

Weights and Measures

Avoirdupois Weight

Drams

16	= 1 oz.	= 437.5 grains troy
256	= 16	= 1 lb. = 1.2153 lb. troy
6400	= 400 = 25	= 1 quarter
25600	= 1600 = 100 = 4	= 1 cwt.
512000	= 32000 = 2000 = 80 = 20	= 1 ton

Troy Weight

Grains

24	= 1 pwt.		
480	= 20	= 1 oz.	
5760	= 240 = 12	= 1 lb.	= 22.816 in. ³ of distilled water at 62°F

Dry Measure

Pints = 33.6 in.³

2	= 1 qt.	= 67.2 in. ³
8	= 4	= 1 gal. = 268.8 in. ³
16	= 8	= 1 peck = 537.6 in. ³
64	= 32 = 8 = 4	= 1 bushel

Note: The standard U.S. bushel is the Winchester bushel, which is in cylinder form, 18½" in diameter, and 8" deep, and contains 2150.42 in.³.

Square Measure

Inches

144	= 1 ft.	
1296	= 9	= 1 yd.
39204	= 272.25 = 30.25	= 1 perch
1568160	= 10890 = 1210 = 40	= 1 rod
6272640	= 43580 = 4840 = 160 = 4	= 1 acre

An acre is 69.5701 yd.²; or, 208.710321 ft.²

A township is 6 mi.² = 36 sections

A section is 1 mi.² = 640 acres

¼ section is ½ mi.² = 160 acres

⅙ section is ¼ mi.² = 40 acres

A span is distance that can be reached between end of middle finger and the end of the thumb. Among sailors, 8 spans are equal to 1 thumb.

A geographic mile is ½₁₆₀₀ of distance around center of earth.

A square mile of land is called a section.

A Gunter's chain, used by land surveyors, is 4 rods, or 66' long, and consists of 100 links — 7.92" make a link.

Canal and railroad engineers use an engineer's chain, which consists of 100 links, each 1' long.

Paper Measure

Quire of paper	24 sheets
Ream of paper	20 quires or 480 sheets
Bundle	2 reams
Bale	5 bundles
Roll of parchment	60 skins

Sheet of paper folded into:

2 leaves is termed folio size	... 16 leaves is termed 16mo.
4 leaves is termed 4to. or quarto	18 leaves is termed 18mo.
8 leaves is termed 8vo. or octavo	...
24 leaves is termed 24mo.	... 12 leaves is termed 12mo. or 48 leaves is termed 48mo. ... duodecim

Apothecaries' Weight

Grains

20	= 1 scruple	480 = 24 = 8 = 1 oz
60	= 3 scruple = 1 dram	5760 = 288 = 96 = 12 = 1 lb.

Apothecaries' Measure

60 minims	= 1 fluid dram	16 fluid-oz. = 1 pt.
8 fluid-drams	= 1 fluid oz.	8 pt. = 1 gal.
Forty-five drops, or a common teaspoonful, make about 1 fluid-dram; 2 tablespoons, about 1 fluid-oz.; a wineglassful, about 1½ fluid oz.; and a teacupful about 4 fluid oz.		

Liquid or Wine Measure

GILLS = 7.2187 in. ³
4 = 1 pint = 28.875 in. ³
8 = 2 = 1 quart = 57.75 in. ³

32 = 8 = 4 = 1 gal.
2016 = 404 = 252 = 63 = 1 hoghead
4032 = 1008 = 504 = 126 = 2 = 1 = pipe
8064 = 2016 = 1008 = 252 = 4 = 2 = 1 ton

Note: The standard unit and liquid measure adopted by the U.S. government is the Winchester wine gallon, which contains 231 in.³, and holds 8.339 lbs., avoirdupois, of distilled water, at its maximum density weighed in air, the barometer being at 30". The imperial gallon, adopted by Great Britain, contains 277.274 in.³, and equals 1.20032 U.S. gal.

The following cylinders contain some of these measures very closely:

Gill, dia. 1¾"; ht., 3"
Pint, dia., 3½"; ht., 3"
Quart, dia., 3½"; ht., 6"
Gallon, dia., 7"; ht., 6"
8 gal., dia., 14"; ht., 12"
10 gal., dia., 14"; ht., 15"

Weight of Water

1 in. ³	= .03617 lbs.
12 in. ³	= .4340 lbs.
1 ft. ³	= 7.48052 U.S. gal.
1 U.S. gallon	= 8.355 lbs.
35.84 ft. ³	= 2240 lbs.
2240 lbs.	= 268.8 U.S. gal.

Liquid Measure

1 gal. distilled water10.00
1 gal. sea water10.32
1 gal. proof spirits9.08

Oils

1 gal. sperm	... 7 ½	1 gal. paraffin, 28° gravity	... 7 ⅜
1 gal. whale	... 7 ½	1 gal. paraffin, 25° gravity	... 7 ½
1 gal. lard	... 7 ½	1 gal. reduced Franklin	... 7 ¼
1 gal. tallow	... 7 ½	1 gal. castor	... 8
1 gal. neat's-foot	7 ½	1 gal. kerosene	... 6 ½

Troy Weight

24 grains = 1 pwt.	12 oz. = 1 lb.
20 pwts. = 1 oz.	

Used for weighing gold, silver, and jewels.

Apothecaries' Weight

20 grains = 1 scruple	8 drams = 1 oz.
3 scruples = 1 dram	12 oz. = 1 lb.

Avoirdupois Weight

27½ ¹ / ₂ grains = 1 dram	... 4 quarters = 1 cwt.
16 drams = 1 oz.	... 2000 lbs. = 1 short ton
16 oz. = 1 lb.	... 2240 lb. = 1 long ton
25 lb. = 1 quarter	

Dry Measure

2 pt. = 1 qt.	4 pecks = 1 bushel
8 qt. = 1 peck	36 bushels = 1 chaldron

Liquid Measure

4 gills = 1 pt.	31½ gal. = 1 barrel
2 pt. = 1 qt.	2 barrels = 1 hoghead
4 qt. = 1 gal.	

Time Measure

60 seconds = 1 min.	24 hrs. = 1 day
60 minutes = 1 hr.	7 days = 1 wk.
28, 29, 30, or 31 days = 1 calendar mon.	

365 days = 1 yr.	(30 days = 1 mon. in computing interest)
	366 days = 1 leap yr.

Circular Measure

60 seconds = 1 min.	30 degrees = 1 sign
60 minutes = 1 degree	90 degrees = 1 quadrant
4 quadrants = 12 signs, or 360 degrees = 1 circle	

Long Measure

12 in. = 1 ft.	40 rods = 1 furlong
3 ft. = 1 yd.	8 furlongs = 1 stat. mi.

5½ yds. = 1 rod	3 mi. = 1 league
-----------------	------------------

Cloth Measure

2¼" = 1 nail	4 quarters = 1 yd.
4 nails = 1 quarter	

Mariners' Measure

6 ft. = 1 fathom	5280 ft. = 1 stat. mi.
120 fathoms = 1 cable length	6085 ft. = 1 naut. mi.
7½ cable lengths = 1 mi.	

Miscellaneous

3" = 1 palm	18" = 1 cubit
4" = 1 hand	21.8" = 1 Bible cubit
9" = 1 span	2 ½' = 1 military step

Square Measure

144 in. ² = 1 ft. ²	40 rods ² = 1 rood
9 ft. ² = 1 yd. ²	4 roods = 1 acre
30 ¼ yds. ² = 1 rod ²	640 acres = 1 mi. ²

Surveyors' Measure

7.92" = 1 link	4 rods = 1 chain
25 links = 1 rod	10 chains ² or 160 rods ² = 1 acre
640 acres = 1 mi. ²	
36 mi. ² (6 miles sq.) = 1 township	

Cubic Measure

1728 in. ³ = 1 ft. ³	128 ft. ³ = 1 cord (wood)
27 ft. ³ = 1 yd. ³	40 ft. ³ = 1 ton (shipping)
2150.42 in. ³ = 1 standard bushel	
231 in. ³ = 1 standard gallon	
1 ft. ³ = about ⅔ of a bushel	

Metric Equivalents

Linear Measure

1 cm = 0.3937"	1" = 2.54 cm
1 dm = 3.937" = .0328 ft.	1' = 3.048 dm
1 m = 39.37" = 1.0936 yds.	1 yard = 0.9144 m
1 dekam = 1.9884 rods	1 rod = 0.5029 dekam
1 km = 0.62137 mi.	1 mile = 1.6093 km

Square Measure

1 cm ² = 0.1550 in. ²	1 in. ² = 6.452 cm ²
1 dm ² = 0.1076 ft. ²	1 ft. ² = 9.2903 dm ²
1 m ² = 1.196 yds. ²	1 yd. ² = 0.8361 m ²
1 acre = 3.954 rods ²	1 rod ² = 0.2529 acres
1 hectare = 2.47 acres	1 acre = 0.4047 hectare
1 km ² = 0.386 mi. ²	1 mi. ² = 2.59 km ²

Measure of Volume

1 cm ³ = 0.061 in. ³	1 in. ³ = 16.39 cm ³
1 dm ³ = 0.0353 ft. ³	1 ft. ³ = 28.317 dm ³
1 m ³ = 1.308 yd. ³	1 yd. ³ = 0.7646 m ³
1 stere = 0.2759 cd.	1 cord = 3.624 steres
1 liter = 0.908 qt. dry	1 qt. dry = 1.101 liters
1 liter = 1.0567 qt. liquid	1 qt. liquid = 0.9463 liter
1 dekal = 2.6417 gal.	1 gal. = 0.3785 dekal
1 hl = 2.8375 bu.	1 pk. = 0.881 dekal
	1 bu. = 0.3524 hl

Weights

1 g = 0.0527 oz.	1 oz. = 28.85 g
1 kg = 2.2046 lb.	1 lb. = 0.4536 kg
1 metric ton = 1.1023 English ton	1 English ton = 0.9072 metric ton

Approximate Metric Equivalents

1 dm = 4"	1 liter = 1.06 qt. liquid
1 m = 1.1 yds.	1 liter = 0.9 qt. dry
1 km = ⅝ mi.	1 hektoliter = 2½ bushel
1 hectare = 2½ acres	1 kg = 2½ lb.
1 stere or m ³ = ¼ cord	1 metric ton = 2200 lbs.

Conversion Table

Inch Fractions and Decimals to Metric Equivalents

Inches			Inches			Inches			Inches		
Fractions	Dec.	mm	Fractions	Dec.	mm	Fractions	Dec.	mm	Fractions	Dec.	mm
—	.0004"	.01	1 1/16"	.6875"	17.463	1 7/8"	1.875"	47.625	—	3.7008"	94
—	.004"	.10	4 5/64"	.7031"	17.859	—	1.8898"	48	—	3.7401"	95
—	.01"	.25	—	.7087"	18	1 29/32"	1.9062"	48.419	3 3/4"	3.750"	95.250
1/64"	.0156"	.397	2 3/32"	.71875"	18.256	—	1.9291"	49	—	3.7795"	96
—	.0197"	.50	—	.7283"	18.5	1 15/16"	1.9375"	49.213	3 13/16"	3.8125"	96.838
—	.0295"	.75	4 7/64"	.73437"	18.653	—	1.9685"	50	—	3.8189"	97
1/32"	.03125"	.794	—	.7480"	19	1 31/32"	1.969"	50.006	—	3.8583"	98
—	.0394"	1	3/4"	.7500"	19.050	2"	2.000"	50.800	3 7/8"	3.875"	98.425
3/64"	.0469"	1.191	4 9/64"	.7656"	19.447	—	2.0079"	51	—	3.8976"	99
—	.059"	1.5	2 5/32"	.78125"	19.844	—	2.0472"	52	—	3.9370"	100
1/16"	.0625"	1.588	—	.7874"	20	2 1/16"	2.062"	52.388	3 5/16"	3.9375"	100.013
3/64"	.0781"	1.984	5 1/64"	.79687"	20.241	—	2.0866"	53	—	3.9764"	101
—	.0787"	2	1 3/16"	.8125"	20.638	2 1/8"	2.125"	53.975	4"	4.000"	101.600
3/32"	.094"	2.381	—	.8268"	21	—	2.126"	54	4 1/16"	4.062"	103.188
—	.0984"	2.5	5 3/64"	.8281"	21.034	—	2.165"	55	4 1/8"	4.125"	104.775
7/64"	.1093"	2.776	2 7/32"	.84375"	21.431	2 1/16"	2.1875"	55.563	—	4.1338"	105
—	.1181	3	5 5/64"	.85937"	21.828	—	2.2047"	56	4 3/16"	4.1875"	106.363
1/8"	.1250"	3.175	—	.8662"	22	—	2.244"	57	4 1/4"	4.250"	107.950
—	.1378"	3.5	7/8"	.8750"	22.225	2 1/4"	2.250"	57.150	4 5/16"	4.312"	109.538
9/64"	.1406"	3.572	5 7/64"	.8906"	22.622	—	2.2835"	58	—	4.3307"	110
5/32"	.15625"	3.969	—	.9055"	23	2 5/16"	2.312"	58.738	4 3/8"	4.375"	111.125
—	.1575"	4	2 9/32"	.90625"	23.019	—	2.3228"	59	4 7/16"	4.438"	112.713
1 1/64"	.17187"	4.366	5 9/64"	.92187"	23.416	—	2.3622"	60	4 1/2"	4.500"	114.300
—	.177	4.5	1 5/16"	.9375"	23.813	2 3/8"	2.375"	60.325	—	4.5275"	115
3/16"	.1875"	4.763	—	.9449"	24	—	2.4016"	61	4 9/16"	4.562"	115.888
—	.1969"	5	6 1/64"	.9531"	24.209	2 1/16"	2.438"	61.913	4 3/8"	4.625"	117.475
1 3/64"	.2031"	5.159	3 1/32"	.96875"	24.606	—	2.4409"	62	—	4.7244"	120
—	.2165"	5.5	—	.9843"	25	—	2.4803"	63	4 3/4"	4.750"	120.650
7/32"	.21875"	5.556	1	1.000"	25.4	2 1/2"	2.500"	63.500	4 7/8"	4.875"	123.825
1 5/64"	.23437"	5.953	—	1.0236"	26	—	2.5197"	64	—	4.9212"	125
—	.2362"	6	1 1/32"	1.0312"	26.194	—	2.559"	65	5"	5.000"	127
1/4"	.2500"	6.350	1 1/16"	1.062"	26.988	2 1/16"	2.562"	65.088	—	5.1181"	130
—	.2559"	6.5	—	1.063"	27	—	2.5984"	66	5 1/4"	5.250"	133.350
1 7/64"	.2656"	6.747	1 3/32"	1.094"	27.781	2 5/8"	2.625"	66.675	5 1/2"	5.500"	139.700
—	.2756"	7	—	1.1024"	28	—	2.638"	67	—	5.5118"	140
9/32"	.28125"	7.144	1 1/8"	1.125"	28.575	—	2.6772"	68	5 3/4"	5.750"	146.050
—	.2953"	7.5	—	1.1417"	29	2 1 1/16"	2.6875"	68.263	—	5.9055"	150
1 9/64"	.29687"	7.541	1 5/32"	1.156"	29.369	—	2.7165"	69	6"	6.000"	152.400
5/16"	.3125"	7.938	—	1.1811"	30	2 3/4"	2.750"	69.850	6 1/4"	6.250"	158.750
—	.3150"	8	1 3/16"	1.1875"	30.163	—	2.7559"	70	—	6.2992"	160
2 1/64"	.3281"	8.334	1 7/32"	1.219"	30.956	—	2.7953"	71	6 1/2"	6.500"	165.100
—	.335"	8.5	—	1.2205"	31	2 1 1/16"	2.8125"	71.438	—	6.6929"	170
1 1 1/32"	.34375"	8.731	1 1/4"	1.250"	31.750	—	2.8346"	72	6 3/4"	6.750"	171.450
—	.3543"	9	—	1.2598"	32	—	2.8740"	73	7"	7.000"	177.800
2 3/64"	.35937"	9.128	1 9/32"	1.281"	32.544	2 7/8"	2.875"	73.025	—	7.0866"	180
—	.374"	9.5	—	1.2992"	33	—	2.9134"	74	—	7.4803"	190
3/8"	.3750"	9.525	1 5/16"	1.312"	33.338	2 5/16"	2.9375"	74.613	7 1/2"	7.500"	190.500
2 5/64"	.3906"	9.922	—	1.3386"	34	—	2.9527"	75	—	7.8740"	200
—	.3937"	10	1 1 1/32"	1.344"	34.131	—	2.9921"	76	8"	8.000"	203.200
1 3/32"	.4062"	10.319	1 3/8"	1.375"	34.925	3"	3.000"	76.200	—	8.2677"	210
—	.413"	10.5	—	1.3779"	35	—	3.0315"	77	8 1/2"	8.500"	215.900
2 7/64"	.42187"	10.716	1 1 1/32"	1.406"	35.719	3 1/16"	3.062"	77.788	—	8.6614"	220
—	.4331"	11	—	1.4173"	36	—	3.0709"	78	9"	9.000"	228.600
7/16"	.4375"	11.113	1 7/16"	1.438"	36.513	—	3.1102"	79	—	9.0551"	230
2 9/64"	.4531"	11.509	—	1.4567"	37	3 1/8"	3.125"	79.375	—	9.4488"	240
1 5/32"	.46875"	11.906	1 5/32"	1.469"	37.306	—	3.1496"	80	9 1/2"	9.500"	241.300
—	.4724"	12	—	1.4961"	38	3 3/16"	3.1875"	80.963	—	9.8425"	250
3 1/64"	.48437"	12.303	1 1/2"	1.500"	38.100	—	3.1890"	81	10"	10.000"	254.000
—	.492"	12.5	1 1 1/32"	1.531"	38.894	—	3.2283"	82	—	10.2362"	260
1/2"	.500"	12.700	—	1.5354"	39	3 1/4"	3.250"	82.550	—	10.6299"	270
—	.5118"	13	1 9/16"	1.562"	39.688	—	3.2677"	83	11"	11.000"	279.400
3 3/64"	.5156"	13.097	—	1.5748"	40	—	3.3071"	84	—	11.0236"	280
1 7/32"	.53125"	13.494	1 1 1/32"	1.594"	40.481	3 5/16"	3.312"	84.1377	—	11.4173"	290
3 5/64"	.54687"	13.891	—	1.6142"	41	—	3.3464"	85	—	11.8110"	300
—	.5512"	14	1 3/8"	1.625"	41.275	3 3/8"	3.375"	85.725	12"	12.000"	304.800
9/16"	.5625"	14.288	—	1.6535"	42	—	3.3858"	86	13"	13.000"	330.200
—	.571"	14.5	1 1 1/32"	1.6562"	42.069	—	3.4252"	87	—	13.7795"	350
3 7/64"	.57812"	14.684	1 1 1/16"	1.6875"	42.863	3 7/16"	3.438"	87.313	14"	14.000"	355.600
—	.5906"	15	—	1.6929"	43	—	3.4646"	88	15"	15.000"	381
1 9/32"	.59375"	15.081	1 2 1/32"	1.719"	43.656	3 1/2"	3.500"	88.900	—	15.7480"	400
3 9/64"	.60937"	15.478	—	1.7323"	44	—	3.5039"	89	16"	16.000"	406.400
5/8"	.6250"	15.875	1 3/4"	1.750"	44.450	—	3.5433"	90	17"	17.000"	431.800
—	.6299"	16	—	1.7717"	45	3 9/16"	3.562"	90.4877	—	17.7165"	450
4 1/64"	.6406"	16.272	1 2 5/32"	1.781"	45.244	—	3.5827"	91	18"	18.000"	457.200
—	.6496"	16.5	—	1.8110"	46	—	3.622"	92	19"	19.000"	482.600
2 1/32"	.65625"	16.669	1 1 3/16"	1.8125"	46.038	3 3/8"	3.625"	92.075	—	19.6850"	500
—	.6693"	17	—	1.844"	46.831	—	3.6614"	93	20"	20.000"	508
4 3/64"	.67187"	17.066	1 1 1/2"	1.8504"	47	3 1 1/16"	3.6875"	93.663	21"	21.000"	533.400

Decimal Equivalents of Parts of an Inch

Fraction	Decimal	Fraction	Decimal	Fraction	Decimal
1/64"	.01563"	23/64"	.35938"	45/64"	.70313"
1/32"	.03125"	3/8"	.375"	23/32"	.71875"
3/64"	.04688"	25/64"	.39063"	47/64"	.73438"
1/16"	.0625"	13/32"	.40625"	3/4"	.75"
5/64"	.07813"	27/64"	.42188"	49/64"	.76563"
3/32"	.09375"	7/16"	.4375"	25/32"	.78125"
7/64"	.10938"	29/64"	.45313"	51/64"	.79688"
1/8"	.125"	15/32"	.46875"	13/16"	.8125"
9/64"	.14063"	31/64"	.48438"	53/64"	.82813"
5/32"	.15625"	1/2"	.5"	27/32"	.84375"
11/64"	.17188"	33/64"	.51563"	55/64"	.85938"
3/16"	.1875"	17/32"	.53125"	7/8"	.875"
13/64"	.20313"	35/64"	.54688"	57/64"	.89063"
7/32"	.21875"	9/16"	.5625"	29/32"	.90625"
15/64"	.23438"	37/64"	.57813"	59/64"	.92188"
1/4"	.25"	19/32"	.59375"	15/16"	.9375"
17/64"	.26563"	39/64"	.60938"	61/64"	.95313"
9/32"	.28125"	5/8"	.625"	31/32"	.96875"
19/64"	.29688"	41/64"	.64063"	63/64"	.98438"
5/16"	.3125"	21/32"	.65625"	1"	1.00000"
21/64"	.32813"	43/64"	.67188"	—	—
11/32"	.34375"	11/16"	.6875"	—	—

Metric Conversion Table

mm	x	.03937	= in.
mm	x	25.4	= in.
cm	x	.3937	= in.
cm	+	2.54	= in.
m	x	39.37	= in.
m	x	3.281	= ft.
m	x	1.094	= yds.
km	x	.621	= mi.
km	+	1.6093	= mi.
km	x	3280.8693	= ft.
mm ²	x	.00155	= in. ²
mm ²	+	645.1	= in. ²
cm ²	x	.155	= in. ²
cm ²	+	6.451	= in. ²
m ²	x	10.764	= ft. ²
km ²	x	247.1	= acres
hectare	x	2.471	= acres
cm ³	+	16.383	= in. ³
cm ³	+	3.69	= fl. drams
cm ³	+	29.57	= fl. oz.
m ³	x	35.315	= ft. ³
m ³	x	1.308	= yds. ³
m ³	x	264.2	= gal. (231 in. ³)
liters	x	61.022	= in. ³
liters	x	33.84	= fl. oz.
liters	x	.2642	= gal. (231 in. ³)
liters	+	3.78	= gal. (231 in. ³)
liters	+	28.316	= ft. ³
hectoliters	x	3.531	= ft. ³
hectoliters	x	2.84	= bu. (2150.42 in. ³)
hectoliters	x	.131	= yds. ³
hectoliters	+	26.42	= gal. (231 in. ³)
grams	x	15.432	= grains
grams	+	981	= dynes
grams (water)	+	29.57	= fl. oz.
grams	+	28.35	= oz. Avoir.
Joule	x	.7373	= lb. ft.
kg	x	2.2046	= lb.
kg	x	35.3	= oz. Avoir.
kg	+	907.2	= ton (2000 lbs.)
kg/cm ²	x	14.223	= psi
kg m	x	7.233	= lb. ft.
kg/m	x	.672	= lb./ft.
kg/m ³	x	.062	= lb./ft. ³
kg/Cheval	x	2.235	= lb./HP
Watts	+	.746	= HP
Watts	x	.7373	= lb. ft./sec.
Calorie	x	3.968	= BTU
Cheval Vapeur	x	.9863	= HP
(Degrees Centigrade x 1.8) + 32			= Degrees Fahrenheit
Acceleration due to gravity at Paris			= 980.94 cm/sec.

Mensuration of Surfaces and Volumes

Area of rectangle = length x breadth
 Area of triangle = base x 1/2 perpendicular height
 Diameter of circle = radius x 2
 Circumference of circle = diameter x 3.1416
 Area of circle = square of diameter x .7854
 Area of sector of circle = $\frac{\text{area of circle} \times \text{no. of degrees in arc}}{360}$
 Area of surface of cylinder = circumference x length + area of two ends
 To find the diameter of circle having given area: divide the area by .7854, and extract the square root
 To find the volume of a cylinder: multiply the area of the section in square inches by the length in inches = the volume in cubic inches. Cubic inches divided by 1728 = volume in cubic feet
 Surface of a sphere = square of diameter x 3.1416
 Solidity of a sphere = cube of diameter x .5236
 Side of an inscribed cube = radius of a sphere x 1.1547
 Area of the base of a pyramid or cone, whether round, square, or triangular multiplied by one-third of its height = the solidity
 Diameter x .8862 = side of an equal square
 Diameter x .7071 = side of an inscribed square
 Radius x 6.2832 = circumference
 Circumference = 3.5446 x $\sqrt{\text{area of circle}}$
 Diameter = 1.1283 x $\sqrt{\text{area of circle}}$
 Length of arc = number of degrees x .017453 radius
 Degrees in arc whose length equals radius = 57° 29'58"
 Length of an arc of 1° = radius x .017543
 Length of an arc of 1 min. = radius x .0002909
 Length of an arc of 1 sec. = radius x .0000048
 n = Proportion of circumference to diameter = 3.1415926
 $n^2 = 9.8696044$
 $\sqrt{n} = 1.7724538$
 Log n = 0.49715
 1/n = 0.31831
 1/360 = .002778
 360/n = 114.59

Conversion Table

ft.	x	.00019	= mi.
yd.	x	.0006	= mi. ^o
in. ²	x	.007	= ft. ²
ft. ²	x	.111	= yd. ²
yd. ²	x	.0002067	= Acres
Acres	x	4840	= yd. ²
in. ³	x	.00058	= ft. ³
ft. ³	x	.03704	= yds. ³
Circular Inches	x	.00546	= ft. ²
Cylinder Inches	x	.0004546	= ft. ³
Cylinder Feet	x	.02909	= yd. ³
Links	x	.22	= yd.
Links	x	.66	= ft.
ft.	x	1.5	= Links
Width in Chains	x	8.	= Acres/mi.
183346 Circular Inches			= 1 ft. ²
2200 Cylindrical Inches			= 1 ft. ³
ft. ³	x	7.48	= U.S. gal.
in. ³	x	.004329	= U.S. gal.
U.S. gal.	x	.1336	= ft. ³
U.S. gal.	x	231.	= in. ³
ft. ³	x	.8036	= U.S. bushel
in. ³	x	.000466	= U.S. bushel
Cylindrical Feet of Water	x	6	= U.S. gal.
lb. Avoir.	x	.009	= Cwt. (112)
lb. Avoir.	x	.00045	= Tons (2240)
ft. ³ of Water	x	62.5	= lb. Avoir.
in. ³ of Water	x	.03617	= lb. Avoir.
Cylindrical Feet of Water	x	49.1	= lb. Avoir.
Cylindrical Inch of Water	x	.0284	= lb. Avoir.
13.44 U.S. gal. of Water			= 1 Cwt.
268.8 U.S. gal. of Water			= 1 Ton
1.8 ft. ³ of Water			= 1 Cwt.
35.88 ft. ³ of Water			= 1 Ton
Column of Water, 12" High x 1" Dia.			= .341 lb.
U.S. bushel	x	.049	= yd. ³
U.S. bushel	x	1.2446	= ft. ³
U.S. bushel	x	2150.42	= in. ³

No. of U.S. Gallons in Round Tank for One Foot Depth

Dia. of Tank Ft. In.	Cap. U.S. Gal.	Vol. Ft. ³ & Area Ft. ²	Dia. of Tank Ft. In.	Cap. U.S. Gal.	Vol. Ft. ³ & Area Ft. ²
1 —	5.87	.785	9 —	475.89	63.62
1 1	6.89	.922	9 3	502.70	67.20
1 2	8.00	1.069	9 6	530.24	70.88
1 3	9.18	1.227	9 9	558.51	74.66
1 4	10.44	1.396	10 —	587.52	78.54
1 5	11.79	1.576	10 3	617.26	82.52
1 6	13.22	1.767	10 6	647.74	86.59
1 7	14.73	1.969	10 9	678.95	90.76
1 8	16.32	2.182	11 —	710.90	95.03
1 9	17.99	2.405	11 3	743.58	99.40
1 10	19.75	2.640	11 6	776.99	103.87
1 11	21.58	2.885	11 9	811.14	108.43
2 —	23.50	3.142	12 —	846.03	113.10
2 1	25.50	3.409	12 3	881.65	117.86
2 2	27.58	3.687	12 6	918.00	122.72
2 3	29.74	3.976	12 9	955.09	127.66
2 4	31.99	4.276	13 —	992.91	132.72
2 5	34.31	4.587	13 3	1031.5	137.89
2 6	36.72	4.909	13 6	1070.8	143.14
2 7	39.21	5.241	13 9	1110.8	148.49
2 8	41.78	5.585	14 —	1151.5	153.94
2 9	44.43	5.940	14 3	1193.0	159.48
2 10	47.16	6.305	14 6	1235.3	165.13
2 11	49.98	6.681	14 9	1278.2	170.87
3 —	52.88	7.069	15 —	1321.9	176.71
3 1	55.86	7.467	15 3	1366.4	182.65
3 2	58.92	7.876	15 6	1411.5	188.69
3 3	62.06	8.296	15 9	1457.4	194.83
3 4	65.28	8.727	16 —	1504.1	201.06
3 5	68.58	9.168	16 3	1551.4	207.39
3 6	71.97	9.621	16 6	1599.5	213.82
3 7	75.44	10.085	16 9	1648.4	220.35
3 8	78.99	10.559	17 —	1697.9	226.98
3 9	82.62	11.045	17 3	1748.2	233.71
3 10	86.33	11.541	17 6	1799.3	240.53
3 11	90.13	12.048	17 9	1851.1	247.45
4 —	94.00	12.566	18 —	1903.6	254.47
4 1	97.96	13.095	18 3	1956.8	261.59
4 2	102.00	13.635	18 6	2010.8	268.80
4 3	106.12	14.186	18 9	2065.5	276.12
4 4	110.32	14.748	19 —	2120.9	283.53
4 5	114.61	15.321	19 3	2177.1	291.04
4 6	118.97	15.905	19 6	2234.0	298.65
4 7	123.42	16.500	19 9	2291.7	306.35
4 8	127.95	17.106	20 —	2350.1	314.16
4 9	132.56	17.723	20 3	2409.2	322.06
4 10	138.25	18.351	20 6	2469.1	330.06
4 11	144.02	18.990	20 9	2529.6	338.16
5 —	146.88	19.639	21 —	2591.0	346.36
5 1	151.82	20.299	21 3	2653.0	354.66
5 2	156.83	20.970	21 6	2715.8	363.05
5 3	161.93	21.651	21 9	2779.3	371.54
5 4	167.12	22.343	22 —	2843.6	380.13
5 5	172.38	23.046	22 3	2908.6	388.82
5 6	177.72	23.760	22 6	2974.3	397.61
5 7	183.15	24.485	22 9	3040.8	406.49
5 8	188.66	25.222	23 —	3108.0	415.48
5 9	194.25	25.970	23 3	3175.9	424.56
5 10	199.92	26.730	23 6	3244.6	433.74
5 11	205.67	27.499	23 9	3314.0	443.01
6 —	211.51	28.279	24 —	3384.1	452.39
6 3	229.50	30.688	24 3	3455.0	461.86
6 6	248.23	33.188	24 6	3526.6	471.44
6 9	267.69	35.778	24 9	3597.9	481.11
7 —	287.88	38.458	25 —	3670.0	490.87
7 3	308.81	41.228	25 3	3745.8	500.74
7 6	330.48	44.088	25 6	3820.3	510.71
7 9	352.88	47.028	25 9	3895.6	520.77
8 —	376.01	50.048	26 —	3971.6	530.93
8 3	399.88	53.148	26 3	4048.4	541.19
8 6	424.48	56.328	26 6	4125.9	551.55
8 9	449.82	59.588	26 9	4204.1	562.00

To find the capacity of tanks larger than given in the table, set table for tank one-half of the given size, and multiply its capacity by 4, or one of one-third its size and multiply by 9, etc. Thirty-one and one-half gallons equal one barrel. To find the capacity of a square tank, find the capacity of a round tank with diameter same as length of side and divide by .7854. A 10' diameter round tank, 1' high, holds 587.52 gallons. A square tank 10'x10' by 1' high equals 587.52 divided by .7854 equals 748 gallons.

Capacity of Steel Tanks

Dia.	Gal. per Ft. Lgth.	Dia.	Gal. per Ft. Lgth.	Dia.	Gal. per Ft. Lgth.
12"	5.87	22"	19.75	32"	41.78
13"	6.89	23"	21.58	33"	44.43
14"	8.00	24"	23.50	34"	47.16
15"	9.18	25"	25.50	35"	49.98
16"	10.44	26"	27.58	36"	52.88
17"	11.79	27"	29.74	37"	55.86
18"	13.22	28"	31.99	38"	58.92
19"	14.73	29"	34.31	39"	62.06
20"	16.32	30"	36.72	40"	65.28
21"	17.99	31"	39.21	—	—

Number of Gallons in Cisterns and Tanks

Dpth.	Dia.					
	5'	6'	7'	8'	9'	10'
5'	725	1060	1440	1875	2380	2925
6'	870	1270	1728	2250	2855	3510
7'	1015	1480	2016	2625	3330	4112
8'	1160	1690	2304	3000	3805	4680
9'	1305	1900	2592	3375	4280	5265
10'	1450	2110	2880	3750	4755	5850

Dpth.	Dia.					
	11'	12'	13'	14'	15'	16'
5'	3550	4237	4960	5765	6698	7520
6'	4260	5084	5952	6918	8038	9024
7'	4970	5931	6944	8071	9378	10528
8'	5680	6778	7936	9224	10718	12032
9'	6380	7625	8928	10377	12058	13536
10'	7100	8472	9920	11530	13398	15040

**Friction of Water in 90° Elbows
Equivalent Number of Feet of Straight Pipe**

Size of Elbow	¼"	½"	¾"	1"
Friction Equivalent"	3'	4'	5'	6'
Size of Elbow	1 ¼"	1 ½"	2"	2 ½"
Friction Equivalent"	8'	8'	8'	11'
Size of Elbow	4"	5"	6"	8"
Friction Equivalent"	16'	18'	18'	24'
Size of Elbow	12"	14"	15"	16"
Friction Equivalent"	40'	54'	55'	70'
Size of Elbow	24"	30"	36"	42"
Friction Equivalent"	80'	100'	120'	140'

The figures given are based on the assumption that the total velocity head of the water flowing through the elbow is used up to overcome the friction.

^a Straight pipe.

**Comparison of Centigrade and Fahrenheit
Thermometer Scales**

°C	°F	°C	°F	°C	°F	°C	°F
0	32.0	26	78.8	52	125.6	78	172.4
1	33.8	27	80.6	53	127.4	79	174.2
2	35.6	28	82.4	54	129.2	80	176.0
3	37.4	29	84.2	55	131.0	81	177.8
4	39.2	30	86.0	56	132.8	82	179.6
5	41.0	31	87.8	57	134.6	83	181.4
6	42.8	32	89.6	58	136.4	84	183.2
7	44.6	33	91.4	59	138.2	85	185.0
8	46.4	34	93.2	60	140.0	86	186.8
9	48.2	35	95.0	61	141.8	87	188.6
10	50.0	36	96.8	62	143.6	88	190.4
11	51.8	37	98.6	63	145.4	89	192.2
12	53.6	38	100.4	64	147.2	90	194.0
13	55.4	39	102.2	65	149.0	91	195.8
14	57.2	40	104.0	66	150.8	92	197.6
15	59.0	41	105.8	67	152.6	93	199.4
16	60.8	42	107.6	68	154.4	94	201.2
17	62.6	43	109.4	69	156.2	95	203.0
18	64.4	44	111.2	70	158.0	96	204.8
19	66.2	45	113.0	71	159.8	97	206.6
20	68.0	46	114.8	72	161.6	98	208.4
21	69.8	47	116.6	73	163.4	99	210.2
22	71.6	48	118.4	74	165.2	100	212.0
23	73.4	49	120.2	75	167.0	—	—
24	75.2	50	122.0	76	168.8	—	—
25	77.0	51	123.8	77	170.6	—	—

Temperature corrections based on room temperature of 25°C. If the temperature of room during a test differs from 25°C, corrections should be made changing the observed rise of temperature by one-half percent for each degree C. Thus, with a room temperature of 35°C, the observed rise has to be decreased by 5 percent, and with a room temperature of 15°C, the observed rise has to be increased by 5 percent.

Table Giving the Circumference and Area of Circles

Dia.	Circum.	Area, In. ²	Dia.	Circum.	Area, In. ²	Dia.	Circum.	Area, In. ²	Dia.	Circum.	Area, In. ²	Dia.	Circum.	Area, In. ²	Dia.	Circum.	Area, In. ²
1/8	.3926	.0122	6	18.84	28.274	19 1/2	61.26	298.64	41	128.81	1320.25	68	213.63	3631.68	95	298.45	7088.22
1/4	.7854	.0491	6 1/2	20.42	33.183	20	62.83	314.16	42	131.95	1385.44	69	216.77	3739.28	96	301.59	7238.23
3/8	1.178	.1104	7	21.99	38.484	20 1/2	64.40	330.06	43	135.09	1452.20	70	219.91	3848.46	97	304.73	7389.81
1/2	1.570	.1963	7 1/2	23.56	44.178	21	65.97	346.36	44	138.23	1520.53	71	223.05	3959.20	98	307.88	7542.96
5/8	1.963	.3067	8	25.13	50.265	21 1/2	67.54	363.04	45	141.37	1590.43	72	226.19	4071.50	99	311.02	7697.69
3/4	2.356	.4417	8 1/2	26.70	56.745	22	69.11	380.13	46	144.51	1661.90	73	229.34	4185.39	100	314.16	7853.98
7/8	2.748	.6013	9	28.27	63.617	22 1/2	70.68	397.60	47	147.65	1734.94	74	232.48	4300.84	101	317.30	8011.85
1	3.141	.7854	9 1/2	29.84	70.882	23	72.25	415.47	48	150.80	1809.56	75	235.62	4417.86	102	320.44	8171.28
1 1/8	3.543	.9940	10	31.41	78.54	23 1/2	73.82	433.73	49	153.94	1885.74	76	238.76	4536.46	103	323.58	8332.29
1 1/4	3.927	1.227	10 1/2	32.98	86.59	24	75.39	452.39	50	157.08	1963.50	77	241.90	4656.64	104	326.73	8494.87
1 3/8	4.319	1.484	11	34.55	95.03	24 1/2	76.96	471.43	51	160.22	2042.82	78	245.04	4778.36	105	329.87	8659.01
1 1/2	4.712	1.767	11 1/2	36.12	103.86	25	78.54	490.87	52	163.36	2123.72	79	248.19	4901.67	106	333.01	8824.73
1 5/8	5.105	2.073	12	37.69	113.09	26	81.68	530.93	53	166.50	2206.18	80	251.33	5026.55	107	336.15	8992.02
1 3/4	5.497	2.405	12 1/2	39.27	122.71	27	84.82	572.55	54	169.65	2290.22	81	254.47	5153.00	108	339.29	9160.88
1 7/8	5.890	2.761	13	40.84	132.73	28	87.96	615.75	55	172.79	2375.83	82	257.61	5281.02	109	342.43	9331.32
2	6.283	3.141	13 1/2	42.41	143.13	29	91.10	660.52	56	175.93	2463.01	83	260.75	5410.61	110	345.58	9503.32
2 1/4	7.068	3.976	14	43.98	153.93	30	94.24	706.86	57	179.07	2551.76	84	263.89	5541.77	111	348.72	9676.89
2 1/2	7.854	4.908	14 1/2	45.55	165.13	31	97.38	754.76	58	182.21	2642.08	85	267.04	5674.50	112	351.86	9852.03
2 3/4	8.639	5.939	15	47.12	176.78	32	100.53	804.24	59	185.35	2733.97	86	270.18	5808.80	113	355.00	10028.75
3	9.424	7.068	15 1/2	48.69	188.69	33	103.67	855.30	60	188.50	2827.43	87	273.32	5944.68	114	358.14	10207.03
3 1/4	10.21	8.295	16	50.26	201.06	34	106.81	907.92	61	191.64	2922.47	88	276.46	6082.12	115	361.28	10386.89
3 1/2	10.99	9.621	16 1/2	51.83	213.82	35	109.96	962.11	62	194.78	3019.07	89	279.60	6221.14	116	364.42	10568.32
3 3/4	11.78	11.044	17	53.40	226.98	36	113.10	1017.88	63	197.92	3117.25	90	282.74	6361.73	117	367.57	10751.32
4	12.56	12.566	17 1/2	54.97	240.52	37	116.24	1075.21	64	201.06	3216.99	91	285.88	6503.88	118	370.71	10935.88
4 1/2	14.13	15.904	18	56.54	254.46	38	119.38	1134.11	65	204.20	3318.31	92	289.03	6647.61	119	373.85	11122.02
5	15.70	19.635	18 1/2	58.11	268.80	39	122.52	1194.59	66	207.34	3424.29	93	292.17	6792.91	120	376.99	11309.73
5 1/2	17.27	23.758	19	59.69	283.52	40	125.66	1256.64	67	210.49	3525.65	94	295.31	6939.78	121	380.13	11499.01

Wire Gage Standards

Wire Gage No.	Decimal Thickness						U.S. Standard for Plate Gage	Weight Lbs./Ft. ²
	American or Brown & Sharpe Gage	Birmingham or Stubs' Wire Gage	Washburn & Moen Steel Wire Gage	American S.&W. Co's Music Wire Gage	Imperial Wire Gage	Stubs' Steel Wire Gage		
0000000	.651354"	—	.4900"	—	.500"	—	.500"	20.00
000000	.580049"	—	.4615"	.004"	.464"	—	.46875"	18.75
00000	.516549"	.500"	.4305"	.005"	.432"	—	.4375"	17.50
0000	.460"	.454"	.3938"	.006"	.400"	—	.40625"	16.25
000	.40964"	.425"	.3625"	.007"	.372"	—	.375"	15.00
00	.3648"	.380"	.3310"	.008"	.348"	—	.34375"	13.75
0	.32486"	.340"	.3065"	.009"	.324"	—	.3125"	12.50
1	.2893"	.300"	.2830"	.010"	.300"	.227"	.28125"	11.25
2	.25763"	.284"	.2625"	.011"	.276"	.219"	.265625"	10.625
3	.22942"	.259"	.2437"	.012"	.252"	.212"	.250"	10.00
4	.20431"	.238"	.2253"	.013"	.232"	.207"	.234375"	9.375
5	.18194"	.220"	.2070"	.014"	.212"	.204"	.21875"	8.75
6	.16202"	.203"	.1920"	.016"	.192"	.201"	.203125"	8.125
7	.14428"	.180"	.1770"	.018"	.176"	.199"	.1875"	7.5
8	.12849"	.165"	.1620"	.020"	.160"	.197"	.171875"	6.875
9	.11443"	.148"	.1483"	.022"	.144"	.194"	.15625"	6.25
10	.10189"	.134"	.1350"	.024"	.128"	.191"	.140625"	5.625
11	.090742"	.120"	.1205"	.026"	.116"	.188"	.125"	5.00
12	.080808"	.109"	.1055"	.029"	.104"	.185"	.109375"	4.375
13	.071961"	.095"	.0915"	.031"	.092"	.182"	.09375"	3.75
14	.064084"	.083"	.0800"	.033"	.080"	.180"	.078125"	3.125
15	.057068"	.072"	.0720"	.035"	.072"	.178"	.0703125"	2.8125
16	.05082"	.065"	.0625"	.037"	.064"	.175"	.0625"	2.5
17	.045257"	.058"	.0540"	.039"	.056"	.172"	.05625"	2.25
18	.040303"	.049"	.0475"	.041"	.048"	.168"	.050"	2.00
19	.03589"	.042"	.0410"	.043"	.040"	.164"	.04375"	1.75
20	.031961"	.035"	.0348"	.045"	.036"	.161"	.0375"	1.50
21	.028462"	.032"	.0317"	.047"	.032"	.157"	.034375"	1.375
22	.025347"	.028"	.0286"	.049"	.028"	.155"	.03125"	1.25
23	.022571"	.025"	.0258"	.051"	.024"	.153"	.028125"	1.125
24	.0201"	.022"	.0230"	.055"	.022"	.151"	.025"	1.00
25	.0179"	.020"	.0204"	.059"	.020"	.148"	.021875"	.875
26	.01594"	.018"	.0181"	.063"	.018"	.146"	.01875"	.75
27	.014195"	.016"	.0173"	.067"	.0164"	.143"	.0171875"	.6875
28	.012641"	.014"	.0162"	.071"	.0149"	.139"	.015625"	.625
29	.011257"	.013"	.0150"	.075"	.0136"	.134"	.0140625"	.5625
30	.010025"	.012"	.0140"	.080"	.0124"	.127"	.0125"	.5
31	.008928"	.010"	.0132"	.085"	.0116"	.120"	.0109375"	.4375
32	.00795"	.009"	.0128"	.090"	.0108"	.115"	.01015625"	.40625
33	.00708"	.008"	.0118"	.095"	.0100"	.112"	.009375"	.375
34	.006304"	.007"	.0104"	—	.0092"	.110"	.00859375"	.34375
35	.005614"	.005"	.0095"	—	.0084"	.108"	.0078125"	.3125
36	.005"	.004"	.0090"	—	.0076"	.106"	.00703125"	.28125
37	.004453"	—	.0085"	—	.0068"	.103"	.006640625"	.265625
38	.003965"	—	.080"	—	.0060"	.101"	.00625"	.25

Gage Standards

It is at times confusing to know what Gage Standard applies to a given product. Therefore, we publish the following for your information.

Steel Sheets: All carbon steel, uncoated, Manufacturers' Standard Gage; galvanized steel, Galvanized Sheet Gage; stainless steel, Manufacturers' Standard Gage.

Hot Rolled Strip Steel, Spring Steel Bars and Sheets, Tool Steel Sheets, and Boiler Tubes: The standard is Birmingham Wire Gage.

Cold Rolled Strip Steel and Cold Rolled Flat Wire: While Birmingham Wire Gage is sometimes used, decimal measure is better.

Brass, Copper, Bronze, and German Silver Sheets and Strips: The standard is Brown & Sharpe Gage (B&S).

Brass and Copper Tubing: Birmingham Wire Gage

Steel Wire: Washburn and Moen Gage (W.&M.) is standard except for telephone and telegraph wire.

Telephone and Telegraph Wire: Generally designated by Birmingham Wire Gage.

Music Wire: Should be ordered by decimal since manufacturers are not in agreement as to diameters for certain gages.

Copper Wire: Brown & Sharpe Gage is standard.

Drill and Coppered Bessemer Rods: Order by decimal equivalent of size desired.

Copper Sheets: Specified in ounces per square foot.

Zinc Sheets: Standard Zinc Gage.

Tin Plates and Terns: Order by base weight and specific size.

Carbon Plates: 40.8 lb. psf per inch of thickness.

U.S. Standard Gage

For Sheet and Plate Iron and Steel

Number of Gage	Iron		Steel		Weight Lbs./Ft. ²
	Approx. Thickness Fractions	Approx. Thickness Decimal	Approx. Thickness Decimal	Approx. Thickness Decimal	
0000000	1/2"	.5"	.4902"		20.00
000000	15/32"	.46875"	.4596"		18.75
000000	7/16"	.4375"	.4289"		17.50
0000	13/32"	.40625"	.3983"		16.25
000	3/8"	.375"	.3676"		15.00
00	11/32"	.34375"	.3370"		13.75
0	5/16"	.3125"	.3064"		12.50
1	9/32"	.28125"	.2757"		11.25
2	17/64"	.265625"	.2604"		10.625
3	1/4"	.25"	.2451"		10.00
4	15/64"	.234375"	.2298"		9.375
5	7/32"	.21875"	.2145"		8.75
6	13/64"	.203125"	.1991"		8.125
7	3/16"	.1875"	.1838"		7.5
8	11/64"	.171875"	.1685"		6.875
9	5/32"	.15625"	.1532"		6.25
10	9/64"	.140625"	.1379"		5.625
11	1/8"	.125"	.1225"		5.00
12	7/64"	.109375"	.1072"		4.375
13	3/32"	.09375"	.09191"		3.75
14	5/64"	.078125"	.07659"		3.125
15	9/128"	.0703125"	.06893"		2.8125
16	1/16"	.0625"	.06127"		2.5
17	9/160"	.05625"	.05515"		2.25
18	1/20"	.05"	.04902"		2.
19	7/160"	.04375"	.04289"		1.75
20	3/80"	.0375"	.03676"		1.50
21	11/320"	.034375"	.03370"		1.375
22	1/32"	.03125"	.03064"		1.25
23	9/320"	.028125"	.02757"		1.125
24	1/40"	.025"	.02451"		1.
25	7/320"	.021875"	.02145"		.875
26	3/160"	.01875"	.01838"		.75
27	11/640"	.0171875"	.01685"		.6875
28	1/64"	.015625"	.01532"		.625
29	9/640"	.0140625"	.01379"		.5625
30	1/80"	.0125"	.01225"		.5
31	7/640"	.0109375"	.01072"		.4375
32	13/1280"	.01015625"	.00996"		.40625
33	3/320"	.009375"	.00919"		.375
34	11/1280"	.00859375"	.00843"		.34375
35	3/640"	.0078125"	.00766"		.3125
36	9/1280"	.00703125"	.00689"		.28125
37	17/2560"	.006640625"	.00651"		.265625
38	1/160"	.00625"	.00613"		.25

ANSI Pipe Schedules

Pipe Sizes	OD	Dimensions & Weights of Seamless and Welded Pipe														Desc.
		5	10	20	30	40	STD	60	80	EH	100	120	140	160	Dble. EH	
1/8	.405"	.035" .1383	.049" .1863	—	—	.068" .2447	.068" .2447	—	.095" .3145	.095" .3145	—	—	—	—	—	Nom. Wall Thck. Wt. Lbs./Ft.
1/4	.540"	.049" .2570	.065" .3297	—	—	.088" .4248	.088" .4248	—	.119" .5351	.119" .5351	—	—	—	—	—	Nom. Wall Thck. Wt. Lbs./Ft.
3/8	.675"	.049" .3276	.065" .4235	—	—	.091" .5676	.091" .5676	—	.126" .7388	.126" .7388	—	—	—	—	—	Nom. Wall Thck. Wt. Lbs./Ft.
1/2	.840"	.065" .5383	.083" .6710	—	—	.109" .8510	.109" .8510	—	.147" 1.088	.147" 1.088	—	—	—	.187" 1.304	.294" 1.714	Nom. Wall Thck. Wt. Lbs./Ft.
3/4	1.050"	.065" .6838	.083" .8572	—	—	.113" 1.131	.113" 1.131	—	.154" 1.474	.154" 1.474	—	—	—	.218" 1.937	.308" 2.441	Nom. Wall Thck. Wt. Lbs./Ft.
1	1.315"	.065" .8678	.109" 1.404	—	—	.133" 1.679	.133" 1.679	—	.179" 2.172	.179" 2.172	—	—	—	.250" 2.844	.358" 3.659	Nom. Wall Thck. Wt. Lbs./Ft.
1 1/4	1.660"	.065" 1.107	.109" 1.806	—	—	.140" 2.273	.140" 2.273	—	.191" 2.997	.191" 2.997	—	—	—	.250" 3.765	.382" 5.214	Nom. Wall Thck. Wt. Lbs./Ft.
1 1/2	1.900"	.065" 1.274	.109" 2.085	—	—	.145" 2.718	.145" 2.718	—	.200" 3.631	.200" 3.631	—	—	—	.281" 4.859	.400" 6.408	Nom. Wall Thck. Wt. Lbs./Ft.
2	2.375"	.065" 1.604	.109" 2.638	—	—	.154" 3.653	.154" 3.653	—	.218" 5.022	.218" 5.022	—	—	—	.343" 7.444	.436" 9.029	Nom. Wall Thck. Wt. Lbs./Ft.
2 1/2	2.875"	.083" 2.475	.120" 3.531	—	—	.203" 5.793	.203" 5.793	—	.276" 7.661	.276" 7.661	—	—	—	.375" 10.01	.552" 13.70	Nom. Wall Thck. Wt. Lbs./Ft.
3	3.5"	.083" 3.029	.120" 4.332	—	—	.216" 7.576	.216" 7.576	—	.300" 10.25	.300" 10.25	—	—	—	.437" 14.32	.600" 18.58	Nom. Wall Thck. Wt. Lbs./Ft.
3 1/2	4.0"	.083" 3.472	.120" 4.973	—	—	.226" 9.109	.226" 9.109	—	.318" 12.51	.318" 12.51	—	—	—	—	.636" 22.85	Nom. Wall Thck. Wt. Lbs./Ft.
4	4.50"	.083" 3.915	.120" 5.613	—	—	.237" 10.79	.237" 10.79	.281" 12.66	.337" 14.98	.337" 14.98	—	.437" 19.01	—	.531" 22.51	.674" 27.54	Nom. Wall Thck. Wt. Lbs./Ft.
4 1/2	5.0"	—	—	—	—	—	.247" 12.53	—	—	.355" 17.61	—	—	—	—	.710" 32.53	Nom. Wall Thck. Wt. Lbs./Ft.
5	5.563"	.109" 6.349	.134" 7.770	—	—	.258" 14.62	.258" 14.62	—	.375" 20.78	.375" 20.78	—	.500" 27.04	—	.625" 32.96	.750" 38.55	Nom. Wall Thck. Wt. Lbs./Ft.
6	6.625"	.109" 7.585	.134" 9.289	—	—	.280" 18.97	.280" 18.97	—	.432" 28.57	.432" 28.57	—	.562" 36.39	—	.718" 45.30	.864" 53.16	Nom. Wall Thck. Wt. Lbs./Ft.
7	7.625"	—	—	—	—	—	.301 23.57	—	—	.500 38.05	—	—	—	—	.875" 63.08	Nom. Wall Thck. Wt. Lbs./Ft.
8	8.625"	.109" 9.914	.148" 13.40	.250" 22.36	.277" 24.70	.322" 28.55	.322" 28.55	.406" 35.64	.500" 43.39	.500" 43.39	.593" 50.87	.718" 60.93	.812" 67.76	.906" 74.69	.875" 72.42	Nom. Wall Thck. Wt. Lbs./Ft.
9	9.625"	—	—	—	—	—	.342" 33.90	—	—	.500" 48.72	—	—	—	—	—	Nom. Wall Thck. Wt. Lbs./Ft.
10	10.75"	.134" 15.19	.165" 18.70	.250" 28.04	.307" 34.24	.365" 40.48	.365" 40.48	.500" 54.74	.593" 64.33	.500" 54.74	.718" 76.93	.843" 89.20	1.000" 104.1	1.125" 115.7	—	Nom. Wall Thck. Wt. Lbs./Ft.
11	11.75"	—	—	—	—	—	.375 45.55	—	—	.500 60.07	—	—	—	—	—	Nom. Wall Thck. Wt. Lbs./Ft.
12	12.75"	.165" 22.18	.180" 24.20	.250" 33.38	.330" 43.77	.406" 53.53	.375" 49.56	.562" 73.16	.687" 88.51	.500" 65.42	.843" 107.2	1.000" 125.5	1.125" 139.7	1.312" 160.3	—	Nom. Wall Thck. Wt. Lbs./Ft.
14	14.0"	—	.250" 36.71	.312" 45.68	.375" 54.57	.437" 63.37	.375" 54.57	.593" 84.91	.750" 106.1	.500" 72.09	.937" 130.7	1.093" 150.7	1.250" 170.2	1.406" 189.1	—	Nom. Wall Thck. Wt. Lbs./Ft.
16	16.0"	—	.250" 42.05	.312" 52.36	.375" 62.58	.500" 82.77	.375" 62.58	.656" 107.5	.843" 136.5	.500" 82.77	1.031" 164.8	1.218" 192.3	1.437" 223.5	1.593" 245.1	—	Nom. Wall Thck. Wt. Lbs./Ft.
18	18.0"	—	.250" 47.39	.312" 59.03	.437" 82.06	.562" 104.8	.375" 70.59	.750" 138.2	.937" 170.8	.500" 93.45	1.156" 208.0	1.375" 244.1	1.562" 274.2	1.781" 308.5	—	Nom. Wall Thck. Wt. Lbs./Ft.
20	20.0"	—	.250" 52.73	.375" 78.60	.500" 104.1	.593" 122.9	.375" 78.60	.812" 166.4	1.031" 208.9	.500" 104.1	1.280" 256.1	1.500" 296.4	1.750" 341.1	1.968" 379.0	—	Nom. Wall Thck. Wt. Lbs./Ft.
22	22.0"	—	.250" 58.07	.375" 86.61	.500" 114.8	—	.375" 86.61	.875" 197.4	1.125" 250.8	.500" 114.8	1.375" 302.9	1.625" 353.6	1.875" 403.0	2.125" 451.1	—	Nom. Wall Thck. Wt. Lbs./Ft.
24	24.0"	—	.250" 63.41	.375" 94.62	.562" 140.8	.687" 171.2	.375" 94.62	.968" 238.1	1.218" 296.4	.500" 125.5	1.531" 367.4	1.812" 429.4	2.062" 483.1	2.343" 541.9	—	Nom. Wall Thck. Wt. Lbs./Ft.
26	26.000"	—	.312" 85.60	.500" 136.2	—	—	.375" 102.6	—	—	.500" 136.2	—	—	—	—	—	Nom. Wall Thck. Wt. Lbs./Ft.
28	28.000"	—	.312" 92.26	.500" 146.8	.625" 182.7	—	.375" 110.6	—	—	.500" 146.8	—	—	—	—	—	Nom. Wall Thck. Wt. Lbs./Ft.
30	30.000"	—	.312" 98.95	.500" 157.5	.625" 196.01	—	.375" 118.6	—	—	.500" 157.5	—	—	—	—	—	Nom. Wall Thck. Wt. Lbs./Ft.
32	32.000"	—	.312" 105.6	.500" 168.2	.625" 209.4	—	.375" 126.7	—	—	.500" 168.2	—	—	—	—	—	Nom. Wall Thck. Wt. Lbs./Ft.
34	34.000"	—	.312" 112.3	.500" 178.9	.625" 222.8	.688" 244.8	.375" 134.7	—	—	.500" 178.9	—	—	—	—	—	Nom. Wall Thck. Wt. Lbs./Ft.
36	36.000"	—	.312" 118.9	.500" 189.5	.625" 236.1	.750" 252.3	.375" 142.7	—	—	.500" 189.6	—	—	—	—	—	Nom. Wall Thck. Wt. Lbs./Ft.

WELDBEND

Pressure-Temperature Ratings

Carbon Steel Butt Weld Fittings

Standard		Working Pressure PSI at the Temp Indicated			
Size (in.)	Nom. Wall Thick (in.)	-20°F to 650°F	700°F	750°F	800°F
1/2	.109	1695	1621	1463	1220
3/4	.113	1455	1392	1256	1046
1	.133	1575	1506	1359	1134
1 1/4	.140	1065	1019	919	766
1 1/2	.145	1005	960	867	723
2	.154	900	861	777	648
2 1/2	.203	1215	1162	1048	874
3	.216	1095	1047	945	788
3 1/2	.226	1020	975	880	734
4	.237	975	932	841	702
5	.258	885	846	764	637
6	.280	840	803	725	604
8	.322	765	731	660	550
10	.365	720	688	621	518
12	.375	630	602	543	453
14	.375	570	545	492	410
16	.375	495	473	427	356
18	.375	450	430	388	324
20	.375	405	387	349	291
24	.375	330	315	284	237

Extra Strong		Working Pressure PSI at the Temp Indicated			
Size (in.)	Nom. Wall Thick (in.)	-20°F to 650°F	700°F	750°F	800°F
1/2	.147	3030	2898	2615	2181
3/4	.154	2595	2482	2240	1868
1	.179	2610	2496	2253	1879
1 1/4	.191	1935	1851	1670	1393
1 1/2	.200	1815	1736	1566	1306
2	.218	1665	1592	1437	1198
2 1/2	.276	1935	1851	1670	1393
3	.300	1770	1693	1528	1274
3 1/2	.318	1665	1592	1437	1198
4	.337	1590	1521	1372	1144
5	.375	1470	1406	1269	1058
6	.432	1470	1406	1269	1058
8	.500	1350	1291	1165	972
10	.500	1065	1018	919	766
12	.500	900	861	777	648
14	.500	810	774	699	583
16	.500	705	674	608	507
18	.500	630	602	543	453
20	.500	570	545	492	410
24	.500	465	444	401	334

Carbon Steel Flange

Welded manufactured flanges in Classes 150, 300, and 600 have pressure ratings in psi at temperatures measured in degrees Fahrenheit. Each column shows working pressure rating Class. Note that the table below specifically rates carbon steel products within temperatures listed.

Temperature in °F	Working Pressure in PSIG by Classes		
	Class 150	Class 300	Class 600
-20 to 100	290	750	1500
200	260	750	1500
300	230	730	1455
400	200	705	1410
500	170	665	1330
600	140	605	1210
650	125	590	1175
700	110	570	1135
750	95	530	1065
800	80	510	1015
850	65	485	975
900	50	450	900
950	35	385	775
1000	20	365	725
1050	—	360	720
1100	—	325	645
1150	—	275	550
1200	—	205	410
1250	—	180	365
1300	—	140	275
1350	—	105	205
1400	—	75	150
1450	—	60	115
1500	—	40	85

NOTE: Stated pressure temperature maximum ratings include built-in anticipated stress limitations.

- Standard nom. wall thickness corresponds to the thickness of Wall Grade B steel pipe
- Standard working pressure at the PSI apply in accordance with sections 1 and 5 of the code for pressure pipe
- Standard and extra Strong 800°F temp. is upon prolonged exposure to temperatures above 775°F the carbide phase of carbon steel may be converted to graphite
- Extra Strong nom. wall thickness corresponds to the thickness of Wall Grade B steel pipe

Friction of Water in Pipes
Loss of Head in Feet Due to Friction, per 100' of Ordinary Iron Pipe

Gallons per Minute	Size Pipe									
	1/4"		3/8"		1/2"		3/4"		1"	
	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.
1	3.08	28.0	1.67	6.4	1.05	2.1	—	—	—	—
2	6.16	103.0	3.35	23.3	2.10	7.4	1.20	1.9	—	—
3	—	—	5.02	49.0	3.16	15.8	1.80	4.1	1.12	1.26
4	—	—	6.70	84.0	4.21	27.0	2.41	7.0	1.49	2.14
5	—	—	8.37	126.0	5.26	41.0	3.01	10.5	1.86	3.25
10	—	—	—	—	10.52	147.0	6.02	38.0	3.72	11.7
15	—	—	—	—	—	—	9.02	80.0	5.60	25.0
20	—	—	—	—	—	—	12.03	136.0	7.44	42.0
25	—	—	—	—	—	—	—	—	9.30	64.0
30	—	—	—	—	—	—	—	—	11.15	89.0
35	—	—	—	—	—	—	—	—	13.02	119.0
40	—	—	—	—	—	—	—	—	14.88	152.0
45	—	—	—	—	—	—	—	—	—	—

Gallons per Minute	Size Pipe									
	1 1/4"		1 1/2"		2"		2 1/2"		3"	
	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.
4	0.86	0.57	0.63	0.26	—	—	—	—	—	—
5	1.07	0.84	0.79	0.39	—	—	—	—	—	—
10	2.14	3.05	1.57	1.43	1.02	0.50	0.65	0.17	0.45	0.07
15	3.2	6.50	2.36	3.0	1.53	1.0	0.98	0.36	0.68	0.15
20	4.29	11.1	3.15	5.2	2.04	1.82	1.31	0.61	0.91	0.25
25	5.36	16.6	3.94	7.8	2.55	2.73	1.63	0.92	1.13	0.38
30	6.43	23.5	4.72	11.0	3.06	3.84	1.96	1.29	1.36	0.54
35	7.51	31.2	5.51	14.7	3.57	5.1	2.29	1.72	1.59	0.71
40	8.58	40.0	6.30	18.8	4.08	6.6	2.61	2.20	1.82	0.91
45	9.65	50.0	7.08	23.2	4.60	8.2	2.94	2.80	2.05	1.15
50	10.72	60.0	7.87	28.4	5.11	9.9	3.27	3.32	2.27	1.38
70	15.01	113.0	11.02	53.0	7.15	18.4	4.58	6.2	3.18	2.57
90	—	—	14.17	84.0	9.19	29.4	5.88	9.8	4.09	4.08
100	—	—	15.74	102.0	10.21	35.8	6.54	12.0	4.54	4.96
120	—	—	18.89	143.0	12.25	50.0	7.84	16.8	5.45	7.0
140	—	—	22.04	190.0	14.30	67.0	9.15	22.3	6.35	9.2
160	—	—	—	—	16.34	86.0	10.46	29.0	7.26	11.8
180	—	—	—	—	18.38	107.0	11.76	35.7	8.17	14.8
200	—	—	—	—	20.42	129.0	13.07	43.1	9.08	17.8
220	—	—	—	—	22.47	154.0	14.38	52.0	9.99	21.3
240	—	—	—	—	24.51	182.0	15.69	61.0	10.89	25.1
260	—	—	—	—	26.55	211.0	16.99	70.0	11.80	29.1
280	—	—	—	—	—	—	18.30	81.0	12.71	33.4
300	—	—	—	—	—	—	19.61	92.0	13.62	38.0
350	—	—	—	—	—	—	—	—	—	—

Vel. – Velocity in Feet per Second

Fric. – Friction Head in Feet

Gallons per Minute	Size Pipe											
	4"		5"		6"		8"		10"		12"	
	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.
40	1.02	0.22	—	—	—	—	—	—	—	—	—	—
45	1.17	0.28	—	—	—	—	—	—	—	—	—	—
50	1.28	0.34	—	—	—	—	—	—	—	—	—	—
70	1.79	0.63	1.14	0.21	—	—	—	—	—	—	—	—
75	1.92	0.73	1.22	0.24	—	—	—	—	—	—	—	—
100	2.55	1.23	1.63	0.39	1.14	0.14	—	—	—	—	—	—
120	3.06	1.71	1.96	0.57	1.42	0.25	—	—	—	—	—	—
125	3.19	1.81	2.04	0.64	1.48	0.28	—	—	—	—	—	—
150	3.84	2.55	2.45	0.88	1.71	0.32	—	—	—	—	—	—
175	4.45	3.36	2.86	1.18	2.00	0.48	—	—	—	—	—	—
200	5.11	4.37	3.27	1.48	2.28	0.62	—	—	—	—	—	—
225	6.32	6.61	3.67	1.86	2.57	0.74	—	—	—	—	—	—
250	6.40	6.72	4.08	2.24	2.80	0.92	1.60	0.22	—	—	—	—
270	6.90	7.70	4.42	2.60	3.03	1.13	1.70	0.25	—	—	—	—
275	7.03	7.99	4.50	2.72	3.06	1.15	1.73	0.27	—	—	—	—
300	7.66	9.38	4.90	3.15	3.40	1.29	1.90	0.36	—	—	—	—
350	8.90	12.32	5.72	4.19	3.98	1.69	2.20	0.41	—	—	—	—
400	10.20	15.82	6.54	5.33	4.54	2.21	2.60	0.56	—	—	—	—
450	11.50	19.74	7.35	6.65	5.12	2.74	2.92	0.64	1.80	0.21	—	—
470	12.16	22.40	7.78	7.42	5.49	3.12	3.07	0.77	1.92	0.24	—	—
475	12.30	22.96	7.88	7.22	5.55	3.21	3.10	0.79	1.94	0.25	—	—
500	12.77	24.08	8.17	8.12	5.60	3.26	3.20	0.81	2.04	0.28	1.42	—
550	—	—	8.99	9.66	6.16	3.93	3.52	0.98	2.25	0.33	1.57	—
600	—	—	9.80	11.34	6.72	4.70	3.84	1.16	2.46	0.39	1.71	—
650	—	—	10.62	13.16	7.28	5.50	4.16	1.34	2.66	0.46	1.85	—
700	—	—	11.44	15.12	7.84	6.38	4.46	1.54	2.86	0.52	2.00	—
750	—	—	12.26	17.22	8.50	7.00	4.80	1.74	3.06	0.59	2.13	—
800	—	—	—	—	9.08	7.90	5.12	1.97	3.28	0.67	2.27	—
850	—	—	—	—	9.58	8.75	5.48	2.28	3.48	0.75	2.41	—
900	—	—	—	—	10.30	10.11	5.75	2.46	3.68	0.83	2.56	—
950	—	—	—	—	10.72	10.71	6.06	2.87	3.88	0.91	2.70	—
1000	—	—	—	—	11.32	12.04	6.40	3.02	4.08	1.01	2.84	—
1050	—	—	—	—	11.90	13.30	6.70	3.21	4.29	1.09	2.98	—
1100	—	—	—	—	12.50	14.31	7.03	3.51	4.50	1.20	3.13	—
1150	—	—	—	—	12.95	15.34	7.35	3.84	4.71	1.34	3.27	—
1200	—	—	—	—	13.52	16.69	7.67	4.26	4.91	1.46	3.41	—
1250	—	—	—	—	14.10	18.20	8.00	4.45	5.11	1.51	3.55	—
1500	—	—	—	—	—	—	9.60	6.27	6.10	2.09	4.20	—
2000	—	—	—	—	—	—	12.70	10.71	8.10	3.50	5.60	—
2500	—	—	—	—	—	—	—	—	10.10	5.33	7.00	—
3000	—	—	—	—	—	—	—	—	12.10	7.42	8.40	—
3500	—	—	—	—	—	—	—	—	14.10	10.08	9.80	—
4000	—	—	—	—	—	—	—	—	—	—	11.35	—
4200	—	—	—	—	—	—	—	—	—	—	11.93	—
4500	—	—	—	—	—	—	—	—	—	—	12.78	—
5000	—	—	—	—	—	—	—	—	—	—	14.20	—

Vel. – Velocity in Feet per Second

Fric. – Friction Head in Feet

Pressure Drop of Water per 100 Feet of Flexible Plastic Pipe

GPM	½ Inch		¾ Inch		1 Inch		1¼ Inch		1½ Inch		2 Inch		3 Inch		4 Inch		6 Inch	
	Velocity Ft./Sec.	Press. Drop PSI	Velocity Ft./Sec.	Press. Drop PSI	Velocity Ft./Sec.	Press. Drop PSI	Velocity Ft./Sec.	Press. Drop PSI	Velocity Ft./Sec.	Press. Drop PSI	Velocity Ft./Sec.	Press. Drop PSI	Velocity Ft./Sec.	Press. Drop PSI	Velocity Ft./Sec.	Press. Drop PSI	Velocity Ft./Sec.	Press. Drop PSI
1	1.06	0.65	0.60	0.14	0.37	0.04	—	—	—	—	—	—	—	—	—	—	—	—
2	2.11	2.20	1.20	0.49	0.74	.13	0.43	0.04	—	—	—	—	—	—	—	—	—	—
3	3.17	4.55	1.80	1.04	1.12	.26	.64	.08	0.47	0.04	—	—	—	—	—	—	—	—
4	4.23	7.71	2.40	1.65	1.49	.44	.86	.14	.63	.07	—	—	—	—	—	—	—	—
5	5.28	11.26	3.60	2.43	1.86	.62	1.07	.20	.79	.10	—	—	—	—	—	—	—	—
6	6.34	15.59	4.20	3.25	2.24	.84	1.28	.28	.95	.13	0.57	0.04	—	—	—	—	—	—
8	8.45	26.41	4.80	5.20	2.98	1.38	1.72	.45	1.26	.22	.76	.06	—	—	—	—	—	—
10	10.6	39.89	6.01	7.93	3.72	2.12	2.14	.69	1.57	.33	.96	.10	—	—	—	—	—	—
15	—	—	9.02	16.81	5.60	4.38	3.21	1.43	2.36	.67	1.43	.21	—	—	—	—	—	—
20	—	—	—	—	7.44	7.15	4.29	2.38	3.15	1.10	1.91	.36	0.87	0.05	—	—	—	—
25	—	—	—	—	—	—	5.36	3.51	3.94	1.65	2.39	.53	1.08	.08	—	—	—	—
30	—	—	—	—	—	—	6.43	4.68	4.72	2.25	2.87	.73	1.30	.11	—	—	—	—
35	—	—	—	—	—	—	7.51	6.07	5.51	2.86	3.35	.95	1.52	.14	0.88	0.04	—	—
40	—	—	—	—	—	—	—	—	6.30	3.68	3.82	1.21	1.74	.18	1.01	.05	—	—
45	—	—	—	—	—	—	—	—	7.08	4.38	4.30	1.47	1.95	.23	1.13	.06	—	—
50	—	—	—	—	—	—	—	—	7.87	5.16	4.78	1.77	2.17	.27	1.26	.07	—	—
60	—	—	—	—	—	—	—	—	—	—	5.74	2.47	2.60	.37	1.51	.10	—	—
70	—	—	—	—	—	—	—	—	—	—	6.69	3.16	3.04	.48	1.76	.13	—	—
80	—	—	—	—	—	—	—	—	—	—	7.65	3.99	3.48	.61	2.01	.16	—	—
90	—	—	—	—	—	—	—	—	—	—	8.60	4.85	3.91	.78	2.26	.20	—	—
100	—	—	—	—	—	—	—	—	—	—	9.56	6.02	4.34	.95	2.52	.24	1.11	0.04
125	—	—	—	—	—	—	—	—	—	—	11.95	6.54	5.42	1.43	3.15	.38	1.39	.06
150	—	—	—	—	—	—	—	—	—	—	—	—	6.51	1.95	3.78	.51	1.67	.08
175	—	—	—	—	—	—	—	—	—	—	—	—	7.59	2.64	4.41	.67	1.94	.10
200	—	—	—	—	—	—	—	—	—	—	—	—	8.68	3.25	5.04	.86	2.22	.13
225	—	—	—	—	—	—	—	—	—	—	—	—	9.77	4.03	5.67	1.05	2.50	.16
250	—	—	—	—	—	—	—	—	—	—	—	—	10.85	4.76	6.30	1.26	2.78	.19
275	—	—	—	—	—	—	—	—	—	—	—	—	11.94	5.63	6.93	1.52	3.06	.23
300	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7.56	1.82	3.33	.27
325	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8.18	2.08	3.61	.31
350	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8.82	2.34	3.89	.36
375	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9.45	2.69	4.16	.40
400	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10.08	2.90	4.44	.44
425	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10.70	3.25	4.72	.49
450	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11.33	3.64	5.00	.54
475	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11.96	4.03	5.27	.60
500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12.59	4.33	5.55	.65
550	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13.84	5.03	6.11	.77
600	—	—	—	—	—	—	—	—	—	—	—	—	—	—	15.10	6.02	6.66	.89
650	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7.21	1.02
700	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7.77	1.19
750	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8.32	1.34
800	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8.88	1.47
850	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9.44	1.65
900	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10.00	1.82
950	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10.55	1.95
1000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11.10	2.17
1100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12.22	2.56
1200	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13.32	2.90
1300	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14.43	3.38

The value of "C" as calculated by the Hazen and Williams Pipe Formula is 140.

To convert pressure from psi to feet (head) of water: ft. = 2.31 × psi. To convert pressure from feet (head) of water to psi: psi = 0.4331 × ft.

Equivalent Pressure Drop of Insert Fittings

Diameter	½"	¾"	1"	1¼"	1½"	2"	3"	4"	6"
Insert Adaptor	1	1.5	2	2.75	3.5	4.5	6.5	9	14
Insert Coupling	0.5	0.75	1	1.25	1.5	2	3	4	6.25

Figures shown are equivalent length of straight pipe in feet, and are used to find pressure drop for insert fittings.

Bursting Pressures of Pipe

Calculated by Barlow's Formula $P=2\frac{St}{D}$

P=pressure, psi; t=wall thickness, in.; D=OD, in.
S=tensile stress, psi

for welded pipe, ultimate stress =50000 psi
for A-Grade Seamless, =50000 psi
for B-Grade Seamless, =60000 psi
for C-Grade Seamless =75000 psi

Standard Pipe

Ultimate Bursting Press., PSI

Size	External Wall Dia.	Wall Thickness	Welded & A-Grade Seamless	B-Grade Seamless	C-Grade Seamless
1/8"	.405"	.068"	16775	20148	25185
1/4"	.540"	.088"	16296	19556	24444
3/8"	.675"	.091"	13481	16178	20222
1/2"	.840"	.109"	12976	15571	19464
3/4"	1.050"	.113"	10762	12914	16143
1"	1.315"	.133"	10114	12137	15171
1 1/4"	1.660"	.140"	8434	10120	12651
1 1/2"	1.900"	.145"	7632	9158	11447
2"	2.375"	.154"	6484	7781	9726
2 1/2"	2.875"	.203"	7061	8473	10591
3"	3.500"	.216"	6171	7406	9257
3 1/2"	4.000"	.226"	5650	6780	8475
4"	4.500"	.237"	5267	6320	7900
4 1/2"	5.000"	.247"	4940	5928	7410
5"	5.563"	.258"	4638	5565	6957
6"	6.625"	.280"	4226	5072	6340
7"	7.625"	.301"	3948	4737	5921
8"	8.625"	.277"	3212	3854	4817
8"	8.625"	.322"	3733	4480	5600
9"	9.625"	.342"	3553	4264	5330
10"	10.750"	.279"	2595	3114	3893
10"	10.750"	.307"	2856	3427	4284
10"	10.750"	.365"	3395	4074	5093
11"	11.750"	.375"	3191	3830	4787
12"	12.750"	.330"	2588	3106	3882
12"	12.750"	.375"	2941	3529	4412

Extra Strong Pipe

1/8"	.405"	.095"	23457	28148	35185
1/4"	.540"	.119"	22037	26444	33056
3/8"	.675"	.126"	18667	22400	28000
1/2"	.840"	.147"	17500	21000	26250
3/4"	1.050"	.154"	14667	17600	22000
1"	1.315"	.179"	13612	16335	20418
1 1/4"	1.660"	.191"	11506	13807	17259
1 1/2"	1.900"	.200"	10526	12632	15789
2"	2.375"	.218"	9179	11015	13768
2 1/2"	2.875"	.276"	9600	11520	14400
3"	3.500"	.300"	8571	10286	12857
3 1/2"	4.000"	.318"	7950	9540	11925
4"	4.500"	.337"	7489	8987	11233
4 1/2"	5.000"	.355"	7100	8520	10650
5"	5.563"	.375"	6741	8089	10111
6"	6.625"	.432"	6521	7825	9781
7"	7.625"	.500"	6557	7869	9836
8"	8.625"	.500"	5797	6957	8696
9"	9.625"	.500"	5195	6234	7792
10"	10.750"	.500"	4651	5581	6977
11"	11.750"	.500"	4255	5106	6383
12"	12.750"	.500"	3922	4706	5882

Double Extra Strong Pipe

1/2"	.840"	.294"	35000	42000	52500
3/4"	1.050"	.308"	29333	35200	44000
1"	1.315"	.358"	27224	32669	40837
1 1/4"	1.660"	.382"	23012	27614	34518
1 1/2"	1.900"	.400"	21053	25263	31579
2"	2.375"	.436"	18358	22029	27537
2 1/2"	2.875"	.552"	19200	23040	28800
3"	3.500"	.600"	17143	20571	25714
3 1/2"	4.000"	.636"	15900	19080	23850
4"	4.500"	.674"	14978	17973	22467
4 1/2"	5.000"	.710"	14200	17040	21300
5"	5.563"	.750"	13482	16178	20223
6"	6.625"	.864"	13042	15650	19562
7"	7.625"	.875"	11475	13770	17213
8"	8.625"	.875"	10145	12174	15217

The allowable working pressure in bursting depending upon operating conditions, is determined by dividing the ultimate bursting pressure by one of the following factors of safety:

Operating Conditions	Factor of Safety
Steady, gradually increasing pressure	4
Sudden change (0 to Max.) in pressure	6
Vehement pulsations	8

Internal Fluid Pressures for Pipe

Based on Barlow's Formula $P=2\frac{fF}{D}$

D = OD, in.; t = Thickness of wall, in.; P = Pressure, in psi; f = Fiber stress, psi

Standard Pipe

Pressures at Various Factors of Safety

Size	Ultimate Bursting Pressure		Factor of Safety=5		Factor of Safety=6		Factor of Safety=8	
	Butt-Weld, Fiber Stress=40000 PSI	Lap-Weld, Fiber Stress=50000 PSI	Butt-Weld, Fiber Stress=8000 PSI	Lap-Weld, Fiber Stress=10000 PSI	Butt-Weld, Fiber Stress=6667 PSI	Lap-Weld, Fiber Stress=8333 PSI	Butt-Weld, Fiber Stress=5000 PSI	Lap-Weld, Fiber Stress=6250 PSI
1/8"	13432	—	2686	—	2239	—	1679	—
1/4"	13037	—	2607	—	2173	—	1630	—
3/8"	10785	—	2157	—	1798	—	1348	—
1/2"	10381	—	2076	—	1730	—	1298	—
3/4"	8610	—	1722	—	1435	—	1076	—
1"	8091	—	1618	—	1349	—	1011	—
1 1/4"	6747	8434	1349	1687	1124	1406	843	1054
1 1/2"	6105	7632	1221	1526	1018	1272	763	954
2"	5187	6484	1037	1297	865	1081	648	811
2 1/2"	5649	7061	1130	1412	941	1177	706	883
3"	4937	6171	987	1234	823	1029	617	771
3 1/2"	—	5650	—	1130	—	942	—	706
4"	—	5267	—	1053	—	878	—	658
4 1/2"	—	4940	—	988	—	823	—	618
5"	—	4638	—	928	—	773	—	580
6"	—	4226	—	845	—	704	—	528
7"	—	3948	—	790	—	658	—	493
8"	—	3212	—	642	—	535	—	401
8"	—	3733	—	747	—	622	—	467
9"	—	3553	—	711	—	592	—	444
10"	—	2595	—	519	—	433	—	324
10"	—	2856	—	571	—	476	—	357
10"	—	3395	—	679	—	566	—	424
11"	—	3191	—	638	—	532	—	399
12"	—	2588	—	518	—	431	—	324
12"	—	2941	—	588	—	490	—	368
14" OD	—	2679	—	536	—	446	—	335
15" OD	—	2500	—	500	—	417	—	313
16" OD	—	2344	—	469	—	391	—	293
17" OD	—	2312	—	462	—	385	—	286
18" OD	—	2272	—	454	—	379	—	284
20" OD	—	2045	—	409	—	341	—	256

Extra Strong Pipe

1/8"	18765	—	3753	—	3128	—	2346	—
1/4"	17630	—	3526	—	2938	—	2204	—
3/8"	14933	—	2987	—	2489	—	1867	—
1/2"	14000	—	2800	—	2333	—	1750	—
3/4"	11733	—	2347	—	1956	—	1467	—
1"	10890	—	2178	—	1815	—	1361	—
1 1/4"	9205	11506	1841	2301	1534	1918	1151	1438
1 1/2"	8421	10526	1684	2105	1404	1754	1053	1316
2"	7343	9179	1469	1836	1224	1530	918	1147
2 1/2"	7680	9600	1536	1920	1280	1600	960	1200
3"	6857	8571	1371	1714	1143	1429	857	1071
3 1/2"	—	7950	—	1590	—	1325	—	994
4"	—	7489	—	1498	—	1248	—	936
4 1/2"	—	7100	—	1420	—	1183	—	888
5"	—	6741	—	1348	—	1124	—	843
6"	—	6521	—	1304	—	1087	—	815
7"	—	6557	—	1311	—	1093	—	820
8"	—	5797	—	1159	—	966	—	725
9"	—	5195	—	1039	—	866	—	649
10"	—	4651	—	930	—	775	—	581
11"	—	4255	—	851	—	709	—	532
12"	—	3922	—	784	—	654	—	490

Double Extra Strong Pipe

1/2"	28000	—	5600	—	4667	—	3500	—
3/4"	23467	—	4693	—	3911	—	2933	—
1"	21779	—	4356	—	3630	—	2722	—
1 1/4"	18410	—	3682	—	3068	—	2301	—
1 1/2"	16842	21053	3368	4211	2807	3509	2105	2632
2"	14686	18358	2937	3672	2448	3060	1836	2295
2 1/2"	15360	19200	3072	3840	2560	3200	1920	2400
3"	—	17143	—	3429	—	2857	—	2143
3 1/2"	—	15900	—	3180	—	2650	—	1988
4"	—	14978	—	2996	—	2496	—	1872
4 1/2"	—	14200	—	2840	—	2367	—	1775
5"	—	13482	—	2696	—	2247	—	1685
6"	—	13042	—	2608	—	2174	—	1630
7"	—	11475	—	2295	—	1913	—	1434
8"	—	10145	—	2029	—	1691	—	1268

Tap Drill Size Recommendations

Tap	Tap Drill	Decimal Equiv. of Tap Drill	Approx. % of Thrd.	Tap	Tap Drill	Decimal Equiv. of Tap Drill	Approx. % of Thrd.	Tap	Tap Drill	Decimal Equiv. of Tap Drill	Approx. % of Thrd.	Tap	Tap Drill	Decimal Equiv. of Tap Drill	Approx. % of Thrd.
0-80	56	.0465	83	6-32	33	.1130	62	1/4-28	3	.2130	80	3/4-16	11/16	.6876	77
0-80	54	.0469	81	6-40	34	.1110	83	1/4-28	7/32	.2188	67	7/8-9	19/32	.7656	76
1-64	54	.0550	89	6-40	33	.1130	77	1/4-28	2	.2210	63	7/8-9	25/32	.7812	65
1-64	53	.0595	67	6-40	32	.1160	68	3/16-18	F	.2570	77	7/8-14	51/64	.7969	84
1-72	53	.0595	75	8-32	29	.1360	69	3/16-18	G	.2610	71	7/8-14	13/16	.8125	67
1-72	51	.0625	58	8-32	28	.1405	58	3/16-18	17/64	.2656	65	1-8	55/64	.8594	87
2-56	51	.0670	82	8-36	29	.1360	78	3/16-18	H	.2660	64	1-8	7/8	.875	77
2-56	50	.0700	69	8-36	28	.1405	68	3/16-24	I	.2660	86	1-8	57/64	.8906	67
2-56	49	.0730	56	8-36	26	.1406	68	3/16-24	J	.2720	75	1-8	29/32	.9063	58
2-64	50	.0700	79	10-24	27	.1440	85	3/16-24	K	.2770	66	1-12	29/32	.9063	87
2-64	49	.0730	64	10-24	26	.1470	79	3/16-24	L	.2810	77	1-12	19/32	.9219	72
3-48	48	.0760	85	10-24	25	.1495	75	3/16-24	M	.2810	73	1-12	59/64	.9375	58
3-48	47	.0785	77	10-24	24	.1520	70	3/16-24	N	.2810	64	1-14	59/64	.9219	84
3-48	46	.0810	67	10-24	23	.1540	67	3/8-24	21/64	.3281	87	1-14	15/16	.9375	67
3-48	45	.0820	63	10-24	22	.1563	62	3/8-24	Q	.3320	79	1 1/8-7	31/32	.9688	84
3-56	46	.0810	78	10-24	21	.1570	61	3/8-24	R	.3390	67	1 1/8-7	63/64	.9844	76
3-56	45	.0820	73	10-32	22	.1563	83	7/16-14	T	.3580	86	1 1/8-7	1	1.000	67
3-56	44	.0860	56	10-32	21	.1590	76	7/16-14	23/64	.3594	84	1 1/8-7	1 1/8	1.0156	59
4-40	44	.0860	80	10-32	20	.1610	71	7/16-14	U	.3680	75	1 1/8-12	1 1/2	1.0313	87
4-40	43	.0890	71	10-32	19	.1660	59	7/16-14	V	.3770	65	1 1/8-12	1 3/4	1.0469	72
4-40	42	.0935	57	12-24	17	.1710	82	7/16-20	W	.3770	69	1 1/8-12	1 3/4	1.0469	84
4-40	41	.0935	61	12-24	17	.1730	79	7/16-20	X	.3906	72	1 1/8-12	1 3/4	1.0469	67
4-48	42	.0935	68	12-24	16	.1770	72	7/16-20	Y	.3970	62	1 1/8-12	1 3/4	1.0469	87
4-48	41	.0938	68	12-24	15	.1800	67	1 1/2-13	27/64	.4219	78	1 1/8-12	1 3/4	1.0469	72
4-48	41	.0960	59	12-24	14	.1820	63	1 1/2-13	7/16	.4375	63	1 1/8-12	1 3/4	1.0469	87
5-40	40	.0980	83	12-28	16	.1770	84	1 1/2-20	29/64	.4531	72	1 1/8-12	1 3/4	1.0469	79
5-40	39	.0995	79	12-28	15	.1800	78	1 1/2-20	15/32	.4688	87	1 1/8-12	1 3/4	1.0469	72
5-40	38	.1015	72	12-28	14	.1820	73	1 1/2-20	31/64	.4844	72	1 1/8-12	1 3/4	1.0469	65
5-40	37	.1040	65	12-28	13	.1850	67	1 1/2-20	1/2	.500	87	1 1/8-12	1 3/4	1.0469	87
5-44	38	.1015	79	12-28	12	.1875	61	1 1/2-20	33/64	.5156	65	1 1/8-12	1 3/4	1.0469	72
5-44	37	.1040	71	1 1/4-20	9	.1960	83	1 1/2-20	17/32	.5313	79	1 1/8-12	1 3/4	1.0469	87
5-44	36	.1065	63	1 1/4-20	8	.1990	79	1 1/2-20	35/64	.5469	66	1 1/8-12	1 3/4	1.0469	79
6-32	37	.1040	84	1 1/4-20	7	.2010	75	1 1/2-20	7/16	.5625	87	1 1/8-12	1 3/4	1.0469	72
6-32	36	.1065	78	1 1/4-20	6	.2031	72	1 1/2-20	37/64	.5781	65	1 1/8-12	1 3/4	1.0469	65
6-32	35	.1094	70	1 1/4-20	6	.2040	71	1 1/2-20	41/64	.6406	84	1 1/8-12	1 3/4	1.0469	87
6-32	35	.1100	69	1 1/4-20	5	.2055	69	1 1/2-20	21/32	.6563	72	1 1/8-12	1 3/4	1.0469	72
6-32	34	.1110	67	1 1/4-20	4	.2090	63								

Pipe Tap Drill Sizes

Taper*		Straight		Taper*		Straight		Taper*		Straight		Taper*		Straight	
Tap Size	Tap Drill	Dec. Equiv. Tap Drill	Tap Drill	Tap Size	Tap Drill	Dec. Equiv. Tap Drill	Tap Drill	Tap Size	Tap Drill	Dec. Equiv. Tap Drill	Tap Drill	Tap Size	Tap Drill	Dec. Equiv. Tap Drill	Tap Drill
1/2"	D	0.246	3/4	1 1/2"	1 1/2	1.500	1 1/2	1 1/2"	1 1/2	1.500	1 1/2	1 1/2"	1 1/2	1.500	1 1/2
3/4"	R	0.339	13/16	1 3/4"	1 3/4	1.875	1 3/4	1 3/4"	1 3/4	1.875	1 3/4	1 3/4"	1 3/4	1.875	1 3/4
1"		0.438	7/8	2"	2	2.000	2	2"	2	2.000	2	2"	2	2.000	2
1 1/4"		0.578	23/16	3"	3	3.000	3	3"	3	3.000	3	3"	3	3.000	3

*For tapping without reaming

Form Taps

Except for changes in hole sizes, Form Taps in no way differ from conventional cutting taps. Form Taps work equally well in standard tapping heads, automatic screw machines, or lead screw tappers.

Cutting oil or lubricant should be used rather than a coolant for Form Tapping.

Form Taps may be used with higher spindle speeds than those recommended for conventional taps.

Countersinking or chamfering is recommended so that the extrusion from tapping will raise within the countersink and not interfere with the mating part.

Core holes may be tapped, provided that the core pins are first changed to form the proper hole size. Because core pins are slightly tapered, the theoretical hole size should be at a point on the pin that is one-half the required

length of engagement of the thread to be formed.

The tap drill selector chart is designed to show the flow characteristics of all ductile materials. It will be necessary to deviate slightly from the recommended hole size when tapping extremely ductile or extra hard metals, or when using an oversize Form Tap.

The formula for these theoretical hole size determinations is as follows:

$$\text{Basic Tap OD} = \frac{.0068 \times \% \text{ of thread}}{\text{Threads per inch}}$$

Form Tap Drill Selector Chart

Tap Size	TPI	75% Thread			70% Thread			65% Thread			60% Thread			55% Thread			50% Thread		
		Theor. Hole Core Size	Nearest Drill Size	Dec. Equiv.	Theor. Hole Core Size	Nearest Drill Size	Dec. Equiv.	Theor. Hole Core Size	Nearest Drill Size	Dec. Equiv.	Theor. Hole Core Size	Nearest Drill Size	Dec. Equiv.	Theor. Hole Core Size	Nearest Drill Size	Dec. Equiv.	Theor. Hole Core Size	Nearest Drill Size	Dec. Equiv.
0	80	.0536	1.35mm	.0531	.0540	1.35mm	.0531	.0545	—	—	.0549	54	.055	.0554	54	.055	.0558	1.4mm	.0551
1	64	.0650	1.65mm	.0650	.0655	1.65mm	.0650	.0661	—	—	.0666	—	—	.0672	51	.0670	.0677	51	.067
1	72	.0659	1.65mm	.0650	.0663	—	—	.0669	1.7mm	.0669	.0673	51	.067	.0679	51	.067	.0683	—	—
2	56	.0769	1.95mm	.0768	.0774	1.95mm	.0768	.0781	3/4	.0781	.0787	47	.0785	.0794	2.0mm	.0787	.0799	—	—
2	64	.0780	1.95mm	.0781	.0785	47	.0785	.0791	2.0mm	.0787	.0796	2.0mm	.0787	.0802	—	—	.0807	2.05mm	.0808
3	48	.0884	2.25mm	.0886	.0890	43	.089	.0898	43	.089	.0905	2.3mm	.0906	.0913	2.3mm	.0906	.0919	—	—
3	56	.0899	43	.089	.0904	—	—	.0911	2.3mm	.0906	.0917	2.3mm	.0906	.0924	2.35mm	.0925	.0929	2.35mm	.0925
4	40	.0993	2.5mm	.0984	.1000	39	.0995	.1010	39	.0995	.1018	38	.1015	.1028	2.6mm	.1024	.1035	2.6mm	.1024
4	48	.1014	38	.1015	.1020	38	.1015	.1028	2.6mm	.1024	.1035	2.6mm	.1024	.1043	37	.1040	.1049	37	.1040
5	40	.1123	34	.1110	.1130	33	.1130	.1140	33	.113	.1148	2.9mm	.1142	.1158	32	.1160	.1165	32	.1160
5	44	.1134	33	.113	.1141	2.9mm	.1142	.1150	2.9mm	.1142	.1157	—	—	.1166	32	.1160	.1173	32	.116
6	32	.1221	3.1mm	.1220	.1230	3.1mm	.1220	.1243	—	—	.1252	1/4	.1250	.1264	3.2mm	.1260	.1274	—	—
6	40	.1253	1/4	.1250	.1260	3.2mm	.1260	.1270	3.2mm	.1260	.1278	3.25mm	.128	.1288	30	.1285	.1295	30	.1285
8	32	.1481	3.75mm	.1476	.1490	—	—	.1503	25	.1495	.1512	3.8mm	.1496	.1524	24	.1520	.1534	3.9mm	.1535
8	36	.1498	25	.1495	.1507	3.8mm	.1496	.1518	24	.1520	.1526	24	.1520	.1537	3.9mm	.1535	.1546	23	.1540
10	24	.1688	—	—	.1700	18	.1695	.1717	1 1/4	.1719	.1729	1 1/4	.1719	.1746	17	.1730	.1758	—	—
10	32	.1741	17	.1730	.1750	—	—	.1763	—	—	.1772	16	.1770	.1784	4.5mm	.1772	.1794	—	—
12	24	.1948	10	.1935	.1960	9	.1960	.1977	5.0mm	.1968	.1989	8	.1990	.2006	5.1mm	.2008	.2018	7	.2010
12	28	.1978	5.0mm	.1968	.1989	8	.1990	.2003	8	.1990	.2014	7	.2010	.2028	—	—	.2039	1 3/4	.2031
1/4	20	.2245	5.7mm	.2244	.2260	—	—	.2280	1	.2280	.2295	1	.2280	.2315	—	—	.2330	5.9mm	.2323
1/4	28	.2318	—	—	.2329	5.9mm	.2323	.2343	A	.2340	.2354	1 3/4	.2344	.2368	6.0mm	.2362	.2379	B	.2380
3/16	18	.2842	7.2mm	.2835	.2861	7.25mm	.2854	.2879	7.3mm	.2874	.2898	1	.2900	.2917	7.4mm	.2913	.2936	—	—
3/16	24	.2912	7.4mm	.2913	.2927	—	—	.2941	M	.2950	.2955	7.5mm	.2953	.2969	1 3/4	.2969	.2983	7.6mm	.2992
3/8	16	.3431	1 1/2	.3437	.3452	8.75mm	.3445	.3474	S	.3480	.3495	8.9mm	.3504	.3516	—	—	.3537	9.0mm	.3543
3/8	24	.3537	9.0mm	.3543	.3552	9.0mm	.3543	.3566	—	—	.3580	T	.3580	.3594	2 3/4	.3594	.3608	—	—
7/16	14	.4011	—	—	.4035	Y	—	.4059	1 3/2	—	.4084	—	—	.4108	—	—	.4132	Z	—
7/16	20	.4120	Z	—	.4137	10.5mm	—	.4154	—	—	.4171	—	—	.4188	—	—	.4205	—	—
1 1/2	13	.4608	—	—	.4634	—	—	.4660	—	—	.4686	1 1/2	—	.4712	12mm	—	.4738	12mm	—
1 1/2	20	.4745	—	—	.4762	—	—	.4779	—	—	.4796	—	—	.4813	—	—	.4830		

Suggested Speeds and Feeds for High Speed Steel and Carbide Drills

This data is intended as a general guide; specific jobs may require modifications of the suggested recommendations shown.

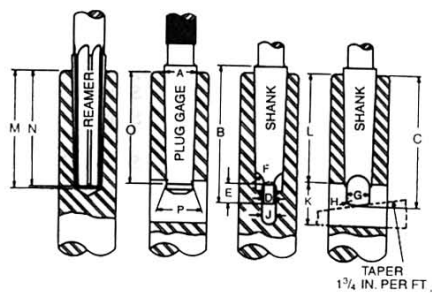
Material	Type of Application	Type of Drill	Type of Drill Pt.	Point Angle Deg.	Lip Relief Angle Deg.	Speed SFM	Feed ^a Light-Medium Heavy	Type of Coolants
Aluminum	Deep Hole	Fast Spiral	Regular	118	15-18	200-350	M-H	Dry or Kerosene
Aluminum Alloys	Sheet	Regular	C' Shaft	135	8-12	200-350	M-H	Soluble Oil
Brass	Drill Press	Slow Spiral	Regular	118	12-15	200-300	M-H	Soluble Oil
Brass Leaded, Free Cutting	Deep Hole Turret or Screw Mach.	Fast Spiral { Straight Flute }	Regular { 0° Rake Cutting Lips }	118	12-15	200-300	M-H	Soluble Oil
				118	12-15	200-300	M-H	Soluble Oil
Brass, Yellow & Red	Drill Press	Slow Spiral	Regular	118	12-15	80-150	M-H	Soluble Oil
Bronze Phos	Drill Press	Fast Spiral	Regular	118	12-15	80-120	M-H	Min. Lard Oil
Bronze Leaded	Drill Press	Slow Spiral	Regular	118	12-15	100-200	M-H	{ Soluble Oil Min. Lard Oil
Copper	Drill Press	Slow Spiral	Regular	118	12-15	60-100	M-H	{ Soluble Oil Min. Lard Oil
Nickel Alloy, Hi-Temp Temp. Inconel, Hastelloy, etc.	Drill Press	{ Cotter Pin Heavy Duty }	C' Shaft	135	6-9	15-40	H	Soluble Oil
				118	12-15	250-500	M	Dry
Magnesium	Drill Press	Fast Spiral	Regular	118	12-15	250-500	M	Dry
Materials Rock. C 48-68	Drill Press	{ Carbide Tip Str. Flute }	Special	118	12-15	100-120	.002	Soluble Oil
				90	18-20	200-500	M-H	Dry-Air Jet
Plastic	Shallow Hole	Slow Spiral	Special	90	18-20	200-500	M-H	Dry-Air Jet
Bakelite, etc.	Deep Hole	Fast Spiral	Special	90	18-20	200-500	M-H	Dry-Air Jet
Cast Iron:								
Soft	Drill Press	Heavy Duty	Regular	118	8-12	100-150	M-H	Dry-Air Jet
Soft	Drill Press	Cobalt	Regular	118	8-12	130-180	M-H	Dry-Air Jet
Soft	Drill Press	{ Carbide Tipped }	Regular	118	8-12	260-360	M-H	Dry-Air Jet
Medium	Drill Press	Heavy Duty	Regular	118	8-12	70-100	M-H	Dry-Air Jet
Medium	Drill Press	Cobalt	Regular	118	8-12	90-130	M-H	Dry-Air Jet
Medium	Drill Press	{ Carbide Tipped }	Regular	118	8-12	140-200	M-H	Dry-Air Jet
Hard	Drill Press	Heavy Duty	Regular	118	8-12	50-70	M-H	Dry-Air Jet
Hard	Drill Press	Cobalt	Regular	118	8-12	65-90	M-H	Dry-Air Jet
Hard	Drill Press	{ Carbide Tipped }	Regular	118	8-12	100-140	M-H	Dry Air Jet
Cast Steel	Drill Press	Heavy Duty	Regular	118	8-12	50-70	M-H	Soluble Oil
Titanium	Drill Press	{ Heavy Duty Cotter Pin }	C' Shaft	135	6-9	25-30	H	Soluble Oil
Alloy Steel:								
Over 300 BHN	Drill Press	{ Cotter Pin Heavy Duty }	C' Shaft	135	6-9	20-30	M-H	Soluble Oil
200-300 BHN	Drill Press	Heavy Duty	Regular	118	8-12	30-60	M-H	Soluble Oil
Under 200 BHN	Drill Press	{ General Purpose }	Regular	118	8-12	60-80	M-H	Soluble Oil
Annealed Steel	Drill Press	{ General Purpose }	Regular	118	8-12	80-100	M-H	Soluble Oil
			Regular	118	8-12	80-100	M-H	Soluble Oil
Heat-Treated Steel	Drill Press	Heavy Duty	Regular	118	8-12	40-60	M-H	Soluble Oil
Stainless Steel:								
400 Series	Drill Press	Heavy Duty	C' Shaft	135	6-9	40-50	M-H	Soluble Oil
300 Series	Drill Press	Cotter Pin	C' Shaft	135	6-9	25-35	H	Soluble Oil
300 Series	Drill Press	Heavy Duty	C' Shaft	135	6-9	25-35	H	Soluble Oil
Stainless:								
A286	Drill Press	{ Heavy Duty Cotter Pin }	C' Shaft	135	6-9	15-20	H ^b	Soluble Oil
U500	Drill Press	{ Cotter Pin Heavy Duty }	C' Shaft	118	8-12	7-9	H	Soluble Oil

^aRecommended feeds based on diameter drill used

^bFeed is 50 percent heavier than shown in table.

Drill Dia. Range In.				Deep Hole Reductions				Reduce Feed Percent	Reduce Speed Percent
	Light	Medium	Heavy	Hole Depth					
#80-1/8	.0002-.001	.0005-.002	.001-.003	3 Times Drill Diameter				10	10
1/8-1/4	.001-.002	.002-.003	.003-.005	4 Times Drill Diameter				10	20
1/4-1/2	.002-.004	.003-.006	.005-.008	5 Times Drill Diameter				20	30
1/2-1	.004-.008	.006-.012	.008-.015	6-8 Times Drill Diameter				20	35-40
1 & Up	.008-.015	.012-.020	.015-.025						

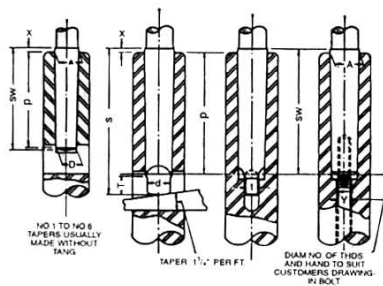
**MORSE
Taper Shanks**



Taper No.	Dia.		Shank		Dpth.		
	Plug at Small End P	At End of Socket A	OA Lgth. B	Dpth. C	Drilled Hole M	Reamed Hole N	Std. Plug O
0	.25200"	.35610"	2 11/12"	2 7/32"	2 1/16"	2 1/32"	2"
1	.36900"	.47500"	2 9/16"	2 7/16"	2 3/16"	2 5/32"	2 1/8"
2	.57223"	.70000"	3 1/8"	2 15/16"	2 21/32"	2 39/64"	2 9/16"
3	.77800"	.93800"	3 7/8"	3 11/16"	3 5/16"	3 1/4"	3 3/16"
4	1.02000"	1.23100"	4 7/8"	4 5/8"	4 3/16"	4 1/8"	4 1/16"
4 1/2	1.26600"	1.50000"	5 3/8"	5 1/8"	4 5/8"	4 9/16"	4 1/2"
5	1.47500"	1.74800"	6 1/8"	5 7/8"	5 5/16"	5 1/4"	5 3/16"
6	2.11600"	2.49400"	8 9/16"	8 1/4"	7 13/32"	7 21/64"	7 1/4"
7	2.75000"	3.27000"	11 5/8"	11 1/4"	10 5/32"	10 5/64"	10"

Taper No.	Tang				Tang Slot		Socket End to Tang Slot L	Taper		
	Thck. D	Lgth. E	Mill Radius F	Dia. G	Tang Radius H	Wdth. J		Lgth. K	Per Ft.	Per In.
0	5/32"	1/4"	5/32"	15/64"	3/64"	11/64"	9/16"	1 15/16"	.62460"	.052050"
1	13/64"	3/8"	3/16"	11/32"	3/64"	7/32"	3/4"	2 1/16"	.59858"	.049882"
2	1/4"	7/16"	1/4"	17/32"	1/16"	17/64"	7/8"	2 1/2"	.59941"	.049951"
3	5/16"	9/16"	9/32"	23/32"	5/64"	21/64"	1 3/16"	3 1/16"	.60235"	.050196"
4	15/32"	5/8"	5/16"	31/32"	3/32"	31/64"	1 1/4"	3 7/8"	.62326"	.051938"
4 1/2	9/16"	11/16"	3/8"	1 13/64"	1/8"	37/64"	1 3/8"	4 5/16"	.62400"	.052000"
5	5/8"	3/4"	3/8"	1 13/32"	1/8"	21/32"	1 1/2"	4 15/16"	.63151"	.052626"
6	3/4"	1 1/8"	1/2"	2"	5/32"	25/32"	1 3/4"	7"	.62565"	.052138"
7	1 1/8"	1 3/8"	3/4"	2 5/8"	3/16"	1 5/32"	2 5/8"	9 1/2"	.62400"	.052000"

**BROWN & SHARPE
Taper Shanks**



Taper No.	Dia.			Shank Lgth.			Tongue			Taper	
	Plug at Small End D	At End of Socket A	Plug Depth P	w/Tang S	w/o Tang SW	Project. X	Wdth. t	Dia. d	Lgth. T	Per Foot	Per Inch
1	.20000"	.23922"	15/16"	1 9/32"	1 1/16"	3/32"	1/8"	.170"	3/16"	.50200"	.04183"
2	.25000"	.29968"	1 3/16"	1 19/32"	1 11/32"	3/32"	5/32"	.220"	1/4"	.50200"	.04183"
3	.31250"	.37525"	1 1/2"	1 31/32"	1 41/64"	3/32"	3/16"	.282"	5/16"	.50200"	.04183"
4	.35000"	.40233"	1 1/4"	1 3/4"	1 25/64"	3/32"	7/32"	.320"	11/32"	.50240"	.04187"
5	.45000"	.52315"	1 3/4"	2 9/32"	1 29/32"	3/32"	1/4"	.420"	3/8"	.50160"	.04180"
6	.50000"	.59961"	2 3/8"	2 31/32"	2 17/32"	3/32"	9/32"	.460"	7/16"	.50329"	.04194"
7	.60000"	.72537"	3"	3 5/8"	3 3/32"	3/32"	5/16"	.560"	15/32"	.50147"	.04179"
8	.75000"	.89873"	3 9/16"	4 1/4"	3 11/16"	1/8"	11/32"	.710"	1/2"	.50100"	.04175"
9	.90010"	1.06705"	4"	4 3/4"	4 1/8"	1/8"	3/8"	.860"	9/16"	.50085"	.04174"
10	1.04465"	1.28927"	5 11/16"	6 17/32"	5 13/16"	1/8"	7/16"	1.010"	21/32"	.51612"	.04301"
11	1.24995"	1.53176"	6 3/4"	7 19/32"	6 7/8"	1/8"	7/16"	1.210"	21/32"	.50100"	.04175"
12	1.50010"	1.79681"	7 1/8"	8 1/16"	7 1/4"	1/8"	1/2"	1.460"	3/4"	.49973"	.04164"
13	1.75005"	2.07310"	7 3/4"	8 11/16"	7 7/8"	1/8"	1/2"	1.710"	3/4"	.50020"	.04168"
14	2.00000"	2.34375"	8 1/4"	9 9/32"	8 3/8"	1/8"	9/16"	1.960"	27/32"	.50000"	.04167"
15	2.25000"	2.61458"	8 3/4"	9 25/32"	8 7/8"	1/8"	9/16"	2.210"	27/32"	.50000"	.04167"
16	2.50000"	2.88542"	9 1/4"	10 3/8"	9 3/8"	1/8"	5/8"	2.450"	15/16"	.50000"	.04167"
17	2.75000"	3.15625"	9 3/4"	—	9 7/8"	1/8"	—	—	—	.50000"	.04167"
18	3.00000"	3.42708"	10 1/4"	—	10 3/8"	1/8"	—	—	—	.50000"	.04167"