4715.4100 USEFUL INFORMATION.

Subpart 1. **Weights and measures.**

Commercial Weights

16 drams or 437.5 grains = 1 ounce
16 ounces or 7000 grains = 1 pound
16 ounces = 1 pound
2000 pounds = 1 ton

Square Measure

144 square inches = 1 sq. foot
9 square feet = 1 sq. yard
30 1/4 square yards = 1 sq. rod
272 1/4 square feet = 1 sq. rod
43,560 square feet = 1 acre

Cubic Measure

231 cubic inches = 1 gallon
1728 cubic inches = 1 cu. ft.
27 cubic feet = 1 cu. yd.

Long Measure

12 inches = 1 foot
3 feet = 1 yard
16 1/2 feet = 1 rod
320 rods = 1 mile
5280 feet = 1 mile

Liquid Measure

4 gills = 1 pint
2 pints = 1 quart

4 quarts = 1 gallon

31 1/2 gallons = 1 U.S. barrel

Water Pressure

To find the pressure in pounds per square inch corresponding to any head in feet, multiply the head by 0.434.

To find the head in feet when the pressure in pounds per square inch is known, multiply the pressure by 2.3.

One pound pressure per square inch is caused by 2.3 feet head of water.

Subp. 2. **Pressure and head equivalents.** Table based on water at 62.5 pounds per cubic foot.

Head (feet)	Pressure (pounds per square inch)	Head (feet)	Pressure (pounds per square inch)
2.304	1	1	0.434
4.608	2	2	0.868
6.912	3	3	1.302
9.216	4	4	1.736
11.520	5	5	2.170
13.824	6	6	2.604
16.128	7	7	3.038
18.432	8	8	3.472
20.736	9	9	3.906
23.040	10	10	4.340

Subp. 3. **Water pressure.** Example: What pressure in pounds per square inch corresponds to a head of 123'-6"?

123'-6" = 123.5' (See table III)

From table I (right half)

120' = 12x10 = 12x4.34 = 52.08

3' = 1x3 = 1x1.302 = 1.302

.5' = .5x1 = .5x.434 = .217

53.599 lbs/sq. in. (Ans.)

Example: How many feet of head is equivalent to a pressure of 28 pounds per square inch?

From table I (left half)

20 = 10x2 = 10x4.608 = 46.08
8 = 1x8 = 1x18.432 = 18.432

64.512' or 64'-6" (Ans.)

Subp. 4. **Effect of variations of temperatures on water.** Water freezes at 32 degrees Fahrenheit. Water boils at 212 degrees Fahrenheit. Water expands when freezing to about one and one-twelfth of its bulk. Fifteen hundred and ninety-five cubic inches of water will expand in freezing to one cubic foot of ice, which weighs approximately 57.5 pounds.

Water freezing in a pipe or closed vessel exerts a pressure of approximately 2,000 pounds per square inch which is the force that causes pipes to burst.

Subp. 5. **Changing common fractions into decimals.** In several computations used in plumbing work it is desirable to convert fractions into decimals and decimals into fractions in order to facilitate computations and measurements.

A. Example: Change 1/8 to decimals of an inch.

1/8 = 8)1.000 = .125 (Ans.)

B. Example: Change .3125 to closest 1/16 of an inch.

1/16 = .0625
.0625).3125 = 5 hence 5/16 (Ans.)

C. Example: Change 2" into decimals of a foot.

2" = 2/12 = 2x1/12 = 2x.08333 = .16667 (Ans.)

Subp. 6. **Decimal equivalents of common fractions in inches.**

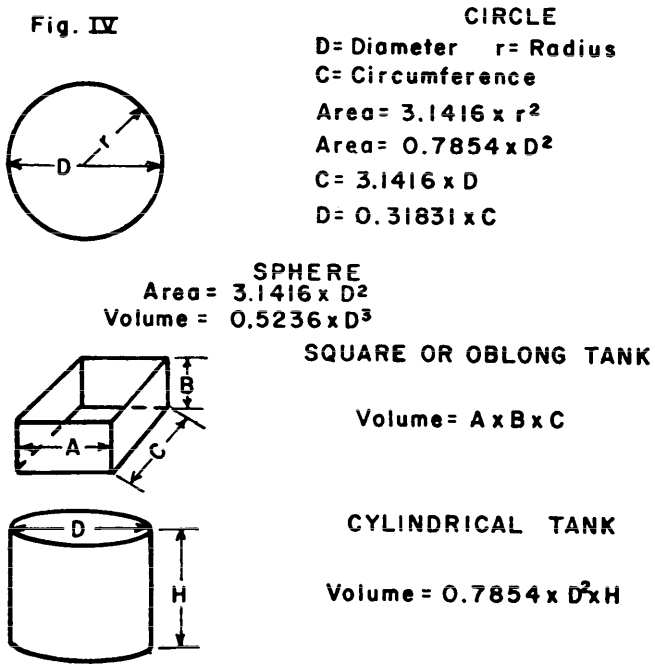
Fraction	Decimal	Fraction	Decimal
1/32	0.03125	17/32	0.53125
1/16	.0625	9/16	.5625
3/32	.09375	19/32	.59375
1/8	.125	5/8	.625
5/32	.15625	21/32	.65625
3/16	.1875	11/16	.6875
7/32	.21875	23/32	.71875
1/4	.25	3/4	.75
9/32	.28125	25/32	.78125
5/16	.3125	13/16	.8125
11/32	.34375	27/32	.84375
3/8	.375	7/8	.875
13/32	.40625	29/32	.90625
7/16	.4375	15/16	.9375
15/32	.46875	31/32	.96875
1/2	.5	1	1.0

Subp. 7. **Decimal equivalents of inches in feet.**

Inches	Decimal
1	0.08333
2	0.16667
3	0.25000
4	0.33333
5	0.41667
6	0.5000
7	0.58331
8	0.66667

9	0.75
10	0.83333
11	0.91666
12	1.00

Subp. 8. **Geometric calculations.**



Subp. 9. **Diameter, area, circumference, and volume.**

Diameter (inches)	Area (sq. inch)	Circumference (inches)	Volume (gal. per ft.)
1/2	0.19635	1.5708	0.010
5/8	0.30680	1.9635	.016
3/4	0.44179	2.3562	.023
1	0.7854	3.1416	.041
1 1/4	1.22719	3.9270	.064
1 1/2	1.76715	4.71240	.092
2	3.1416	6.2832	.163
2 1/2	4.90875	7.8540	.255
3	7.0686	9.4248	.367
4	12.5664	12.5664	.652
5	19.6350	15.7080	1.020
6	28.2744	18.8496	1.470
8	50.2656	25.1328	2.610

10	78.5400	31.4160	4.080
12	113.0976	37.6992	5.870

A. Example: What is the area of a pipe in square inches having a diameter of six inches?

($A = Pi/4xD^2$) $A = 0.7854xD^2$

$A = 0.7854x6x6 =$ 28.27 sq. in. (Ans.)

B. Example: What is the diameter in inches of a pipe having a circumference of approximately 15-3/4 inches?

($D = Cx1/Pi$) $D = Cx0.31831$

$D = 15.75x0.31831 = 5$ inches (Ans.)

C. Example: What is the volume of a tank in cubic feet and gallons having a length of eight feet, a width of four feet, and a depth of six feet?

$V =$ 8'x4'x6' = 192 cubic feet (Ans.)

1 cu. ft. = 7 1/2 gallons

$V = 192x7.5 =$ 1440 gallons (Ans.)

D. Example: What is the volume of a tank in cubic feet and gallons having a diameter of 18 inches and a height of 4 feet?

$V = 0.7854xD^2xH$

$= 0.7854x1.5'x1.5'x4' =$ 7.0686 cubic feet (Ans.)

$V = 7.0686 =$ 53.01 gallons (Ans.)

Doubling the diameter of a pipe increases its area four times.

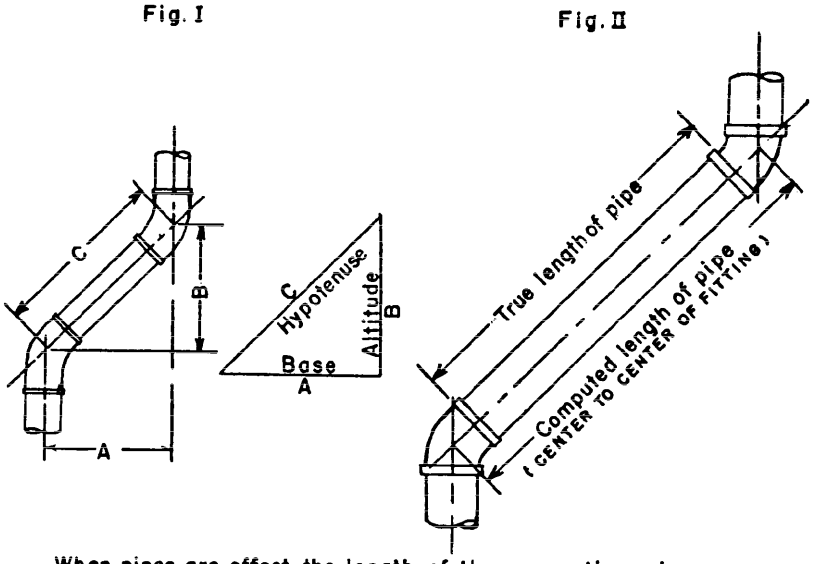
Doubling the diameter of a pipe increases its volume four times per unit of length.

The side of a square equal in area to a given circle equals diameter x 0.8862.

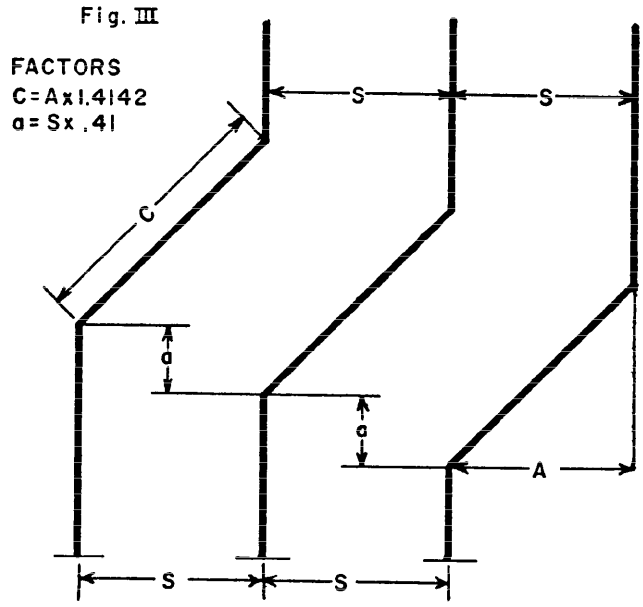
A gallon of water (U.S. standard) weighs 8-1/3 lbs.

A cubic foot of water contains 7-1/2 gallons, 1728 cubic inches and weighs 62-1/2 pounds.

Subp. 10. **Illustration of measurements.**



When pipes are offset, the length of the connecting pipe may be figured, when the angle of the fittings is known and one of the the dimensions A, B, or C is known.



Subp. 11. **Pipe fitting angle calculations.**

Fittings		A	B	C
1/64 bend	5-5/8 degrees	A = Cx.098	B = Cx.9952	C = Bx1.005
		A = Bx.0985	B = Ax10.1532	C = Ax10.204
1/32 bend	11-1/4 degrees	A = Cx.195	B = Cx.981	C = Bx1.019

		A = Bx.1989	B = Ax5.0273	C = Ax5.1258
1/16 bend	22-1/2 degrees	A = Cx.3827	B = Cx.9239	C = Bx1.0823
		A = Bx.4142	B = Ax2.4142	C = Ax2.6131
1/12 bend	30 degrees	A = Cx.5	B = Cx.866	C = Bx1.1547
		A = Bx.5774	B = Ax1.7321	C = Ax2.00
1/8 bend	45 degrees	A = Cx.7071	B = Cx.7071	C = Bx1.4142
		A = B	B = A	C = Ax1.4142
1/6 bend	60 degrees	A = Cx.866	B = Cx.5	C = Bx2.0
		A = Bx1.732	B = Ax.5774	C = Ax1.1547
3/16 bend	67-1/2 degrees	A = Cx.9239	B = Cx.3827	C = Bx2.6131
		A = Bx2.4142	B = Ax.4142	C = Ax1.0923
1/5 bend	72 degrees	A = Cx.951	B = Cx.309	C = Bx.324
		A = Bx3.0777	B = Ax.325	C = Ax1.0514

When the figures from this table are used, it will be necessary to allow for the distance taken up by the fittings. (See Fig. II, in subpart 10.)

Examples:

A. What is the length of pipe center to center of 45 degree elbows, with an offset of 22 inches?

From table V under 45 degree fittings

C = Ax1.4142

C = 22x1.4142 = 31.1124 inches

31.1124' = 2' 7-1/8" (Ans.)

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B. What is the length of pipe center to center of 60 degree fittings, with an offset of 2' 8"?

From table V under 60 degree fittings

C = Ax1.1547

C = 32x1.1547 = 36.9504 inches

36.9504" = 3' 15/16" (Ans.)

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Statutory Authority: *MS s 326.37 to 326.45; 326B.43 to 326B.49*

History: *L 2007 c 140 art 6 s 15; art 13 s 4*

Published Electronically: *May 14, 2012*