1/2	.0000	.0030
Over 1/2 thru 1	.0000	.0040
Over 1 thru 2	.0000	.0060
Over 2 thru 3	.0000	.0080
Over 3	.0000	.0100

Round Hot Rolled Bars

Size Inches	Plus	Minus	Out of Round or Square
3/8 thru 1	.009	.009	.013±
Over 1 thru 1 1/8	.010	.010	.015±
Over 1 1/8 thru 1 1/4	.011	.011	.016±
Over 1 1/4 thru 1 3/4	.012	.012	.018±
Ovre 1 3/8 thru 1 1/2	.014	.014	.021±
Over 1 1/2 thru 2	1/64	1/64	.023±
Over 2 thru 2 1/2	1/32	.000	.023±
Over 2 1/2 thru 3 1/2	3/64	.000	.035±
Over 3 1/2 thru 4 1/8	1/16	.000	.046±
Over 4 1/8 thru 5 1/2	5/64	.000	.058±

Flat Bars-Hot Rolled

Width, Inches	Over 1/3 to 1/2 Incl.	Over 1/2 to 1 Incl.	Over 1 to 2 Incl.	From Width +	From Width -
3/8 thru 1	.008	.010	-	1/64	1/64
Over 1 thru 2	.012	.015	1/32	1/32	1/32
Over 2 thru 4	.015	.020	1/32	1/16	1/32
Over 4 thru 6	.015	.020	1/32	3/32	1/16

Note: PH grades, heat treated or picked after cold drawing, tolerances are doubted.

STAINLESS STEEL TOLERANCES

THICKNESS TOLERANCES
Cold Rolled Sheets In Cut Lengths and Coils

		Thickness Tolerance, In, (mm) Plus and Minus	
Numbers	**Specified Thickness (In.)**	**48 & Under**	**Over 48**
30	Over 0.007 to 0.016 Incl.	0.002	-
27/24	Over 0.016 to 0.026 Incl.	0.003	0.003
22/19	Over 0.026 to 0.040 Incl.	0.004	0.004
18/17	Over 0.040 to 0.058 Incl.	0.004	0.005
16/15	Over 0.050 to 0.072 Incl.	0.005	0.006
14	Over 0.072 to 0.003 Incl.	0.005	0.007
13	Over 0.083 to 0.098 Incl.	0.006	0.008
12	Over 0.098 to 0.114 Incl.	0.007	0.009
11	Over 0.114 to 0.130 Incl.	0.008	0.010
10	Over 0.130 to 0.145 Incl.	0.010	0.012
9/8	Over 0.145 to 3/16 excl.	0.012	0.014

Note (1) : Thickness measurements are taken at least 3/8 In (9.53 mm) from the edge of the sheet.
Note (2) : Tolerances shown are based on ASTM A480.

Sheet Width-Length Tolerances

Widths	Lengths
Up to 48"…. ….. ..... 1/16" Over, 0 Under	Up to 120".. …..... 1/16" Over, 0 Under
48" and Over …… …1/8" Over, 0 Under	120" and Over…….. ..1/8" Over, 0 Under

Thickness 0.131" and heavier all widths and lengths 1/4" over, 0 Under.

Plate Thickness Tolerances

Specified Thickness Inches	Thickness Tolerance-Over Variation* Width, Inches to 120 Inclusive
3/16 to 3/8 Exclusive	.050 Decimal Inch
3/8 to 3/4 Exclusive	.058 Decimal Inch
3/4 to 1 Exclusive	.064 Decimal Inch
1 to 2 Inclusive	.074 Decimal Inch

“No plate shall vary more than 0.01" under the thickness ordered. Spot grind not to exceed 0.01" under the specified thickness is permitted to remove surface imperfections.

SECTION 12

REFERENCE SECTION

ASTM SPECIFICATIONS

Copies of these specifications are available on request.

A 6-87d	Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use.
A 7	Discontinued-Replaced by A 36 (for rolled shapes), A 283, A 663, A 675.
A 20-87a	Specification for General Requirements for Steel Plates for Pressure Vessels.
A 29-87b	Specification for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished, General Requirements for.
A 36-87	Specification for Structural Steel.
A 53-87b	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
A 105-87a	Specification for Forgings, Carbon Steel, for Piping Components.
A 106-87a	Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
A 108-81	Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
A 109-85	Specification for Steel, Carbon, Cold-Rolled Strip.
A 120-84	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses (Discontinued).
A 135-86	Specification for Electric-Resistance-Welded Steel Pipe.
A 242-87	Specification for High-Strength Low-Alloy Structural Steel.
A283-87	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars,
A 285-82	Specification for Pressure Vessel Plates, Carbon Steel, Low - and Intermediate- Tensile Strength.
A 304-79	Specification for Alloy Steel Bars Subject to End-Quench Hardenability Requirements.
A 320-85a	Specification for Alloys- Steel Bolting Materials for Low-Temperature Service.
A 322-87	Specification for Steel Bars, Alloy, Standard Grades.
A 366-85	Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
A 370-87c	Test Methods and Definitions for Mechanical Testing of Steel Products.
A 387	Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum.
A 414-83	Specification for Carbon Steel Sheet for Pressure Vessels.
A 434-81	Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered.
A 441-85	Specification for High-Strength Low-Alloy Structural Manganese Vanadium Steel.
A 446-87	Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical Quality).
A 455	Pressure Vessel Plates, Carbon Steel, High-Strength Manganese.
A 463-85	Specification for Steel Sheet, Cold-Rolled, Aluminum-Coated Type I and Type II.
A 500-84	Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
A 501-84	Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
A 513-85	Specification for Electric-Resistance-Welded Carbon And Alloy Steel Mechanical Tubing.
A 514-87a	Specification for High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.
A 515-82	Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher - Temperature Service.

ASTM SPECIFICATIONS (Continued)

A 516-86	Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.
A 517-87a	Specification for Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered.
A 519-86b	Specification for Seamless Carbon and Alloy Steel Mechanical Tubing.
A 537-86	Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel.
A 568-83	Specification for General Requirements for Steel, Carbon and High-Strength Low-Alloy Hot-Rolled Sheet and Cold-Rolled Sheet.
A 569-85	Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
A 570-85	Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.
A 572-84	Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality.
A 576-87	Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
A 588-87	Specification for High-Strength Low-Alloy Structural Steel With 50 ksi (345 MPa) Minimum Yield Point to 4” Thick.
A 591-77	Specification for Steel Sheet, Cold-Rolled, Electrolytic Zinc-Coated.
A 607-85	Specification for Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, High-Strength, Low-Alloy Columbium and/or Vanadium.
A 612	Pressure vessel plates, carbon steel, high strength, for moderate and lower temperature service.
A 616-87	Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.
A 620-84	Specification for Steel, Sheet, Carbon, Drawing Quality, Special Killed, Cold-Rolled.
A 621-82	Specification for Steel Sheet and Strip, Carbon, Hot-Rolled, Drawing Quality.
A 622-82	Specification for Steel, Sheet and Strip, Carbon, Drawing Quality, Special Killed, Hot-Rolled.
A 633	Normalized high strength, low alloy structural steel.
A 635	Steel, sheet and strip, heavy thickness coils, carbon, hot rolled.
A 653CQ	Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
A 653LCQ	Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
A 656-87a	Specification for Hot-Rolled Structural Steel, High-Strength, Low-Alloy Plate with Improved Formability.
A 663-85	Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
A 700-81	Practices for packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment.
A 706	Low Alloy steel deformed bars for concrete reinforcement.
A 709	Structural steel for bridges.
A 715-87	Specification for Steel Sheet and Strip, High-Strength, Hot-Rolled, and Steel Sheet, Cold-Rolled, High-Strength, Low-Alloy, with Improved Formability.
A 792-95	Specification for 55% Aluminum-Zinc Alloy-Coated steel sheet in coils and cut lengths.
A 924	Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

FEDERAL SPECIFICATIONS

Federal Specifications are identified with a QQ prefix followed by the letter S designating steel and the specifications number. Copies of these specifications are available upon request. Cancelled specifications are also listed since these specifications are still in use.

Specification Number	Specification Title
QQ-S-626	Steel Plate, Alloy (Structural Quality)
QQ-S-630	Steel, Bar, Carbon, Hot Rolled (Merchant Quality) CANCELLED Replaced by ASTM A575 and A663
QQ-S-631	Steel, Bar, Carbon, Hot Rolled (Special Quality) CANCELLED Replaced by ASTM A576 and A675
QQ-S-632	Steel Bar, Reinforcing (for Concrete)
QQ-S-633	Steel Bars, Carbon, Cold Finished and Hot Rolled (General Purpose) Replaced by ASTM A 108, A575, A663 and A675
QQ-S-634	Steel Bar, Carbon, Cold-Finished (Standard Quality) CANCELLED Replaced by ASTM A108
QQ-S-635	Steel Plate, Carbon
QQ-S-637	Steel Bar, Carbon, Cold Finished (Standard Quality, Free Machining) CANCELLED Replaced by ASTM A108
QQ-S-693	Steel, Sheet, Carbon - Hot Rolled CANCELLED this specification is for low carbon, medium carbon and untempered spring steel sheet and strip. Applicable specifications for low carbon sheet and strip are ASTM Nos. A109, 366, 569, 570, 611, 619, 620 and 621. For medium and high carbon--QQ-S-700. Refer to QQ-S-777 for untempered spring steel.
QQ-S-698	Steel Sheet and Strip, Low Carbon, Refer to ASTM Nos. A569, A570 and A621 for Hot Rolled Sheet Steel; and ASTM A109 for Cold Rolled Strip.
QQ-S-700	Steel Sheet and Strip, Medium and High Carbon.
QQ-S-741	Steel, Carbon, Structural Shapes, Plates, and Bars
QQ-S-775	Steel Sheets, Carbon, Zinc-Coated (Galvanized) by the Hot Dip Process
QQ-S-781	Strapping, Steel, and Seals
QQ-F-461	Floor Plate, Steel, Rolled

MILITARY SPECIFICATIONS

Military Specifications for steel are identified as Mil-S numbers. Some of these Specifications have been cancelled, but are still listed for reference. Other military specifications for inspection requirements, and quality control are listed under Miscellaneous Specifications. Copies of military specifications are available upon request.

Specification Number	Specification Title
Mil-S-872	Steel Bars, Billets and Forgings-Carbon-Molybdenum Alloy
Mil-S-890	Steel Forgings and Bars for Hulls, Engines, and Ordnance (heat treated)
Mil-S-5000	Steel: Chrome-Nickel-Molybdenum (E4340) Bars and Reforging Stock
Mil-S-5626	Steel: Chrome-Molybdenum (4140) Bars, Rods and Forging Stock (for aircraft applications)
Mil-S-6758	Steel: Chrome-Molybdenum (4130) Bars and Reforging Stock (aircraft quality)
Mil-S-7952	Steel: Sheet and Strip, Uncoated, Carbon (1020 and 1025) (aircraft quality)
Mil-S-8699	Steel Bars and Forging Stock (4330) Vanadium Modified, Aircraft Quality
Mil-S-13326	Steel, Alloy; Plate, Heat Treated, High Strength for Welded Structures
Mil-S-13281	Steel, Carbon, Alloy, and High Strength Low Alloy for Welded Structures (Stress Relieved)
Mil-S-16113	Steel Plate, High Tensile (HT), Hull and Structural CANCELLED Replaced by Mil-S-22698
Mil-S-16216	Steel Plate, Alloy, Structural, High Yield Strength (HY-80 and HY-100)
Mil-S-16974	Steel Bars, Billets Blooms and Slabs; Carbon and Alloy (For Reforging or Other Operations before Heat Treatment)
Mil-S-18729	Steel Plate, Sheet, and Strip, Alloy 4130, Aircraft Quality
Mil-S-20166	Steel Structural Shapes, Weldable Medium Carbon and High Tensile; Hull and Structural
Mil-S-22698	Steel Plate and Shapes, Weldable Ordinary Strength and Higher Strength; Hull Structural
Mil-S-23284	Steel Forgings, Carbon and Alloy, for Shafts, Sleeves, Couplings, and Stocks (Rudders and Diving Planes)
Mil-S-24093	Steel Forgings, Carbon and Alloy Heat Treated
Mil-S-24113	Steel Plates, Carbon Manganese-Heat Treated by Normalizing or Quenching and Tempering
Mil-S-24238	Steel Plate Carbon and Low Alloy

MILITARY SPECIFICATIONS (Continued)

MISCELLANEOUS

Specification Number	Specification Title
Mil-A-12560	Armor Plate, Steel, Wrought, Homogenous
Mil-I-8950	Inspection, Ultrasonic, Wrought Metals, process For
Mil-45208	Inspection System Requirements
Mil-M-17194	Metal, Expanded, Steel
Mil-Q-9858	Quality Program Requirements
Mil-Std-295	Bills of Materials, Preparation of
Mil-Std-1520	Corrective Action and Disposition System for Nonconforming Material

CANADIAN STRUCTURAL STEEL SPECIFICATIONS

Comparison of ASTM Specifications with CSA G40.21/M Grades

ASTM Specifications	G40.21 Grade	G40.21/M Grade	Chemical Compositions Comparison	Mechanical Property Comparison G40.21	Mechanical Property Comparison G40.21/M"
A-36	33G	230G	Approximately the same.	Minimum yield strength and minimum tensile strength 3 ksi lower Grade 33G.	Minimum yield point and tensile strength 20MPa lower in Grade 230G.
	38W	260W	Lower carbon content in Grade 38W/260W.	Up to 1 1/2" thick, minimum yield point and minimum tensile strength is 2 ksi higher in Grade 38W.	Up to 40 mm thick, minimum yield point and tensile strength is 10 MPa higher in Grade 260W.
	44W	300W	Carbon content is lower and maximum manganese higher in Grade 44W/300W and may have grain refining elements present.	Up to 1 1/2" thick, minimum yield and tensile strength is 8 ksi higher in Grade 44W.	Up to 40 mm thick, minimum yield and tensile strength is 50 MPa higher in Grade 300W.
A-36 Killed Fine Grain	38T	260T	Lower carbon content in Grade 38T/260T.	Up to 2 1/2" thick, minimum yield point and tensile strength is 2 ksi higher in Grade 38T.	Up to 65 mm thick, minimum yield point and tensile strength is 10 MPa higher in Grade 260T.

CANADIAN STRUCTURAL STEEL SPECIFICATIONS (Continued)

Comparison of ASTM Specifications with CSA G40.21/M Grades

ASTM Specifications	G40.21 Grade	G40.21/M Grade	Chemical Compositions Comparison	Mechanical Property Comparison G40.21	Mechanical Property Comparison G40.21/M
A-36 Killed Fine Grain	44T	300T	Carbon content is lower and maximum manganese higher in Grade 44T/300T and may have grain refining elements present.	Minimum tensile strength is 8 ksi higher in Grade 44T. Minimum yield is 8 ksi higher up to 1 1/2" thick decreasing to 6 ksi higher up to 2 1/2" thick and to 4 ksi higher over 2 1/2" to 4" thick.	Minimum tensile strength is 50MPa higher in Grade 300T. Minimum yield is 50 MPa higher up to 40 mm thick, decreasing to 40 MPa higher up to 65 mm thick and to 30 MPa higher over 65 mm to 100 mm thick.
ASTM A-283 Grade D	33G	230G	Grade 33G/230G has limits on maximum carbon and manganese contents.	Same except tensile strength on 33G is 55-72 ksi instead of 60-72 ksi.	Same except tensile strength of 230G is 380-500 MPa instead of 415-495 MPa.
A-572 Grade 42	44W	300W	Slightly higher carbon and manganese contents permitted in Grade 44/W 300W.	Tensile strength is 65-85 ksi for Grade 44W instead of 60ksi minimum Yield point is 44 ksi up to 1 1/2 thickness instead of 42 ksi.	Tensile strength is 450-620 Mpa for Grade 300W instead of 415 Mpa min. Yield point is 300 Mpa up to 40 mm instead of 290 MPa.
A-572 Grade 50	50W	350W	Higher manganese permitted in Grade 50W/350W	Tensile strength is 65-90 ksi for Grade 50W instead of 65 ksi minimum.	Tensile strength is 450-620 Mpa for Grade 350W instead if 450 Mpa min Yield point is 350 Mpa up to 40 mm instead of 345 Mpa.
ASTM-A 572 Grade 50 Killed Fine Grain	50T	350T	Higher Manganese permitted in Grade 50T/350T.	Tensile strength is 65-90 ksi for Grade 50T instead of 65 ksi minimum. Yield strength is 50 ksi up to 1 1/2", decreasing to 48 ksi 1 1/2 - 2 1/2" and decreasing to 46 ksi over 2 1/2".	Tensile strength is 450-650 MPa for Grade 350T instead of 450 MPa min. Yield strength is 350 MPa up to 40 mm, decreasing to 330 MPa 40-65 mm and decreasing to 320 MPa over 65 mm thick.

CANADIAN STRUCTURALS STEEL SPECIFICATIONS
(Continued)

Comparison of ASTM Specifications with CSA G40.21/3 Grades

ASTM Specifi-cations	G40.21 Grade	G40.21/M Grade	Chemical Compositions Comparison	Mechanical Property Comparison G40.21	Mechanical Property Comparison G40.21/M
A-572 Grade 60	60W	400W	Lower carbon content and higher manganese content in Grade 60W/ 400W.	Tensile strength is 65-85 ksi for Grade 44W instead of 60 ksi minimum. Yield Point is 44 ksi instead of 45 ksi.	Tensile strength is 520-690- MPa in Grade 400W instead of 520 MPa min. Yield strength is 400 MPa up to 14 mm instead of 415 MPa.
A-588	50A	350A	Majority of grades in A-588 are covered in Grade 50A-350A Composition.	Identical.	Yield strength is 350 MPa in Grade 350A instead of 345 MPa. Tensile strength is 480-650 MPa instead of 485 MPa min.
A-514	100Q	700Q	Identical without specific proprietary grades in A-514.	Identical	Identical

CHEMICAL ELEMENTS IN STEEL

The following list of elements form the chemical composition of steel which is an alloy of iron consisting of carbon manganese phosphorous, sulfur and silicon. The many different grades and types of steel are manufactured by controlling the carbon content and/or alloying with one or a combination of elements to produce specific properties.The desired properties are then developed by controlled rolling or heat treatment after parts are machined or fabricated. Some of the steel categories or types of steel for special requirements would be carbon and alloy steels, free machining steels, tool and die, cutting tools, high temperature, stainless and electrical steels.

ELEMENTS IN CARBON STEELS

Carbon Steel	Steel is considered to be carbon steel when no minimum content is specified or required for chromium, cobalt, columbium, molybdenum, nickel, titanium, vanadium or zirconium, or any other element added to obtain a desired alloying effect; when the specified minimum for copper does not exceed 0.40 percent; or when the maximum content specified for any of the following elements does not exceed the percentage noted: manganese
Carbon **C**	Carbon is the most important element in steel and as the percentage of carbon is increased it greatly affects the hardness and tensile strength. In percentages below .10% the steel product will have good ductility and malleability. The carbon content for structural steels is in the .12 to .25% range A carbon content of at least .30% is required for consistent heat treating results.
Manganese **Mn**	Manganese strengthens steel by increasing the strength of the iron grains, which increases impact strength and hardenability. It is usually present in quantities of .40 to 1.6% in most steels. Hadfield Manganese Steel which is a rapid work hardening steel will have a manganese content of 11 -13%.
Phosphorous **P**	Increasing phosphorous increases strength and hardness and decreases ductility and notch-impact toughness in the as-rolled condition, Higher phosphorous contents in the .04-.12% range improves machinability.
Sulfur **S**	With the exception of free-machining steels sulfur is considered an impurity in steel and forms with iron and manganese to form inclusions. Free machining steels will have sulfur contents of .08 to .33%
Silicon **Si**	This element is one of the principal deoxidizers used in steelmaking and when used in levels of .15% and above helps to produce a rolled steel product void of porosity. Electrical steels will have silicon levels of 2-6%.

ADDITIONAL ELEMENTS IN ALLOY STEELS

Chromium **Cr**	Chromium is a strong carbide former. It is added to steel to increase strength, hardness and hardenability. At higher percentage levels it improves corrosion resistance, high temperature strength and oxidation resistance at high temperatures. Chromium percentages will vary from .40 to 1.10% in commercial alloys and from 2 to 11H% in tool and die steels.

CHEMICAL ELEMENTS IN STEEL (Continued)

Nickel **Ni**	Nickel is a ferrite strengthener like manganese and increases strength and toughness In combination with chromium, nickel produces alloy steels with greater hardenability, high impact strength, and greater fatigue resistance than are possible with carbon steels. Nickel percentages will vary from .40 to 2.00% in structural alloys and up to 3.75% In some carburizing grades.
Molybdenum **Mo**	Molybdenum is added to constructional steels in the normal amounts of .10-.60%. Alloy steels which contain .15-.30% molybdenum show a minimized susceptibility to temper embrittlement.
Vanadium **V**	Vanadium is one of the strong carbide forming elements. Vanadium treated steels show a much finer structure than steels of a similar composition without vanadium. Vanadium is used as a strengthener in some types of A572 high strength-low alloy steel. Percentages In this case would be .01-.15%.
Tungsten **W**	This alloy combines with carbon in steel forming very hard abrasion resistant tungsten carbides. Steel alloys with tungsten are used in combination with other alloys for high speed cutting tools where abrasion resistance and high red hardness are important. Other uses for the alloy are high temperature super alloys and tungsten carbide welding rod to protect steel surfaces from abrasive wear.
Cobalt **Co**	This alloy is generally used in high speed cutting tools in combination with other alloys to increase hot hardness or red hardness. Also used for hard facing and abrasion resistant alloys, permanent and soft magnets and superalloys.

OTHER ELEMENTS USED IN STEEL

Boron **B**	Boron is added to fully killed steel to improve hardenability. Boron treated steels are produced to a range of .0005-.003%. Boron is very effective in lower carbon steels.
Columbium **Cb**	Columbium or niobium has the same application as vanadium to form carbides and Increase the strength of steel. Used in high strength-low alloy steels In percentages of .005-.05%.
Copper **Cu**	When added in amounts above .20%, copper increases the corrosion resistance of carbon steels by two times. Corrosion resistance of carbon steels can be increased four to six times by Increasing the copper content up to .50% and adding small percentages of chromium and nickel
Lead **Pb**	An element added to free machining steels, which could be carbon or alloy steels, to Increase the machinability of the steel by lubricating the cutting tool. Lead Is generally added in percentages of .15-.35%.
Nitrogen **N**	This element in small percentages of .004 to .020% greatly affects the hardness, tensile and yield strength of steel. Nitrogen is used in many high strength low alloy sheet and plate steels.

AISI/SAE CHEMICAL ANALYSIS

PLAIN CARBON GRADES-TABLE 1

Steel Designation AISI or SAE	Chemical Composition, Percent				
	UNS Number	C	Mn	P Max	S Max
1005	G10050	0.06 Max.	0.35 Max.	0.040	0.050
1006	G10060	0.08 Max.	0.25 Max.	0.040	0.050
1008	G10080	0.10 Max	0.30/0.50	0.040	0.050
1010	G10100	0.08/0.13	0.30/0.60	0.040	0.050
1012	G10120	0.10/0.15	0.30/0.60	0.040	0 050
1015	G10150	0.13/0.18	0.30/0.60	0.040	0.050
1016	G10160	0.13/0.18	0.60/0.90	0.040	0.050
1017	G10170	0.15/0.20	0.30/0.60	0.040	0.050
1018	G10180	0.15/0.20	0.60/0.90	0.040	0.050
1019	G10190	0.15/0.20	0.70/1.00	0.040	0.050
1020	G10200	0.18/0.23	0.30/0.60	0.040	0 050
1021	G10210	0 18/0.23	0 60/0.90	0.040	0.050
1022	G10220	0.18/0.23	0.70/1.00	0.040	0.050
1023	G10230	0.20/0.25	0.30/0.60	0.040	0 050
1025	G10250	0.22/0.28	0.30/0.60	0.040	0.050
1026	G10260	0.22/0.28	0.60/0.90	0.040	0.050
1029	G10290	0 2570.31	0 60/0.90	0.040	0.050
1030	G10300	0 28/0.34	0.60/0.90	0.040	0.050
1035	G10350	0.32/0.38	0.60/0.90	0.040	0 050
1037	G10370	0.32/0.38	0.70/1.00	0.040	0.050
1038	G10380	0.35/0.42	0.60/0.90	0.040	0.050
1039	G10390	0.37/0.44	0.70/1.00	0.040	0.050
1040	G10400	0 37/0.44	0 60/0.90	0.040	0.050
1042	G10420	0.40/0.47	0.60/0.90	0.040	0.050
1043	G10430	0.40/0.47	0.70/1.00	0.040	0.050
1044	G10440	0.43/0.50	0.30/0.60	0.040	0.050
1045	G10450	0.43/0.50	0.60/0.90	0.040	0.050
1046	G10460	0.43/0.50	0.70/1.00	0.040	0.050
1049	G10490	0 46/0.53	0.60/0.90	0.040	0 050
1050	G10500	0.48/0.55	0.60/0.90	0.040	0.050
1053	G10530	0.48/0.55	0.70/1.00	0.040	0.050
1055	G10550	0.50/0.60	0.60/0.90	0.040	0.050
1059	G10590	0.55/0.65	0.50/0.80	0.040	0.050
1060	G10600	0.55/0.65	0.60/0.90	0.040	0.050
1070	G10700	0.65/0.75	0.60/0.90	0.040	0.050
1078	G10780	0.72/0.85	0.30/0.60	0.040	0.050
1080	G10800	0.75/0.88	0.60/0.90	0.040	0.050
1084	G10840	0.80/0.93	0.60/0.90	0.040	0.050
1086	G10860	0.80/0.93	0.30/0.50	0.040	0.050
1090	G10900	0.85/0.98	0.60/0.90	0.040	0.050
1095	G10950	0.90/1.03	0.30/0.50	0.040	0.050

Note. In the case of certain qualities, the foregoing standard steels are ordinarily furnished lo lower phosphorous and lower sulfur maxima as hereinafter Indicated.

Silicon. Where silicon is required, the following limits and ranges are commonly used: for steel designations up to but excluding 1015, 0.10% max, for 1015 to 1025,0 10% max or ranges of 0.10-0.20%, 0.15-0.30%, 0.20-0.40%, or 0.30-0.60%; for over 1025, ranges of 0.10-0.20%, 0.15-0 .30%, 0.20-0.40%, or 0.30-0.60%.

Copper. When copper is required, 0.20 percent minimum is generally specified.

Lead. Standard carbon steels can be produced with a lead range of 0 15 to 0 35 percent, to improve machinability. Such steels are identified by inserting the letter "L" between the second and third numerals of the AISI number, e.g. 10L45. Lead is generally reported as a range of to 0.35 percent.

Boron. Standard killed carbon steels, which are generally fine grain, may be produced with a boron treatment addition to improve hardenability. Such steels can be expected to contain 0.005 to 0.003 percent boron. These steels are identified by inserting the letter "B" between the second and third numerals of the AISI number, e.g. 10B46.

AISI/SAE CHEMICAL ANALYSIS
(Continued)

PLAIN CARBON-HIGH MANGANESE GRADES-TABLE 2

Steel Designation AISI or SAE	Chemical Composition, Percent				
	UNS Number	C	Mn	P Max	S Max
1513	G15130	0 10/0.16	1.10/1.40	0.040	0.050
1522	G15220	0 18/0.24	1.10/1.40	0.040	0.050
1524	G15240	0.19/0.25	1.35/1.65	0.040	0.050
1526	G15260	0.22/0.29	1.10/1.40	0.040	0.050
1527	G15270	0.22/0.29	1.20/1.50	0.040	0.050
1541	G15410	0 36/0 44	1.35/1.65	0.040	0.050
1548	G15480	0 44/0.52	1.10/1.40	0.040	0.050
1551	G15510	0.45/0.56	0.85/1.15	0.040	0.050
1552	G15520	0.47/0.55	1.20/1.50	0.040	0.050
1561	G15610	0.55/0.65	0.75/1.05	0.040	0.050
1566	G15660	0.6O/0 71	0.85/1.15	0.040	0.050

Note. In the case of certain qualities, the foregoing standard steels are ordinarily furnished to lower phosphorous and lower sulfur maxima as hereinafter indicated.

Silicon. Where silicon ranges or limits are required, the values shown in Table I apply.

Copper. When copper is required, 0.20 percent minimum is generally specified.

Lead. See footnote for lead under Table I.

Boron. See footnote for boron under Table I.

RESULPHURIZED CARBON GRADES-TABLE 3

Steel Designation AISI or SAE	Chemical Composition, Percent				
	UNS Number	C	Mn	P Max	S Max
1110	G11100	0.08/0.13	0 30/0.60	0.040	0.08/0.13
1117	G11170	0.14/0.20	1.00/1.30	0.040	0.08/0.13
1118	G11180	0.14/0.20	1.30/1.60	0.040	0.08/0.13
1137	G11370	0.32/0.39	1.35/1.65	0.040	0.08/0.13
1139	G11390	0.35/0.43	1.35/1.65	0.040	0.13/0.20
1140	G11400	0.37/0.44	0.70/1.00	0.040	0.08/0.13
1141	G11410	0.37/0.45	1.35/1.65	0.040	0.08/0.13
1144	G11440	0.40/0.48	1 35/1.65	0.040	0 24/0.33
1146	G11460	0.42/0.49	0 70/1 00	0.040	0.08/0.13
1151	G11510	0.48/0.55	0.70/1.00	0.040	0.08/0.13

Silicon. Where silicon ranges or limits are required, the values shown in Table I apply.
Lead. See footnote for lead under Table I.
Note. Resulphurized steel is not subject to check analysis for sulphur.
u Standard grade generally more readily available.
*Former AISI grades identified as 1000 series, Example: 1524 was 1024.

AISI/SAE CHEMICAL ANALYSIS (Continued)

REPHOSPHORIZED-RESULPHURIZED CARBON GRADES-TABLE 4

Steel Designation AISI or SAE	Chemical Composition, Percent				
	UNS Number	C	Mn	P Max	S Max
1211	G12110	0.13 Max.	0.60/0.90	0.07/0.12	0.10/0.15
1212	G12120	0.13 Max.	0.70/1.00	0.07/0.12	0.16/0.23
1213	G12130	0.13 Max.	0.70/1.00	0.07/0.12	0.24/0.33
1215	G12150	0.09 Max.	0.75/1.05	0.04/0.09	0.26/0.35
12L14*	G12144	0.15 Max.	0.85/1.15	0.04/0.09	0.26/0.35

*Pb-0.15/0.35

Silicon. It is not common practice to produce the 12XX series of steels to specified limits for silicon because of its adverse effect on machinability.

Lead. Standard carbon steels can be produced with a lead range of 0.15 to 0.35 percent to improve machinability. Such steel is identified by inserting the letter “L" between the second and third numerals of the AISI steel designation, e.g. "12L15." Lead is generally reported as a range of 0.15 to 0.35%.

AISI/SAE CHEMICAL ANALYSIS
(Continued)

STANDARD ALLOY GRADE TABLE 5

Steel Designation AISI or SAE	UNS Number	Chemical Composition, Percent							
		C	Mn	P Max	S Max	Si	Ni	Cr	Mo
1330	G13300	0.28/0.33	1.60/1.90	0.035	0.040	0.15/0.30	-	-	-
1335	G13350	0.33/0.38	1.60/1.90	0.035	0.040	0.15/0.30	-	-	-
1340	G13400	0.38/0.43	1.60/1.90	0.035	0.040	0.15/0.30	-	-	-
1345	G13450	0.43/0.48	1.60/1.90	0.035	0.040	0.15/0.30	-	-	-
4023	G40230	0.25/0.25	0.70/0.90	0.035	0.040	0.15/0.30	-	-	0.20/0.30
4024	G40240	0.25/0.25	0.70/0.90	0.035	0.035/0.050	0.15/0.30	-	-	0.20/0.30
4027	G40270	0.25/0.30	0.70/0.90	0.035	0.040	0.15/0.30	-	-	0.20/0.30
4028	G40280	0.25/0.30	0.70/0.90	0.035	0.035/0.050	0.15/0.30	-	-	0.20/0.30
4037	G40370	0.35/0.40	0.70/0.90	0.035	0.040	0.15/0.30	-	-	0.20/0.30
4047	G40470	0.45/0.50	0.70/0.90	0.035	0.040	0.15/0.30	-	-	0.20/0.30
4118	G41180	0.18/0.23	0.70/0.90	0.035	0.040	0.15/0.30	-	0.40/0.60	0.08/0.15
4130	G41300	0.28/0.33	0.40/0.60	0.035	0.040	0.15/0.30	-	0.80/1.10	0.15/0.25
4137	G41370	0.35/0.40	0.70/0.90	0.035	0.040	0.15/0.30	-	0.80/1.10	0.15/0.25
4140	G41400	0.38/0.43	0.75/1.00	0.035	0.040	0.15/0.30	-	0.80/1.10	0.15/0.25
4142	G41420	0.40/0.45	0.75/1.00	0.035	0.040	0.15/0.30	-	0.80/1.10	0.15/0.25
4145	G41450	0.43/0.48	0.75/1.00	0.035	0.040	0.15/0.30	-	0.80/1.10	0.15/0.25
4147	G41470	0.45/0.50	0.75/1.00	0.035	0.040	0.15/0.30	-	0.80/1.10	0.15/0.25
4150	G41500	0.48/0.53	0.75/1.00	0.035	0.040	0.15/0.30	-	0.80/1.10	0.15/0.25
4161	G41610	0.56/0.64	0.75/1.00	0.035	0.040	0.15/0.30	-	0.70/0.90	0.25/0.35
4320	G43200	0.17/0.22	0.45/0.65	0.035	0.040	0.15/0.30	1.65/2.00	0.40/0.60	0.20/0.30
4340	G43400	0.38/0.43	0.60/0.80	0.035	0.040	0.15/0.30	1.65/2.00	0.70/0.90	0.20/0.30
E4340	G43406	0.38/0.43	0.65/0.85	0.035	0.025	0.15/0.30	1.65/2.00	0.70/0.90	0.20/0.30
4615	G46150	0.13/0.18	0.45/0.65	0.035	0.040	0.15/0.30	1.65/2.00	-	0.20/0.30
4620	G46200	0.17/0.22	0.45/0.65	0.035	0.040	0.15/0.30	1.65/2.00	-	0.20/0.30
4626	G46260	0.24/0.29	0.45/0.65	0.035	0.040	0.15/0.30	0.70/1.00	-	0.15/0.25
4720	G47200	0.17/0.22	0.50/0.70	0.035	0.040	0.15/0.30	0.90/1.20	0.35/0.55	0.20/0.30
4815	G48150	0.13/1.18	0.40/0.60	0.035	0.040	0.15/0.30	3.25/3.75	-	0.20/0.30
4817	G48170	0.15/0.20	0.40/0.60	0.035	0.040	0.15/0.30	3.25/3.75	-	0.20/0.30
4820	G48200	0.50/0.70	0.18/0.23	0.035	0.040	0.15/0.30	3.25/3.75	-	0.20/0.30

AISI/SAE CHEMICAL ANALYSIS
(Continued)

STANDARD ALLOY GRADES-TABLE 5

Steel Designation AISI or SAE	UNS Number	Chemical Composition, Percent							
		C	M_N	P Max	S Max	S_I	N_I	C_R	M_O
5117	G51770	0.15/0.20	0.70/0.90	0.035	0.04	0.15/0.30	---	0.70/0.90	---
5120	G51200	0.17/0.22	0.70/0.90	0.035	0.04	0.15/0.30	---	0.70/0.90	---
5130	G51300	0.28/0.33	0.70/0.90	0.035	0.04	0.15/0.30	---	0.80/1.10	---
5132	G51320	0.30/0.35	0.60/0.80	0.035	0.04	0.15/0.30	---	0.75/1.00	---
5135	G51350	0.33/0.38	0.60/0.80	0.035	0.04	0.15/0.30	---	0.80/1.05	---
5140	G51400	0.38/0.43	0.70/0.90	0.035	0.04	0.15/0.30	---	0.70/0.90	---
5150	G51500	0.48/0.53	0.70/0.90	0.035	0.04	0.15/0.30	---	0.70/0.90	---
5155	G51550	0.51/0.59	0.70/0.90	0.035	0.04	0.15/0.30	---	0.70/0.90	---
5160	G51600	0.56/0.64	0.75/1.00	0.035	0.04	0.15/0.30	---	0.70/0.90	---
E51100	G51986	0.98/1.10	0.25/0.45	0.025	0.025	0.15/0.30	---	0.90/1.15	---
E52100	G52986	0.98/1.10	0.25/0.45	0.025	0.025	0.15/0.30	---	1.30/1.60	---
6118	G61180	0.16/0.21	0.50/0.70	0.035	0.04	0.15/0.30	---	0.50/0.70	0.10/0.15V
6150	G61500	0.48/0.53	0.70/0.90	0.035	0.04	0.15/0.30	---	0.80/1.10	0.15 Min.V
8615	G86150	0.13/0.18	0.70/0.90	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.15/0.25
8617	G86170	0.15/0.20	0.70/0.90	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.15/0.25
8620	G86200	0.18/0.23	0.70/0.90	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.15/0.25
8622	G86220	0.20/0.25	0.70/0.90	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.15/0.25
8625	G86250	0.23/0.28	0.70/0.90	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.15/0.25
8627	G86270	0.25/0.30	0.70/0.90	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.15/0.25
8630	G86300	0.28/0.33	0.70/0.90	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.15/0.25
8637	G86370	0.35/0.40	0.75/1.00	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.15/0.25
8640	G86400	0.38/0.43	0.75/1.00	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.15/0.25
8642	G86420	0.40/0.45	0.75/1.00	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.15/0.25
8645	G86450	0.43/0.48	0.75/1.00	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.15/0.25
8655	G86550	0.51/0.59	0.75/1.00	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.15/0.25
8720	G87200	0.18/0.23	0.70/0.90	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.20/0.30
8822	G88220	0.20/0.25	0.75/1.00	0.035	0.04	0.15/0.30	0.40/0.70	0.40/0.60	0.30/0.40
9260	G92600	0.56/0.64	0.75/1.00	0.035	0.04	1.80/2.20	---	---	---

AISI/SAE CHEMICAL ANALYSIS
(Continued)

STANDARD ALLOY GRADES-TABLE 5

NOTES

Note 1. Grades shown in the preceding list with prefix letter E are normally made by the basic electric furnace process. All others are normally manufactured by the basic open hearth or basic oxygen process but may be manufactured by the basic electric furnace process.

Note 2. If electric furnace practice is specified or required for grades other than those designated (i.e., E4340) the limits for phosphorous and sulfur are 0.025 percent respectively and the prefix E is added.

Note 3. For acid electric and acid open hearth steels, the limits for phosphorous and sulfur are 0.050 percent respectively.

Note 4. In the case of certain qualities the foregoing standard steels are ordinarily furnished to lower phosphorous and lower sulfur maxima as hereinafter indicated.

Note 5. Small quantities of certain elements are present in alloy steels which are not specified or required. These elements are considered as incidental and may be present to the following maximum amounts. Copper, 0.35%; Nickel, 0.25%; Chromium, 0.20%; and Molybdenum, 0.06%.

Note 6. The chemical ranges and limits shown in Table VI and in the notes below that Table are subject to the product analysis tolerances published by the AISI.

Note 7. Standard Steels can be produced with a lead range of 0.15/0.35 percent Such steels are identified by inserting the letter "L" between the second and third numerals of the AISI number, e.g. 41L40. Lead is generally reported as a range of 0.15/0.35 percent.

Note 8. Where minimum and maximum sulfur content is shown it is indicative of resulfurized steel.

Note 9. Standard Alloy Steels, which are generally fine grain, may be produced with a boron treatment addition to improve hardenability. Such steels can be expected to contain 0.0005 to 0.003 percent boron. These steels are identified by inserting the letter "B" between the second and third numerals of the AISI number, e.g. 50B46.

TENSILE METRIC (N/mm2)

The International System of Units (SI for short) is a modern version of the metric system used internationally to standardize engineering units. This chart is used for conversion of yield and tensile strengths.

Look up stress to be converted in the boldface column. If in Ksi (10^3 psi), read MP a in right hand column. If in Mpa, read ksi in left hand column. Conversion factors: 1 MPa = 1 MN/m^2 (meganewton per square metre) or 1 N/mm2 (newton per square milimetre); 1 Mpa = 0.1450377 ksi, and 1 ksi = 6.894759 MPa.

0 to 100

ksi		MPa	ksi		MPa
-	0	-	7.25	50	344.7
0.15	1	6.89	7.40	51	351.6
0.29	2	13.79	7.54	52	358.5
0.44	3	20.68	7.69	53	365.4
0.58	4	27.57	7.83	54	372.3
0.73	5	34.47	7.98	55	379.2
0.87	6	41.37	8.12	56	386.1
1.02	7	48.26	8.27	57	393.0
1.16	8	55.16	8.41	58	399.9
1.31	9	62.05	8.56	59	406.8
1.45	10	68.95	8.70	60	413.7
1.60	11	75.84	8.85	61	420.6
1.74	12	82.74	8.99	62	427.5
1.89	13	89.63	9.14	63	434.4
2.03	14	96.53	9.28	64	441.3
2.18	15	103.4	9.43	65	448.2
2.32	16	110.3	9.57	66	455.1
2.47	17	117.2	9.72	67	462.0
2.61	18	124.1	9.86	68	468.8
2.76	19	131.0	10.01	69	475.7
2.90	20	137.9	10.15	70	482.6
3.05	21	144.8	10.30	71	489.5
3.19	22	151.7	10.44	72	496.4
3.34	23	158.6	10.59	73	503.3
3.48	24	165.6	10.73	74	510.2
3.63	25	172.4	10.88	75	517.1
3.77	26	179.3	11.02	76	524.0
3.92	27	186.2	11.17	77	530.9
4.06	28	193.1	11.31	78	537.8
4.21	29	199.9	11.46	79	544.7
4.35	30	206.8	11.60	80	551.6
4.50	31	213.7	11.75	81	558.5
4.64	32	220.6	11.89	82	565.4
4.79	33	227.5	12.04	83	572.3
4.93	34	234.4	12.18	84	579.2
5.08	35	241.3	12.33	85	586.1
5.22	36	248.2	12.47	86	593.0
5.37	37	255.1	12.62	87	899.8
5.51	38	262.0	12.76	88	606.7
5.66	39	268.9	12.91	89	613.6
5.80	40	275.8	13.05	90	620.5
5.95	41	282.7	13.20	91	627.4
6.09	42	289.6	13.34	92	634.3
6.24	43	296.5	13.49	93	641.2
6.38	44	303.4	13.63	94	648.1
6.53	45	310.3	13.78	95	655.0
6.67	46	317.2	13.92	96	661.9
6.82	47	324.1	14.07	97	668.8
6.96	48	331.0	14.21	98	675.7
7.11	49	337.8	14.36	99	682.6
			14.50	100	689.5

TENSILE (N/mm2) (Continued)

100 to 200

ksi		MPa	ksi		MPa
14.50	100	689.5	21.76	150	1034
14.65	101	696.4	21.90	151	1041
14.79	102	703.3	22.05	152	1048
14.94	103	710.2	22.19	153	1054
15.08	104	717.1	22.34	154	1062
15.23	105	724.0	22.48	155	1069
15.37	106	730.8	22.63	156	1076
15.52	107	737.7	22.77	157	1082
15.66	108	744.6	22.92	158	1089
15.81	109	751.5	23.06	159	1096
15.95	110	758.4	23.21	160	1103
16.10	111	765.3	23.35	161	1110
16.24	112	772.2	23.50	162	1117
16.39	113	779.1	23.64	163	1124
16.53	114	786.0	23.79	164	1131
16.68	115	792.9	23.93	165	1138
16.82	116	799.8	24.08	166	1145
16.97	117	806.7	24.22	167	1151
17.11	118	813.8	24.37	168	1158
17.26	119	820.5	24.51	169	1165
17.40	120	827.4	24.66	170	1172
17.55	121	834.3	24.80	171	1179
17.69	122	841.2	24.95	172	1186
17.84	123	848.1	25.09	173	1193
17.98	124	855.0	25.24	174	1200
18.13	125	861.8	25.38	175	1207
18.27	126	868.7	25.53	176	1213
18.42	127	875.6	25.67	177	1220
18.56	128	882.5	25.82	178	1227
18.71	129	889.4	25.96	179	1234
18.85	130	896.3	26.11	180	1241
19.00	131	903.2	26.25	181	1248
19.14	132	910.1	26.40	182	1255
19.29	133	917.0	26.54	183	1262
19.44	134	923.9	26.69	184	1269
19.58	135	930.8	26.83	185	1276
19.73	136	937.7	26.98	186	1282
19.87	137	944.6	27.12	187	1289
20.02	138	951.5	27.27	188	1296
20.16	139	958.4	27.41	189	1303
20.31	140	965.3	27.56	190	1310
20.45	141	972.2	27.70	191	1317
20.60	142	979.1	27.85	192	1324
20.74	143	986.0	27.99	193	1331
20.89	144	992.9	28.14	194	1338
21.03	145	999.7	28.28	195	1344
21.18	146	1007	28.43	196	1351
21.32	147	1014	28.57	197	1358
21.47	148	1020	28.72	198	1365
21.61	149	1027	28.86	199	1372
			29.01	200	1379

TENSILE (N/mm2) (Continued)

200 to 300

ksi		MPa	ksi		MPa
29.01	200	1379	36.40	251	1731
29.15	201	1386	36.55	252	1737
29.30	202	1393	36.69	253	1744
29.44	203	1400	36.84	254	1751
29.59	204	1407	36.98	255	1758
29.73	205	1413	37.13	256	1765
29.88	206	1420	37.27	257	1772
30.02	207	1427	37.42	258	1779
30.17	208	1434	37.56	259	1786
30.31	209	1441	37.71	260	1793
30.46	210	1448	37.85	261	1800
30.60	211	1455	38.00	262	1806
30.75	212	1462	38.14	263	1813
30.89	213	1469	38.29	264	1820
31.04	214	1475	38.43	265	1827
31.18	215	1482	38.58	266	1834
31.33	216	1489	38.73	267	1841
31.47	217	1496	38.87	268	1848
31.62	218	1503	39.02	269	1855
31.76	219	1510	39.16	270	1862
31.91	220	1517	39.31	271	1868
32.05	221	1524	39.45	272	1875
32.20	222	1531	39.60	273	1882
32.34	223	1538	39.74	274	1889
32.49	224	1544	39.89	275	1896
32.63	225	1551	40.03	276	1903
32.78	226	1558	40.18	277	1910
32.92	227	1565	40.32	278	1917
33.07	228	1572	40.47	279	1924
33.21	229	1579	40.61	280	1931
33.36	230	1586	40.76	281	1937
33.50	231	1593	40.90	282	1944
33.65	232	1600	41.05	283	1951
33.79	233	1606	41.19	284	1958
33.94	234	1613	41.34	285	1965
34.08	235	1620	41.48	286	1972
34.23	236	1627	41.63	287	1979
34.37	237	1634	41.77	288	1986
34.52	238	1641	41.92	289	1963
34.66	239	1648	42.06	290	1999
34.81	240	1655	42.21	291	2006
34.95	241	1662	42.35	292	2013
35.10	242	1669	42.50	293	2020
35.24	243	1675	42.64	294	2027
35.39	244	1682	42.79	295	2034
35.53	245	1689	42.93	296	2041
35.68	246	1696	43.07	297	2048
35.82	247	1703	43.22	298	2055
35.97	248	1710	43.37	299	2062
36.11	249	1717	43.51	300	2068
36.26	250	1724			

TENSILE (N/mm2) (Continued)

300 to 400

ksi		MPa	ksi		MPa
43.51	300	2068	50.76	350	2413
43.66	301	2075	50.91	351	2420
43.80	302	2082	51.05	352	2427
43.95	303	2089	51.20	353	2434
44.09	304	2096	51.34	354	2441
44.24	305	2103	51.49	355	2448
44.38	306	2110	51.63	356	2455
44.53	307	2117	51.78	357	2461
44.67	308	2124	51.92	358	2468
44.82	309	2130	52.07	359	2475
44.96	310	2137	52.21	360	2482
45.11	311	2144	52.36	361	2489
45.25	312	2151	52.50	362	2496
45.40	313	2158	52.65	363	2503
45.54	314	2165	52.79	364	2510
45.69	315	2172	52.94	365	2517
45.83	316	2179	53.08	366	2523
45.98	317	2186	53.23	367	2530
46.12	318	2193	53.37	368	2537
46.27	319	2199	53.52	369	2544
46.41	320	2206	53.66	370	2551
46.56	321	2213	53.81	371	2558
46.70	322	2220	53.95	372	2565
46.85	323	2227	54.10	373	2572
46.99	324	2234	54.24	374	2579
47.14	325	2241	54.39	375	2585
47.28	326	2248	54.53	376	2592
47.43	327	2255	54.68	377	2599
47.57	328	2261	54.82	378	2606
47.72	329	2268	54.97	379	2613
47.86	330	2275	55.11	380	2620
48.01	331	2285	55.26	381	2627
48.15	332	2289	55.40	382	2634
48.30	333	2296	55.55	383	2641
48.44	334	2303	55.69	384	2648
48.59	335	2310	55.84	385	2654
48.73	336	2317	55.98	386	2661
48.88	337	2324	56.13	387	2668
49.02	338	2330	56.27	388	2675
49.17	339	2337	56.42	389	2682
49.31	340	2344	56.56	390	2689
49.46	341	2351	56.71	391	2696
49.60	342	2358	56.85	392	2703
49.75	343	2365	57.00	393	2710
49.89	344	2372	57.14	394	2717
50.04	345	2379	57.29	395	2723
50.18	346	2386	57.43	396	2730
50.33	347	2392	57.58	397	2737
50.47	348	2399	57.72	398	2744
50.62	349	2406	57.87	399	2751
			58.02	400	2758

TENSILE (N/mm²) (Continued)

500 TO 5000

ksi		MPa	ksi		MPa
72.52	**500**	3447	145.04	**1000**	6895
87.02	**600**	4137	290.08	**2000**	13.790
101.53	**700**	4826	435.11	**3000**	20.684
116.03	**800**	5516	580.15	**4000**	27.579
130.53	**800**	6205	725.19	**5000**	34.474

To convert ksi or Mpa values above 400, use the supplemental table. Example: Convert 1320 MPa to ksi. Solution: 1000 MPa = 145.04 ksi (from the small table), and 320 MPa = 46.41 ksi (from the large table). Then 145.04 + 46.41 = 191.45 ksi.

DECIMAL AND MILLIMETER EQUIVALENTS OF INCH FRACTIONS

Fraction	Decimal	Millimeter	Fraction	Decimal	Millimeter
1/64	.0156	0.397	33/64	.5156	13.095
1/32	.0312	0.794	17/32	.5312	13.494
3/64	.0468	1.191	35/64	.5468	13.891
1/16	.0625	1.588	9/16	.5625	14.288
5/64	.0781	1.984	37/64	.5781	14.684
3/32	.0937	2.381	19/32	.5937	15.081
7/64	.0193	2.778	39/64	.6093	15.478
1/8	.1250	3.175	5/8	.6250	15.875
9/64	.1406	3.572	41/64	.6406	16.272
5/32	.1562	3.969	21/32	.6562	16.669
11/64	.1718	4.366	43/64	.6718	17.066
3/16	.1875	4.763	11/16	.6875	17.463
13/64	.2031	5.159	45/64	.7031	17.859
7/32	.2187	5.556	23/32	.7187	18.256
15/64	.2343	5.953	47/64	.7343	18.653
1/4	.2500	6.350	3/4	.7500	19.050
17/64	.2656	6.747	49/64	.7656	19.447
9/32	.2812	7.144	25/32	.7812	19.844
19/64	.2968	7.541	51/64	.7968	20.241
5/16	.3125	7.938	13/16	.8125	20.638
21/64	.3281	8.334	53/64	.8281	21.034
11/32	.3437	8.731	27/32	.8437	21.431
23/64	.3593	9.128	55/64	.8593	21.828
3/8	.3750	9.525	7/8	.8750	22.225
25/64	.3906	9.922	57/64	.8906	22.622
13/32	.4062	10.319	29/32	.9062	23.019
27/64	.4218	10.716	59/64	.9218	23.416
7/16	.4375	11.113	15/16	.9375	23.813
29/64	.4531	11.509	61/64	.9531	24.209
15/32	.4687	11.906	31/32	.9687	24.606
31/64	.4843	12.303	63/64	.9843	25.003
1/2	.5000	12.700	1	1.0000	25.400

HARDNESS CONVERSION TABLE

BRINELL AND ROCKWELL HARDNESS

NUMBERS FOR STEEL AND THE APPROXIMATE TENSILE STRENGTH

Brinell Indentation Diameter mm	Brinell Hardness Number 300-Kg. 10mm Tungsten Carbide Ball	B-Scale 100Kg. Load 1/16 in Dia. Ball	C-Scale 150-Kg. Load Brale Penetrator	Tensile Strength (Approx-imate) in 1000 psi
2.25	745	-	65.3	-
2.35	682	-	61.7	-
2.40	653	-	60.0	-
2.45	627	-	58.7	-
2.50	601	-	57.3	-
2.55	578	-	56.0	-
2.60	555	-	54.7	298
2.65	534	-	53.5	288
2.70	514	-	52.1	274
2.75	495	-	51.0	264
2.80	477	-	49.6	252
2.85	461	-	48.5	242
2.90	444	-	47.1	230
2.95	429	-	45.7	219
3.00	415	-	44.5	212
3.05	401	-	43.1	202
3.10	388	-	41.8	193
3.15	375	-	40.4	184
3.20	363	-	39.1	177
3.25	352	-	37.9	171
3.30	341	-	36.6	164
3.35	331	-	35.5	159
3.40	321	-	34.3	154
3.45	311	-	33.1	149
3.50	302	-	32.1	146
3.55	293	-	30.9	141
3.60	285	-	29.9	138
3.65	277	-	28.8	134
3.70	269	-	27.6	130
3.75	262	-	26.6	127
3.80	255	-	25.4	123
3.85	248	-	24.2	120
3.90	241	100.0	22.8	116
3.95	235	99.0	21.7	114
4.00	229	98.2	20.5	111
4.05	223	97.3	(18.8)	108
4.10	217	96.4	(17.5)	105
4.15	212	95.5	(16.0)	102
4.20	207	94.6	(15.2)	100

HARDNESS CONVERSION TABLE
(Continued)

Brinell Indentation Diameter mm	Brinell Hardness Number 300-Kg. 10mm Tungsten Carbide Ball	B-Scale 100Kg. Load 1/16in Dia. Ball	C-Scale 150-Kg. Load Brate Penetrator	Tensile Strength (Approx-imate) in 1000 psi
4.25	201	93.8	(13.8)	98
4.30	197	92.8	(12.7)	95
4.35	192	91.9	(11.5)	93
4.40	187	90.7	(10.0)	90
4.45	183	90.0	(9.0)	89
4.50	179	89.0	(8.0)	87
4.55	174	87.8	(6.4)	85
4.60	170	86.8	(5.4)	83
4.65	167	86.0	(4.4)	81
4.70	163	85.0	(3.3)	79
4.80	156	82.9	(0.9)	76
4.90	149	80.8	-	73
5.00	143	78.7	-	71
5.10	137	76.4	-	67
5.20	131	74.0	-	65
5.30	126	72.0	-	63
5.40	121	69.8	-	60
5.50	116	67.6	-	58
5.60	111	65.7	-	56

TEMPERATURE CONVERSIONS

The general arrangement of this table was devised by Sauveur and Boylston more than 40 years ago. The middle column of figures (in bold-faced type) contains the reading (F or C) to be converted. If converting from degrees Fahrenheit to degrees Centigrade (Celsius), read the Centigrade equivalent in the column headed “C”. If converting from Centigrade to Fahrenheit, read the Fahrenheit equivalent in the column headed “F”.

F		C	F		C
-148.0	**-100**	-73.33	+32.0	**±0**	-17.78
-144.4	**-98**	-72.22	+35.6	**+2**	-16.67
-140.8	**-96**	-71.11	+39.2	**+4**	-15.56
-137.2	**-94**	-70.00	+42.8	**+6**	-14.44
-133.6	**-92**	-68.89	+46.4	**+8**	-13.33
-130.0	**-90**	-67.78	+50.00	**+10**	-12.22
-126.4	**-88**	-66.67	+53.6	**+12**	-11.11
-122.8	**-86**	-65.56	+57.2	**+14**	-10.00
-119.2	**-84**	-64.44	+60.8	**+16**	-8.89
-115.6	**-82**	-63.33	+64.4	**+18**	-7.78
-112.0	**-80**	-62.22	+68.0	**+20**	-6.67
-108.4	**-78**	-61.11	+71.6	**+22**	-5.56
-104.8	**-76**	-60.00	+75.2	**+24**	-4.44
-101.2	**-74**	-58.89	+78.8	**+26**	-3.33
-97.6	**-72**	-57.78	+82.4	**+28**	-2.22
-94.0	**-70**	-56.67	+86.0	**+30**	-1.11
-90.4	**-68**	-55.56	+89.6	**+32**	+0.00
-86.8	**-66**	-54.44	+93.2	**+34**	+1.11
-83.2	**-64**	-53.33	+96.8	**+36**	+2.22
-79.6	**-62**	-52.22	+100.4	**+38**	+3.33
-76.0	**-60**	-51.11	+104.0	**+40**	+4.44
-72.4	**-58**	-50.00	+107.6	**+42**	+5.56
-68.8	**-56**	-48.89	+111.2	**+44**	+6.67
-65.2	**-54**	-47.78	+114.8	**+46**	+7.78
-61.6	**-52**	-46.67	+118.4	**+48**	+8.89
-58.0	**-50**	45.56	+122.0	**+50**	+10.00
-54.4	**-48**	-44.44	+125.6	**+52**	+11.11
-50.8	**-46**	-43.33	+129.2	**+54**	+12.12
-47.2	**-44**	-42.22	+132.8	**+56**	+13.33
-43.6	**-42**	-41.11	+136.4	**+58**	+14.44
-40.0	**-40**	-40.00	+140.0	**+60**	+15.56
-36.4	**-38**	-38.89	+143.6	**+62**	+16.67
-32.8	**-36**	-37.78	+147.2	**+64**	+17.78
-29.2	**-34**	-36.67	+150.8	**+66**	+18.89
-25.6	**-32**	-35.56	+154.4	**+68**	+20.00
-22.0	**-30**	-34.44	+158.0	**+70**	+21.11
-18.4	**-28**	-33.33	+161.6	**+72**	+22.22
-14.8	**-26**	-32.22	+165.2	**+74**	+23.33
-11.2	**-24**	-31.11	+168.8	**+76**	+24.44
-7.6	**-22**	-30.00	+172.4	**+78**	+25.56
-4.0	**-20**	-28.89	+176.0	**+80**	+26.67
-0.4	**-18**	-27.78	+179.6	**+82**	+27.78
+3.2	**-16**	-26.67	+183.2	**+84**	+28.89
+6.8	**-14**	-25.56	+186.8	**+86**	+30.00
+10.4	**-12**	-24.44	+190.4	**+88**	+31.11
+14.0	**-10**	-23.33	+194.0	**+90**	+32.22
+17.6	**-8**	-22.22	+197.6	**+92**	+33.33
+21.2	**-6**	-21.11	+201.2	**+94**	+34.44
+24.8	**-4**	-20.00	+204.8	**+96**	+35.56
+28.4	**-2**	-18.89	+208.4	**+98**	+36.67
			+212.0	**+100**	+37.78

APPROXIMATE HARDNESS AND STRENGTH LEVEL OF VARIOUS STEEL PRODUCTS

Approx. Tensile Strength X1000psi	Brinell Hardness	Rockwell Hardness B	Rockwell Hardness C	Steel Grades	
			66	High Speed Tool Steel	
			62		
			61	Tool and Die Steels	
			54		
264	505		51		Carbon and Alloy Steel Machinery Parts
234	456		48	Spring Steel Hardness Range	
204	405		44		
195	388		42		
				AR 360	
180	360		39		
				AR 321	
161	322		34	4140 Heat Treated and 4150 mod	
131	265		27		
				A514	
124	252		25	AR Plate	
121	247		24	Stressproof	
119	242		23	4140 Annealed	
				1045 As-Rolled	
101	219		18		
		95	16		
88	190	92	11	A656 Gr.80	
84	171	87			A656 Gr. 70
				HSLA-A537	
				A572 A588	
				A607 GR50 Sheet	
75	152	82			
				A36 Plate and Structurals	
				A285 A516 A607 Sheet	
				Tubing and Pipe	
62	124	71			
		60		CRCQ Sheet	
				CRCQ Sheet	
		38		CRDQSK Sheet	

SHEAR STRENGTH CHART

Material Description	Hardness	Ultimate	
		Tensile P.S.I	Shear P.S.I
STEELS			
Low Carbon, H.R. Sheet ASTM A-415	Rb 70	60,000	50,000
Low Carbon, C.R. Sheet Special killed Drawing Quality	Rb 50	50,000	40,000
Low Carbon, C.R. Sheet			
(Soft)	Rb 45-60	53,000	42,000
(1/4 Hard)	Rb 60-75	60,000	45,000
(1/2 Hard)	Rb 70-85	72,000	50,000
(Hard)	Rb 80-95	92,000	61,000
40-50% Carbon Steel H.R. Sheet	BHN 200	100,000	80,000
SAE 1074 C.R. Annealed Spring Steel	Rb 90	95,000	75,000
SAE 1095 C.R. Annealed Spring Steel	Rb 95	100,000	80,000
SAE 1074 or 1095 Spring Steel Hardened to Spring Temper	Rc 45-50	260,000	200,000
Abrasion-Resisting H.R. Sheet Steel	BHN 200/245	120,000	100,000
Cor-Ten Steel	BHN 140	70,000	55,000
Tri-Ten Steel	BHN 120	60,000	50,000
T-1 Steel (Types A&B) 100,000 P.S.I. Y.S.	BHN 260	130,000	105,000
STAINLESS STEELS			
202- Annealed	Rb 95	110,000	90,000
302, 303, 304 - Annealed	Rb 85	95,000	75,000
310- Annealed	Rb 90	105,000	90,000
316, 321, 430 - Annealed	Rb 90	95,000	75,000
410- Annealed	Rb 85	85,000	75,000

To determine the punching load for press capacity the following formula can be used to calculate the tonnage requirements. The ultimate shear strength from the above table can be used in place of S in the table. To calculate tonnage divide through by 2000.

PUNCHING LOAD (PER PUNCH)

P = LTS where:

P = Punching load (lb)
L = Length of cut (in)
T = Stock thickness (in)
S = Ultimate shear strength (lb/in2)

MACHINABILITY RATINGS

The factors involved in machinability and the machinability rating index are cutting speed, resultant surface produced and tool life. There are many variables involved in machinability such as steel hardness, inclusions, size and shape of the cutting tool and cutting fluids. The following table is a composite of many tables from steel mills and the Society of Automotive Engineers. Machinability ratings are based on 1212 which is rated at 100% or 168 surface feet per minute.

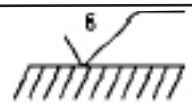
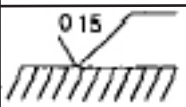
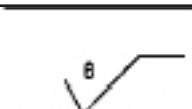
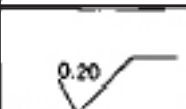
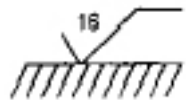
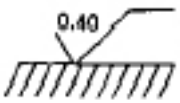
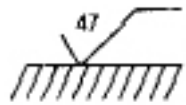
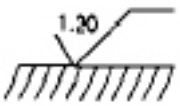
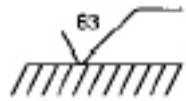
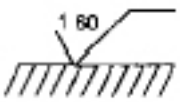
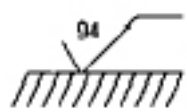
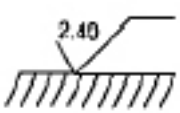
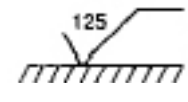
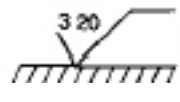
Steel Grade	Condition	Machinability Rating	Surface Feet Per Minute
CARBON STEELS			
A36	HR	53	88
1018	CD	66	111
1020	HR	58	98
1040	HR	62	104
1045	HR	55	92
FREE MACHINING			
1117	CD	89	150
1144	CD	83	140
STRESSPROOF	CD	83	140
1212	CD	100	168
12L14	CD	195	325
1215	CD	137	230
ALLOYS			
4130	HRN&T	65	110
4140	HRA	65	110
4140	HRHT	47	78
4150+	HRHT	57	85
4340	HRA	51	80
8620	HR	60	100
8630	HRA	60	100
8640	HRA	54	90
EDT 150		75	125

HR hot rolled
CD cold drawn
A annealed
N&T normalized and tempered
HT heat treated (262-321)
+ resulfurized and heat treated (262-321)

SURFACE ROUGHNESS DATA

This section is a guide to engineering, shop and inspection departments as to finishes which can be attained with automatic screw machines and various secondary operations.

The typical methods of producing the finishes listed here do not include all possible means of obtaining the desired results. There are other additional methods not listed which may be used to obtain the specified surface finish.

Surface Roughness µ In	Surface Roughness µ m	Ordinary Method of Producing	Relative Costs
		Superfinish buff. Produced by microphone lap, or very fine buff.	Very expensive.
		Ground, lapped, honed, fine honed fine buffed, etc	Expensive.
		Very fine grind, lapped, honed, fine buffed, etc.	Expensive except where a special machine can be used in mass production setups.
		Fine grind, broached burnished, buffed, cold pressed, smooth emery buff, etc.	Fairly inexpensive for hardened steel on a high production basis impracti-able on automatics except for burnishing operations.
		Finish grind, very fine machine finish, broached, reamed, shaved, buffed, hand finish with emery cloth, etc.	Very difficult and relatively expensive on automatics. Relatively inexpensive for cylindrical or surface grinding, especially on hardened steel.
		Smooth grind, broached, rolled, very light machine cut, shaved, turned, bored, milled, reamed, smooth disc grind, ball seat swaging, etc.	Possible but difficult even with best tool practice for automatic screw machine work . Easily attained in many secondary operations.
		Medium grind, light finish tool cut, reamed, shaved, turned, bored, milled, etc	Less difficult but requires care and proper tooling in machining operations.
		Commercial grind, finish tool cut, broached, rolled, reamed, shaved, turned, bored, milled, drilled, spotfaced, counter-bored, fine filed, etc.	This finish should be maintained in most automatic operations.

STEEL FASTENERS

MECHANICAL AND MATERIAL REQUIREMENTS FOR EXTERNALLY THREADED FASTENERS- SAE J429 JAN 80 SAE STANDARD

This SAE standard covers the mechanical and material requirements for steel bolts, screws, studs, sems[1], and U-bolts[2] used in automotive and related industries in sizes to 1 1/2 in., inclusive

[1]Sems: Screw and washer assemblies.

[2]U-bolts covered by this SAE Standard are those used primarily in the suspension and related areas of vehicles. For specification purposes, this standard treats U-bolts as studs. Thus, whenever the word “studs” appears, “U-bolts” is also implied. (Designers should recognize that the “U” configuration may not sustain a load equivalent to two bolts or studs of the same size and grade; thus, actual load carrying capacity of U-bolts should be determined by saddle load tests.

Designation System--Grades are designated by numbers where increasing numbers represent increasing tensile strength, and by decimals of whole numbers where decimals represent variations at the same strength level. The grade designations are given in Table 1

Grades--Bolts and screws are normally available only in Grades 1,2,5, 5.2, 7, 8, and 8.2. Studs are normally available only in Grades 1, 2,4, 5,8, and 8.1. Grade 5.1 is applicable to sems which are heat treated following assembly of the washer on the screw, and to products without assembled washer.

Steel Characteristics--Bolts, screws, studs, and sems shall be made of steel conforming to the description and chemical composition requirements specified in Table 2.

MECHANICAL REQUIREMENTS AND IDENTIFICATION MARKING

FOR BOLTS, SCREWS, STUDS, SEMS AND U-BOLTS"

Grade Designation	Products	Nominal Diameter, Inch	Full Size Bolts Screws, Studs, Sems		Machine Test Specimens of Bolts, Screws, and Studs				Surface Hardness	Core Hardness		Grade Identification Marking
			Proof Load (Stress), psi	Tensile Strength (Stress) Min., psi	Yields Strength (Stress) Min., psi	Tensile Strength (Stress) Min., psi	Elongation Min., %	Reduction of area Min.%	Rockwell 30N Max.	Rockwell Min.	Rockwell Max.	
1	Bolts Screws, Studs	1/4 thru 1 1/2	33,000[i]	60,000	36,000[b]	60,000	18	35	-	B70	B100	None
2	Bolts Screws, Studs	1/4 thru 3/4[c]	55,000[i]	74,000	57,000	74,000	18	35	-	B80	B100	
		over 3/4 to 11/2	33,000	60,000	36,000[b]	60,000	18	35	-	B70	B100	None
4	Studs	1/4 thru 1 1/2	65,000	115,000	100,000	115,000	10	35	-	C22	C32	None
5	Bolts Screws, Studs	1/4 thru 1	85,000	120,000	92,000	120,000	14	35	54	C25	C34	
		Over 1 to 1 1/2	74,000	105,000	81,000	105,000	14	35	50	C19	C30	
5.1[d]	Sems[g] Bolts, Screws	No. 6 thru 5/8	85,000	120,000	-	-	-	-	59.5[f]	C25	C40[j]	
		No. 6 thru 1/2										
5.2	Bolts Screws	1/4 thru 1	85,000	120,000	92,000	120,000	14	35	56	C26	C36	
7[e]	Bolts	1/4 thru 1 1/2	105,000	133,000	115,000	133,000	12	35	54	C28	C34	

MECHANICAL REQUIREMENTS AND IDENTIFICATION MARKING (CONTINUED)

FOR BOLTS, SCREWS, STUDS, SEMS AND U-BOLTS[h]

Grade Designation	Products	Nominal Diameter, inch	Full Size Bolts Screws, Studs, Sems		Machine Test Specimens of Bolts, Screws, and Studs			Surface Hardness	Core Hardness	Grade Identification Marking
			Proof Load (Stress) psi	Tensile Strength (Stress) Min. psi	Yield Strength (Stress) Min. psi	Tensile Strength (Stress) Min. psi	Elongation Min., %	Reduction of Area Min., %	Rockwell 30N Max.	Rockwell Min. Max	
8	Bolts, Screws, Studs	1/4 thru 1 1/2	120,000	150,000	130,000	150,000	12	35	58.6	C33 C39	None
8.1	Studs	1/4 thru 1 1/2	120,000	150,000	130,000	150,000	10	35	-	C32 C38	
8.2	Bolts Screws	1/4 thru 1	120,000	150,000	130,000	150,000	10	35	61	C35 C42	

[a] Yield strength is stress at which a permanent set of 0.2% of gage length occurs.

[b] Yield point shall apply instead of yield strength at 0.2% offset.

[c] Grade 2 requirements for sizes 1/4 through 3/4 in apply only to bolts and screws 6 in. and shorter in length, and to studs of all lengths. For bolts and screws longer than 6 in., grade 1 requirements shall apply.

[d] Grade 5 material heat treated before assembly with a hardened washer is an acceptable substitute.

[e] Grade 7 bolts and screws are roll threaded after heat treatment.

[f] Hex washer head and hex flange products without assembled washers shall have a core hardness not exceeding Rockwell C38 and a surface hardness not exceeding Rockwell 30N 57.5.

[g] Sems and similar products without washers.

[h] Not applicable to studs or slotted and cross recess head products.

[i] Proof load tests: Requirements in these grades only apply to stress relieved products.

CHEMICAL COMPOSITION

REQUIREMENTS FOR STEEL FASTENERS

Grade	Material and Treatment	Element, %					
		C		MN Min.	P Max.	S Max.	B Min.
		Min.	Max.				
1	Low or medium carbon steel	-	0.55	-	0.048	0.058	-
2	Low or medium carbon steel	-	0.55	-	0.048	0.058[b]	-
4	Medium carbon cold drawn steel	-	0.55	-	0.048	0.058	-
5	Medium carbon steel, quenched and tempered	0.28	0.55	-	0.048	0.058[c]	-
5.1	Low or medium carbon steel, quenched and tempered[e]	0.15	0.30	-	0.048	0.058	-
5.2	Low carbon martensite steel, fully killed, fine grain quenched and tempered	0.15	0.25	0.74	0.048	0.058	0.005
7	Medium carbon alloy steel, quenched and tempered[d]	0.28	0.55	-	0.040	0.045	-
8	Medium carbon alloy steel, quenched and tempered[d]	0.28	0.55	-	0.040	0.045	-
8.1	Elevated temperature drawn steel-medium carbon alloy or SAE 1541 (or 1541H steel)	0.28	0.55	-	0.048	0.058	-
8.2	Low carbon martensite steel, fully killed, fine grain quenched and tempered[f]	0.15	0.25	0.74	0.048	0.058	0.0005

[a]All values are for product analysis use (percent by weight). For cast or heat analysis, use standard permissible variations as shown in SAE J409 (January, 1942).
[b]For studs only, sulfur content may be 0.33% max.
[c]For studs only, sulfur content may be 0.13% max.
[d]Steel shall be fine grain, with hardenability that will produce a minimum hardness of Rockwell C47 on the center of a transverse section one diameter from the threaded end of the bolt, screw, or stud after all quenching (see SAE J407 August, 947). Carbon steel may be used by agreement between producer and consumer for sizes 1/4-3/4in. diameter products.
ϕSAE 1541 (or 1541H) steel, oil quenched and tempered, may be used at the option of the producer for products 7/» in. nominal diameter and smaller.
[e]For sems only, sizes 7/ie-H in. diameter, low carbon martensite steel (as specified for Grade 5.2) may be used.
[f]Steel with hardenability that will produce a minimum hardness of Rockwell C38 at the center of a transverse section one diameter from the threaded end of the bolt or screw after quenching.

HEAT TREATMENT PRACTICE

Grade 1 bolts and screws and Grades 1 and 2 studs need not be heat treated. When specified by purchaser, Grade 2 cold headed bolts and screws shall be stress relieved at a minimum stress relief temperature of 875° F (468° C) Grades 4 and 8.1 studs are manufactured from pretreated material and the studs, as manufactured, need no further heat treatment. Grades 5 and 5.2 bolts, screws, and studs shall be heat treated, oil or water quenched, at option of manufacturer, and tempered at a minimum tempering temperature of 800° F (427° C). Grade 5.1 bolts, screws, and sems shall be heat treated, quenched, and tempered at a minimum tempering temperature of 650° F (343° C). For Grade 5.1 sems, quenchants whose principal constituent is water shall not be used, unless specifically approved by the user. Grades 7 and 8 bolts and screws and Grade 8 studs shall be heat treated, oil quenched, and tempered at a minimum tempering temperature of 800° F (427° C). Grade 8.2 bolts and screws shall be fully austenitized, quenched in oil or water, and tempered at a minimum temperature of 650° F (340° C).

ASTM GRADES FOR STEEL FASTENERS

Specification	Classification	Nominal Size Range 6 In.
A193	Alloy steel and stainless steel bolting materials for high temperature service.	
A307	Carbon steel externally threaded standard fasteners.	1/4 thru 4
A320	Alloy steel bolting materials for low temperature service	1/4 thru 2 1/2
A325	High strength bolts for structural steel joints.	1/2 thru 1 1/2
A449	Quench and tempered steel bolts and studs.	1/4 thru 3
A490	Quench and tempered alloy steel bolts for structural steel joints.	1/2 thru 1 1/2

RECOMMENDED ELECTRODES

FOR SHIELDED METAL ARC WELDING OF CARBON AND LOW ALLOY STEELS

ASTM Specification	Description	Grades	Recommended Electrodes
A36	structural 36,000 PSI YS min	-	(2)
A131	ship structural	A,B,C, CS, D	(2)
		AH, DH & EH	E7018
A148	steel castings for structural use	80-40 & 50	E8018-C3
		90-60	E9018-G
A242	high strength structurals	all	E7018 or E7028[4]
A283	structural plates	all	(2)
A285	pressure vessel plates	all	(2)
A366	commercial quality sheets	-	(2)
A414	pressure vessel sheets.	A,B,C&D	(2)
		E & F	E7018 or E7028
A441	high strength structurals	all	E7018 or E7028[4]
A514	quenched and tempered plates	all	E7018-M[7]
A515	pressure vessel plates	all	E7018 or E7028
A516	pressure vessel plates	55 & 60	E7018 or E7028
		65 & 70	E7018 or E8018-C3
A517	quenched and tempered plates	all	E11018-M[7]
A526	galvanized sheet, commercial	-	(2.5)
A537	pressure vessel plates	class 1	BOXXC1-C2-C3
A570	structural sheets and strip	all	(2)
A572	structural steel	42 & 45	(2)
		50 & 55	E7018 or E7028
		60 & 65	E8018-C3
A588	high strength structurals	all	E7018 or E70283[4]
A615	reinforcement bars	40	(2)
		60	E9018-G
		75	E11018-M
A656	high strength plate	70 & 80	E8018
A53	steel pipe	all	(2), (8)
A106	seamless carbon steel pipe	all	(2), (8)
A120	steel pipe	all	(2), (8)
A500	structural tubing	A, B & C	E7018[5]
Steel Grades			
1018/1020	low carbon steel		(2)
1045	medium carbon steel		E11018-M
4140	alloy steel		E12018-M

1. These recommendations are based on matching the tensile properties of the weld deposit and plate, and also the compositions of the weld deposit where chemistry is important. Since it is impossible to foresee all the conditions of every application, electrodes other than those recommended here may also be satisfactory and should be tested before the weldment is started.
2. Unless restricted by specifications, use any E60XX or E70XX electrode for steel grades with 60,000 psi or lower tensile strength; for steel grades with 60,000 to 70,000 psi tensile strength, use E70XX electrodes.

FOR SHIELDED METAL ARC WELDING OF CARBON AND LOW ALLOY STEELS

3. Do not use E1018-B2 for low temperature applications.
4. Use E-8018-C1 or E8010-B2 for best color match on unpainted steels with enhanced atmospheric corrosion resistance. Consult the steel supplier.
5. Usually E6010 is the most satisfactory electrode for galvanized sheet.
6. E7018 or E7028 for fillets, or E8018-C3 for general- purpose welding, can be used on these steels. If the weldment is to be precipitation hardened or high weld strength is required, use E8012-B2.
7. E7018 or E8018-C3 are frequently used for fillet welds.
8. Use E7010-G, an electrode designed for field welding of pipe.
9. Unless restricted by specifications, any E60XX or E70XX electrode may also be used for grades with 60,000 psi or lower tensile strength; any E70XX electrode may be used for grades with 60,000 to 70,000 psi tensile strength.
10. It is standard practice to preheat the following steel categories; over 80,000 psi tensile, over .30% carbon content and quench and tempered steels.

GEOMETRIC FORMULAS

CIRCLES
Area = Square of Diameter x .7854
or Square of Radius x π (3.1416, etc.)
CIRCUMFERENCE = Diameter x π
DIAMETER = Circumference x .3183
Doubling diameter increases area four times; tripling diameter increases area nine times.

CONE
AREA OF CURVED SURFACE = Diameter of base x Slant Height x 1.5708
VOLUME = Diameter of Base Squared x Perpendicular Height
x.2618 or Area of Base x 1/3 Perpendicular Height

CUBE
AREA OF SURFACE = Square of Side x 6
VOLUME = Cube of Side
DIAGONAL = Side x 1.732

CYLINDER
AREA OF CURVED SURFACE = Diameter x Length x π
VOLUME = Square of Diameter x Length x .7854

HEXAGON
AREA = Square of Distance across Flats x.866
or Square of Side x 2.598
SIDE = 1/2 Of Diagonal
or Distance across Flats x .577
DIAGONAL = Distance across Flats x 1.155
or Side x 2

OCTAGON
AREA = Square of Distance across Flats x .828
or Square of Side x 4.828
SIDE = Diagonal x. 383
or Distance across Flats x .414
DIAGONAL = Distance across Flats x 1.082
or Side x 2.613

RECTANGLE
AREA = Length x Width
DIAGONAL = Square root of sum of squares of Width and Length

SPHERE
AREA OF SURFACE = Square of Diameter x π
VOLUME - Cube of Diameter x .5236
Holds the largest volume possible for the smallest surface.

SQUARE
AREA = Square of Side
DIAGONAL = Side x 1.4142
SIDE = Diagonal x .7071

SQUARE INSCRIBED IN CIRCLE
SIDE OF SQUARE = Diameter of Circle x .7071
or Circumference of Circle x .2251
DIAMETER OF CIRCLE = Side of Square x 1.4142
CIRCUMFERENCE OF CIRCLE - Side of Square x 4.4429

SQUARE AND CIRCLE OF EQUAL AREA
SIDE OF SQUARE - Diameter of Circle x .8862
DIAMETER OF CIRCLE - Side of Square x 1.128
CIRCUMFERENCE OF CIRCLE = Side of Square x 3.545

TRIANGLE
AREA - Base x 1/2 of Perpendicular Height
180° = Sum of all inside angles

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam. In.	Circum. In.	Area Sq. In.
1/64	.04909	.00019
1/32	.09818	.00077
3/64	.14726	.00173
1/16	.19635	.00307
3/32	.29452	.00690
1/8	.39270	.01227
5/32	.49087	.01917
3/16	.58905	.02761
7/32	.68722	.03758
1/4	.78540	.04909
9/32	.88357	.06213
5/16	.98175	.07670
11/32	1.0799	.09281
3/8	1.1781	.11045
13/32	1.2763	.12962
7/16	1.3744	.15033
15/32	1.4726	.17257
1/2	1.5708	.19635
17/32	1.6690	.22166
9/16	1.7671	.24850
19/32	1.8653	.27688
5/8	1.9635	.30680
21/32	2.0617	.33824
11/15	2.1598	.37122
23/32	2.2580	.40574
3/4	2.3562	.44179
25/32	2.4544	.47937
13/16	2.5525	.51849
27/32	2.6507	.55914
7/8	2.7489	.60132
29/32	2.8471	.64504
15/16	2.9452	.69029
3 1/32	3.0434	.73708
1	3.1416	.7854
1 1/16	3.3379	.8866
1 1/8	3.5343	.9940
1 3/16	3.7306	1.1075
1 1/4	3.9270	1.2272
1 5/16	4.1233	1.3530
1 3/8	4.3197	1.4849
1 7/16	4.5160	1.6230
1 1/2	4.7124	1.7671
1 9/16	4.9087	1.9175
1 5/8	5.1051	2.0739
1 11/16	5.3014	2.2365
1 3/4	5.4978	2.4053
1 13/16	5.6941	2.5802
1 7/8	5.8905	2.7612
1 15/16	6.0868	2.9483
2	6.2832	3.1416
2 1/16	6.4795	3.3410
2 1/8	6.6759	3.5466
2 3/16	6.8722	3.7583
2 1/4	7.0686	3.9761
2 5/16	7.2649	4.2000
2 3/8	7.4613	4.4301
2 7/16	7.6576	4.6664
2 1/2	7.8540	4.9087
2 9/16	8.0503	5.1572
2 5/8	8.2467	5.4119
2 11/16	8.4430	5.6727
2 3/4	8.6394	5.9396
2 13/16	8.8357	6.2126
2 7/8	9.0321	6.4918
2 15/16	9.2284	6.7771
3	9.4248	7.0686
3 1/16	9.6211	7.3662
3 1/8	9.8175	7.6699
3 3/16	10.014	7.9798
3 1/4	10.210	8.2958
3 5/16	10.407	8.6179
3 3/8	10.603	8.9462
3 7/16	10.799	9.2806
3 1/2	10.996	9.6211
3 9/16	11.192	9.9678
3 5/8	11.388	10.321
3 11/16	11.585	10.680
3 3/4	11.781	11.045
3 13/16	11.977	11.416
3 7/8	12.174	11.793
3 15/16	12.370	12.177
4	12.566	12.566
4 1/16	12.763	12.962
4 1/8	12.959	13.364
4 3/16	13.155	13.772
4 1/4	13.352	14.186
4 5/16	13.548	14.607
4 3/8	13.744	15.033
4 7/16	13.941	15.466
4 1/2	14.137	15.904
4 9/16	14.334	16.349
4 5/8	14.530	16.800
4 11/16	14.726	17.257
4 3/4	14.923	17.721
4 3/16	15.119	18.190
4 7/8	15.315	18.665
4 15/16	15.512	19.147
5	15.708	19.635
5 1/16	15.904	20.129
5 1/8	16.101	20.629

CIRCUMFERENCE AND AREAS OF CIRCLES
(CONTINUED)

Diam. In.	Circum In.	Area Sq. In.
5 3/16	16.297	21.135
5 1/4	16.493	21.648
5 5/16	16.690	22.166
5 3/8	16.886	22.691
5 7/16	17.082	23.221
5 1/2	17.279	23.758
5 9/16	17.475	24.301
5 5/8	17.671	24.850
5 11/16	17.686	25.406
5 3/4	18.064	25.967
5 13/16	18.261	26.535
5 7/8	18.457	27.109
5 15/16	18.653	27.688
6	18.850	28.274
6 1/8	19.242	29.465
6 1/4	19.635	30.680
6 3/8	20.028	31.919
6 1/2	20.420	33.183
6 5/8	20.813	34.472
6 3/4	21.206	35.785
6 7/8	21.598	37.122
7	21.991	38.485
7 1/8	22.384	39.871
7 1/4	22.776	41.282
7 3/8	23.169	42.718
7 1/2	23.562	44.179
7 5/8	23.955	45.664
7 3/4	23.347	47.173
7 7/8	24.740	48.707
8	25.133	50.265
8 1/8	25.525	51.849
8 1/4	25.918	53.456
8 3/8	26.311	55.088
8 1/2	26.704	56.745
8 5/8	27.096	58.426
8 3/4	27.489	60.132
8 7/8	27.882	61.862
9	28.274	63.617
9 1/8	28.667	65.397
9 1/4	29.060	67.201
9 3/8	29.452	69.029
9 1/2	29.845	70.882
9 5/8	30.238	72.760
9 3/4	30.631	74.662
9 7/8	31.023	76.589
10	31.416	78.540
10 1/8	31.809	80.516
10 1/4	32.201	82.516
10 3/8	32.594	84.541
10 1/2	32.987	86.590
10 5/8	33.379	88.664
10 3/4	33.772	90.763
10 7/8	34.165	92.886
11	34.558	95.033
11 1/8	34.950	97.205
11 1/4	35.343	99.402
11 3/8	35.736	101.62
11 1/2	36.128	103.87
11 5/8	36.521	106.14
11 3/4	36.914	108.43
11 7/8	37.306	110.75
12	37.699	113.10
12 1/8	38.092	115.47
12 1/4	38.485	117.86
12 3/8	38.877	120.28
12 1/2	39.270	122.72
12 5/8	39.663	125.19
12 3/4	40.055	127.68
12 7/8	40.448	130.19
13	40.841	132.73
13 1/8	41.233	135.30
13 1/4	41.626	137.89
13 3/8	42.019	140.50
13 1/2	42.412	143.14
13 5/8	42.804	145.80
13 3/4	43.197	148.49
13 7/8	43.590	151.20
14	43.982	153.94
14 1/8	44.375	156.70
4 1/4	44.768	159.48
14 3/8	45.160	162.30
14 1/2	45.553	165.13
14 5/8	45.946	167.99
14 3/4	46.338	170.87
14 7/8	46.731	173.78
15	47.124	176.71
15 1/8	47.517	179.67
15 1/4	47.909	182.65
15 3/8	48.302	185.66
15 1/2	48.695	188.69
15 5/8	49.087	191.75
15 3/4	49.480	194.83
15 7/8	49.873	197.93
16	50.265	201.06
16 1/8	50.658	204.22
16 1/4	51.051	207.39
16 3/8	51.444	210.60
16 1/2	51.836	213.82
16 5/8	52.229	217.08
16 3/4	52.622	220.35
16 7/8	53.014	223.65

CIRCUMFERENCES AND AREAS OF CIRCLES
(Continued)

Diam. In.	Circum In.	Area Sq. In.
17	53.407	226.98
17 1/8	53.800	230.33
17 1/4	54.192	233.71
17 3/8	54.585	237.10
17 1/2	54.978	240.53
17 5/8	55.371	243.98
17 3/4	55.763	247.45
17 7/8	56.156	250.95
18	56.549	254.47
18 1/8	56.941	258.02
18 1/4	57.334	261.59
18 3/8	57.727	265.18
18 1/2	58.119	268.80
18 5/8	58.512	272.45
18 3/4	58.905	276.12
18 7/8	59.298	279.81
19	56.690	283.53
19 1/8	60.083	287.27
19 1/4	60.476	291.04
19 3/8	60.868	294.83
19 1/2	61.261	298.65
19 5/8	61.654	302.49
19 3/4	62.046	306.35
19 7/8	62.439	310.24
20	62.832	314.16
20 1/8	63.225	318.10
20 1/4	63.617	322.06
20 3/8	64.010	326.05
20 1/2	64.403	330.06
20 5/8	64.795	334.10
20 3/4	65.188	338.16
20 7/8	65.581	342.25
21	65.973	346.36
21 1/8	66.366	350.50
21 1/4	66.759	354.66
21 3/8	67.152	358.84
21 1/2	67.544	363.05
21 5/8	67.937	367.28
21 3/4	68.330	371.54
21 7/8	68.722	375.83
22	69.115	380.13
22 1/8	69.508	384.46
22 1/4	69.900	388.82
22 3/8	70.293	393.20
22 1/2	70.686	397.61
22 5/8	71.079	402.04
22 3/4	71.471	406.49
22 7/8	71.864	410.97
23	72.257	415.48
23 1/8	72.649	420.00
23 1/4	73.042	424.56
23 3/8	73.435	429.13
23 1/2	73.827	433.74
23 5/8	74.220	438.36
23 3/4	74.613	443.01
23 7/8	75.006	447.69
24	75.398	452.39
24 1/8	75.791	547.11
24 1/4	76.184	461.86
24 3/8	76.576	466.64
24 1/2	76.969	471.44
24 5/8	77.362	476.26
24 3/4	77.754	481.11
24 7/8	78.147	485.98
25	78.540	490.87
25 1/8	78.933	495.79
25 1/4	79.325	500.74
25 3/8	79.718	505.71
25 1/2	80.111	510.71
25 5/8	80.503	515.72
25 3/4	80.896	520.77
25 7/8	81.289	525.84
26	81.681	530.93
26 1/8	82.074	536.05
26 1/4	82.467	541.19
26 3/8	82.860	546.35
26 1/2	83.252	551.55
26 5/8	83.645	556.76
26 3/4	84.038	562.00
26 7/8	84.430	567.27
27	84.823	572.56
27 1/8	85.216	577.87
27 1/4	85.608	583.21
27 3/8	86.001	588.57
27 1/2	86.394	593.96
27 5/8	86.786	599.37
27 3/4	87.179	604.81
27 7/8	87.572	610.27
28	87.965	615.75
28 1/8	88.357	621.26
28 1/4	88.750	626.80
28 3/8	89.143	632.36
28 1/2	89.535	637.94
28 5/8	89.928	643.55
28 3/4	90.321	649.18
28 7/8	90.713	654.84
29	91.109	660.52
29 1/8	91.499	666.23

CIRCUMFERENCES AND AREAS OF CIRCLES
(Continued)

Diam In.	Circum In.	Area Sq. In.
29 1/4	91.892	671.96
29 3/8	92.284	677.71
29 1/2	92.677	683.49
29 5/8	93.070	689.30
29 3/4	93.462	695.13
29 7/8	93.855	700.98
30	94.248	706.86
30 1/8	94.640	712.70
30 1/4	95.033	718.69
30 3/8	95.426	724.64
30 1/2	95.819	730.62
30 5/8	96.211	736.62
30 3/4	96.604	742.64
30 7/8	96.997	748.69
31	97.389	754.77
31 1/8	97.782	760.87
31 1/4	98.175	766.99
31 3/8	98.567	773.14
31 1/2	98.960	779.31
31 5/8	99.353	785.51
31 3/4	99.746	791.73
31 7/8	100.138	797.98
32	100.531	804.25
32 1/8	100.924	810.54
32 1/4	101.316	816.86
32 3/8	101.709	823.21
32 1/2	102.102	829.58
32 5/8	102.494	835.97
32 3/4	102.887	842.39
32 7/8	103.280	848.83
33	103.673	855.30
33 1/8	104.065	861.79
33 1/4	104.458	868.31
33 3/8	104.851	874.85
33 1/2	105.243	881.74
33 5/8	105.636	888.00
33 3/4	106.029	894.62
33 7/8	106.421	901.26
34	106.814	907.92
34 1/8	107.207	914.61
34 1/4	107.600	921.32
34 3/8	107.992	928.06
34 1/2	108.385	934.82
34 5/8	108.778	941.61
34 3/4	109.170	948.42
34 7/8	109.563	955.25
35	109.956	962.11
35 1/8	110.348	969.00
35 1/4	110.741	975.91
35 3/8	111.134	982.84
35 1/2	111.527	989.80
35 5/8	111.919	996.87
35 3/4	112.312	1003.8
35 7/8	112.705	1010.8
36	113.097	1017.9
36 1/3	113.490	1025.0
36 1/4	113.883	1032.1
36 3/8	114.275	1039.2
36 1/2	114.668	1046.3
36 5/8	115.061	1053.5
36 3/4	115.454	1060.7
36 7/8	115.846	1068.0
37	116.239	1075.2
37 1/8	116.632	1082.5
37 1/4	117.024	1089.8
37 3/8	117.417	1097.1
37 1/2	117.810	1104.5
37 5/8	118.202	1111.8
37 3/4	118.596	1119.2
37 7/8	118.988	1126.7
38	119.381	1134.1
38 1/8	119.773	1141.0
38 1/4	120.166	1149.1
38 3/8	120.559	1156.6
38 1/2	120.951	1164.2
38 5/8	121.344	1171.7
38 3/4	121.737	1179.3
38 7/8	122.129	1186.9
39	122.522	1194.6
39 1/8	122.915	1202.3
39 1/4	123.308	1210.0
39 3/8	123.700	1217.7
39 1/2	124.093	1225.4
39 5/8	124.486	1233.2
39 3/4	124.878	1241.0
39 7/8	125.271	1248.8
40	125.664	1256.6
40 1/8	126.056	1264.5
40 1/4	126.449	1272.4
40 3/8	126.842	1280.3
40 1/2	127.235	1288.2
40 5/8	127.627	1296.2
40 3/4	128.020	1304.2
40 7/8	128.413	1312.2
41	128.805	1320.3
41 1/8	129.198	1328.3
41 1/4	129.591	1336.3
41 3/8	129.983	1344.3

CIRCUMFERENCES AND AREAS OF CIRCLES (Continued)

Diam In.	Circum In.	Area Sq. In.
41 1/2	130.376	1352.7
41 5/8	130.769	1360.8
41 3/4	131.161	1369.0
41 7/8	131.554	1377.2
42	131.947	1385.4
42 1/8	132.340	1393.7
42 1/4	132.732	1402.0
42 3/8	133.125	1410.3
42 1/2	133.518	1418.6
42 5/8	133.910	1427.0
42 3/4	134.303	1435.4
42 7/8	134.696	1443.8
43	135.088	1452.2
43 1/8	135.481	1460.7
43 1/4	135.874	1469.1
43 3/8	136.267	1477.6
43 1/2	136.659	1486.2
43 5/8	137.052	1494.7
43 3/4	137.445	1503.3
43 7/8	137.837	1511.9
44	138.230	1520.5
44 1/8	138.623	1529.2
44 1/4	139.015	1537.9
44 3/8	139.408	1546.6
44 1/2	139.801	1555.3
44 5/8	140.194	1564.0
44 3/4	140.586	1572.8
44 7/8	140.979	1581.6
45	141.372	1590.4
45 1/8	141.764	1599.3
45 1/4	142.157	1608.0
45 3/8	142.550	1617.0
45 1/2	142.942	1626.0
45 5/8	143.335	1634.9
45 3/4	143.728	1643.9
45 7/8	144.121	1652.9
46	144.513	1661.9
46 1/8	144.906	1670.9
46 1/4	145.299	1680.0
46 3/8	145.691	1689.1
46 1/2	146.084	1698.2
46 5/8	146.477	1707.4
46 3/4	146.869	1716.5
46 7/8	147.262	1725.7
47	147.655	1734.9
47 1/8	148.048	1744.2
47 1/4	148.440	1753.5
47 3/8	148.833	1762.7
47 1/2	149.226	1772.1
47 5/8	149.618	1781.4
47 3/4	150.011	1790.8
47 7/8	150.404	1800.1
48	150.796	1809.6
48 1/8	151.189	1819.0
48 1/4	151.582	1828.5
48 3/8	151.975	1837.9
48 1/2	152.367	1847.5
48 5/8	152.760	1857.0
48 3/4	153.153	1866.5
48 7/8	153.545	1876.1
49	153.938	1885.7
49 1/8	154.331	1895.4
49 1/4	154.723	1905.0
49 3/8	155.116	1914.7
49 1/2	155.509	1924.4
49 5/8	155.902	1934.2
49 3/4	156.294	1943.9
49 7/8	156.687	1953.7
50	157.080	1963.5
50 1/8	157.472	1973.3
50 1/4	157.865	1983.2
50 3/8	158.258	1993.1
50 1/2	158.650	2003.0
50 5/8	159.043	2012.9
50 3/4	159.436	2022.8
50 7/8	159.829	2032.8
51	160.221	2042.8
51 1/8	160.614	2052.8
51 1/4	161.007	2062.9
51 3/8	161.399	2073.0
51 1/2	161.792	2083.1
51 5/8	162.185	2093.2
51 3/4	162.577	2103.3
51 7/8	162.970	2113.5
52	163.363	2123.7
52 1/8	163.756	2133.9
52 1/4	164.148	2144.2
52 3/8	164.541	2154.5
52 1/2	164.934	2164.8
52 5/8	165.326	2175.1
52 3/4	165.719	2185.4
52 7/8	166.112	2195.8
53	166.504	2206.2
53 1/8	166.897	2216.6
53 1/4	167.290	2227.0
53 3/8	167.683	2237.5
53 1/2	168.075	2248.0
53 5/8	168.468	2258.5

CIRCUMFERENCES AND AREAS OF CIRCLES
(Continued)

Diam. In.	Circum. In.	Area Sq. In.
53 3/4	168.861	2269.1
53 7/8	169.253	2279.6
54	169.646	2290.2
54 1/8	170.039	2300.8
54 1/4	170.431	2311.5
54 3/8	170.824	2322.1
54 1/2	171.217	2332.8
54 5/8	171.609	2343.5
54 3/4	172.002	2354.3
54 7/8	172.395	2365.0
55	172.788	2375.8
55 1/8	173.180	2386.6
55 1/4	173.573	2397.5
55 3/8	173.966	2408.3
55 1/2	174.358	2419.2
55 5/8	174.751	2430.1
55 3/4	175.144	2441.1
55 7/8	175.536	2542.0
56	175.929	2463.0
56 1/8	176.322	2474.0
56 1/4	176.715	2485.0
56 3/8	177.107	2496.1
56 1/2	177.500	2507.2
56 5/8	177.893	2518.3
56 3/4	178.285	2529.4
56 7/8	178.678	2540.6
57	179.071	2551.8
57 1/8	179.463	2563.0
57 1/4	179.856	2574.2
57 3/8	180.249	2585.4
57 1/2	180.642	2596.7
57 5/8	181.034	2608.0
57 3/4	181.427	2619.4
57 7/8	181.820	2630.7
58	182.212	2642.1
58 1/8	182.605	2653.5
58 1/4	182.998	2664.9
58 3/8	183.390	2676.4
58 1/2	183.783	2687.8
58 5/8	184.176	2699.3
58 3/4	184.569	2710.9
58 7/8	184.961	2722.4
59	184.354	2734.0
59 1/8	185.747	2745.6
59 1/4	186.139	2757.2
59 3/8	186.532	2768.8
59 1/2	186.925	2780.5
59 5/8	187.317	2792.2
59 3/4	187.710	2803.9
59 7/8	188.103	2815.7
60	188.496	2827.4
60 1/8	188.888	2839.2
60 1/4	189.281	2851.0
60 3/8	189.674	2862.9
60 1/2	190.006	2874.8
60 5/8	190.459	2886.6
60 3/4	190.852	2898.6
60 7/8	191.244	2910.5
61	191.637	2922.5
61 1/8	192.030	2934.5
61 1/4	192.423	2946.5
61 3/8	192.815	2958.5
61 1/2	193.208	2970.6
61 5/8	193.601	2982.7
61 3/4	193.993	2994.8
61 7/8	194.386	3006.9
62	194.779	3019.1
62 1/8	195.171	3031.3
62 1/4	195.564	3043.5
62 3/8	195.957	3055.7
62 1/2	195.350	3068.0
62 5/8	196.742	3080.3
62 3/4	197.135	3092.6
62 7/8	197.528	3104.9
63	197.920	3117.2
63 1/8	198.313	3129.6
63 1/4	198.706	3142.0
63 3/8	199.098	3154.5
63 1/2	199.491	3166.9
63 5/8	199.884	3179.4
63 3/4	200.277	3191.9
63 7/8	200.669	3204.4
64	201.062	3217.0
64 1/8	201.455	3229.6
64 1/4	201.847	3242.2
64 3/8	202.240	3254.8
64 1/2	202.633	3267.5
64 5/8	203.025	3280.1
64 3/4	203.418	3292.8
64 7/8	203.811	3305.6
65	204.204	3318.3
65 1/8	204.596	3331.1
65 1/4	204.989	3343.9
65 3/8	205.382	3356.7
65 1/2	205.774	3369.6
65 5/8	206.167	3382.4
65 3/4	206.560	3395.3
65 7/8	206.952	3408.2

CIRCUMFERENCES AND AREAS OF CIRCLES
(Continued)

Diam. In.	Circum. In.	Area Sq. In.
66	207.345	3421.2
66 1/8	207.738	3434.2
66 1/4	208.131	3447.2
66 3/8	208.523	3460.2
66 1/2	208.916	3473.2
66 5/8	209.309	3486.3
66 3/4	209.701	3499.4
66 7/8	210.094	3512.5
67	210.487	3525.7
67 1/8	210.879	3538.8
67 1/4	211.272	3552.0
67 3/8	211.665	3565.2
67 1/2	212.058	3578.5
67 5/8	212.450	3591.7
67 3/4	212.843	3605.0
67 7/8	213.236	3618.3
68	213.628	3631.7
68 1/8	214.021	3645.0
68 1/4	214.414	3658.4
68 3/8	214.806	3671.8
68 1/2	215.199	3685.3
68 5/8	215.592	3698.7
68 3/4	215.984	3712.2
68 7/8	216.377	3725.7
69	216.770	3739.3
69 1/8	217.163	3752.8
69 1/4	217.555	3766.4
69 3/8	217.948	3780.0
69 1/2	218.341	3793.7
69 5/8	218.733	3807.3
69 3/4	219.126	3821.0
69 7/8	219.519	3834.7
70	219.911	3848.5
70 1/8	220.304	3862.2
70 1/4	220.697	3876.0
70 3/8	221.090	3889.8
70 1/2	221.482	3903.6
70 5/8	221.875	3917.5
70 3/4	222.268	3931.4
70 7/8	222.660	3945.3
71	223.053	3959.2
71 1/8	223.446	3973.1
71 1/4	223.838	3987.1
71 3/8	224.231	4001.1
71 1/2	224.624	4015.2
71 5/8	225.017	4029.2
71 3/4	225.409	4043.3
71 7/8	225.802	4057.4
72	226.195	4071.5
72 1/8	226.587	4085.7
72 1/4	226.980	4099.8
72 3/8	227.373	4114.0
72 1/2	227.765	4128.2
72 5/8	228.158	4142.5
72 3/4	228.551	4156.8
72 7/8	228.944	4171.1
73	229.336	4185.4
73 1/8	229.729	4199.7
73 1/4	230.122	4214.1
73 3/8	230.514	4228.5
73 1/2	230.907	4242.9
73 5/8	231.300	4257.4
73 3/4	231.692	4271.8
73 7/8	232.085	4286.3
74	232.478	4300.8
74 1/8	232.871	4315.4
74 1/4	233.263	4329.9
74 3/8	233.656	4344.5
74 1/2	234.049	4359.2
74 5/8	234.441	4373.8
74 3/4	234.834	4388.5
74 7/8	235.227	4403.1
75	235.619	4417.9
75 1/8	236.012	4432.6
75 1/4	236.405	4447.4
75 3/8	236.798	4462.2
75 1/2	237.190	4477.0
75 5/8	237.583	4491.8
75 3/4	237.976	4506.7
75 7/8	238.368	4521.5
76	238.761	4536.5
76 1/8	239.154	4551.4
76 1/4	239.546	4566.4
76 3/8	239.939	4581.3
76 1/2	240.332	4596.3
76 5/8	240.725	4611.4
76 3/4	241.117	4626.4
76 7/8	241.510	4641.5
77	241.903	4656.6
77 1/8	242.295	4671.8
77 1/4	242.688	4686.9
77 3/8	243.081	4702.1
77 1/2	243.473	4717.3
77 5/8	243.866	4732.5
77 3/4	244.259	4747.8
77 7/8	244.652	4763.1
78	245.044	4778.4
78 1/8	245.437	4793.7

CIRCUMFERENCES AND AREAS OF CIRCLES
(Continued)

Diam in.	Circum. In.	Area Sq. In.
78 1/4	245.830	4809.0
78 3/8	246.222	4824.4
78 1/2	246.615	4839.8
78 5/8	247.008	4855.2
78 3/4	247.400	4870.7
78 7/8	247.793	4886.2
79	248.186	4901.7
79 1/8	248.579	4917.2
79 1/4	248.971	4932.7
79 3/8	249.364	4948.3
79 1/2	249.757	4963.9
79 5/8	250.149	4979.5
79 3/4	250.542	4995.2
79 7/8	250.935	5010.9
80	251.327	5026.5
80 1/8	251.720	5042.3
80 1/4	252.113	5058.0
80 3/8	252.506	5073.8
80 1/2	252.898	5089.6
80 5/8	253.291	5105.4
80 3/4	253.684	5121.2
80 7/8	254.076	5137.1
81	254.469	5153.0
81 1/8	254.862	5168.9
81 1/4	255.254	5184.9
81 3/8	255.647	5200.8
81 1/2	256.040	5216.8
81 5/8	256.433	5232.8
81 3/4	256.825	5248.9
81 7/8	257.218	5264.9
82	257.611	5281.0
82 1/8	258.003	5297.1
82 1/4	258.396	5313.3
82 3/8	258.789	5329.4
82 1/2	259.181	5345.6
82 5/8	259.574	5361.8
82 3/4	259.967	5378.1
82 7/8	260.359	5394.3
83	260.752	5410.6
83 1/8	261.145	5426.9
83 1/4	261.538	5443.3
83 3/8	261.930	5459.6
83 1/2	262.323	5476.0
83 5/8	262.716	5492.4
83 3/4	263.108	5508.8
83 7/8	263.501	5525.3
84	263.894	5541.8
84 1/8	264.286	5558.3
84 1/4	264.679	5574.8
84 3/8	265.072	5591.4

Diam. In.	Circum. In	Area Sq. In.
84 1/2	265.465	5607.9
84 5/8	266.857	5624.5
84 3/4	266.250	5641.2
84 7/8	266.643	5657.8
85	267.035	5674.5
85 1/8	267.428	5691.2
85 1/4	267.821	5707.9
85 3/8	268.213	5724.7
85 1/2	268.060	5741.5
85 5/8	268.999	5758.3
85 3/4	269.392	5775.1
85 7/8	269.784	5791.9
86	270.177	5808.8
86 1/8	270.570	5825.7
86 1/4	270.962	5842.6
86 3/8	271.355	5859.6
86 1/2	271.748	5876.5
86 5/8	272.140	5893.5
86 3/4	272.533	5910.6
86 7/8	272.926	5927.6
87	273.319	5944.7
87 1/8	273.711	5961.8
87 1/4	274.104	5978.9
87 3/8	274.497	5996.0
87 1/2	274.889	6013.2
87 5/8	275.282	6030.4
87 3/4	275.675	6047.6
87 7/8	276.067	6064.9
88	276.460	6082.1
88 1/8	276.853	6099.4
88 1/4	277.246	6116.7
88 3/8	277.638	6134.1
88 1/2	278.031	6151.4
88 5/8	278.424	6168.8
88 3/4	278.816	6186.2
88 7/8	279.209	6203.7
89	279.602	6221.1
89 1/8	279.994	6238.6
89 1/4	280.387	6256.1
89 3/8	280.780	6273.1
89 1/2	281.173	6291.2
89 5/8	281.565	6308.8
89 3/4	281.958	6326.4
89 7/8	282.351	6344.1
90	282.743	6361.7
90 1/8	283.136	6379.4
90 1/4	283.529	6397.1
90 3/8	283.921	6414.9
90 1/2	284.314	6432.6
90 5/8	284.707	6450.4

CIRCUMFERENCES AND AREAS OF CIRCLES
(Continued)

Diam In.	Circum In.	Area Sq. In.
90 3/4	285.100	6468.2
90 7/8	285.492	6486.0
91	285.885	6503.9
91 1/8	286.278	6521.8
91 1/4	286.670	6539.7
91 3/8	287.063	6555.6
91 1/2	287.456	6575.5
91 5/8	287.848	6593.5
91 3/4	288.241	6611.5
91 7/8	288.634	6629.6
92	289.027	6647.6
92 1/8	289.419	6665.7
92 1/4	289.812	6683.8
92 3/8	290.205	6701.9
92 1/2	290.597	6720.1
92 3/8	290.990	6738.2
92 3/4	291.383	6756.4
92 7/8	291.775	6774.7
93	292.168	6792.9
93 1/8	292.561	6811.2
93 1/4	292.954	6829.5
93 3/8	293.346	6847.8
93 1/2	293.739	6866.1
93 5/8	294.132	6884.5
93 3/4	294.524	6902.9
93 7/8	294.917	6921.3
94	295.310	6939.8
94 1/8	295.702	6958.2
94 1/4	296.095	6976.7
94 3/8	296.488	6995.3
94 1/2	296.881	7013.8
94 5/8	297.273	7032.4
94 3/4	297.666	7051.0
94 7/8	298.059	7069.6
95	298.451	7088.2
95 1/8	298.844	7106.9
95 1/4	299.237	7125.6

Diam. In.	Circum In.	Area Sq. In.
95 3/8	299.629	7144.3
95 1/2	300.022	7163.0
95 5/8	300.415	7181.8
95 3/4	300.807	7200.6
95 7/8	301.200	7219.4
96	301.593	7238.2
96 1/8	301.986	7257.1
96 1/4	302.378	7276.0
96 3/8	302.771	7294.9
96 1/2	303.164	7313.8
96 5/8	303.556	7332.8
96 3/4	303.949	7351.8
96 7/8	304.342	7370.8
97	304.734	7389.8
97 1/8	305.127	7408.9
97 1/4	305.520	7428.0
97 3/8	305.913	7447.1
97 1/2	306.305	7466.2
97 5/8	306.698	7485.3
97 3/4	307.091	7504.5
97 7/8	307.483	7523.7
98	307.876	7543.0
98 1/8	308.269	7562.2
98 1/4	308.661	7581.5
98 3/8	309.054	7600.8
98 1/2	309.447	7620.1
98 5/8	309.840	7639.5
98 3/4	310.232	7658.9
98 7/8	310.625	7678.3
99	311.018	7697.7
99 1/8	311.410	7717.1
99 1/4	311.803	7736.6
99 3/8	312.196	7756.1
99 1/2	312.588	7775.6
99 5/8	312.981	7795.2
99 3/4	313.374	7814.8
99 7/8	313.767	7834.4
100	314.159	7854.0

STEEL PROPRIETARY PRODUCTS COMPARISON CHART

A572 (PLATES, A607 (Sheets)

Ex-ten	(42, 45, 50, 60, 65)	U.S. Steel
INX	(42, 45, 50, 60, 65)	Inland Steel
"v"	(42, 45, 50, 60, 65)	Bethlehem Steel
Orelloy	(42, 45, 50, 60, 65)	Oregon Steel Mills
"c"	(42, 45, 50)	Armco Steel

A 514 (Plates) or A514 Alloy Type (Plates)

T-1	U.S. Steel
RQ 100	Bethlehem Steel
NA-XTRA 100	National Steel
Orelloy 100	Oregon Steel Mills
SSS 100	Armco Steel
INX 100	Inland Steel
Wel-ten 80C	Nippon Steel (A514 Alloy type) - Japanese
Sumi-ten 80S	Sumitomo Metals (A514 Alloy type) - Japanese
River Ace Ko	Kawasaki Steel

A588, A242

Corten	U.S. Steel
Mayari R	Bethlehem Steel
Orelloy 588/242	Oregon Steel Mills
Hi Strength A	Armco

AR Plates - Types - (235, 320, 360, 400, 500 Brinnell)

AR235	Bethlehem Steel
US AR	U.S. Steel
Wearalloy	Ford Steel
Firm-x	International Alloy

Other

"Z" Steel	Oregon Steel Mills
Orelloy 70FG	Oregon Steel Mills
Stressproof	LaSalle Steel - C1144
Fatigue-proof	LaSalle Steel
Century Series	Republic Engineered Products - C1144
Multi-cut	Republic Engineered Products
Strain Tempered	Bliss & Laughlin - C1144
"e.t.d."	LaSalle Steel

GLOSSARY OF STEEL TERMS

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

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

Alloy -A mixture with metallic properties composed of two or more elements of which at least one is a metal.

Alloy Elements - Alloy elements in steel would be chromium, cobalt, nickel, molybdenum, tungsten and vanadium. These are added to steel to modify its properties. Other common elements added are copper, aluminium, titanium, columbium and boron. In each case established minimum percentages must be met to qualify the element as an alloy addition.

Annealing - The term annealing usually implies relatively slow cooling in a heat treating furnace. The more important purposes for which steel is annealed are as follows: to remove stresses, to induce softness, increase ductility and increase electrical and magnetic properties.

Anodizing - Forming of a conversion coating on a metal surface by anodic oxidation most frequently applied to aluminum.

As Rolled - A term used to describe steel bars or plate that are hot rolled only without any subsequent heat treating operation.

Bend Radius - The inside radius of a bent section.

Brinell Hardness - A test for determining the hardness of a metal by forcing a hard steel or carbide ball of specified diameter into the surface of the steel. The hardness number is a number in direct proportion to the diameter of the hole.

Carbon Equivalent - Various formulas used to determine the weldability of steel by adding the percentage of carbon plus the equivalent carbon of the other elements. It is assumed that if the carbon equivalent (CE) is not more that .45% the steel is considered weldable without preheating or postheating.

Carburizing - Increasing the surface carbon content of steel in a heat treating furnace. This process is used to increase wear resistance.

Case Hardening - A heat treatment method of surface treating steel for wear resistance. The most common methods would be carburizing and nitriding. Both of these elements are added to the surface of the steel to increase wear resistance. The other two methods are flame hardening and induction hardening with electrical current.

Charpy - An impact test to determine the toughness of steels conducted on a Charpy Impact Machine. The test is conducted on a small steel bar with a V-notch. The test is abbreviated CVN.

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 Drawing - Reducing the cross section of steel bars by pulling the steel through a die of reduced size, usually 1 /32". This process is done at ambient temperatures and is used to enhance the surface appearance, produce close tolerances and increase machinability.

Cold Rolling - Reducing the thickness of steel by rolling or ironing the steel below the recrystallization temperature. This method is used for sheet steel to produce lighter gauges and increase surface finish appearance.

GLOSSARY OF STEEL TERMS (Continued)

Cold Working - Any method used to plastically deform or reduce the thickness or cross sectional size of steel at ambient temperatures.

Corrosion - The deterioration of a metal by chemical or electrochemical reaction with its environment.

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

Decarburlzatlon - A loss of carbon on the surface of steel which accelerates at temperatures above 1400 degrees F. All steels which are hot rolled, forged or heat treated in furnaces without controlled atmosphere will have a decarburized surface.

Deep Drawing - A process for stretching sheet steel in a die with a punch which is mounted in a stamping press.

Ductility - The ability of a material to deform plastically without fracturing. It is commonly evaluated by tensile testing.

Elastic Limit - The greatest unit stress to which a material may be subjected without permanent deformation remaining upon complete release of the stress.

Elongation - The percentage increase in the gauge length of a tensile specimen after it has been tension tested to failure.

Fatigue - The phenomenon leading to fracture under repeated or fluctuating stresses having a maximum value less than the tensile strength of the material.

Ferrite - Technical terms for the two types of iron occurring in steel.

Flame Hardening - Heating the surface of steel to its hardening temperature range and then immediately quenching the surface with water or a synthetic quenchant.

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

Free Machining - Pertains to the machining characteristics of steel to which an ingredient has been introduced to give small broken chips, lower power consumption, better surface finish and longer tool life.

Galvanizing - In steel terms to hot dip steel in a bath of molten zinc.

Hardenabillty - The property that determines the depth of hardness of steel after it has been heat treated by quenching and temperature.

Hardness - The ability of metal to resist penetration. The principal methods of hardness testing are the Rockwell and Brinell hardness testers.

Heat Affected Zone (HAZ) - 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.

Honing - Removing stock generally on the internal cylindrical surface of a tube with an abrasive tool mounted in a holder

Hot Rolling - Rolling bars, plate, sheet, structurals through a series of rolls for size reduction or shape at temperatures of 1550 to 2100 degrees F.

Impact Test - A test used to determine the toughness of steel by impact with a falling pendulum. The common test used is the Charpy or Izod impact test which is conducted on specially designed equipment.

GLOSSARY OF STEEL TERMS (Continued)

Inclusions - Non-metallic impurities in steel in the form of oxides, sulfides, or silicates. These impurities are formed during the solidifacation of the steel in the ingot molds, or continuously cast blooms, billets or slabs.

Induction Hardening - This is a method of hardening the surface of a steel part electrically with high frequency current. The current is passed through a coil that is held very close to the surface to be hardened and the surface is immediately heated to approximately 1600º F. The surface is immediately quenched with water or a synthetic oil.

Killed Steel - Steel which is deoxidized or degassified in the melting operation to eliminate porosity and produce more sound steel products. Silicon and aluminum are two elements used to eliminate the gases in steel.

Laminations - The general term used for surface or internal defects parallel to the rolled surface of the steel product. Surface defects are slivers and laps: internal lamination is called piped steel and occurs in plate and sheet.

Longitudinal Direction - The principal direction of flow in a worked metal.

Mechanical Properties - Defined as tensile and yield strength, elongation, torsional strength and impact strength.

Modules of Elasticity - The ratio within the limit of elasticity of the stress to the corresponding strain The stress in pounds per square inch is divided by the elongation in fractions of an inch for each inch of original gauge length of the specimen.

Normalizing - Heating steels to approximately 100 degrees F above the critical temperature range followed by cooling to below that range in still air For instance, the normalizing temperature for A36 or A572 would be 1650° F.

Orange Peel - A pebble grained surface which develops in forming of metals having coarse grains.

Oxidation - A reaction with oxygen. In the case of steel, oxidation burns the carbon out of the surface of steel if the temperatures are above 1200° F. The resultant surface is termed decarburized.

Physical Properties - Are defined as electrical, magnetic, density coefficient of thermo expansion, etc

Pickling - A chemical treatment with acids to remove the scale or iron oxides on the surface of hot rolled steel products.

Pitting - Forming small sharp cavities in a metal surface by nonuniform electro-deposition or by corrosion.

Post Heating - Heating the weld and weld are to slow down the rate of cooling to eliminate weld cracking or cracking in the heat affected area.

Pre Heating - A welding term used to designate heating steel to a specific temperature prior to welding to prevent weld cracks.

Quenching - Rapid cooling of a metal during a heat treating operation. The quenching coolant could be water, oil or air. This is the method used to increase the hardness and strength of steel.

Reduction of Area - The percentage reduction of area is the difference between the original cross-sectional area and the least cross-sectional area of a tensile test specimen after rupture.

GLOSSARY OF STEEL TERMS (Continued)

Rimmed Steel -A method of producing very low carbon steels in an ingot mold by letting the steel form gases and solidify slowly. This results in a pure iron rim on the surface of the ingot which remains on the surface of the rolled product which is generally sheet steel.

Rockwell - Hardness testing device used to measure the resistance of metal to be indented. The numbers usually in Rockwell B or C hardness will designate the relative hardness and strength of the metal.

Scale - A complex iron oxide formed on the surface of steel when it is hot rolled or forged. Iron oxide will start to form at approximately 1100° in air.

Seams - A defect on the steel surface which is always in the rolling direction and appears as a thin crack.

Semi-Killed - Steel that is partially deoxidized where some of the gasses from the solidification in the ingot mold are still remaining. Semi-killed steels are intermediate between rimmed and killed.

Special Killed - Steel that has been completely deoxidized to prevent gases from forming during solidification in the ingot mold. Deoxidizing elements used to remove the gasses are aluminum and silicon. The term “killed” is used because such additions cause the steel to be quiet in the molds instead of boiling from the gasses.

Tensile Strength - The maximum load per unit of original cross-sectional area obtained before rupture of a tensile specimen

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.

Transverse - Across, usually signifying a direction or plain perpendicular to the direction of working such as cold drawing or rolling.

Toughness - Ability of a metal to absorb energy and deform plastically before fracturing. It is usually measured by the energy absorbed in a notch impact test. The most common test is the Charpy V-Notch Test.

Yield Point - This is the load per unit area at which the tensile specimen starts to deform or elongate without increase of load The yield point can also be defined as the stress at which a marked increase in strain occurs without an increase in stress.

Yield Strength - Stress corresponding to some fixed permanent deformation such as .1 or .2% offset from the modulus slope in the tensile test.

Daily delivery to most areas