Table of Contents

CHAPTER 13: USEFUL INFORMATION

1301 TOWNSHIP SUBDIVISION

1302 SECTION SUBDIVISION

1303 CURVE COMPUTATION BY ARC DEFINITION

1304 CURVE COMPUTATION BY DEFLECTION ANGLE

1305 SPIRAL CURVE TRANSITIONS

1306 GEOMETRIC SOLUTIONS
1306-1 AREAS OF PLANE FIGURES
1306-2 TRIANGLES

1307 FRACTIONS OF INCH IN DECIMALS

1308 CONVERSION FACTORS
1308-1 LINEAR CONVERSIONS
1308-2 AREA CONVERSIONS
1308-3 VOLUME CONVERSIONS
1308-4 WEIGHT CONVERSIONS
1308-5 MISCELLANEOUS CONVERSIONS

1309 WEIGHTS AND MEASUREMENTS
1309-1 GENERAL WEIGHTS AND MEASUREMENTS
1309-2 WEIGHT AND MEASUREMENT EQUIVALENTS

1310 VOLUME CORRECTIONS FOR ASPHALT

1311 CAPACITY CHART FOR CYLINDRICAL TANKS

1312 TEMPERATURE CONVERSIONS

1313 MISCELLANEOUS INFORMATION

1314 MEASUREMENT OF GRADES

1315 WEIGHTS OF MATERIALS

1316 WINDROW CONTENTS

1317 STOCKPILING AGGREGATE

1318 LOADING HOPPERS

1319 FILLING AGGREGATE BINS

1320 DISCHARGING CONCRETE

1321 STOCKPILING FROM CONVEYOR BELTS

1322 BATCHING EQUIPMENT

1323 WATER CEMENT RATIO AND PROBABLE STRENGTH

1324 APPROXIMATE CYLINDER STRENGTH

1325 CULVERT PIPE THICKNESS

1326 CALIBRATION OF SLURRY SEAL MACHINE

Table of Contents

CHAPTER 13: USEFUL INFORMATION

1327 MARKINGS FOR STEEL BOLTS

1328 STEEL WIRE GAUGES

1329 CEMENT CONVERSION FACTORS

1330 EQUIVALENT VELOCITIES

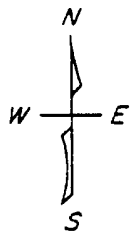
1331 RANDOM NUMBER TABLE

REFERENCES

BLANK FORMS

There are no blank forms associated with this chapter at the present time.

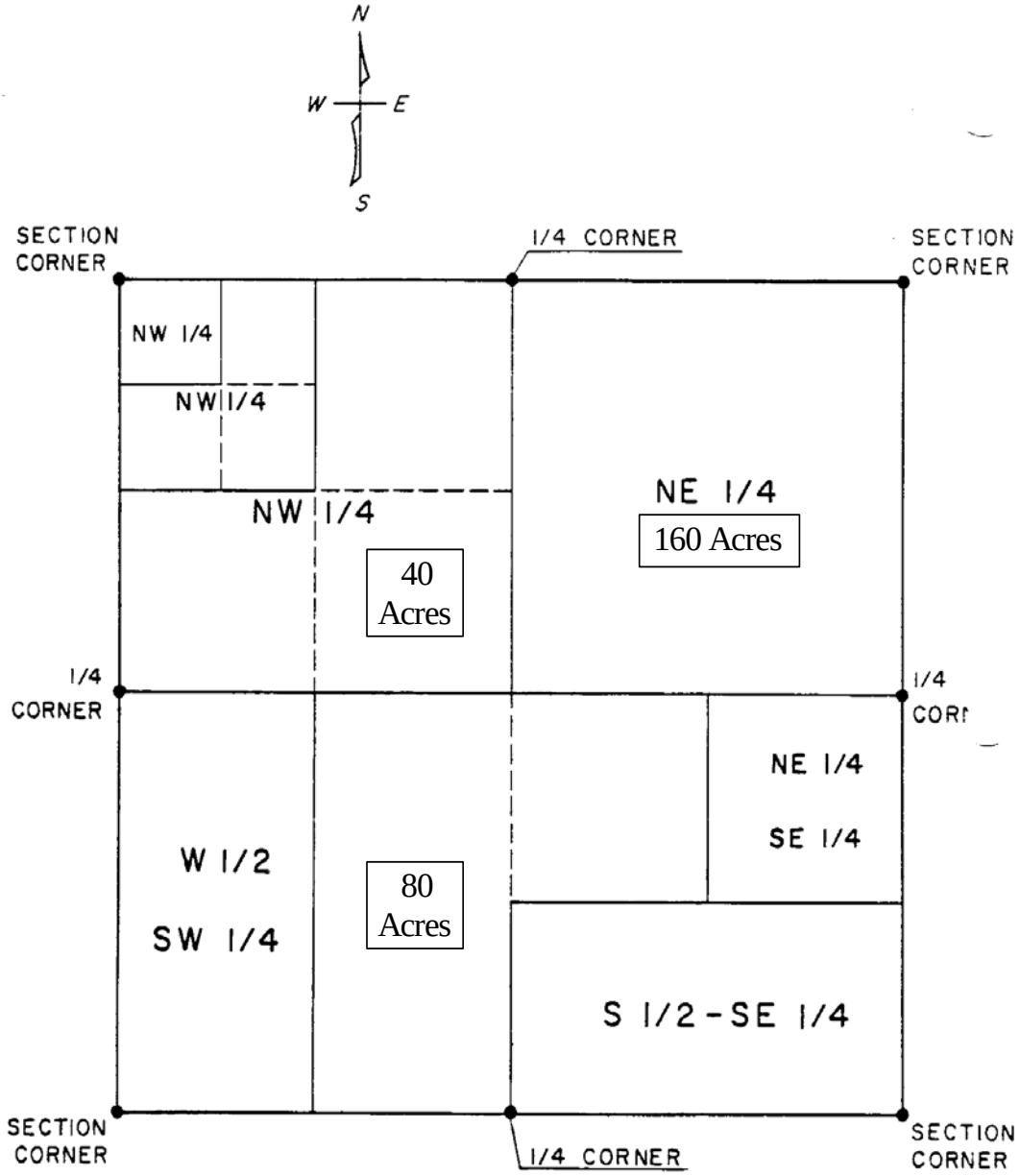
1301 TOWNSHIP SUBDIVISION



R.103 W. R.102 W. R.102 W. R.101 W.

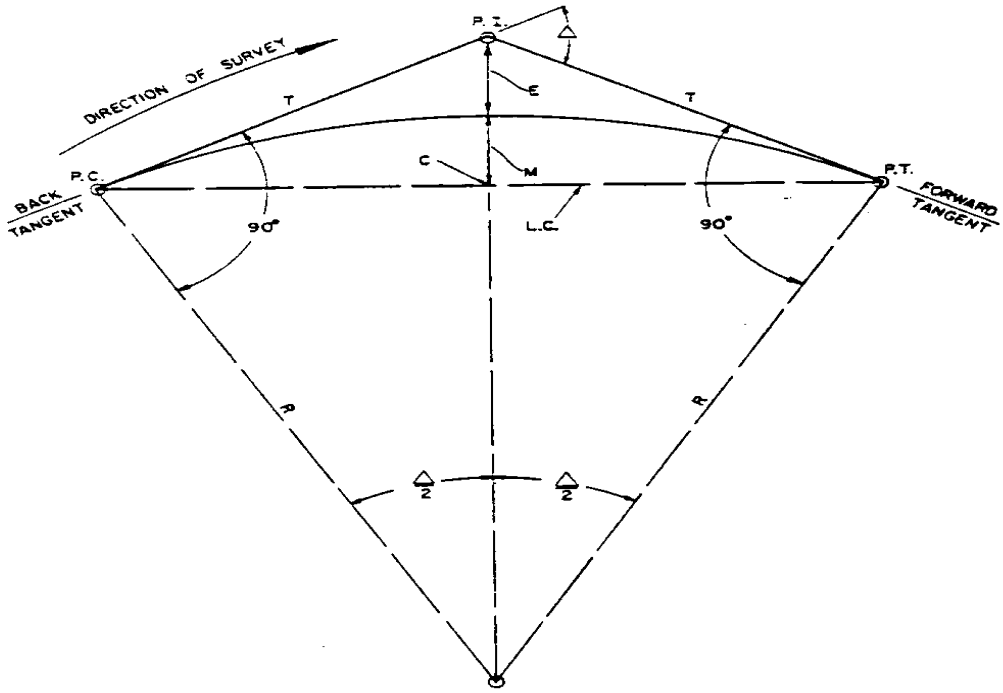
T. 43 N.	36 RANGE LINE	31	32	33	34	35	36 RANGE LINE	31 TOWNSHIP LINE
T. 42 N.	1	6	5	4	3	2	1	6
	12	7	8	9	10	11	12	7
	13	18	17	16	15	14	13	18
	24	19	20	21	22	23	24	19
	25	30	29	28	27	26	25	30
T. 42 N.	36	31	32	33	34	35	36	31 TOWNSHIP LINE
T. 41 N.	1	6	5	4	3	2	1	6

1302 SECTION SUBDIVISION



640 Acres per Section (Square Mile)

1303 CURVE COMPUTATION BY ARC DEFINITION



P.I. = POINT OF INTERSECTION
P.C. = POINT OF CURVATURE
P.T. = POINT OF TANGENTCY
Δ = DEFLECTION ANGLE BETWEEN THE TANGENTS
T = TANGENT DISTANCE

E = EXTERNAL DISTANCE
R = RADIUS OF THE CIRCULAR ARC
M = MIDDLE ORDINATE
L.C. = LONG CHORD (DISTANCE BETWEEN P.C. AND P.T.)
C = MIDPOINT OF LONG CHORD
D = DEGREE OF CURVATURE

GENERAL FORMULAS FOR ARC DEFINITION

$T = R \tan(\Delta / 2)$

$D = 5729.578 / R$

$L.C. = 2 R \sin(\Delta / 2)$

$E = T \tan(\Delta / 4)$

WHEN 'R' IS KNOWN, $E = R \sec(\Delta / 2) - R = R \operatorname{exsec}(\Delta / 2)$

$M = E \cos(\Delta / 2)$

WHEN 'R' IS KNOWN, $M = R (1 - \cos(\Delta / 2)) = R \operatorname{vers}(\Delta / 2)$

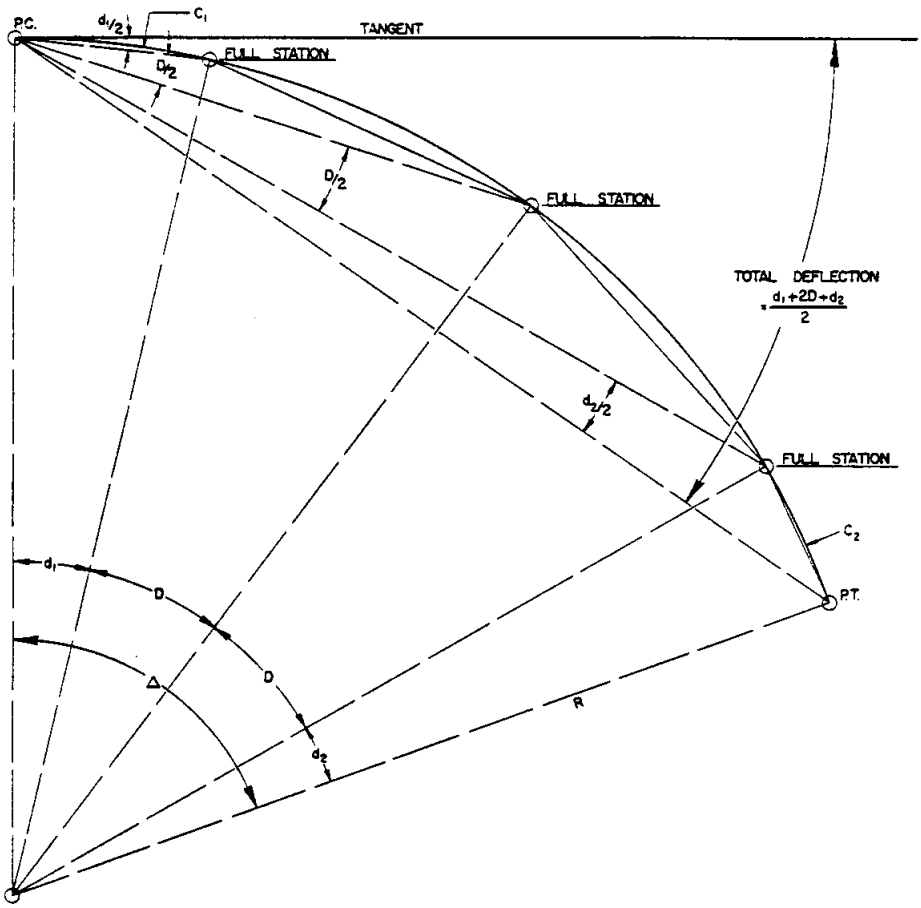
LENGTH OF CURVE, $L = (100 \Delta) / D$ WHEN Δ AND 'D' ARE IN MINUTES

LOCATING THE P.C. AND P.T.

STA. P.C. = STA. P. I. - T

STA. P.T. = STA. P.C. + L

1304 CURVE COMPUTATION BY DEFLECTION ANGLE



D = CENTRAL ANGLE FOR A FULL STATION OF ARC LENGTH
C_1 = LENGTH OF ARC FROM P.C. TO THE FIRST FULL STATION
C_2 = LENGTH OF ARC FROM THE LAST FULL STATION TO P.T.

1. FROM THE GENERAL FORMULAS IN FIGURE 12-100.1, COMPUTE 'D' AND STATIONS P.C. AND P.T.

2. SOLVING FOR THE DEFLECTION ANGLES, IN MINUTES, HAVING LENGTHS OF THE ARC LESS THAN A FULL STATION,

$$d_1/2 = 0.30\ C_1\ D$$
$$d_2/2 = 0.30\ C_2\ D$$

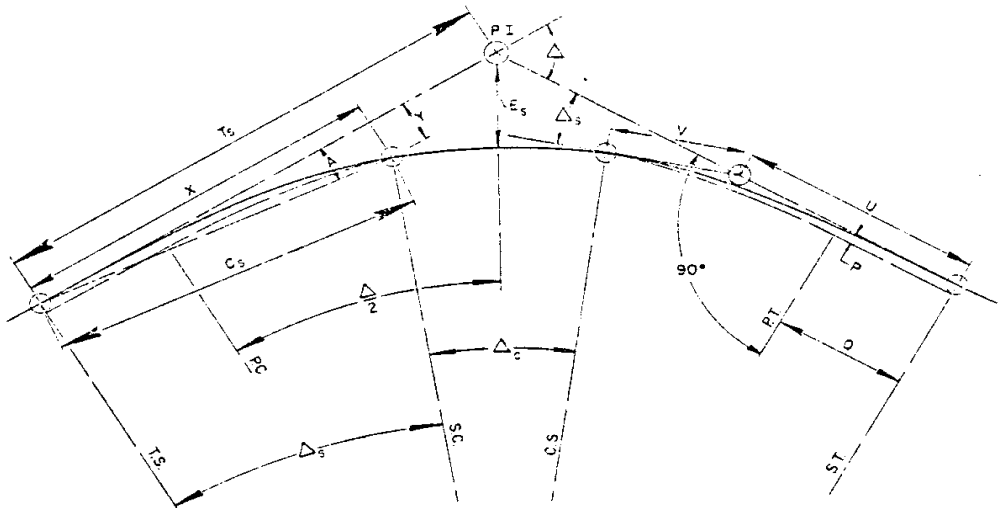
3. THE DEFLECTION ANGLE IN DEGREES, FOR A FULL STATION ARC LENGTH EQUALS D / 2.

4. THE DEFLECTION ANGLE, IN MINUTES, FOR ANY ARC LENGTH,
DEFLECTION = (1718.873 / R) X ARC LENGTH

5. A RUNNING TOTAL OF STATION TO STATION DEFLECTIONS GIVES THE TOTAL DEFECTION ANGLE FROM THE P.C.

COMPUTE CHECK: THE TOTAL DEFLECTION ANGLE TO THE P.T. MUST EQUAL Δ / 2

1305 SPIRAL CURVE TRANSITIONS



L_S = LENGTH OF SPIRAL
D = DEGREE OF CURVATURE OF THE CIRCULAR CURVE
T_S = TANGENT DISTANCE
Δ = DEFLECTION ANGLE BETWEEN THE TANGENTS
Δ_S = SPIRAL ANGLE
Δ_C = CENTRAL ANGLE BETWEEN THE S.C. AND C.S.
E_S = EXTERNAL DISTANCE
C_S = LONG CHORD
U = LONG TANGENT
V = SHORT TANGENT

X = SPIRAL CO-ORDINATE (ABSCISSA)
Y = SPIRAL CO-ORDINATE (ORDINATE)
Q = SIMPLE CURVE CO-ORDINATE (ABSCISSA)
P = SIMPLE CURVE CO-ORDINATE (ORDINATE)
A = DEFLECTION ANGLE OF SPIRAL CURVE
K = CONSTANT OF INCREASING CURVATURE
T.S. = TANGENT TO SPIRAL
S.C. = SPIRAL TO CURVE
C.S. = CURVE TO SPIRAL
S.T. = SPIRAL TO TANGENT

SPIRAL CURVE FORMULAS

$\Delta_S = (D\ L_S)/200$ $\quad$ $D = K\ L_S$ $\quad$ $\Delta_S = (K\ (L_S)^2)/200$

TO CALCULATE T_S AND E_S OF A SIMPLE CURVE WITH EQUAL SPIRALS:

$T_S = (R+P)\ TAN\ (\Delta / 2) + Q$ $\quad$ $E_S = (R+P)\ EXSEC\ (\Delta / 2) + P$

$T_S = T + Q + P\ \ TAN\ (\Delta / 2)$ $\quad$ $E_S = E + P/\ COS\ (\Delta / 2)$

TO CALCULATE THE TANGENT DISTANCES OF A SIMPLE CURVE WITH UNEQUAL SPIRALS:

$T_{S1} = ((R+P)_2 / SIN\Delta) - (R+P)_1\ COT\Delta + Q_1$ $\quad$ $T_{S2} = ((R+P)_1 / SIN\Delta) - (R+P)_2\ COT\Delta + Q_2$

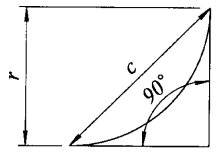
FOR DEFLECTION ANGLES TO INTERMEDIATE POINTS ON A SPIRAL:
Δ (IN MINUTES) = 10K S^2, WHERE S = DISTANCE IN STATIONS TO POINT. THIS VALUE MAY HAVE TO BE ADJUSTED DOWNWARD. NOTE THAT THE ONE-TENTH MINUTES OF THE TABULATED DEFLECTION ANGLES FORM A WAVE LIKE PATTERN (EQUIVALENT TO THE ABOVE FORMULA) UNTIL THEY FALL OFF NEAR THE BOTTOM OF THE TABLE. ADJUSTMENTS FOR INTERMEDIATE POINTS MAY BE INTERPOLATED.

TO SET STAKES WITH THE INSTRUMENT SET UP AT A POINT ON THE SPIRAL, WE TAKE ADVANTAGE OF THE FACT THAT THE SPIRAL IS LAID OUT ON A SYSTEM OF CO-ORDINATES. WE FIRST SET THE INSTRUMENT PLATE ZERO PARALLEL TO THE TANGENT TO THE SPIRAL. THIS IS DONE BY SIGHTING BACK ON THE T.S. WITH 'A' FOR THE INSTRUMENT SET-UP POINT ON THE PLATES; OR BY BRINGING THE INSTRUMENT TANGENT TO THE CURVE WITH Δ_S FOR THE INSTRUMENT SETUP POINTS ON THE PLATES. THEN THE DIFFERENCE BETWEEN CO-ORDINATES OF POINTS TO BE SET AND THE INSTRUMENT GIVES US DEFLECTION ANGLES:

$$\text{DEFL. ANGLE} = TAN^{-1}\ \frac{Y_1 - Y_0}{X_1 - X_0}$$

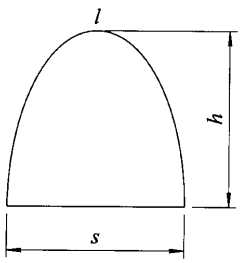
1306 GEOMETRIC SOLUTIONS

1306-1 Areas of Plane Figures



Spandrel

Area = $0.2146 r^2 = 0.1073 c^2$
Example $r = 3$
Area = $0.2146 \times 3^2 = 1.0314$ Ans.



Parabola

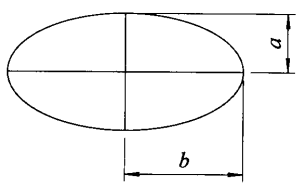
l = length of curvedline = periphery - s

$$l = \frac{s^2}{8h}\left[\sqrt{c(1+c)} + 2.0326 \times \log\left(\sqrt{c} + \sqrt{1+c}\right)\right] \text{ in which } c = \left(\frac{4h}{s}\right)^2$$

Area = $\frac{l}{3} sh$

Example $s = 3$; $h = 4$;

Area = $\frac{l}{3}$ x3x4=8 Ans.



Ellipse

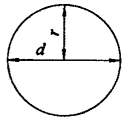
Area = π ab = 3.1416 ab

Circum = 2 $\pi \sqrt{\frac{a^2 + b^2}{2}}$

(close approximation)

Example a = 3; b =4
Area = 3.1416 x 3 x 4 = 37.6992 Ans.

Circum = 2 x 3.1416 x $\sqrt{\frac{3^2 + 4^2}{2}}$ = 6.2832 x $\sqrt{12.5}$ = 6.2832 x 3.5355 = 22.21 Ans.



Circle

π = 3.1416; A = area; d = diameter; p = circumference or periphery; r = radius;

$p = \pi d = 3.1416\,d.$ $\quad p = 2\sqrt{\pi A} = 3.54\sqrt{A}$

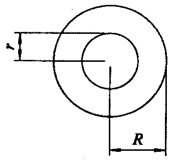
$p = 2\pi r = 6.2832\,r.$ $\quad p = \frac{2A}{r} = \frac{4A}{d}$

$d = \frac{p}{\pi} = \frac{p}{3.1416}$ $\quad d = 2\sqrt{\frac{A}{\pi}} = 1.128\sqrt{A}$

$r = \frac{p}{2\pi} = \frac{p}{6.2832}$ $\quad r = \sqrt{\frac{A}{\pi}} = 0.564\sqrt{A}$

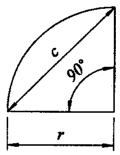
$A = \frac{rd^2}{4} = 0.7854\,d^2$ $\quad A = \frac{p^2}{4\pi} = \frac{p^2}{12.57}$

$A = \pi r^2 = 3.1416\,r^2$ $\quad A = \frac{pr}{2} = \frac{pd}{4}$



Circular Ring

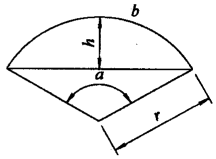
Area = $\pi\,(R^2 - r^2) = 3.1416\,(R^2 - r^2)$
Area = $0.7854\,(D^2 - d^2) = 0.7854\,(D-d)(D+d)$
Area = difference in areas between the inner and outer circles.
Example. $R = 4$; $r = 2$
Area = $3.1416(4^2 - 2^2) = 37.6992$ Ans.



Quadrant

Area = $\frac{\pi r^2}{4} = 0.7854\,r^2 = 0.3927\,c^2$

Example. $r = 3$; c = chord
Area = $.7854 \times 3^2 = 7.0686$ Ans.



Segment

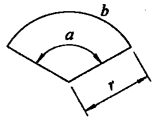
b = length of arc, a = angle in degrees
c = chord = $\sqrt{4\,(2hr - h^2)}$
Area = $1/2\,[br - c(r-h)]$

or $\quad = \pi r^2 \frac{a}{360} - \frac{c(r-h)}{2}$

When o is greater than 180° than $\frac{c}{2}$ x difference between r and h is added to the fraction $\frac{\pi r^2}{360}$

Example. $r = 3$; $a = 120°$; $h = 1.5$

Area = $3.1416 \times 3^2 \times \frac{120}{360} - \frac{5.196(3-1.5)}{2} = 5.5278$ Ans.



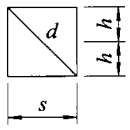
Sector

Area = $\frac{br^2}{2}$ or $\pi r^2 \frac{a}{360°}$

a = angle in degrees; b = length of arc

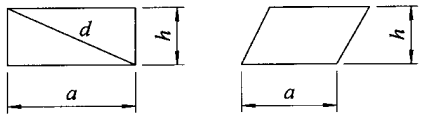
Example. $r = 3$; $a = 120°$

Area = $3.1416 \times 3^2 \times \frac{120}{360} = 9.4248$ Ans.



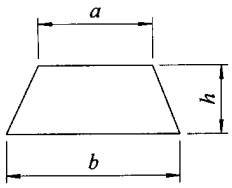
Square

Diagonal = $d = s\sqrt{2}$
Area = $s^2 = 4b^2 = 0.5d^2$
Example. $s = 6$: $b = 3$. Area = $(6)^2 = 36$ Ans.
$d = 6 \times 1.414 = 8.484$ Ans



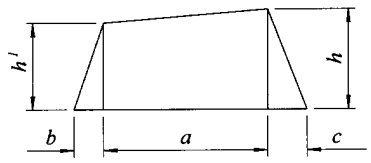
Rectangle and Parallelogram

Area = ab or $b\sqrt{d^2 - b^2}$
Example $a = 6$: $b = 3$.
Area = $3x6 = 18$ Ans.



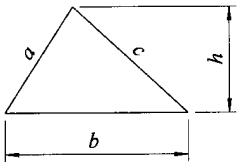
Trapezoid

Area = $1/2\ h(a + b)$
Example. $a = 2$; $b = 4$; $h = 3$.
Area = $1/2 \times 3(2+4) = 9$ Ans.



Trapesium

Area = $1/2[a(h+h^1) + bh^1 + ch]$
Example. $a = 4$; $b = 2$; $c = 2$; $h = 3$; $h^1 = 2$.
Area = $1/2[4(3+2)+(2x2)+(2x3)] = 15$ Ans



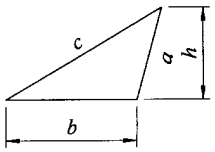
Triangles

Both formulas apply to both figures

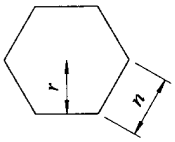
Area = $1/2bh$
Example. $h=3$; $b=5$
Area = $1/2(3x5)=7\ 1/2$ Ans.
Area = $\sqrt{S(S-a)(S-b)(S-c)}$ when $S = \frac{a+b+c}{2}$
Example. $a=2$; $b=3$; $c=4$

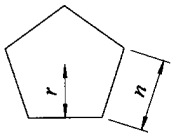
$$S = \frac{2+3+4}{2} = 4.5$$

$$\text{Area} = \sqrt{4.5(4.5-2)(4.5-3)(4.5-4)} = 2.9\ Ans$$



Regular Polygons





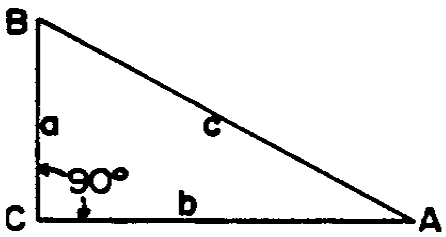
	5 sides = 1.720477	$S^2 =$ 3.63271	r^2
	6 sides = 2.598150	$S^2 =$ 3.46410	r^2
	7 sides = 3.633875	$S^2 =$ 3.37101	r^2
Area	8 sides = 4.828427	$S^2 =$ 3.31368	r^2
	9 sides = 6.181875	$S^2 =$ 3.27573	r^2
	10 sides = 7.894250	$S^2 =$ 3.24920	r^2
	11 sides = 9.365675	$S^2 =$ 3.22993	r^2
	12 sides = 11.196300	$S^2 =$ 3.21539	r^2

n= number of sides r= short radius
S= length of side R= long radius

$$\text{Area} = \frac{n}{4} S^2 \cot. \frac{180°}{n} = \frac{n}{2} R^2 \sin. \frac{360°}{n} = nr^2 \tan. \frac{180°}{n}$$

1306-2 Triangles

RIGHT TRIANGLE



(1) sin A = a / c = cos B

(2) cos A = b / c = sin B

(3) tan A = a / b = cot B

(4) cot A = b / a = tan B

(5) sec A = c / b = csc B

(6) csc A = c / a = sec B

(7) vers A = 1 - cos A = 1 - b /c

(8) exsec A = sec A - 1 = c/b -1

(9) $a = \sqrt{(c+b)(c-b)}$

(10) $b = \sqrt{(c+a)(c-a)}$

(11) $c = \sqrt{(a)^2 + (b)^2}$

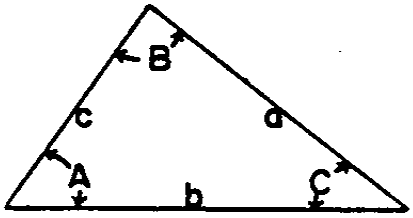
(12) Area = (1/2) a b

(13) Area = (1/2) b^2 tan A

Trigonometric Functions of any Angle

$\sin(90^0 + \theta) = \cos\theta$
$\cos(90^0 + \theta) = -\sin\theta$
$\tan(90^0 + \theta) = -\cot\theta$
$\cot(90^0 + \theta) = -\tan\theta$

OBLIQUE TRIANGLE



(1) Law of Sines
(When two angles and included side are known)

(sin A) /a = (sin B) / b = (sin C)/c

(2) Law of Tangents
(When two sides and the included angle are known)

(a +b) / (a -b) =
(tan (1/2) (A + B)) / (tan (1/2) (A-B))

(3) Law of Cosines
(When two sides and the included angle are known or when all three sides are known)

$a^2 = b^2 + c^2 - 2bc \cos A$
$b^2 = a^2 + c^2 - 2ac \cos B$
$c^2 = a^2 + b^2 - 2ab \cos A$

(4) Half-angle formula
(when all three sides are known)*

* s = (1 / 2) (a + b + c)

$\sin(1/2)A = \sqrt{\frac{(s-b)(s-c)}{bc}}$

(5) Area = (1/2)ab sin C
Area = (1/2)bc sin A
Area = (1/2)ac sin B

1307 FRACTIONS OF INCH IN DECIMALS

Inches and Fractions of an Inch in Decimals of a Foot
1/16 Inch = 0.005208333 Foot

Inch	0"	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"
0	0.0000	0.0833	0.1667	0.2500	0.3333	0.4167	0.5000	0.5833	0.6667	0.7500	0.8333	0.9167
1/32	0.0026	0.0859	0.1693	0.2526	0.3359	0.4193	0.5026	0.5859	0.6693	0.7526	0.8359	0.9193
1/16	0.0052	0.0885	0.1719	0.2552	0.3385	0.4219	0.5052	0.5885	0.6719	0.7552	0.8385	0.9219
3/32	0.0078	0.0911	0.1745	0.2578	0.3411	0.4245	0.5078	0.5911	0.6745	0.7578	0.8411	0.9245
1/8	0.0104	0.0938	0.1771	0.2604	0.3438	0.4271	0.5104	0.5938	0.6771	0.7604	0.8438	0.9271
5/32	0.0130	0.0964	0.1797	0.2630	0.3464	0.4297	0.5130	0.5964	0.6797	0.7630	0.8464	0.9297
3/16	0.0156	0.0990	0.1823	0.2656	0.3490	0.4323	0.5156	0.5990	0.6823	0.7656	0.8490	0.9323
7/32	0.0182	0.1016	0.1849	0.2682	0.3516	0.4349	0.5182	0.6016	0.6849	0.7682	0.8516	0.9349
1/4	0.0208	0.1042	0.1875	0.2708	0.3542	0.4375	0.5208	0.6042	0.6875	0.7708	0.8542	0.9375
9/32	0.0234	0.1068	0.1901	0.2734	0.3568	0.4401	0.5234	0.6068	0.6901	0.7734	0.8568	0.9401
5/16	0.0260	0.1094	0.1927	0.2760	0.3594	0.4427	0.5260	0.6094	0.6927	0.7760	0.8594	0.9427
11/32	0.0286	0.1120	0.1953	0.2786	0.3620	0.4453	0.5286	0.6120	0.6953	0.7786	0.8620	0.9453
3/8	0.0313	0.1146	0.1979	0.2812	0.3646	0.4479	0.5313	0.6146	0.6979	0.7813	0.8646	0.9479
13/32	0.0339	0.1172	0.2005	0.2839	0.3672	0.4505	0.5339	0.6172	0.7005	0.7839	0.8672	0.9505
7/16	0.0365	0.1198	0.2031	0.2865	0.3698	0.4531	0.5365	0.6198	0.7031	0.7865	0.8698	0.9531
15/32	0.0391	0.1224	0.2057	0.2891	0.3724	0.4557	0.5391	0.6224	0.7057	0.7891	0.8724	0.9557
1/2	0.0417	0.1250	0.2083	0.2917	0.3750	0.4583	0.5417	0.6250	0.7083	0.7917	0.8750	0.9583
17/32	0.0443	0.1276	0.2109	0.2943	0.3776	0.4609	0.5443	0.6276	0.7109	0.7943	0.8776	0.9609
9/16	0.0469	0.1302	0.2135	0.2969	0.3802	0.4635	0.5469	0.6302	0.7135	0.7969	0.8802	0.9635
19/32	0.0495	0.1328	0.2161	0.2995	0.3828	0.4661	0.5495	0.6328	0.7161	0.7995	0.8828	0.9661
5/8	0.0521	0.1354	0.2188	0.3021	0.3854	0.4688	0.5521	0.6354	0.7188	0.8021	0.8854	0.9688
21/32	0.0547	0.1380	0.2214	0.3047	0.3880	0.4714	0.5547	0.6380	0.7214	0.8047	0.8880	0.9714
11/16	0.0573	0.1406	0.2240	0.3073	0.3906	0.4740	0.5573	0.6406	0.7240	0.8073	0.8906	0.9740
23/32	0.0599	0.1432	0.2266	0.3099	0.3932	0.4766	0.5599	0.6432	0.7266	0.8099	0.8932	0.9766
3/4	0.0625	0.1458	0.2292	0.3125	0.3958	0.4792	0.5625	0.6458	0.7292	0.8125	0.8958	0.9792
25/32	0.0651	0.1484	0.2318	0.3151	0.3984	0.4818	0.5651	0.6484	0.7318	0.8151	0.8984	0.9818
13/16	0.0677	0.1510	0.2344	0.3177	0.4010	0.4844	0.5677	0.6510	0.7344	0.8177	0.9010	0.9844
27/32	0.0703	0.1536	0.2370	0.3203	0.4036	0.4870	0.5703	0.6536	0.7370	0.8203	0.9036	0.9870
7/8	0.0729	0.1563	0.2396	0.3229	0.4063	0.4896	0.5729	0.6563	0.7396	0.8229	0.9063	0.9896
29/32	0.0755	0.1589	0.2422	0.3255	0.4089	0.4922	0.5755	0.6589	0.7422	0.8255	0.9089	0.9922
15/16	0.0781	0.1615	0.2448	0.3281	0.4115	0.4948	0.5781	0.6615	0.7448	0.8281	0.9115	0.9948
31/32	0.0807	0.1641	0.2474	0.3307	0.4141	0.4974	0.5807	0.6641	0.7474	0.8307	0.9141	0.9974

1308 CONVERSION FACTORS

1308-1 Linear Conversions

Units	Inches	Feet	Yards	Rods	Miles	Meters
1 Inch	1	0.08333	0.027778	0.005051	0.0000157828	0.0254
1 Foot	12	1	0.3333	0.060606	0.00018939	0.304801
1 Yard	36	3	1	0.181818	0.000568182	0.914402
1 Rod (Surveyor's Measure)	198	16.5	5.5	1	0.003125	5.029216
1 Mile (U.S. Statute)	63360	5280	1760	320	1	1609.347
1 Meter	39.37	3.280833	1.093611	0.198838	0.00062137	1
1 Link	7.92	0.66	0.22	0.04	0.000125	0.201168
1 Chain (Surveyor's Measure)	792	66	22	4	0.0125	20.117
1 Station	1200	100	33.33	6.060606	0.0189394	30.4801
1 Furlong	7920	660	220	40	0.125	201.168
1 Mile (Int. Nautical)	72913	6076.103	2025.366	368.248	1.15078	1852
1 Millimeter	0.03937	0.003281	0.001094	0.000199	~~~~~~~	0.001
1 Centimeter	0.3937	0.032808	0.010936	0.001988	~~~~~~~	0.01
1 Kilometer	~~~~~~~	3280.833	1093.611	198.836	0.62137	1000

1308-2 Area Conversions

Units	Square Inches	Square Feet	Square Yards	Square Rods	Acres	Square Miles	Square Meters
1 Square Inch	1	0.006944	0.0007716	~~~~~~~	~~~~~~~	~~~~~~~	0.00064516
1 Square Foot	144	1	0.11111	0.0036731	~~~~~~~	~~~~~~~	0.09290341
1 Square Yard	1,296	9	1	0.033058	0.0002066	~~~~~~~	0.8361307
1 Square Rod	39,204	272.25	30.25	1	0.00625	~~~~~~~	25.29295
1 Acre	~~~~~~~	43560	4840	160	1	0.0015625	4,046.873
1 Square Mile	~~~~~~~	~~~~~~~	3,097,600	102,400	640	1	2589998
1 Square Meter	1,550.00	10.76387	1.195985	0.0395367	0.0002471	~~~~~~~	1
1 Square Link	62.7264	0.4356	0.0484	0.0016	0.00001	~~~~~~~	0.040468
1 Square Chain	627264	4356	484	16	0.1	~~~~~~~	404.689
1 Square	14400	100	11.1111	0.367309	0.0022956	~~~~~~~	9.29034
1 Section	~~~~~~~	~~~~~~~	3097600	102400	640	1	2589998
1 Square Centimeter	0.1549997	0.0010764	0.0001196	~~~~~~~	~~~~~~~	~~~~~~~	0.0001
1 Hectare	~~~~~~~	107638.7	11959.85	395.367	2.471044	0.003861	10000
1 Square Kilometer	~~~~~~~	~~~~~~~	1195985	39536.7	247.1044	0.3861006	1000000

1308-3 Volume Conversions

Units	Cubic Inches	Cubic Feet	Cubic Yards	Pints (Liquid)	Quarts (Liquid)	Gallons (U.S.)	Liters (1000 cc)
1 Cubic Inch	1	0.000579	0.0000214	0.034632	0.017316	0.004329	0.016387
1 Cubic Foot	1728	1	0.037037	59.844	29.922	7.4805	28.31625
1 Cubic Yard	46656	27	1	1615.8	807.9	201.975	764.54
1 Pint (Liquid)	28.875	0.01671	0.000619	1	0.5	0.125	0.473168
1 Quart (Liquid)	57.75	0.03342	0.001238	2	1	0.25	0.946333
1 Gallon (U.S.)	231	0.1336805	0.004951	8	4	1	3.78533
1 Liter (1000 cc)	61.025	0.035316	0.001308	2.11336	1.056682	0.264178	1
1 Gill	7.21876	0.004177	0.000155	0.25	0.125	0.03125	0.118292
1 Pint (Dry)	33.6003	0.019445	0.00072	1.163647	0.581823	0.145456	0.550599
1 Quart (Dry)	67.200625	0.038889	0.00144	2.3273	1.163646	0.290912	1.1012
1 Quart (Imperial)	69.35503	0.040135	0.001486	2.4019	1.2200953	0.300238	1.1365
1 Gallon (Imperial)	277.4201	0.16054	0.0059457	9.60762	4.80381	1.20095	4.54609
1 Peck	537.605	0.311114	0.011523	18.61835	9.309177	2.327294	8.809586
1 Bushel (U.S.)	2150.42	1.2444	0.046089	74.47341	37.23670	9.3092	35.238329
1 Board Foot	144	0.08333	0.003086	4.987012	2.493506	0.623376	2.3597
1 Cord	221184	128	4.74074	7660.051	3830.025	957.506	3624.48
1 Petroleum Barrel	9701.975	5.614569	0.207947	336	168	42	158.9839
1 Barrel (U.S. Liquid)	7276.37	4.21086	0.15596	252	126	31.5	119.237895
1 Cubic Meter	61023.38	35.314445	1.307943	2113.4	1056.7	264.178	999.973
1 Cubic Centimeter	0.061024	0.0000353	~~~~~~~	0.002113	0.001057	0.0002642	0.000999

1308-4 Weight Conversions

Units	Ounces	Pounds	Tons (Short)	Tons (Long)	Kilograms	Tons (Metric)
1 Ounce	1	0.0625	~~~~~~~	~~~~~~~	0.028349	~~~~~~~
1 Pound	16	1	0.0005	0.0004464	0.4535924	0.00045359
1 Ton (Short)	32000	2000	1	0.892857	907.18486	0.907185
1 Ton (Long)	35840	2240	1.12	1	1016.047	1.016047
1 Kilogram	35.27396	2.204622	0.0011023	0.0009842	1	0.001
1 Ton (Metric)	35273.96	2204.62	1.10231	0.98421	1000	1
1 Hundred Weight (Short)	1600	100	0.05	0.044643	45.3592	0.045359
1 Hundred Weight (Long)	1792	112	0.056	0.05	50.8023	0.050802
1 Grain	0.0022857	~~~~~~~	~~~~~~~	~~~~~~~	~~~~~~~	~~~~~~~
1 Gram	0.0352739	0.002204	~~~~~~~	~~~~~~~	0.001	~~~~~~~
1 Milligram	~~~~~~~	~~~~~~~	~~~~~~~	~~~~~~~	0.000001	~~~~~~~

1308-5 Miscellaneous Conversions

Multiply	By	To Obtain
Pounds per foot	1.48816	Kilograms per meter
Pounds per square foot	4.88241	Kilograms per square meter
Pounds per square inch	0.07031	Kilograms per square cm
Pounds per square inch	0.0007031	Kilograms per square mm
Pounds per cubic foot	16.0184	Kilograms per cubic meter
Radians	57.29578	Degrees, angular
Horsepower	550	Ft-Lbs. per second
Horsepower	2544	BTU's per hour
Horsepower	745.5	Watts
BTU	251.98	Calories, gram
BTU	777.98	Ft-Lbs.
Feet per second	0.68182	Miles per hour
Miles per hour	88	Feet per minute
Miles per hour	1.46667	Feet per second
Pounds	444822	Dynes
Kilograms	980665	Dynes
Atmosphere	1.0333	Kilograms per square cm
Atmosphere	14.697	Pounds per square inch
Atmosphere	29.921	Inches of mercury (0^0C. at sea level)
Atmosphere	0.76	Meters of mercury (0^0C. at sea level)
Atmosphere	33.9	Feet of water (4^0C. at sea level)
Pounds of water per minute	0.016021	Cubic feet per minute
Cubic feet per minute	0.12468	Gallons per second
Fathoms	6	Feet
Degrees per foot	0.00057261	Radians per centimeter
Centimeters of mercury (at 20^0C.)	5.34	Inches of water (at 20^0C.)

1309 WEIGHTS AND MEASUREMENTS

1309-1 General Weights And Measurements

Avoirdupois Weight

27-11/32 grains		= 1 dram
16 drams	= 437.5 grains	= 1 ounce
16 ounces	= 7,000 grains	= 1 pound
28 pounds		= 1 quarter
4 quarters	= 112 pounds	= 1 hundred wt. (cwt.)
20 cwt.	= 2240 pounds	= 1 long ton

Surveyors Measure

7.92 inches	= 1 link
25 links	= 1 rod
4 rods	= 1 chain
10 chains	= 1 furlong
8 furlongs	= 1 mile
10 square chains	= 1 acre

Metric Conversion

2.540 centimeters	= 1 inch
39.37 inches	= 1 meter
0.6214 miles	= 1 kilometer
1.057 quarts	= 1 liter
453.59 grams	= 1 pound (av.)
2.205 pounds (av.)	= 1 kilogram

Dry Measure

2 pints	= 1 quart
8 quarts	= 1 peck
4 pecks	= 1 bushel

Liquid Measure

4 gills	= 1 pint
2 pints	= 1 quart
4 quarts	= 1 gallon

Metric Measure

Micro-	= 0.000001 units	Deca-	= 10 units
Milli-	= 0.001 units	Hecto-	= 100 units
Centi-	= 0.01 units	Kilo-	= 1,000 units
Deci-	= 0.1 units	Mega-	= 1,000,000 units

* Examples: 1 centimeter (cm) = 0.01 meters (m)
1 kilogram (kg) = 1000 grams (g)

1309-2 Weight and Measurement Equivalents

(A) Volume Equivalents

Cubic Inches	Cubic Feet	Cubic Yards	Liters	U.S. Gallons	British Imperial Gallons
1	0.0005787	0.00002143	0.01639	0.004329	0.003605
1,728.0	1	0.03704	28.32	7.481	6.229
46,656.0	27.0	1	764.6	202..0	168.2
61.02	0.03531	0.001308	1	0.2642	0.2200
231	0.1337	0.004951	3.785	1	0.8327
277.4	0.1605	0.005946	4.546	1.201	1

(B) Weight Equivalents

Ounces (Avoirdupois)	Pounds (Avoirdupois)	Short Tons	Long Tons	Metric Tons	Kilograms
1	0.0625	0.00003125	0.00002790	0.00002835	0.02835
16.0	1	0.0005000	0.0004464	0.0004536	0.4536
32,000.0	2,000.0	1	0.8929	0.9072	907.2
35,840.0	2,240.0	1.12	1	1.016	1,016
35,274.	2,205	1.102	0.9842	1	1,000.0
35.27	2.205	0.001102	0.0009842	0.001	1

(C) Linear Measure Equivalents

Inches	Feet	Yards	Meters	Rods	Kilometers	Miles
1	0.08333	0.02778	0.02540	0.005051	0.00002540	0.00001578
12.0	1	0.3333	0.3048	0.06061	0.0003048	0.0001894
36.0	3.0	1	0.9144	0.1818	0.0009144	0.0005682
39.37	3.281	1.094	1	0.1988	0.001000	0.0006214
198	16.5	5.5	5.029	1	0.005029	0.003125
39,370.	3,281.	1,094.	1,000.00	198.8	1	0.6214
63,360.0	5,280.0	1,760.0	1,609.00	320.0	1.609	1

(D) Square Measure Equivalents

Square Inches	Square Feet	Square Yards	Square Meters	Square Rods	Acres	Square Miles
1	0.006944	0.0007716	0.0006452	0.00002551	~~~~~~~	~~~~~~~
144.0	1	0.1111	0.09290	0.003673	0.00002296	~~~~~~~
1,296.0	9.0	1	0.8361	0.03306	0.0002066	~~~~~~~
1,550	10.76	1.196	1	0.03954	0.0002471	~~~~~~~
39,204	272.25	30.25	25.29	1	0.006250	~~~~~~~
6,272,640.	43,560.	4,840	4,047.	160.0	1	0.001562
~~	~~~~~~~	3,097,600.	2,589,998.	102,400.00	640.0	1

1310 VOLUME CORRECTIONS FOR ASPHALT

The average number of gallons per ton and the average pounds per gallons for various types and grades of asphalt are shown in Table IX.

TABLE IX
AVERAGE WEIGHTS AND VOLUMES OF ASPHALTS

Grade	Gallons per Ton @ 60° F.	Pounds per Gallon @ 60° F.
LIQUID ASPHALTS		
MC-70	253	7.91
MC-250	249	8.03
MC-800	245	8.16
MC-3000	241	8.30
PAVING ASPHALTS		
PG 76-XX	232	8.62
PG 70-XX	233	8.58
PG 64-XX	235	8.51
PG 58-XX	236	8.47
PG 52-XX	238	8.40
EMULSIFIED ASPHALTS		
All Grades	240	8.33

While actual weights may vary slightly, weights of asphalts used on the Pacific Coast may be considered uniform for all ordinary purposes.

TEMPERATURE - VOLUME CORRECTIONS FOR ASPHALT

Asphalt changes in volume with change in temperature. Change in unit volume, per degree change in temperature, is termed “Coefficient of Expansion”, a factor which varies with the specific gravity of asphalt. A temperature of 60 degrees F., is customarily used as the standard basis for volume determinations of asphalt and other petroleum products. Therefore, if the volume is actually measured at any temperature other than 60 degrees F., a correction factor must be applied to convert the measured volume to volume at 60 degrees F.

The American Society for Testing and Materials prepared and published extensive tables on temperature - volume corrections of petroleum products. These tables appear in a book entitled “ASTM - IP Petroleum Measurement Tables”, published in January 1953 (ASTM Designation D 1250). Temperature-Volume correction tables contained herein have been extracted from this ASTM publication.

Temperature - Volume correction factors are given in the following tabulations for asphalt having a specific gravity at 60 degrees F. above 0.966 (designated by ASTM as Group O materials) and for asphalt having a specific gravity at 60 degrees F. of 0.850 to 0.966 inclusive (designated by ASTM as Group 1 materials), and for emulsified asphalts.

Paving asphalts and liquid asphalts of grades RC, MC and SC 250, 800, and 3000 fall into the Group O classifications. Use Table X for volume corrections. Liquid asphalts of grades RC, MC, SD 70 fall into Group 1. Use Table XI for volume corrections. Use Table XII for temperature-volume corrections factors for emulsified asphalts.

EXAMPLE OF USE: Assume an MC 250 grade of liquid asphalt. Assume also that a volume of this material is measured to be 9,000 gallons at a temperature of 180 degrees F. The volume of this material at the standard temperature of 60 degrees F. is 8,628 gallons (9,000 gallons x 0.9587).

TABLE X
TEMPERATURE - VOLUME CORRECTIONS
FOR ASPHALTIC MATERIALS
GROUP 0 - SPECIFIC GRAVITY AT 60° F ABOVE 0.966
LEGEND t = observed temperature in degrees Fahrenheit
M = multiplier for correcting oil volumes to the basis of 60° F

t	M	t	M	t	M	t	M	t	M
0	1.0211	50	1.0035	100	0.9861	150	0.9689	200	0.9520
1	1.0208	51	1.0031	101	0.9857	151	0.9686	201	0.9516
2	1.0204	52	1.0028	102	0.9854	152	0.9682	202	0.9513
3	1.0201	53	1.0024	103	0.9851	153	0.9679	203	0.9509
4	1.0197	54	1.0021	104	0.9847	154	0.9675	204	0.9506
5	1.0194	55	1.0017	105	0.9844	155	0.9672	205	0.9503
6	1.0190	56	1.0014	106	0.9840	156	0.9669	206	0.9499
7	1.0186	57	1.0010	107	0.9837	157	0.9665	207	0.9496
8	1.0183	58	1.0007	108	0.9833	158	0.9662	208	0.9493
9	1.0179	59	1.0003	109	0.9830	159	0.9658	209	0.9489
10	1.0176	60	1.0000	110	0.9826	160	0.9655	210	0.9486
11	1.0172	61	0.9997	111	0.9823	161	0.9652	211	0.9483
12	1.0169	62	0.9993	112	0.9819	162	0.9648	212	0.9479
13	1.0165	63	0.9990	113	0.9816	163	0.9645	123	0.9476
14	1.0162	64	0.9986	114	0.9813	164	0.9641	214	0.9472
15	1.0158	65	0.9983	115	0.9809	165	0.9638	215	0.9469
16	1.0155	66	0.9979	116	0.9806	166	0.9635	216	0.9466
17	1.0151	67	0.9976	117	0.9802	167	0.9631	217	0.9462
18	1.0148	68	0.9972	118	0.9799	168	0.9628	218	0.9459
19	1.0144	69	0.9969	119	0.9795	169	0.9624	219	0.9456
20	1.0141	70	0.9965	120	0.9792	170	0.9621	220	0.9452
21	1.0137	71	0.9962	121	0.9788	171	0.9618	221	0.9449
22	1.0133	72	0.9958	122	0.9785	172	0.9614	222	0.9446
23	1.0131	73	0.9955	123	0.9782	173	0.9611	223	0.9442
24	1.0126	74	0.9951	124	0.9778	174	0.9607	224	0.9439
25	0.0435	75	0.9948	125	0.9775	175	0.9604	225	0.9436
26	1.0119	76	0.9944	126	0.9771	176	0.9601	226	0.9432
27	1.0116	77	0.9941	127	0.9768	177	0.9597	227	0.9429
28	1.0112	78	0.9937	128	0.9764	178	0.9594	228	0.9426
29	1.0109	79	0.9934	129	0.9761	179	0.9590	229	0.9422
30	1.0105	80	0.9930	130	0.9758	180	0.9587	230	0.9419
31	1.0102	81	0.9993	131	0.9754	181	0.9584	231	0.9416
32	1.0098	82	0.9923	132	0.9751	182	0.9580	232	0.9412
33	1.0095	83	0.9920	133	0.9747	183	0.9577	233	0.9409
34	1.0091	84	0.9916	134	0.9744	184	0.9574	234	0.9405
35	1.0080	85	0.9913	135	0.9740	185	0.9570	235	0.9402
36	1.0084	86	0.9909	136	0.9737	186	0.9567	236	0.9399
37	1.0081	87	0.9906	137	0.9734	187	0.9563	237	0.9395
38	1.0070	88	0.9902	138	0.9730	188	0.9560	238	0.9392
39	1.0074	89	0.9899	139	0.9727	189	0.9557	239	0.9389
40	1.0070	90	0.9896	140	0.9723	190	0.9553	240	0.9385
41	1.0067	91	0.9892	141	0.9720	191	0.9550	241	0.9382
42	1.0063	92	0.9889	142	0.9716	192	0.9547	242	0.9379
43	1.0060	93	0.9885	143	0.9713	193	0.9543	243	0.9375
44	1.0056	94	0.9882	144	0.9710	194	0.9540	244	0.9372
45	1.0053	95	0.9878	145	0.9706	195	0.9536	245	0.9369
46	1.0049	96	0.9875	146	0.9703	196	0.9533	246	0.9365
47	1.0046	97	0.9871	147	0.9699	197	0.9530	247	0.9362
48	1.0042	98	0.9868	148	0.9696	198	0.9526	248	0.9359
49	1.0038	99	0.9864	149	0.9693	199	0.9523	249	0.9356

t	M	t	M	t	M	t	M	t	M
250	0.9352	300	0.9187	350	0.9024	400	0.8864	450	0.8705
251	0.9349	301	0.9184	351	0.9021	401	0.8861	451	0.8702
252	0.9346	302	0.9181	352	0.9018	402	0.8857	452	0.8699
253	0.9342	303	0.9177	353	0.9015	403	0.8854	453	0.8696
254	0.9339	304	0.9174	354	0.9011	404	0.8851	454	0.8693
255	0.9336	305	0.9171	355	0.9008	405	0.8848	455	0.8690
256	0.9332	306	0.9167	356	0.9005	406	0.8845	456	0.8687
257	0.9329	307	0.9164	357	0.9002	407	0.8841	457	0.8683
258	0.9326	308	0.9161	358	0.8998	408	0.8838	458	0.8680
259	0.9322	309	0.9158	359	0.8995	409	0.8835	459	0.8677
260	0.9319	310	0.9154	360	0.8992	410	0.8832	460	0.8674
261	0.9316	311	0.9151	361	0.8989	411	0.8829	461	0.8671
262	0.9312	312	0.9148	362	0.8986	412	0.8826	462	0.8668
263	0.9309	313	0.9145	363	0.8982	413	0.8822	463	0.8665
264	0.9306	314	0.9141	364	0.8979	414	0.8819	464	0.8661
265	0.9302	315	0.9138	365	0.8976	415	0.8816	465	0.8658
266	0.9299	316	0.9135	366	0.8973	416	0.8813	466	0.8655
267	0.9296	317	0.9132	367	0.8969	417	0.8810	467	0.8652
268	0.9293	318	0.9128	368	0.8966	418	0.8806	468	0.8649
269	0.9289	319	0.9125	369	0.8963	419	0.8803	469	0.8646
270	0.9286	320	0.9000	370	0.8960	420	0.8800	470	0.8643
271	0.9283	321	0.9118	371	0.8957	421	0.8797	471	0.8640
272	0.9279	322	0.9115	372	0.8953	422	0.8794	472	0.8636
273	0.9276	323	0.9112	373	0.8950	423	0.8791	473	0.8633
274	0.9273	324	0.9109	374	0.8947	424	0.8787	474	0.8630
275	0.9269	325	0.9105	375	0.8944	425	0.8784	475	0.8627
276	0.9266	326	0.9102	376	0.8941	426	0.8781	476	0.8624
277	0.9263	327	0.9099	377	0.8937	427	0.8778	477	0.8621
278	0.9259	328	0.9096	378	0.8934	428	0.8775	478	0.8618
279	0.9256	329	0.9092	379	0.8931	429	0.8772	479	0.8615
280	0.9253	330	0.9089	380	0.8928	430	0.8768	480	0.8611
281	0.9250	331	0.9086	381	0.8924	431	0.8765	481	0.8608
282	0.9246	332	0.9083	382	0.8921	432	0.8762	482	0.8603
283	0.9243	333	0.9079	383	0.8918	433	0.8759	483	0.8602
284	0.9240	334	0.9076	384	0.8915	434	0.8756	484	0.8599
285	0.9236	335	0.9073	385	0.8912	435	0.8753	485	0.8596
286	0.9233	336	0.9070	386	0.8908	436	0.8749	486	0.8593
287	0.9230	337	0.9066	387	0.8905	437	0.8746	487	0.8590
288	0.9277	338	0.9063	388	0.8902	438	0.8743	488	0.8587
289	0.9223	339	0.9060	389	0.8899	439	0.8740	489	0.8583
290	0.9220	340	0.9057	390	0.8896	440	0.8737	490	0.8580
291	0.9217	341	0.9053	391	0.8892	441	0.8734	491	0.8577
292	0.9213	342	0.9050	392	0.8889	442	0.8731	492	0.8574
293	0.9210	343	0.9047	393	0.8886	443	0.8727	493	0.8571
294	0.9207	344	0.9044	394	0.8883	444	0.8724	494	0.8568
295	0.9204	345	0.9040	395	0.8880	445	0.8721	495	0.8565
296	0.9200	346	0.9037	396	0.8876	446	0.8718	496	0.8562
297	0.9197	347	0.9034	397	0.8873	447	0.8715	497	0.8559
298	0.9194	348	0.9031	398	0.8870	448	0.8712	498	0.8556
299	0.9190	349	0.9028	399	0.8867	449	0.8709	499	0.8552

TABLE XI
TEMPERATURE - VOLUME CORRECTIONS
FOR ASPHALTIC MATERIALS
GROUP 1 - SPECIFIC GRAVITY AT 60° F FROM 0.850 TO 0.966
LEGEND t = observed temperature in degrees Fahrenheit
M = multiplier for correcting oïl volumes to the basis of 60° F

t	M	t	M	t	M	t	M	t	M
0	1.0241	50	1.0040	100	0.9842	150	0.9647	200	0.9456
1	1.0237	51	1.0036	101	0.9838	151	0.9643	201	0.9452
2	1.0233	52	1.0032	102	0.9834	152	0.9639	202	0.9448
3	1.0229	53	1.0028	103	0.9830	153	0.9635	203	0.9444
4	1.0225	54	1.0024	104	0.9826	154	0.9632	204	0.9441
5	1.0221	55	1.0020	105	0.9822	155	0.9628	205	0.9437
6	1.0217	56	1.0016	106	0.9818	156	0.9624	206	0.9433
7	1.0213	57	1.0012	107	0.9814	157	0.9620	207	0.9429
8	1.0209	58	1.0008	108	0.9810	158	0.9616	208	0.9425
9	1.0205	59	1.0004	109	0.9806	159	0.9612	209	0.9422
10	1.0201	60	1.0000	110	0.9803	160	0.9609	210	0.9418
11	1.0197	61	0.9996	111	0.9799	161	0.9605	211	0.9414
12	1.0193	62	0.9992	112	0.9795	162	0.9601	212	0.9410
13	1.0189	63	0.9988	113	0.9791	163	0.9597	123	0.9407
14	1.0185	64	0.9984	114	0.9787	164	0.9591	214	0.9403
15	1.0181	65	0.9980	115	0.9783	165	0.9589	215	0.9399
16	1.0177	66	0.9976	116	0.9779	166	0.9585	216	0.9395
17	1.0173	67	0.9972	117	0.9775	167	0.9582	217	0.9391
18	1.0168	68	0.9968	118	0.9771	168	0.9578	218	0.9388
19	1.0164	69	0.9964	119	0.9767	169	0.9574	219	0.9384
20	1.0160	70	0.9960	120	0.9763	170	0.9570	220	0.9380
21	1.0156	71	0.9956	121	0.9760	171	0.9566	221	0.9376
22	1.0152	72	0.9952	122	0.9756	172	0.9562	222	0.9373
23	1.0148	73	0.9948	123	0.9752	173	0.9559	223	0.9369
24	1.0144	74	0.9944	124	0.9748	174	0.9555	224	0.9365
25	0.0140	75	0.9940	125	0.9744	175	0.9551	225	0.9361
26	1.0136	76	0.9936	126	0.9740	176	0.9547	226	0.9358
27	1.0132	77	0.9932	127	0.9736	177	0.9543	227	0.9354
28	1.0128	78	0.9929	128	0.9732	178	0.9539	228	0.9350
29	1.0124	79	0.9925	129	0.9728	179	0.9536	229	0.9346
30	1.0120	80	0.9921	130	0.9725	180	0.9532	230	0.9343
31	1.0116	81	0.9917	131	0.9721	181	0.9528	231	0.9339
32	1.0112	82	0.9913	132	0.9717	182	0.9524	232	0.9335
33	1.0108	83	0.9909	133	0.9713	183	0.9520	233	0.9331
34	1.0104	84	0.9905	134	0.9707	184	0.9517	234	0.9328
35	1.0100	85	0.9901	135	0.9705	185	0.9513	235	0.9324
36	1.0096	86	0.9897	136	0.9701	186	0.9509	236	0.9320
37	1.0092	87	0.9893	137	0.9697	187	0.9505	237	0.9316
38	1.0088	88	0.9889	138	0.9693	188	0.9501	238	0.9313
39	1.0084	89	0.9885	139	0.9690	189	0.9498	239	0.9309
40	1.0080	90	0.9881	140	0.9686	190	0.9494	240	0.9305
41	1.0076	91	0.9877	141	0.9682	191	0.9490	241	0.9301
42	1.0072	92	0.9873	142	0.9678	192	0.9486	242	0.9298
43	1.0068	93	0.9869	143	0.9674	193	0.9482	243	0.9294
44	1.0064	94	0.9865	144	0.9670	194	0.9478	244	0.9290
45	1.0060	95	0.9861	145	0.9666	195	0.9475	245	0.9286
46	1.0056	96	0.9857	146	0.9662	196	0.9471	246	0.9283
47	1.0052	97	0.9854	147	0.9659	197	0.9467	247	0.9279
48	1.0048	98	0.9850	148	0.9655	198	0.9463	248	0.9275
49	1.0044	99	0.9846	149	0.9651	199	0.9460	249	0.9272

t	M	t	M	t	M	t	M	t	M
250	0.9268	300	0.9083	350	0.8902	400	0.8724	450	0.8550
251	0.9264	301	0.9080	351	0.8899	401	0.8721	451	0.8547
252	0.9260	302	0.9076	352	0.8895	402	0.8717	452	0.8543
253	0.9257	303	0.9072	353	0.8891	403	0.8714	453	0.8540
254	0.9253	304	0.9069	354	0.8888	404	0.8710	454	0.8536
255	0.9249	305	0.9065	355	0.8884	405	0.8707	455	0.8533
256	0.9245	306	0.9061	356	0.8881	406	0.8703	456	0.8529
257	0.9242	307	0.9058	357	0.8877	407	0.8700	457	0.8526
258	0.9238	308	0.9054	358	0.8873	408	0.8696	458	0.8522
259	0.9234	309	0.9050	359	0.8870	409	0.8693	459	0.8519
260	0.9231	310	0.9047	360	0.8866	410	0.8689	460	0.8516
261	0.9227	311	0.9043	361	0.8863	411	0.8686	461	0.8512
262	0.9223	312	0.9039	362	0.8859	412	0.8682	462	0.8509
263	0.9219	313	0.9036	363	0.8956	413	0.8679	463	0.8505
264	0.9216	314	0.9032	364	0.8952	414	0.8675	464	0.8502
265	0.9212	315	0.9029	365	0.8848	415	0.8672	465	0.8498
266	0.9208	316	0.9025	366	0.8845	416	0.8668	466	0.8495
267	0.9205	317	0.9021	367	0.8841	417	0.8665	467	0.8492
268	0.9201	318	0.9018	368	0.8838	418	0.8661	468	0.8488
269	0.9197	319	0.9014	369	0.8834	419	0.8658	469	0.8485
270	0.9194	320	0.9010	370	0.8831	420	0.8654	470	0.8481
271	0.9190	321	0.9007	371	0.8827	421	0.8651	471	0.8478
272	0.9186	322	0.9003	372	0.8823	422	0.8647	472	0.8474
273	0.9182	323	0.9000	373	0.8820	423	0.8644	473	0.8471
274	0.9179	324	0.8996	374	0.8816	424	0.8640	474	0.8468
275	0.9175	325	0.8992	375	0.8813	425	0.8637	475	0.8464
276	0.9171	326	0.8989	376	0.8809	426	0.8633	476	0.8461
277	0.9168	327	0.8985	377	0.8806	427	0.8630	477	0.8457
278	0.9164	328	0.8981	378	0.8802	428	0.8626	478	0.8454
279	0.9160	329	0.8978	379	0.8799	429	0.8623	479	0.8451
280	0.9157	330	0.8974	380	0.8795	430	0.8619	480	0.8447
281	0.9153	331	0.8971	381	0.8792	431	0.8616	481	0.8444
282	0.9149	332	0.8967	382	0.8788	432	0.8612	482	0.8440
283	0.9146	333	0.8963	383	0.8784	433	0.8609	483	0.8437
284	0.9142	334	0.8960	384	0.8781	434	0.8605	484	0.8433
285	0.9138	335	0.8956	385	0.8777	435	0.8602	485	0.8430
286	0.9135	336	0.8952	386	0.8774	436	0.8599	486	0.8427
287	0.9131	337	0.8949	387	0.8770	437	0.8595	487	0.8423
288	0.9127	338	0.8945	388	0.8767	438	0.8592	488	0.8420
289	0.9124	339	0.8942	389	0.8763	439	0.8588	489	0.8416
290	0.9120	340	0.8938	390	0.8760	440	0.8585	490	0.8413
291	0.9116	341	0.8934	391	0.8756	441	0.8581	491	0.8410
292	0.9113	342	0.8931	392	0.8753	442	0.8578	492	0.8406
293	0.9109	343	0.8927	393	0.8749	443	0.8574	493	0.8403
294	0.9105	344	0.8924	394	0.8746	444	0.8571	494	0.8399
295	0.9102	345	0.8920	395	0.8742	445	0.8567	495	0.8396
296	0.9098	346	0.8916	396	0.8738	446	0.8564	496	0.8393
297	0.9094	347	0.8913	397	0.8735	447	0.8560	497	0.8389
298	0.9091	348	0.8909	398	0.8731	448	0.8557	498	0.8386
299	0.9087	349	0.8906	399	0.8728	449	0.8554	499	0.8383

TABLE XII

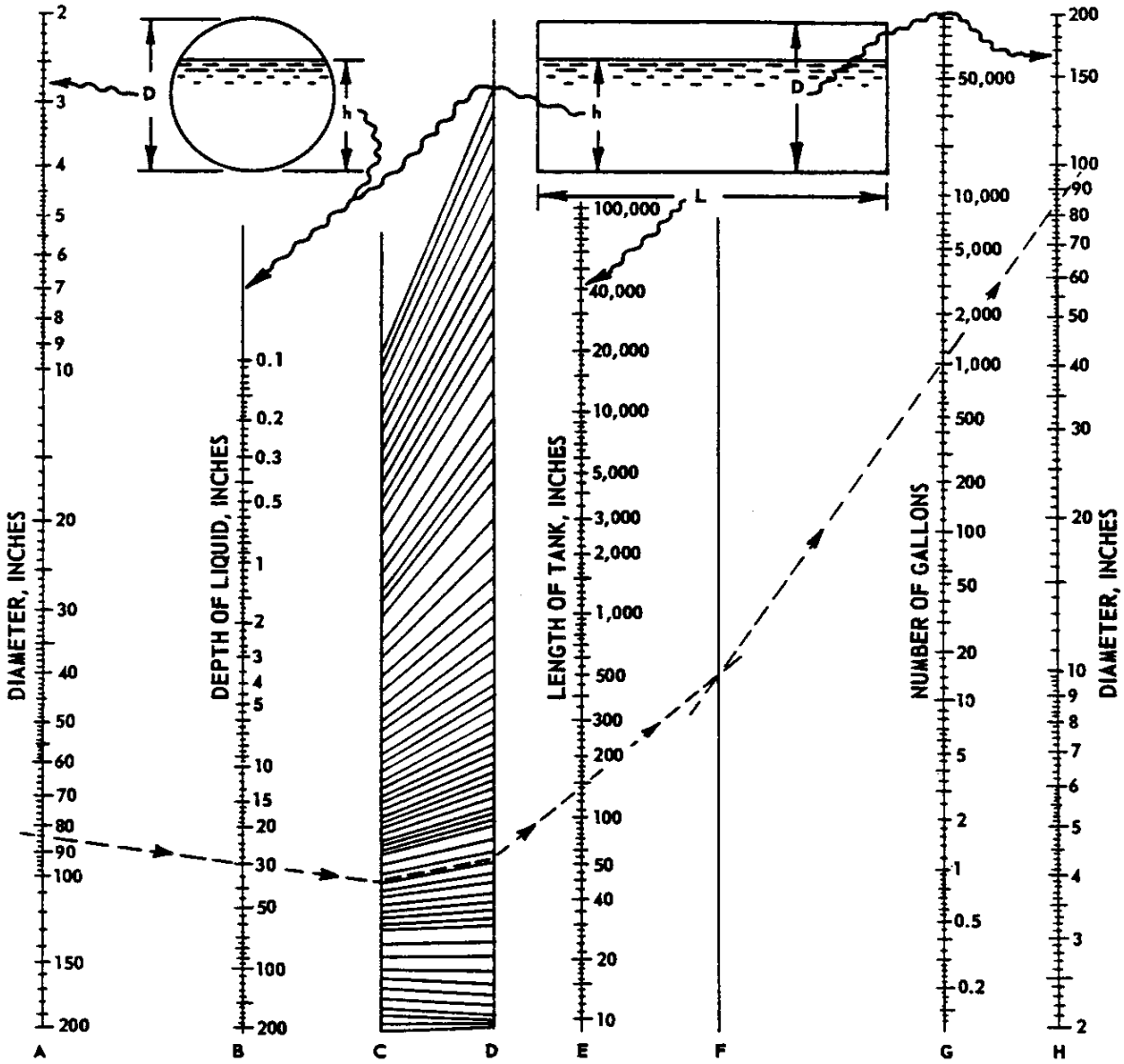
TEMPERATURE-VOLUME CORRECTIONS FOR EMULSIFIED ASPHALTS

LEGEND: t = observed temperature in degrees Fahrenheit

M = multiplier for correcting volumes to the basis of 60 degrees Fahrenheit

t	M	t	M	t	M
50	1.00250	95	0.99125	140	0.98000
51	1.00225	96	0.99100	141	0.97975
52	1.00200	97	0.99075	142	0.97950
53	1.00175	98	0.99050	143	0.97925
54	1.00150	99	0.99025	144	0.97900
55	1.00125	100	0.99000	145	0.97875
56	1.00100	101	0.98975	146	0.97850
57	1.00075	102	0.98950	147	0.97825
58	1.00050	103	0.98925	148	0.97800
59	1.00025	104	0.98900	149	0.97775
60	1.00000	105	0.98875	150	0.97750
61	0.99975	106	0.98850	151	0.97725
62	0.99950	107	0.98825	152	0.97700
63	0.99925	108	0.98800	153	0.97675
64	0.99900	109	0.98775	154	0.97650
65	0.99875	110	0.98750	155	0.97625
66	0.99850	111	0.98725	156	0.97600
67	0.99825	112	0.98700	157	0.97575
68	0.99800	113	0.98675	158	0.97550
69	0.99775	114	0.98650	159	0.97525
70	0.99750	115	0.98625	160	0.97500
71	0.99725	116	0.98600	161	0.97475
72	0.99700	117	0.98575	162	0.97450
73	0.99675	118	0.98550	163	0.97425
74	0.99650	119	0.98525	164	0.97400
75	0.99625	120	0.98500	165	0.97375
76	0.99600	121	0.98475	166	0.97350
77	0.99575	122	0.98450	167	0.97325
78	0.99550	123	0.98425	168	0.97300
79	0.99525	124	0.98400	169	0.97275
80	0.99500	125	0.98375	170	0.97250
81	0.99475	126	0.98350	171	0.97225
82	0.99450	127	0.98325	172	0.97200
83	0.99425	128	0.98300	173	0.97175
84	0.99400	129	0.98275	174	0.97150
85	0.99375	130	0.98250	175	0.97125
86	0.99350	131	0.98225	176	0.97100
87	0.99325	132	0.98200	177	0.97075
88	0.99300	133	0.98175	178	0.97050
89	0.99275	134	0.98150	179	0.97025
90	0.99250	135	0.98125	180	0.97000
91	0.99225	136	0.98100	181	0.96975
92	0.99200	137	0.98075	182	0.96950
93	0.99175	138	0.98050	183	0.96925
94	0.99150	139	0.98025	184	0.96900
				185	0.96875

1311 CAPACITY CHART FOR CYLINDRICAL TANKS



Example: How many gallons are in a tank 84 in. in diameter, the depth of the liquid being 30 in. and the length of the tank being 142 in.?

Run a straight line through the 84, column A, and the 30 in column B and locate the intersection with column C. By eye follow the radiating guide lines to column D, locating a second point of intersection. From this last intersection run through the 142, column E, and locate the point of intersection in column F. Then from this point run over to the 84, column H, and the intersection in column G will be found to be close to 1,050 gallons.

1312 TEMPERATURE CONVERSIONS

^{0}C.		^{0}F.
-78.9	-110	-166.0
-73.3	-100	-148.0
-67.8	-90	-130.0
-62.2	-80	-112.0
-56.7	-70	-94.0
-51.1	-60	-76.0
-45.6	-50	-58.0
-40.0	-40	-40.0
-34.4	-30	-22.0
-28.9	-20	-4.0
-28.3	-19	-2.2
-27.8	-18	-0.4
-27.2	-17	1.4
-26.7	-16	3.2
-26.1	-15	5.0
-25.6	-14	6.8
-25.0	-13	8.6
-24.4	-12	10.4
-23.9	-11	12.2
-23.3	-10	14.0
-22.8	-9	15.8
-22.2	-8	17.6
-21.7	-7	19.4
-21.1	-6	21.2
-20.6	-5	23.0
-20.0	-4	24.8
-19.4	-3	26.6
-18.9	-2	28.4
-18.3	-1	30.2
-17.8	0	32.0
-17.2	1	33.8
-16.7	2	35.6
-16.1	3	37.4
-15.6	4	39.2
-15.0	5	41.0
-14.4	6	42.8
-13.9	7	44.6
-13.3	8	46.4
-12.8	9	48.2
-12.2	10	50.0
-11.7	11	51.8
-11.1	12	53.6
-10.6	13	55.4
-10.0	14	57.2
-9.4	15	59.0
-8.9	16	60.8
-8.3	17	62.6
-7.8	18	64.4
-7.2	19	66.2
-6.7	20	68.0
-6.1	21	69.8
-5.6	22	71.6
-5.0	23	73.4
-4.4	24	75.2
-3.9	25	77.0
-3.3	26	78.8
-2.8	27	80.6
-2.2	28	82.4
-1.7	29	84.2
-1.1	30	86.0

^{0}C.		^{0}F.
-0.6	31	87.8
0.0	32	89.6
0.6	33	91.4
1.1	34	93.2
1.7	35	95.0
2.2	36	96.8
2.8	37	98.6
3.3	38	100.4
3.9	39	102.2
4.4	40	104.0
5.0	41	105.8
5.6	42	107.6
6.1	43	109.4
6.7	44	111.2
7.2	45	113.0
7.8	46	114.8
8.3	47	116.6
8.9	48	118.4
9.4	49	120.2
10.0	50	122.0
10.6	51	123.8
11.1	52	125.6
11.7	53	127.4
12.2	54	129.2
12.8	55	131.0
13.3	56	132.8
13.9	57	134.6
14.4	58	136.4
15.0	59	138.2
15.6	60	140.0
16.1	61	141.8
16.7	62	143.6
17.2	63	145.4
17.8	64	147.2
18.3	65	149.0
18.9	66	150.8
19.4	67	152.6
20.0	68	154.4
20.6	69	156.2
21.1	70	158.0
21.7	71	159.8
22.2	72	161.6
22.8	73	163.4
23.3	74	165.2
23.9	75	167.0
24.4	76	168.8
25.0	77	170.6
25.6	78	172.4
26.1	79	174.2
26.7	80	176.0
27.2	81	177.8
27.8	82	179.6
28.3	83	181.4
28.9	84	183.2
29.4	85	185.0
30.0	86	186.8
30.6	87	188.6
31.1	88	190.4
31.7	89	192.2
32.2	90	194.0

^{0}C.		^{0}F.
32.8	91	195.8
33.3	92	197.6
33.9	93	199.4
34.4	94	201.2
35.0	95	203.0
35.6	96	204.8
36.1	97	206.6
36.7	98	208.4
37.2	99	210.2
37.8	100	212.0
38.3	101	213.8
38.9	102	215.6
39.4	103	217.4
40.0	104	219.2
40.6	105	221.0
41.1	106	222.8
41.7	107	224.6
42.2	108	226.4
42.8	109	228.2
43.3	110	230.0
43.9	111	231.8
44.4	112	233.6
45.0	113	235.4
45.6	114	237.2
46.1	115	239.0
46.7	116	240.8
47.2	117	242.6
47.8	118	244.4
48.3	119	246.2
48.9	120	248.0
49.4	121	249.8
50.0	122	251.6
50.6	123	253.4
51.1	124	255.2
51.7	125	257.0
52.2	126	258.8
52.8	127	260.6
53.3	128	262.4
53.9	129	264.2
54.4	130	266.0
55.0	131	267.8
55.6	132	269.6
56.1	133	271.4
56.7	134	273.2
57.2	135	275.0
57.8	136	276.8
58.3	137	278.6
58.9	138	280.4
59.4	139	282.2
60.0	140	284.0
60.6	141	285.8
61.1	142	287.6
61.7	143	289.4
62.2	144	291.2
62.8	145	293.0
63.3	146	294.8
63.9	147	296.6
64.4	148	298.4
65.0	149	300.2
65.6	150	302.0

^{0}C.		^{0}F.
66.1	151	303.8
66.7	152	305.6
67.2	153	307.4
67.8	154	309.2
68.3	155	311.0
68.9	156	312.8
69.4	157	314.6
70.0	158	316.4
70.6	159	318.2
71.1	160	320.0
71.7	161	321.8
72.2	162	323.6
72.8	163	325.4
73.3	164	327.2
73.9	165	329.0
74.4	166	330.8
75.0	167	332.6
75.6	168	334.4
76.1	169	336.2
76.7	170	338.0
77.2	171	339.8
77.8	172	341.6
78.3	173	343.4
78.9	174	345.2
79.4	175	347.0
80.0	176	348.8
80.6	177	350.6
81.1	178	352.4
81.7	179	354.2
82.2	180	356.0
82.8	181	357.8
83.3	182	359.6
83.9	183	361.4
84.4	184	363.2
85.0	185	365.0
85.6	186	366.8
86.1	187	368.6
86.7	188	370.4
87.2	189	372.2
87.8	190	374.0
88.3	191	375.8
88.9	192	377.6
89.4	193	379.4
90.0	194	381.2
90.6	195	383.0
91.1	196	384.8
91.7	197	386.6
92.2	198	388.4
92.8	199	390.2
93.3	200	392.0
93.9	201	393.8
94.4	202	395.6
95.0	203	397.4
95.6	204	399.2
96.1	205	401.0
96.7	206	402.8
97.2	207	404.6
97.8	208	406.4
98.3	209	408.2
98.9	210	410.0

^{0}C.		^{0}F.
99.4	211	411.8
100.0	212	413.6
100.6	213	415.4
101.1	214	417.2
101.7	215	419.0
102.2	216	420.8
102.8	217	422.6
103.3	218	424.4
103.9	219	426.2
104.4	220	428.0
105.0	221	429.8
105.6	222	431.6
106.1	223	433.4
106.7	224	435.2
107.2	225	437.0
107.8	226	438.8
108.3	227	440.6
108.9	228	442.4
109.4	229	444.2
110.0	230	446.0
110.6	231	447.8
111.1	232	449.6
111.7	233	451.4
112.2	234	453.2
112.8	235	455.0
113.3	236	456.8
113.9	237	458.6
114.4	238	460.4
115.0	239	462.2
115.6	240	464.0
116.1	241	465.8
116.7	242	467.6
117.2	243	469.4
117.8	244	471.2
118.3	245	473.0
118.9	246	474.8
119.4	247	476.6
120.0	248	478.4
120.6	249	480.2
121.1	250	482.0
121.7	251	483.8
122.2	252	485.6
122.8	253	487.4
123.3	254	489.2
123.9	255	491.0
124.4	256	492.8
125.0	257	494.6
125.6	258	496.4
126.1	259	498.2
126.7	260	500.0
127.2	261	501.8
127.8	262	503.6
128.3	263	505.4
128.9	264	507.2
129.4	265	509.0
130.0	266	510.8
130.6	267	512.6
131.1	268	514.4
131.7	269	516.2
132.2	270	518.0

^{0}C.		^{0}F.
132.8	271	519.8
133.3	272	521.6
133.9	273	523.4
134.4	274	525.2
135.0	275	527.0
135.6	276	528.8
136.1	277	530.6
136.7	278	532.4
137.2	279	534.2
137.8	280	536.0
138.3	281	537.8
138.9	282	539.6
139.4	283	541.4
140.0	284	543.2
140.6	285	545.0
141.1	286	546.8
141.7	287	548.6
142.2	288	550.4
142.8	289	552.2
143.3	290	554.0
143.9	291	555.8
144.4	292	557.6
145.0	293	559.4
145.6	294	561.2
146.1	295	563.0
146.7	296	564.8
147.2	297	566.6
147.8	298	568.4
148.3	299	570.2
148.9	300	572.0
151.7	305	581.0
154.4	310	590.0
157.2	315	599.0
160.0	320	608.0
162.8	325	617.0
165.6	330	626.0
168.3	335	635.0
171.1	340	644.0
173.9	345	653.0
176.7	350	662.0
179.4	355	671.0
182.2	360	680.0
185.0	365	689.0
187.8	370	698.0
190.6	375	707.0
193.3	380	716.0
196.1	385	725.0
198.9	390	734.0
201.7	395	743.0
204.4	400	752.0
207.2	405	761.0
210.0	410	770.0
212.8	415	779.0
215.6	420	788.0
218.3	425	797.0
221.1	430	806.0
223.9	435	815.0
226.7	440	824.0
229.4	445	833.0
232.2	450	842.0

Note: The numbers in white face type refer to the temperature, either in degrees Centigrade or Fahrenheit, which it is desired to convert. If converting from ^{0}F. to ^{0}C., the equivalent temperature will be found in the left column. If converting from ^{0}C. to ^{0}F., the answer will be found in the right column: ^{0}F. = (1.8 ^{0}C.) + 32 and ^{0}C. = (^{0}F. - 32) / 1.8.

1313 MISCELLANEOUS INFORMATION

Freezing point of water = 32° F. = 0° C.

Boiling point of water at atmospheric pressure = 212° F. = 100° C.

Absolute zero = -459.7^o F. = -273.2^o C.

$^oC. = 5/9(^oF. - 32^o)$

$^oF. = (9/5\ ^oC.) + 32^o$

1 hp = 550 ft. lbs./sec. = 33,000 ft. lbs./min.

1 hp = 2544 BTU's/hr.

1 hp = 745.5 watts.

1 BTU = 778.26 ft. lbs.

1 cu. ft. of water at 39.2^o F. and atmospheric pressure = 62.428 lbs.

1 cu. ft. of water at 60° F. and atmospheric pressure = 62.30 lbs.

1 cu. ft. of water at 212° F. and atmospheric pressure = 59.83 lbs.

Approximate heat capacity of superheated steam at atmospheric pressure =
0.47 BTU/lb/^{o}F.

Total heat of saturated steam at atmospheric pressure = 1150.4 BTU's.

π = 3.1416 = ratio of circumference of circle to diameter. (C/d)
= ratio of area of circle to square of radius. (A/r^2)

Circumference of circle = diameter x π. ($C = \pi d$)

Diameter of circle = circumference x 0.31831. ($d = 0.31831\ C = C / \pi$)

Area of circle = square of diameter x 0.7854. ($A = 0.7854d^2 = \pi / 4\ (d^2) = \pi\ (r^2)$).

Double diameter of circle increases its area four times. ($4\ A = 0.7854\ (2d)^2$)

Area of rectangle = length x width. (A = l w)
Area of triangle = base x 1/2 perpendicular height. (A = (1/2) b h)

Volume of cone = area of base x 1/3 perpendicular height. (V = (1/3) b h)

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

A gallon of water (U.S. standard) weighs 8.33 pounds (3.78 kilograms) and contains 231 cubic inches (0.00378 cubic meters).

A cubic foot of water contains 7.5 gallons or 1728 cubic inches, and weighs 62.5 pounds.

To find the approximate pressure in pounds per square inch of a column of water, multiply the height of the column in feet by 0.434.

Steam rising from water as its boiling point (212^0 F.) has a pressure equal to the atmosphere (14.7 lbs. per square inch).

Approximate heat capacity of superheated steam at atmospheric pressure equals 0.47 BTU's per lb. per ^{0} F.

Total heat of saturated steam at atmospheric pressure equals 1150.4 BTUs.

To find the capacity in U.S. gallons of cylindrical tanks knowing the dimensions in inches, square the diameter, multiply by the length, and multiply by 0.0034.

CONVERSION TABLES

MULTIPLY	BY	TO OBTAIN
Acres	43,560	Square Feet
Barrels of cement	376	Pounds of cement
Bags of cement	94	Pounds of cement
Cubic feet	7.48052	U.S. Gallons
Cubic feet	1.728	Cubic inches
Cubic feet	0.03704	Cubic yards
Cubic inches	0.0005787	Cubic feet
Cubic inches	0.004329	U.S. Gallons
Cubic yards	27	Cubic feet
Cubic yards	46.656	Cubic inches
Cubic yards	202.0	U.S. Gallons
Fathoms	6	Feet
Feet	0.3048	Meters
Meters	3.281	Feet
Meters	39.37	Inches
Meters	1.094	Yards
Miles	5,280	Feet
Pounds of water	0.01602	Cubic feet
Pounds of water	27.68	Cubic inches
Pounds of water	0.1198	U.S. Gallons
Square feet	144	Square inches
Square miles	640	Acres
Square yards	9	Square feet
Square yards	0.0002066	Acres
Tons (short)	2,000	Pounds
Tons (long)	2,240	Pounds

1314 MEASUREMENT OF GRADES

Under the commonly accepted system of measuring gradients, grade is defined as the change in elevation divided by the horizontal distance traveled, and is expressed as a percentage.

A grade of 100 percent corresponds to an angle of 45 degrees. A 1 in 3 grade is the same as 33 1/3 percent grade, and a 1 in 2 grade the same as a 50 percent grade.

Table of Gradients

SLOPE	PERCENT GRADE	CORRES-PONDING ANGLE (degrees)	RISE or FALL IN ONE MILE (feet)	RISE or FALL IN ONE KILOMETER (meters)
1 in 1	100.00	45.00	5280	1000.0
1 in 2	50.00	26.57	2640	500.0
1 in 3	33.33	18.43	1760	333.3
1 in 4	25.00	14.03	1320	250.0
1 in 5	20.00	11.32	1056	200.0
1 in 6	16.67	9.47	880	166.7
1 in 7	14.29	8.13	754	142.9
1 in 8	12.50	7.12	660	125.0
1 in 9	11.11	6.33	587	111.1
1 in 10	10.00	5.72	528	100.0
1 in11	9.09	5.20	480	90.9
1 in 12	8.33	4.77	440	83.3
1 in 13	7.69	4.40	406	76.9
1 in 14	7.14	4.08	377	71.4
1 in 15	6.67	3.82	352	66.7
1 in 16	6.25	3.58	330	62.5
1 in 17	5.88	3.37	311	58.8
1 in 18	5.56	3.18	293	55.6
1 in 19	5.26	3.02	278	52.6
1 in 20	5.00	2.87	264	50.0
1 in 25	4.00	2.28	211	40.0
1 in 30	3.33	1.90	176	33.3
1 in 35	2.86	1.63	151	28.6
1 in 40	2.50	1.43	132	25.0

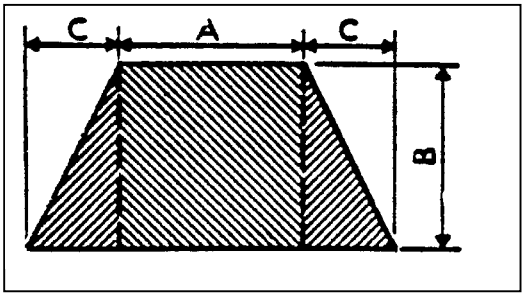
1315 WEIGHTS OF MATERIALS

MATERIAL	Approximate Kilograms per Cubic Meter	Approximate pounds per Cubic Foot
Aluminum	2659.1	166
Ashes	688.8	43
Asphalt	1297.5	81
Brass	8393.7	524
Brick (Common)	1922.2	120 (About 3 tons per thousand)
Brick (Fire)	2322.7	145
Bronze	8553.9	534
Cement	1505.7	94 (= one sack)
Concrete	2402.8	150 (4050 lbs. per cubic yard)
Copper	8601.9	537
Crushed Rock	1521.8	95 (2565 lbs. per cubic yard)
Dry Earth Loose	1217.4	76 (2052 lbs. per cubic yard)
Granite	2867.3	179
Lead	11341.1	708
Lumber -- Fir, Spruce	512.6	32 (2666 lbs. per thousand feet)
Lumber -- Oak	993.1	62 (5166 lbs. per thousand feet)
Mortar	1601.8	100
Portland Cement	1505.7	94 (376 lbs. per barrel)
River Sand	1922.2	120 (3240 lbs. per cubic yard)
Steel	7849.0	490
Water	1001.2	62.5
Zinc	7000.1	437

1316 WINDROW CONTENTS

To calculate the quantity of aggregate in cubic feet per lineal foot of windrow:

Take measurement "A", "B", and "C".
Then, ("A" x "B" x 1 ft.) + ("C" x "B" x 1 ft) = cubic feet of windrowed aggregate per lineal foot.



Example:
"A" = 2' - 0", "B" = 2' - 0", and "C" = 1' - 0"
Then, (2' - 0" x 2' - 0" x 1') + (1' - 0" x 2' - 0" x 1')
= 4.0 ft.^{3} + 2.0 ft.^{3} = 6.0 cubic feet of windrowed aggregate per lineal foot.

* Note: If measurement "C" is not the same on both sides of windrow, use the average measurement.

EQUIVALENT WEIGHTS OF AGGREGATES

Pounds per Cubic Foot	Pounds per Cubic Yard	Tons per Cubic Yard	Cubic Yards per Ton	Kilograms per Cubic Meter
60	1620	0.81	1.23	961
65	1755	0.88	1.14	1041
70	1890	0.95	1.06	1121
75	2025	1.01	0.99	1201
80	2160	1.08	0.93	1281
85	2295	1.15	0.87	1362
90	2430	1.22	0.82	1442
95	2565	1.28	0.78	1522
100	2700	1.35	0.74	1602
105	2835	1.42	0.71	1682
110	2970	1.49	0.67	1762
115	3105	1.55	0.64	1842
120	3240	1.62	0.62	1922
125	3375	1.69	0.59	2002
130	3510	1.76	0.57	2082
135	3645	1.82	0.55	2162
140	3780	1.89	0.53	2243

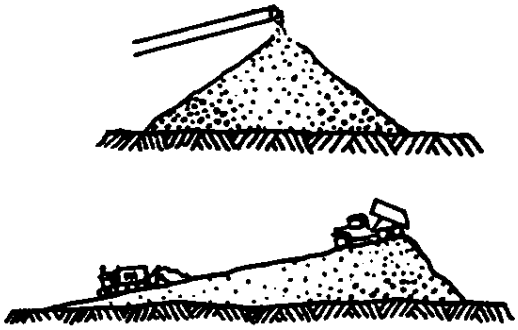
EQUILAVENT WEIGHTS OF AGGREGATE

Pounds per Cubic Yard	Pounds per Cubic Foot	Tons per Cubic Yard	Cubic Yards per Ton	Kilograms per Cubic Meter
1800	66.7	0.90	1.11	1068
1850	68.5	0.93	1.08	1098
1900	70.4	0.95	1.05	1127
1950	72.2	0.97	1.03	1157
2000	74.1	1.00	1.00	1187
2050	75.9	1.03	0.98	1216
2100	77.8	1.05	0.95	1246
2150	79.6	1.08	0.93	1276
2200	81.5	1.10	0.91	1305
2250	83.3	1.13	0.89	1335
2300	85.2	1.15	0.87	1365
2350	87.0	1.18	0.85	1394
2400	88.9	1.20	0.83	1424
2450	90.7	1.23	0.82	1454
2500	92.6	1.25	0.80	1483
2550	94.4	1.28	0.78	1513
2600	96.3	1.30	0.77	1543
2650	98.1	1.33	0.75	1572
2700	100.0	1.35	0.74	1602
2750	101.9	1.38	0.73	1632
2800	103.7	1.40	0.71	1661
2850	105.6	1.43	0.70	1691
2900	107.4	1.45	0.69	1721
2950	109.3	1.48	0.68	1750
3000	111.1	1.50	0.67	1780
3050	113.0	1.53	0.66	1809
3100	114.8	1.55	0.65	1839
3150	116.7	1.58	0.63	1869
3200	118.5	1.60	0.63	1898
3250	120.4	1.63	0.62	1928
3300	122.2	1.65	0.61	1958
3350	124.1	1.68	0.60	1987
3400	125.9	1.70	0.59	2017
3450	127.8	1.73	0.58	2047
3500	129.6	1.75	0.57	2076
3550	131.5	1.78	0.56	2106
3600	133.3	1.80	0.56	2136
3650	135.2	1.83	0.55	2165
3700	137.0	1.85	0.54	2195
3750	138.9	1.88	0.53	2225
3800	140.7	1.90	0.52	2254

1317 STOCKPILING AGGREGATE

CORRECT

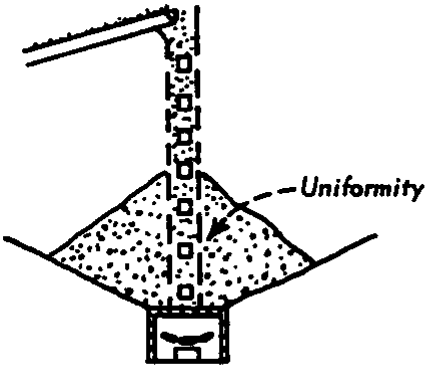
Methods which place material in the pile in individual units not larger than a truck load and which do not permit the aggregate to run down the slopes at the edge of the pile.



INCORRECT

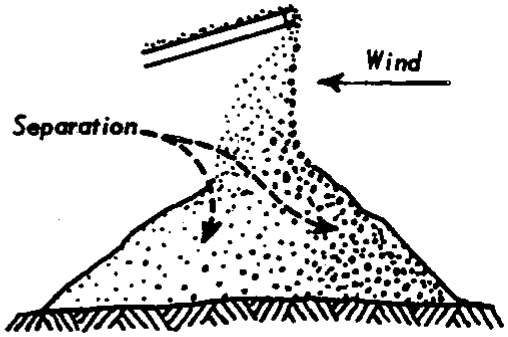
Methods which permit the aggregate to roll down the slope as it is added to the pile. The use of bulldozers is also incorrect.

UNFINISHED AGGREGATE STORAGE



CORRECT

Chimney surrounding material falling from end of conveyor belt to prevent wind from separating fine and coarse material. Openings provided as required to discharge material at various elevations of the pile.

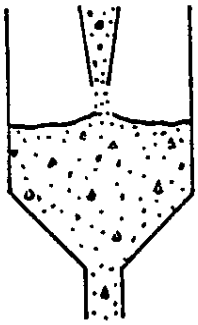


INCORRECT

Free fall of material from high end end of conveyor belt permitting wind to separate fine from coarse material.

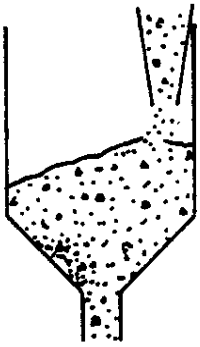
1318 LOADING HOPPERS

LOADING HOPPERS



CORRECT

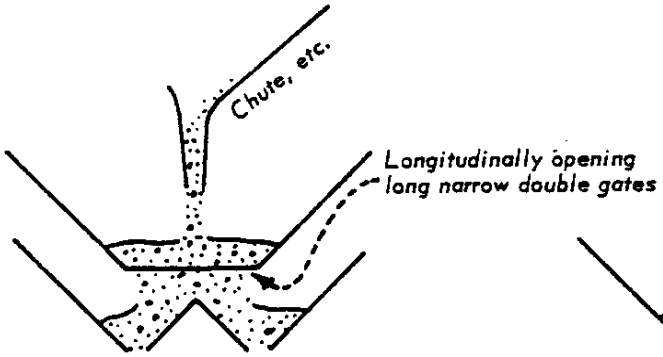
Dropping of concrete directly over gate opening.



INCORRECT

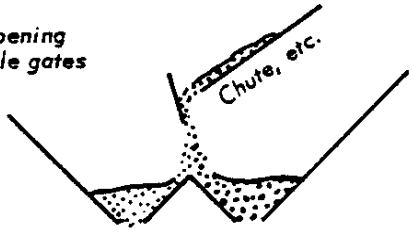
Dropping of concrete on sloping side of hopper.

DIVIDED HOPPERS



CORRECT

The above arrangement shows the only acceptable method if a divided hopper must be used. (Single discharge hoppers are to be used whenever possible.)

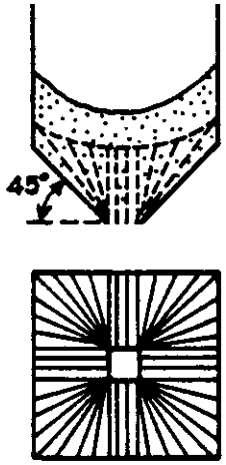


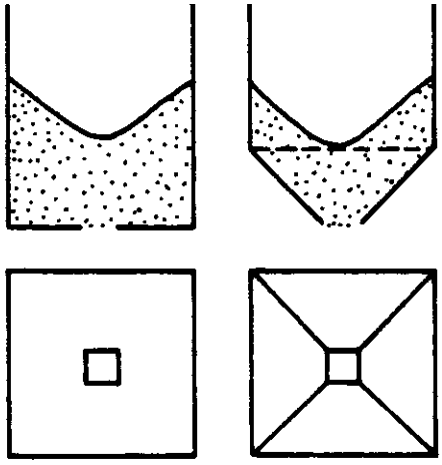
INCORRECT

Filling of divided hopper by flow of concrete. Separation and lack of uniformity in concrete delivered from either gate is inevitable.

1319 FILLING AGGREGATE BINS

SHAPE OF AGGREGATE BIN BOTTOMS





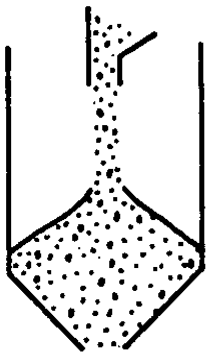
CORRECT

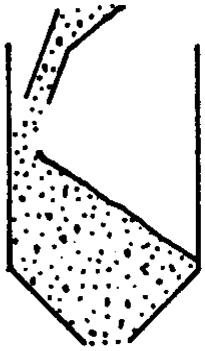
Bottom to slope up from outlet in all directions at not less than 45^0 from the horizontal. Corners to be filled and rounded to maintain required slope at all points.

INCORRECT

Flat bottom bins or those with any arrangement of slopes having corners or areas such that all material in bin will not flow quickly through outlet without shoveling.

AGGREGATE BIN FILLING





CORRECT

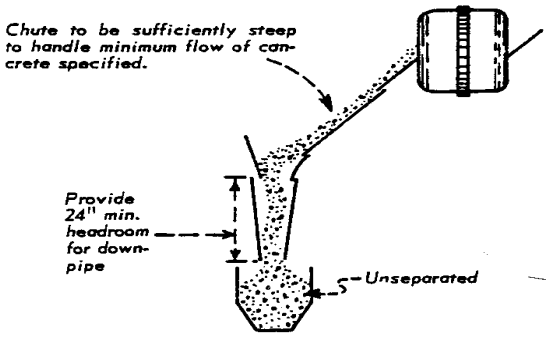
Dropping of material vertically and over discharge.

INCORRECT

Chuting material into bin on an angle so material falls other than directly over discharge.

1320 DISCHARGING CONCRETE

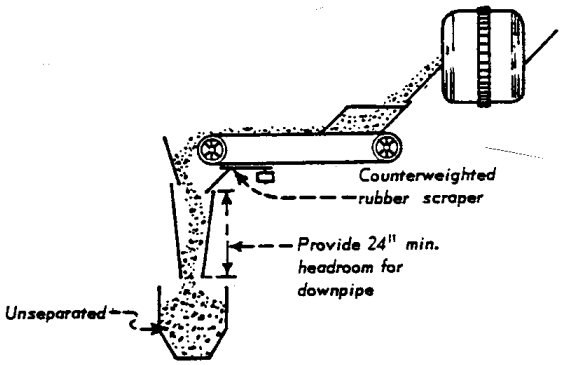
CONTROL OF SEPARATION
AS CONCRETE IS DISCHARGED FROM MIXERS



CORRECT

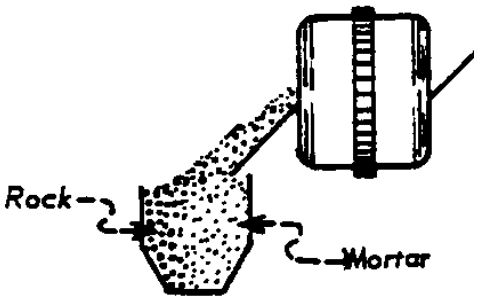
Either of these arrangements for preventing separation, regardless of length of chute or conveyor, whether discharging concrete into buckets, cars or hoppers.

CORRECT



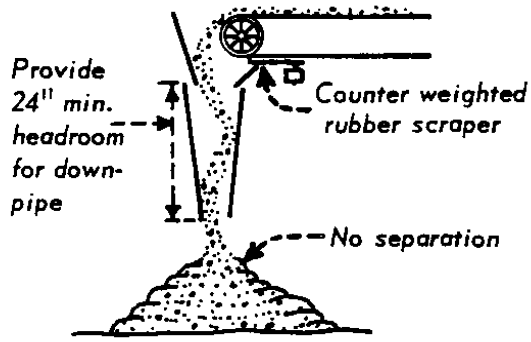
INCORRECT

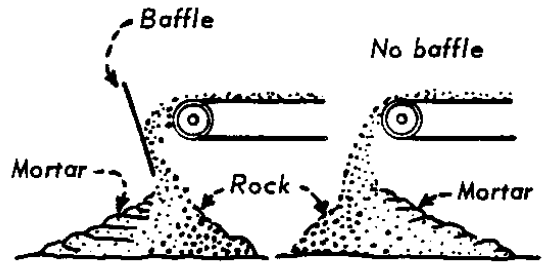
Filing of buckets, cars, hoppers etc. directly from the discharge of any type of mixer



1321 STOCKPILING FROM CONVEYOR BELTS

CONTROL OF SEPARATION OF CONCRETE
AT THE END OF CONVEYOR BELTS





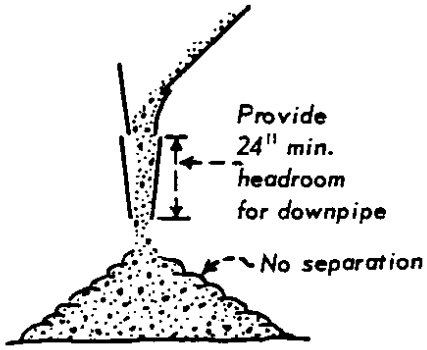
CORRECT

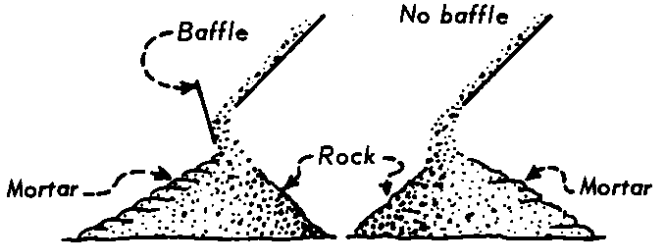
The above arrangement for prevention of separation whether discharging concrete into hoppers, buckets, cars, forms or etc.

INCORRECT

Improper or complete lack of control at the end of belt. Baffles or shallow hoppers usually merely change the direction of separation.

CONTROL OF SEPARATION
AT THE END OF CONCRETE CHUTES
This applies to sloping discharges from mixers, transit mixers, etc., as well as to longer chutes but does not when concrete is discharged into another chute or on to a conveyor belt





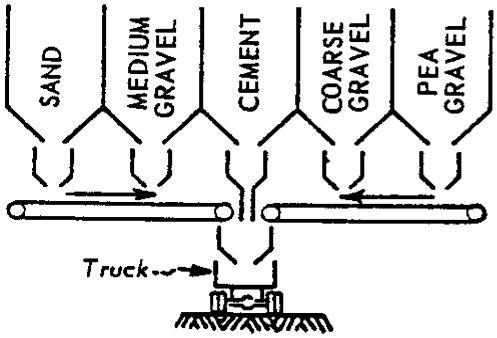
CORRECT

The above arrangement for preventing regardless of length of chute, whether discharging concrete into hoppers, bucket cars, forms or etc.

INCORRECT

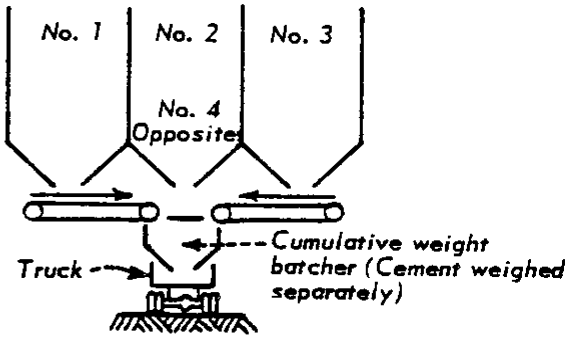
Improper or lack of control at the end of separation any concrete chute regardless of length.
Baffles usually merely change the direction of separation.

1322 BATCHING EQUIPMENT



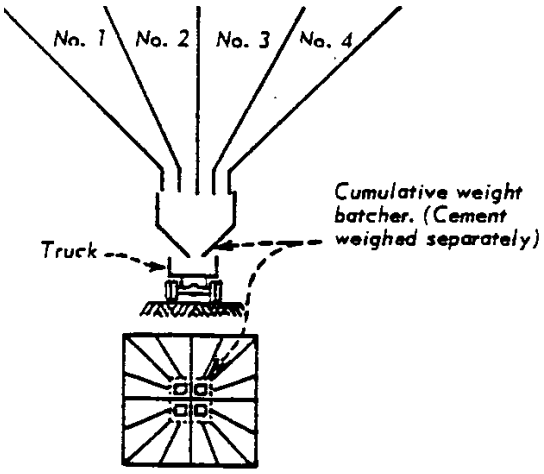
CORRECT

Individual automatic weighing of ingredients assembled into truck or mixer loading hopper by conveyor belts. Discharge of cement batcher to be controlled so that cement is flowing full time aggregate is being delivered by conveyor belts.



CORRECT

Cumulative automatic weighing of aggregates using conveyor belts automatically started and stopped by the weighing equipment and having no gates to stick. Access for representative sampling is afforded.

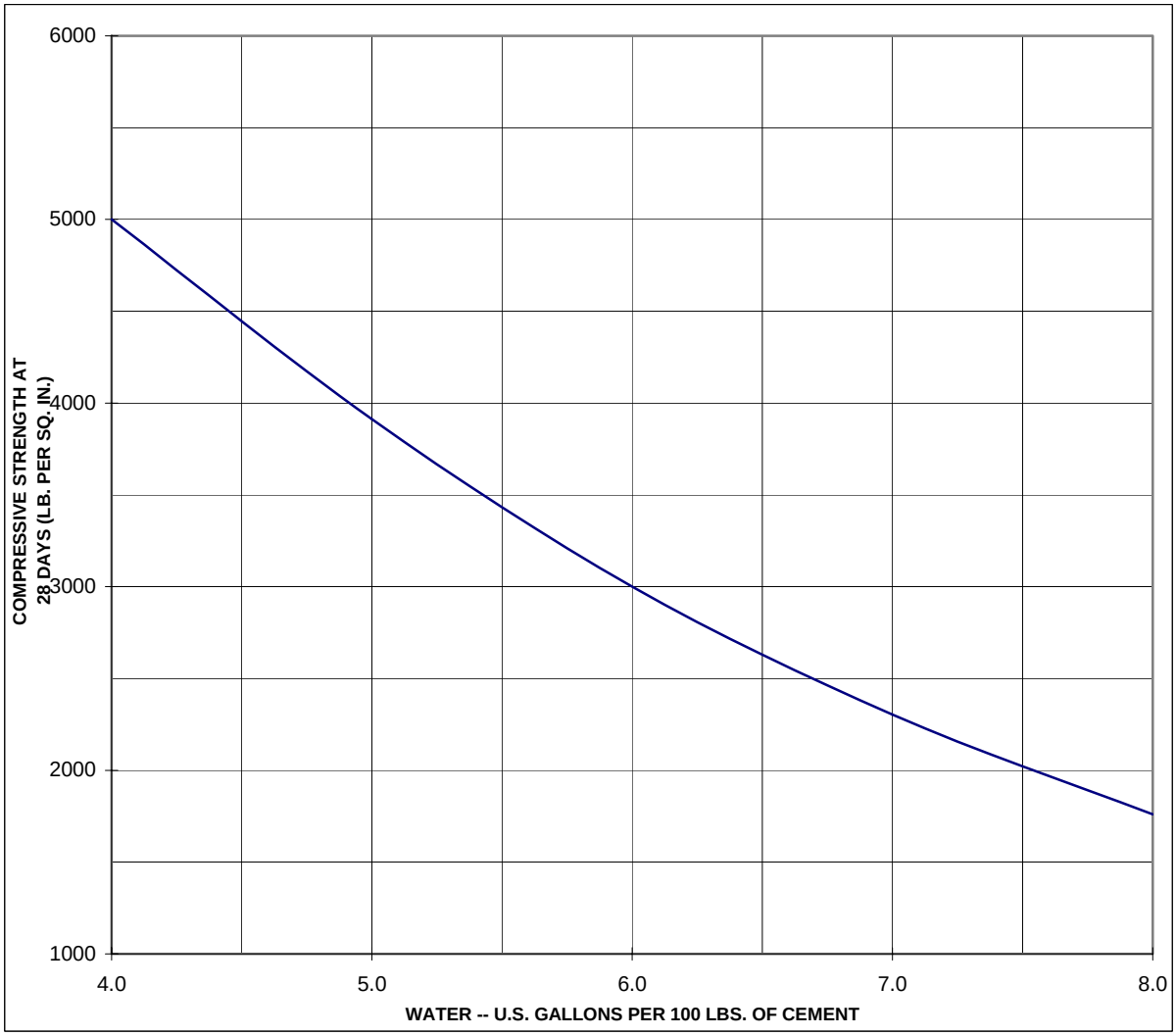


INCORRECT

Either of above close groupings of bin discharges which cause long slopes of material in bins with resulting separation as material is lowered.

1323 WATER CEMENT RATIO AND PROBABLE STRENGTH

For workable mixes using clean sound aggregates, the strength and other desirable features of concrete are governed by the net quantity of mixing water used per unit of cement. The effect of the water-cement ratio is seen in the curve below.



1324 APPROXIMATE CYLINDER STRENGTH

Strength of Concrete Cylinders -- Specification requirements are normally based upon the strength of the concrete at 28 days but it is usually advisable, especially at the start of a project, to submit cylinders for 7 and 14 day tests so that the 28 day strength may be forecast, and to see that the concrete shows normal progressive hardening. For concrete without fly ash, the following formula will give a close approximation of the 28 day strength which may be expected from a known 7 day strength.

$$\text{English: } S_{28} = S_7 + (30\sqrt{S_7})$$

$$\text{Metric: } S_{28} = S_7 + (78.8\sqrt{S_7})$$

In which S_{28} = approximate 28 day strength and S_7 = known 7 day strength.

For approximating strengths at other ages from known strengths at various ages the following table may be used.

Probable Compressive Strength For Concrete Without Fly Ash

AGE	psi	kPa	psi	kPa	Psi	kPa	psi	kPa	psi	kPa
100	1550	10690	2250	15510	2900	19990	3490	24060	4150	28610
90	1500	10340	2180	15030	2830	19510	3440	23720	4050	27920
80	1460	10070	2110	14550	2740	18890	3350	23100	3950	27230
70	1390	9580	2030	14000	2640	18200	3250	22410	3830	26410
60	1330	9170	1940	13380	2540	17510	3120	21510	3690	25440
55	1290	8890	1890	13030	2470	17030	3050	21030	3610	24890
50	1250	8620	1840	12690	2410	16620	2970	20480	3520	24270
45	1200	8270	1780	12270	2330	16060	2890	19930	3420	23580
40	1150	7930	1700	11720	2250	15510	2790	19240	3310	22820
38	1130	7790	1670	11510	2220	15310	2760	19030	3280	22610
36	1110	7650	1640	11310	2190	15100	2720	18750	3230	22270
34	1080	7450	1610	11100	2140	14750	2670	18410	3180	21930
32	1050	7240	1580	10890	2100	14480	2620	18060	3120	21510
30	1030	7100	1540	10620	2050	14130	2560	17650	3060	21100
28	1000	6900	1500	10310	2000	13840	2500	17190	3000	20730
26	960	6620	1450	10000	1950	13440	2450	16890	2930	20200
24	920	6340	1400	9650	1890	13030	2380	16410	2850	19650
22	890	6140	1350	9310	1830	12620	2310	15930	2780	19170
20	850	5860	1300	8960	1770	12200	2240	15440	2700	18620
19	830	5720	1270	8760	1730	11930	2200	15170	2650	18270
18	800	5520	1240	8550	1690	11650	2150	14820	2600	17930
17	780	5380	1200	8270	1650	11380	2100	14480	2550	17580
16	750	5170	1170	8070	1600	11030	2050	14130	2490	17170
15	720	4960	1130	7790	1550	10690	2000	13790	2430	16750
14	690	4760	1090	7520	1500	10340	1950	13440	2360	16270
13	660	4550	1050	7240	1450	10000	1890	13030	2300	15860
12	630	4340	1000	6890	1400	9650	1820	12550	2230	15380
11	590	4070	950	6550	1350	9310	1750	12070	2150	14820
10	550	3790	900	6210	1280	8830	1680	11580	2070	14270
9	510	3520	840	5790	1200	8270	1590	10960	1980	13650
8	460	3170	780	5380	1130	7790	1500	10340	1880	12960
7	400	2760	700	4830	1040	7170	1380	9510	1750	12070
6	340	2340	600	4140	920	6340	1260	8690	1610	11100

Probable Compressive Strength For Concrete Without Fly Ash

AGE	psi	kPa	psi	kPa	psi	KPa	psi	kPa
100	4720	32540	5400	37230	5970	41160	6560	45230
90	4620	31850	5240	36130	5840	40270	6430	44330
80	4510	31100	5150	35510	5710	39370	6290	43370
70	4380	30200	5000	34470	5550	38270	6110	42130
60	4220	29100	4840	33370	5370	37020	5930	40890
55	4140	28540	4750	32750	5270	36340	5820	40130
50	4050	27920	4640	31990	5170	35650	5700	39300
45	3950	27230	4520	31160	5040	34750	5570	38400
40	3830	26410	4400	30340	4910	33850	5430	37440
38	3790	26130	4350	29990	4860	33510	5380	37090
36	3740	25790	4300	29650	4800	33090	5310	36610
34	3680	25370	4220	29100	4720	32540	5240	36130
32	3620	24960	4160	28680	4650	32060	5170	35650
30	3560	24550	4090	28200	4570	31510	5090	35090
28	3500	24150	4000	27590	4500	31050	5000	34460
26	3410	23510	3930	27100	4400	30340	4900	33780
24	3340	23030	3840	26480	4300	29650	4800	33090
22	3250	22410	3750	25860	4200	28960	4700	32410
20	3160	21790	3640	25100	4100	28270	4590	31650
19	3110	21440	3590	24750	4040	27850	4510	31100
18	3050	21030	3520	24270	3980	27440	4450	30680
17	3000	20680	3460	23860	3910	26960	4380	30200
16	2940	20270	3400	23440	3830	26410	4300	29650
15	2870	19790	3310	22820	3770	25990	4210	29030
14	2800	19310	3250	22410	3690	25440	4130	28480
13	2740	18890	3180	21930	3600	24820	4050	27920
12	2660	18340	3090	21300	3500	24130	3960	27300
11	2570	17720	3000	20680	3400	23440	3850	26540
10	2490	17170	2900	19990	3300	22750	3730	25720
9	2380	16410	2780	19170	3170	21860	3600	24820
8	2280	15720	2650	18270	3050	21030	3460	23860
7	2120	14620	2500	17240	2890	19930	3280	22610
6	1980	13650	2340	16130	2700	18620	3100	21370

1325 CULVERT PIPE THICKNESS

CORRUGATED GALVANIZED STEEL (Class 1, Zinc or Aluminum Coated)

	THICKNESS		MINIMUM THICKNESS					
GAUGE NO.	mm	in.	PIPE mm	PIPE in.	PIPEPLATE mm	PIPEPLATE in.	KILOGRAMS / m^2 OF BASE MATERIAL	OUNCES / SQ. FT. OF BASE MATERIAL
	0.71	0.028	0.61	0.024				
22	0.86	0.034	0.76	0.030				
20	1.02	0.040	0.91	0.036			7.32	24
18	1.32	0.052	1.17	0.046			9.76	32
16	1.63	0.064	1.45	0.057			12.21	40
14	2.01	0.079	1.83	0.072			15.26	50
12	2.77	0.109	2.57	0.101	2.46	0.097	21.36	70
10	3.51	0.138	3.28	0.129	3.20	0.126	27.46	90
8	4.27	0.168	4.04	0.159	3.96	0.156	33.57	110
7	4.78	0.188			4.47	0.176	36.62	120
5	5.54	0.218			5.23	0.206	42.72	140
3	6.32	0.249			6.02	0.237	48.82	160
1	7.11	0.280			6.81	0.268	54.93	180

1326 CALIBRATION OF SLURRY SEAL MACHINE

Width of belt = 1.79'
Length of belt Travel per Revolution = 1.67'
Depth of Material (Gate Opening) 3-1/2 = 0.29'
Weight of Aggregate per Cubic Foot = 86.51 pounds

1.79 x 1.67 x 0.29 = 0.866897 Cubic Feet
0.866897 x 86.51 = 75.00 Weight of Material per Revolution

1 Revolution = 1.75 Gallons Emulsion
Weight of Emulsion = 8.33 Pounds
1.75 x 8.33 = 14.58 Pounds Emulsion per Revolution

75.00	Weight of Aggregate per Revolution
14.58	Weight of Emulsion
89.58	

14.58 / 89.58 = 16.3% Specification -- 14-18
75.00 / 89.58 = 83.7% Specification -- 82-86

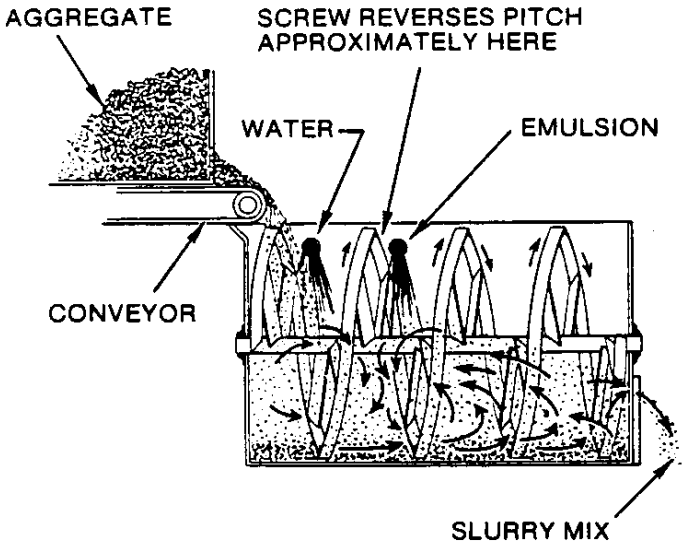


Figure A
Flow diagram of slurry mixer

The mixer contains a specially designed agitator built with a change of pitch in the blades at a point approximately one-third from the feet end. This causes the material in the mixer to be blended toward the middle from both ends of the unit. The product is a homogeneous slurry mix. It is forced by the outer spiral of the agitator to the rear of the mixer where it is allowed to flow out into the spreader. Figure "A" is a diagram of this mixing operation. Note that the emulsion is fed into the mixer at the point where opposing forces are motion meet. This insures that the emulsion does not contact dry material which is important to the success of the process.

1327 MARKINGS FOR STEEL BOLTS

ASTM AND ASE GRADE MARKINGS FOR STEEL BOLTS AND SCREWS

GRADE MARKING	SPECIFICATION	MATERIAL
NO MARK	SAE-Grade 1	Low or Medium Carbon Steel
	ASTM-A 307	Low Carbon Steel
	SAE-Grade 2	Low or Medium Carbon Steel
	SAE-Grade 5	Medium Carbon Steel, Quenched and Tempered
	ASTM-A 449	
	SAE-Grade 5.2	Low Carbon Martensite Steel, Quenched and Tempered
A 325 or A 325	ASTM-A 325 Type 1 ASHTO-M 164	Medium Carbon Steel, Quenched and Tempered
A 325	ASTM-A 325 Type 2 ASHTO-M 164	Low Carbon Martensite Steel, Quenched and Tempered
A 325	ASTM-A 325 Type 3 ASHTO-M 164	Atmospheric Corrosion (Weathering) Steel, Quenched and Tempered
BB	ASTM-A354 Grade BB	Low Alloy Steel, Quenched and Tempered
BC	ASTM-A 354 Grade BC	Low Alloy Steel, Quenched and Tempered
	SAE-Grade 7	Medium Carbon Alloy Steel, Quenched and Tempered Roll Threaded After Heat Treatment
	SAE-Grade 8	Medium Carbon Alloy Steel, Quenched and Tempered
	ASTM-A-354 Grade BD	Alloy Steel, Quenched and Tempered
A 490	ASTM-A 490 ASHTO-M 253	Alloy Steel, Quenched and Tempered

ASTM Standards:
A 307 - Low Carbon Steel Externally and Internally Threaded Standard Fasteners.
A 325 - High Strength Steel Bolts for Structural Steel Joints, including Suitable Nuts and Plain Hardened Washers.
A 449 - Quenched and Tempered Steel Bolts and Studs.
A 354 - Quenched and Tempered Alloy Steel Bolts and Studs with Suitable Nuts.
A 490 - Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints.

SAE Standards:
J429 – Mechanical and Quality Requirements for Externally Threaded Fasteners.

1328 STEEL WIRE GAUGES

GAUGE NO.	DECIMAL EQUIVALENT mm	DECIMAL EQUIVALENT in.	GAUGE NO.	DECIMAL EQUIVALENT mm	DECIMAL EQUIVALENT in.
0/7	12.446	0.490	9	3.759	0.148
0/6	11.735	0.462	9 1/2	3.607	0.142
0/5	10.922	0.430	10	3.429	0.135
0/4	10.008	0.394	10 1/2	3.251	0.128
0/3	9.195	0.362	11	3.048	0.120
0/2	8.407	0.331	11 1/2	2.870	0.113
0/1	7.772	0.306	12	2.692	0.106
1	7.188	0.283	12 1/2	2.515	0.099
1 1/2	6.909	0.272	13	2.337	0.092
2	6.655	0.262	13 1/2	2.184	0.086
2 1/2	6.426	0.253	14	2.032	0.080
3	6.198	0.244	14 1/2	1.930	0.076
3 1/2	5.944	0.234	15	1.829	0.072
4	5.715	0.225	15 1/2	1.702	0.067
4 1/2	5.486	0.216	16	1.575	0.062
5	5.258	0.207	16 1/2	1.473	0.058
5 1/2	5.080	0.200	17	1.372	0.054
6	4.877	0.192	17 1/2	1.295	0.051
6 1/2	4.674	0.184	18	1.219	0.048
7	4.496	0.177	18 1/2	1.118	0.044
7 1/2	4.318	0.170	19	1.041	0.041
8	4.115	0.162	19 1/2	0.965	0.038
8 1/2	3.937	0.155	20	0.889	0.035

The steel wire gauge outlined in this table has been taken from the original Washburn and Moen Gauge Chart. In 20 gauge and courser, sizes originally quoted to 4 decimal equivalent places have been rounded to 3 decimal places in accordance with rounding procedures of ASTM Standard Practice E29.

1329 CEMENT CONVERSION FACTORS

Change from bags to Pounds of Portland Cement and Gallons per bag to a Weight Ratio:

Cement Content

Bag/C.Y.	Lb./C.Y.
4.0	376
4.5	423
5.0	470
5.5	517
6.0	564
6.5	611
7.0	658
7.5	705
8.0	752
8.5	799
9.0	846

Water - Cement Ratio

Gal./Bag	Weight Ratio
4.0	0.36
4.5	0.40
5.0	0.44
5.5	0.49
6.0	0.53
6.5	0.58
7.0	0.62
7.5	0.66
8.0	0.71
8.5	0.75
9.0	0.80

1330 EQUIVALENT VELOCITIES

Miles Per Hour		Feet Per Minute		Feet Per Second		Kilometers Per Hour		Meters Per Minute		Meters Per Second
1	=	88	=	1.46	=	1.61	=	26.82	=	0.45
2	=	176	=	2.94	=	3.22	=	53.64	=	0.89
3	=	264	=	4.40	=	4.83	=	80.47	=	1.34
4	=	352	=	5.87	=	6.44	=	107.29	=	1.79
5	=	440	=	7.33	=	8.05	=	134.11	=	2.24
6	=	528	=	8.80	=	9.66	=	160.93	=	2.68
7	=	616	=	10.26	=	11.27	=	187.76	=	3.13
8	=	704	=	11.73	=	12.87	=	214.58	=	3.58
9	=	792	=	13.20	=	14.48	=	241.40	=	4.02
10	=	880	=	14.67	=	16.09	=	268.22	=	4.47
11	=	968	=	16.13	=	17.70	=	295.05	=	4.92
12	=	1056	=	17.60	=	19.31	=	321.87	=	5.36
13	=	1144	=	19.07	=	20.92	=	348.69	=	5.81
14	=	1232	=	20.52	=	22.53	=	375.51	=	6.26
15	=	1320	=	22.00	=	24.14	=	402.34	=	6.71
16	=	1408	=	23.47	=	25.75	=	429.16	=	7.15
17	=	1496	=	24.93	=	27.36	=	455.98	=	7.60
18	=	1584	=	26.40	=	28.97	=	482.80	=	8.05
19	=	1672	=	27.87	=	30.58	=	509.63	=	8.49
20	=	1760	=	29.33	=	32.19	=	536.45	=	8.94
21	=	1848	=	30.80	=	33.80	=	563.27	=	9.39
22	=	1936	=	32.26	=	35.41	=	590.09	=	9.83
23	=	2024	=	33.72	=	37.01	=	616.92	=	10.28
24	=	2112	=	35.20	=	38.62	=	643.74	=	10.73
25	=	2200	=	36.67	=	40.23	=	670.56	=	11.18
26	=	2288	=	38.14	=	41.84	=	697.38	=	11.62
27	=	2376	=	39.60	=	43.45	=	724.20	=	12.07
28	=	2464	=	41.04	=	45.06	=	751.03	=	12.52
29	=	2552	=	42.50	=	46.67	=	777.85	=	12.96
30	=	2640	=	44.00	=	48.28	=	804.67	=	13.41

1331 RANDOM NUMBER TABLE

0.489	0.190	0.093	0.625	0.045	0.033	0.925	0.366	0.138	0.706
0.352	0.851	0.078	0.627	0.566	0.667	0.099	0.615	0.056	0.994
0.230	0.388	0.759	0.266	0.921	0.814	0.910	0.757	0.939	0.349
0.367	0.710	0.575	0.545	0.705	0.206	0.682	0.053	0.839	0.401
0.589	0.011	0.481	0.292	0.413	0.233	0.188	0.682	0.800	0.109
0.309	0.487	0.633	0.607	0.585	0.041	0.733	0.300	0.705	0.564
0.081	0.811	0.585	0.443	0.605	0.594	0.662	0.484	0.047	0.444
0.973	0.788	0.954	0.660	0.312	0.418	0.318	0.245	0.236	0.493
0.894	0.070	0.209	0.893	0.740	0.395	0.661	0.199	0.991	0.659
0.243	0.058	0.414	0.944	0.060	0.601	0.769	0.016	0.170	0.084
0.507	0.358	0.115	0.410	0.838	0.092	0.778	0.678	0.699	0.198
0.350	0.428	0.651	0.944	0.667	0.728	0.245	0.920	0.730	0.762
0.878	0.596	0.661	0.079	0.670	0.799	0.887	0.152	0.412	0.024
0.844	0.418	0.082	0.981	0.961	0.429	0.000	0.278	0.221	0.301
0.116	0.662	0.077	0.095	0.494	0.710	0.999	0.295	0.499	0.383
0.441	0.036	0.731	0.344	0.502	0.245	0.240	0.458	0.066	0.345
0.037	0.363	0.703	0.675	0.452	0.529	0.113	0.290	0.356	0.719
0.386	0.299	0.787	0.234	0.871	0.384	0.004	0.877	0.929	0.673
0.506	0.015	0.349	0.604	0.046	0.673	0.716	0.960	0.168	0.038
0.502	0.711	0.303	0.305	0.173	0.827	0.950	0.249	0.079	0.719
0.979	0.447	0.425	0.463	0.585	0.545	0.091	0.467	0.917	0.484
0.584	0.725	0.929	0.080	0.914	0.333	0.472	0.879	0.658	0.405
0.155	0.683	0.010	0.061	0.024	0.658	0.086	0.628	0.567	0.419
0.273	0.723	0.098	0.026	0.898	0.368	0.039	0.256	0.003	0.795
0.126	0.104	0.502	0.096	0.088	0.871	0.505	0.371	0.817	0.792
0.091	0.546	0.560	0.571	0.308	0.489	0.171	0.758	0.681	0.612
0.948	0.350	0.016	0.590	0.098	0.550	0.770	0.368	0.335	0.060
0.780	0.103	0.680	0.838	0.623	0.209	0.956	0.714	0.394	0.147
0.044	0.772	0.182	0.126	0.396	0.910	0.021	0.368	0.871	0.473
0.603	0.095	0.399	0.383	0.535	0.891	0.519	0.647	0.412	0.598
0.315	0.681	0.499	0.405	0.784	0.322	0.295	0.273	0.166	0.966
0.763	0.372	0.272	0.712	0.507	0.674	0.333	0.938	0.680	0.354
0.407	0.204	0.902	0.173	0.877	0.889	0.962	0.475	0.060	0.474
0.601	0.977	0.478	0.873	0.146	0.997	0.800	0.721	0.273	0.273
0.004	0.015	0.696	0.036	0.777	0.035	0.045	0.496	0.698	0.928
0.724	0.385	0.220	0.882	0.036	0.725	0.998	0.272	0.337	0.475
0.574	0.718	0.522	0.203	0.978	0.424	0.611	0.458	0.246	0.730
0.717	0.979	0.413	0.279	0.187	0.413	0.990	0.694	0.183	0.682
0.473	0.181	0.497	0.677	0.906	0.967	0.869	0.410	0.034	0.968
0.606	0.304	0.071	0.601	0.765	0.754	0.626	0.150	0.691	0.644
0.797	0.578	0.193	0.941	0.995	0.210	0.134	0.055	0.500	0.176
0.716	0.102	0.297	0.030	0.248	0.730	0.215	0.455	0.669	0.669

REFERENCES

Materials Policy and Procedure Directives Manual, Arizona Department of Transportation, Phoenix, AZ

Metrication Guidelines, Arizona Department of Transportation, Phoenix, AZ