

# APPENDIX

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# DECIMAL EQUIVALENTS

FRACTION	INCHES	M/M
	1/64	.01563 .397
	1/32	.03125 .794
1/16	3/64	.04688 1.191
	5/64	.06250 1.588
3/32	7/64	.07813 1.984
	9/64	.09375 2.381
1/8	11/64	.10938 2.778
	13/64	.12500 3.175
5/32	15/64	.14063 3.572
	17/64	.15625 3.969
3/16	19/64	.17188 4.366
	21/64	.18750 4.763
7/32	23/64	.20313 5.159
	25/64	.21875 5.556
1/4	27/64	.23438 5.953
	29/64	.25000 6.350
5/16	31/64	.26563 6.747
	33/64	.28125 7.144
3/8	35/64	.29688 7.541
	37/64	.31250 7.938
7/16	39/64	.32813 8.334
	41/64	.34375 8.731
5/8	43/64	.35938 9.128
	45/64	.37500 9.525
3/4	47/64	.39063 9.922
	49/64	.40625 10.319
7/8	51/64	.42188 10.716
	53/64	.43750 11.113
15/16	55/64	.45313 11.509
	57/64	.46875 11.906
1/2	59/64	.48438 12.303
	61/64	.50000 12.700

FRACTION	INCHES	M/M
	33/64	.51563 13.097
	17/32	.53125 13.494
9/16	35/64	.54688 13.891
	37/64	.56250 14.288
5/8	39/64	.57813 14.684
	41/64	.59375 15.081
11/16	43/64	.60938 15.478
	45/64	.62500 15.875
3/4	47/64	.64063 16.272
	49/64	.65625 16.669
5/8	51/64	.67188 17.066
	53/64	.68750 17.463
7/8	55/64	.70313 17.859
	57/64	.71875 18.256
15/16	59/64	.73438 18.653
	61/64	.75000 19.050
1	63/64	.76563 19.447
	65/64	.78125 19.844
1	67/64	.79688 20.241
	69/64	.81250 20.638
1	71/64	.82813 21.034
	73/64	.84375 21.431
1	75/64	.85938 21.828
	77/64	.87500 22.225
1	79/64	.89063 22.622
	81/64	.90625 23.019
1	83/64	.92188 23.416
	85/64	.93750 23.813
1	87/64	.95313 24.209
	89/64	.96875 24.606
1	91/64	.98438 25.003
	93/64	1.00000 25.400

**CLAUSING**

DIVISION OF ATLAS PRESS COMPANY

# THREAD CUTTING TABLES

No phase of lathe operation is more interesting or profitable than the cutting of screws and threads; and no operation requires more care and study. The thread cutting range of the modern lathe is practically unlimited.

Every lathe comes equipped for cutting threads in the following standards: National Coarse (U.S.S.), National Fine (S.A.E.), Acme, Square, and Whitworth.

## THREAD CUTTING TERMS

**MAJOR DIAMETER** – The largest diameter of the thread of either the screw or the nut.

**MINOR DIAMETER** – The smallest diameter of the thread of either the screw or the nut.

**PITCH DIAMETER** – On a straight screw thread, the diameter of an imaginary cylinder, the surface of which would pass through the threads at such points as to make equal the width of the threads and the width of the spaces cut by the surface of the cylinder.

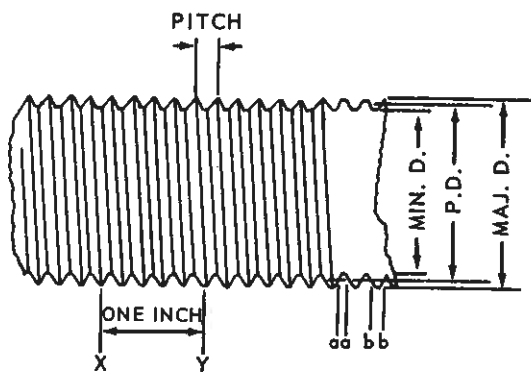


Figure A

In Figure A the lines representing the diameter "PD," are located so as to make spaces "aa" and "bb" equal. On a 60° Vee-type thread and on National Form threads, the pitch diameter is simply the major diameter less the depth of the thread.

**DEPTH OF THREAD** – One-half the difference between the major diameter and the minor diameter. In lathe work, the **DOUBLE DEPTH OF THREAD**, which is the difference between the major and minor diameters, is a quite common term. Thus, knowing the major diameter required, subtracting from it the double depth of thread for the required pitch, gives the minor diameter.

For information on single and double depth of National Form threads, see chart ---- "SINGLE DEPTH AND DOUBLE DEPTH OF NATIONAL FORM THREADS".

**PITCH** – The distance from a point on a screw thread to a corresponding point on the next thread, measured parallel to the axis (refer to Figure A).

**THREADS PER INCH** – The number of complete threads in the space of one inch. In Figure A, the distance between points X and Y represents one inch, and there are five threads per inch.

**LEAD** – The distance a screw thread advances axially in one turn. On a single thread screw, the lead and the pitch are identical; on a double thread screw, the lead is twice the pitch; on a triple thread screw, the lead is three times the pitch, etc.

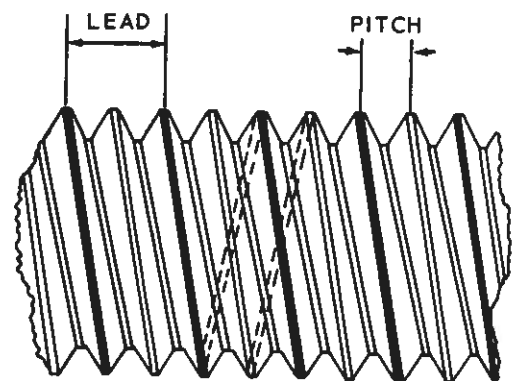


Figure B

Figure B shows a double thread screw. There are two separate grooves or helices around the screw, each of which advances twice the pitch in a single turn. If the pitch of this screw is 1/8 inch, the lead is 1/4 inch.

# SINGLE DEPTH AND DOUBLE DEPTH OF NATIONAL FORM THREADS

THIS TABLE SHOWS

- (I) Single Depth and Double Depth for National Form Threads cut with a NATIONAL FORM TOOL.
- (II) Single Depth and Double Depth of NF Threads cut with a 60° V-type VEE FORM TOOL, making a V-bottom but leaving top of thread with proper amount of flat.

The two right-hand columns give proper Depth of Compound Feed to obtain correct depth of thread with compound rest set at 29°.

Threads per Inch	Pitch Inches	(I) When Cut with NATIONAL FORM TOOL		(II) When Cut with VEE FORM TOOL		Depth of Compound Feed Single Depth	
		Single Depth of Thread	Double Depth of Thread	Single Depth of Thread	Double Depth of Thread	N. F. Tool	Vee Form Tool
4	.2500	.1624	.3248	.1894	.3789	.186	.216
4½	.2222	.1443	.2887	.1684	.3368	.165	.193
5	.2000	.1299	.2598	.1516	.3031	.148	.173
5½	.1818	.1181	.2362	.1378	.2755	.135	.157
6	.1667	.1083	.2165	.1263	.2525	.124	.144
7	.1429	.0928	.1856	.1082	.2165	.106	.123
8	.1250	.0812	.1624	.0947	.1894	.093	.108
9	.1111	.0722	.1443	.0842	.1684	.083	.095
10	.1000	.0650	.1299	.0758	.1515	.074	.087
11	.0909	.0590	.1181	.0689	.1377	.067	.078
12	.0833	.0541	.1083	.0631	.1263	.062	.072
13	.0769	.0500	.0999	.0583	.1166	.057	.067
14	.0714	.0464	.0928	.0541	.1082	.053	.062
16	.0625	.0406	.0812	.0473	.0947	.046	.054
18	.0556	.0361	.0722	.0421	.0842	.041	.047
20	.0500	.0325	.0650	.0379	.0758	.037	.043
22	.0454	.0295	.0590	.0345	.0690	.034	.038
24	.0417	.0271	.0541	.0316	.0632	.031	.036
27	.0370	.0241	.0481	.0281	.0562	.028	.032
28	.0357	.0232	.0464	.0270	.0541	.027	.031
30	.0333	.0217	.0433	.0253	.0506	.025	.029
32	.0313	.0203	.0406	.0237	.0474	.023	.027
36	.0278	.0180	.0361	.0211	.0421	.021	.024
40	.0250	.0162	.0325	.0189	.0379	.019	.021
44	.0227	.0148	.0295	.0172	.0345	.017	.020
48	.0208	.0135	.0271	.0157	.0315	.015	.018
50	.0200	.0130	.0260	.0151	.0303	.015	.017
56	.0179	.0116	.0232	.0135	.0271	.013	.016
64	.0156	.0101	.0203	.0118	.0237	.012	.014
72	.0139	.0090	.0180	.0105	.0210	.010	.012
80	.0125	.0081	.0162	.00945	.0189	.009	.011
96	.0104	.0068	.0136	.00901	.01802	.008	.010

**NOTE:** USING NATIONAL FORM TOOL Minor Diameter = Major Diameter *minus* Double Depth of Thread in National Form Tool column.

USING VEE FORM TOOL Minor Diameter = Major Diameter *minus* Double Depth of Thread in Vee Form Tool column.

# 60° V-TYPE THREAD DIMENSIONS

WITH SIZES OF TAP DRILL AND CLEARANCE DRILL

## NATIONAL COARSE THREAD SERIES (FORMERLY U. S. STANDARD)

Nominal Size	Threads per Inch	Major Diameter Inches	Minor Diameter Inches	Pitch Diameter Inches	Tap Drill for 75% Thread †	Clearance Drill Size *
1	64	.0730	.0527	.0629	53	47
2	56	.0860	.0628	.0744	50	42
3	48	.0990	.0719	.0855	47	36
4	40	.1120	.0795	.0958	43	31
5 (1/8)	40	.1250	.0925	.1088	38	29
6	32	.1380	.0974	.1177	36	25
8	32	.1640	.1234	.1437	29	16
10	24	.1900	.1359	.1629	25	13/64"
12	24	.2160	.1619	.1889	16	7/32"
1/4"	20	.2500	.1850	.2175	7	17/64"
5/16"	18	.3125	.2403	.2764	F	21/64"
3/8"	16	.3750	.2938	.3344	5/16"	25/64"
7/16"	14	.4375	.3447	.3911	U	29/64"
1/2"	13	.5000	.4001	.4500	27/64"	33/64"
9/16"	12	.5625	.4542	.5084	31/64"	37/64"
5/8"	11	.6250	.5069	.5660	17/32"	41/64"
3/4"	10	.7500	.6201	.6850	21/32"	49/64"
7/8"	9	.8750	.7301	.8028	49/64"	57/64"
1"	8	1.0000	.8376	.9188	7/8"	1 1/64"
1 1/8"	7	1.1250	.9394	1.0322	63/64"	1 9/64"
1 1/4"	7	1.2500	1.0644	1.1572	1 7/64"	1 17/64"
1 3/8"	6	1.3750	1.1585	1.2667	1 7/32"	1 25/64"
1 1/2"	6	1.5000	1.2835	1.3917	1 11/32"	1 33/64"
1 3/4"	5	1.7500	1.4902	1.6201	1 9/16"	1 49/64"
2"	4 1/2	2.0000	1.7113	1.8557	1 25/32"	2 1/32"
2 1/4"	4 1/2	2.2500	1.9613	2.1057	2 3/32"	2 9/32"
2 1/2"	4	2.5000	2.1752	2.3376	2 1/4"	2 17/32"
2 3/4"	4	2.7500	2.4252	2.5876	2 1/2"	2 25/32"
3"	4	3.0000	2.6752	2.8376	2 3/4"	3 1/32"
3 1/4"	4	3.2500	2.9252	3.0876	3"	3 9/32"
3 1/2"	4	3.5000	3.1752	3.3376	3 1/4"	3 17/32"
3 3/4"	4	3.7500	3.4252	3.5876	3 1/2"	3 25/32"
4"	4	4.0000	3.6752	3.8376	3 3/4"	4 1/32"

† Refer to tables of "DIAMETERS OF NUMBERED DRILLS" and "DIAMETERS OF LETTERED DRILLS" for sizes.

\* Clearance drill makes hole with standard clearance for diameter of nominal size.

# 60° V-TYPE THREAD DIMENSIONS

WITH SIZES OF TAP DRILL AND CLEARANCE DRILL

## NATIONAL FINE THREAD SERIES

(FORMERLY S. A. E.)

Nominal Size	Threads per Inch	Major Diameter Inches	Minor Diameter Inches	Pitch Diameter Inches	Tap Drill for 75% Thread †	Clearance Drill Size *
0	80	.0600	.0438	.0519	$\frac{3}{64}$ "	51
1	72	.0730	.0550	.0640	53	47
2	64	.0860	.0657	.0759	50	42
3	56	.0990	.0758	.0874	45	36
4	48	.1120	.0849	.0985	42	31
5 ( $\frac{1}{8}$ )	44	.1250	.0955	.1102	37	29
6	40	.1380	.1055	.1218	33	25
8	36	.1640	.1279	.1460	29	16
10	32	.1900	.1494	.1697	21	$\frac{13}{64}$ "
12	28	.2160	.1696	.1928	14	$\frac{7}{32}$ "
$\frac{1}{4}$ "	28	.2500	.2036	.2268	3	$\frac{17}{64}$ "
$\frac{5}{16}$ "	24	.3125	.2584	.2854	1	$\frac{21}{64}$ "
$\frac{3}{8}$ "	24	.3750	.3209	.3479	Q	$\frac{25}{64}$ "
$\frac{7}{16}$ "	20	.4375	.3726	.4050	$\frac{25}{64}$ "	$\frac{29}{64}$ "
$\frac{1}{2}$ "	20	.5000	.4351	.4675	$\frac{29}{64}$ "	$\frac{33}{64}$ "
$\frac{9}{16}$ "	18	.5625	.4903	.5264	$\frac{33}{64}$ "	$\frac{37}{64}$ "
$\frac{5}{8}$ "	18	.6250	.5528	.5889	$\frac{37}{64}$ "	$\frac{41}{64}$ "
$\frac{3}{4}$ "	16	.7500	.6688	.7094	$\frac{11}{16}$ "	$\frac{49}{64}$ "
$\frac{7}{8}$ "	14	.8750	.7822	.8286	$\frac{13}{16}$ "	$\frac{57}{64}$ "
1"	14	1.0000	.9072	.9536	$\frac{15}{16}$ "	1 $\frac{1}{64}$ "
1 $\frac{1}{8}$ "	12	1.1250	1.0168	1.0709	1 $\frac{3}{64}$ "	1 $\frac{9}{64}$ "
1 $\frac{1}{4}$ "	12	1.2500	1.1418	1.1959	1 $\frac{11}{64}$ "	1 $\frac{17}{64}$ "
1 $\frac{3}{8}$ "	12	1.3750	1.2668	1.3209	1 $\frac{19}{64}$ "	1 $\frac{25}{64}$ "
1 $\frac{1}{2}$ "	12	1.5000	1.3918	1.4459	1 $\frac{27}{64}$ "	1 $\frac{33}{64}$ "

† Refer to tables of "DIAMETERS OF NUMBERED DRILLS" and "DIAMETERS OF LETTERED DRILLS" for sizes.

\* Clearance drill makes hole with standard clearance for diameter of nominal size.

# 60° V-TYPE THREAD DIMENSIONS

WITH SIZES OF TAP DRILL AND CLEARANCE DRILL

## FRACTIONAL SIZES

### NATIONAL SPECIAL THREAD SERIES

Nominal Size	Threads per Inch	Major Diameter Inches	Minor Diameter Inches	Pitch Diameter Inches	Tap Drill for 75% Thread †	Clearance Drill Size *
1/16"	64	.0625	.0422	.0524	3/64"	51
5/64"	60	.0781	.0563	.0673	1/16"	45
3/32"	48	.0938	.0667	.0803	49	40
7/64"	48	.1094	.0823	.0959	43	32
1/8"	32	.1250	.0844	.1047	3/32"	29
9/64"	40	.1406	.1081	.1244	32	24
5/32"	32	.1563	.1157	.1360	1/8"	19
5/32"	36	.1563	.1202	.1382	30	19
11/64"	32	.1719	.1313	.1516	9/64"	14
3/16"	24	.1875	.1334	.1604	26	8
3/16"	32	.1875	.1469	.1672	22	8
13/64"	24	.2031	.1490	.1760	20	3
7/32"	24	.2188	.1646	.1917	16	1
7/32"	32	.2188	.1782	.1985	12	1
15/64"	24	.2344	.1806	.2073	10	1/4"
1/4"	24	.2500	.1959	.2229	4	17/64"
1/4"	27	.2500	.2019	.2260	3	17/64"
1/4"	32	.2500	.2094	.2297	7/32"	17/64"
5/16"	20	.3125	.2476	.2800	17/64"	21/64"
5/16"	27	.3125	.2644	.2884	J	21/64"
5/16"	32	.3125	.2719	.2922	9/32"	21/64"
3/8"	20	.3750	.3100	.3425	21/64"	25/64"
3/8"	27	.3750	.3269	.3509	R	25/64"
7/16"	24	.4375	.3834	.4104	X	29/64"
7/16"	27	.4375	.3894	.4134	Y	29/64"
1/2"	12	.5000	.3918	.4459	27/64"	33/64"
1/2"	24	.5000	.4459	.4729	29/64"	33/64"
1/2"	27	.5000	.4519	.4759	15/32"	33/64"
9/16"	27	.5625	.5144	.5384	17/32"	37/64"
5/8"	12	.6250	.5168	.5709	35/64"	41/64"
5/8"	27	.6250	.5769	.6009	19/32"	41/64"
11/16"	11	.6875	.5694	.6285	19/32"	45/64"
11/16"	16	.6875	.6063	.6469	5/8"	45/64"
3/4"	12	.7500	.6418	.6959	43/64"	49/64"
3/4"	27	.7500	.7019	.7259	23/32"	49/64"
13/16"	10	.8125	.6826	.7476	23/32"	53/64"
7/8"	12	.8750	.7668	.8209	51/64"	57/64"
7/8"	18**	.8750	.8028	.8389	53/64"	57/64"
7/8"	27	.8750	.8269	.8509	27/32"	57/64"
15/16"	9	.9375	.7932	.8654	53/64"	61/64"
1"	12	1.0000	.8918	.9459	59/64"	1 1/64"
1"	27	1.0000	.9519	.9759	31/32"	1 1/64"
1 5/8"	5 1/2	1.6250	1.3888	1.5069	1 29/64"	1 41/64"
1 7/8"	5	1.8750	1.6152	1.7451	1 11/16"	1 57/64"
2 1/8"	4 1/2	2.1250	1.8363	1.9807	1 29/32"	2 9/32"
2 3/8"	4	2.3750	2.0502	2.2126	2 1/8"	2 13/32"

† Refer to tables of "DIAMETERS OF NUMBERED DRILLS" and "DIAMETERS OF LETTERED DRILLS" for sizes.

\* Clearance drill makes hole with standard clearance for diameter of nominal size.

\*\* Standard spark plug size.

# 60° V-TYPE THREAD DIMENSIONS

WITH SIZES OF TAP DRILL AND CLEARANCE DRILL

## INTERNATIONAL STANDARD—METRIC

Major Diameter m/m	Pitch m/m	Minor Diameter m/m	Pitch Diameter m/m	Tap Drill for 75% Thread m/m	Tap Drill for 75% Thread † No. or Inches	Clearance Drill Size *
2.0	.40	1.48	1.740	1.6	1/16"	41
2.3	.40	1.78	2.040	1.9	48	36
2.6	.45	2.02	2.308	2.1	45	31
3.0	.50	2.35	2.675	2.5	40	29
3.5	.60	2.72	3.110	2.9	33	23
4.0	.70	3.09	3.545	3.3	30	16
4.5	.75	3.53	4.013	3.75	26	10
5.0	.80	3.96	4.480	4.2	19	3
5.5	.90	4.33	4.915	4.6	14	15/64"
6.0	1.00	4.70	5.350	5.0	9	1/4"
7.0	1.00	5.70	6.350	6.0	15/64"	19/64"
8.0	1.25	6.38	7.188	6.8	H	11/32"
9.0	1.25	7.38	8.188	7.8	5/16"	3/8"
10.0	1.50	8.05	9.026	8.6	R	27/64"
11.0	1.50	9.05	10.026	9.6	V	29/64"
12.0	1.75	9.73	10.863	10.5	Z	1/2"
14.0**	1.25	12.38	13.188	13.0	33/64"	9/16"
14.0	2.00	11.40	12.701	12.0	15/32"	9/16"
16.0	2.00	13.40	14.701	14.0	35/64"	21/32"
18.0**	1.50	16.05	17.026	16.5	41/64"	47/64"
18.0	2.50	14.75	16.376	15.5	39/64"	47/64"
20.0	2.50	16.75	18.376	17.5	11/16"	13/16"
22.0	2.50	18.75	20.376	19.5	49/64"	57/64"
24.0	3.00	20.10	22.051	21.0	53/64"	31/32"
27.0	3.00	23.10	25.051	24.0	15/16"	1 3/32"
30.0	3.50	25.45	27.727	26.5	1 3/64"	1 13/64"
33.0	3.50	28.45	30.727	29.5	1 11/64"	1 21/64"
36.0	4.00	30.80	33.402	32.0	1 17/64"	1 7/16"
39.0	4.0	33.80	36.402	35.0	1 3/8"	1 9/16"
42.0	4.50	36.15	39.077	37.0	1 29/64"	1 43/64"
45.0	4.50	39.15	42.077	40.0	1 37/64"	1 13/16"
48.0	5.00	41.50	44.752	43.0	1 11/16"	1 29/32"

† Refer to tables of "DIAMETERS OF NUMBERED DRILLS" and "DIAMETERS OF LETTERED DRILLS" for sizes.

\* Clearance drill makes hole with standard clearance for diameter of nominal size.

\*\* Standard spark plug size.



# 60° V-TYPE THREAD DIMENSIONS

WITH SIZES OF TAP DRILL AND CLEARANCE DRILL

## MACHINE SCREW SIZES

NATIONAL SPECIAL THREAD SERIES

Nominal Size	Threads per Inch	Major Diameter Inches	Minor Diameter Inches	Pitch Diameter Inches	Tap Drill for 75% Thread †	Clearance Drill Size *
1	56	.0730	.0498	.0614	54	47
4	32	.1120	.0714	.0917	45	31
4	36	.1120	.0759	.0940	44	31
5 (1/4)	36	.1250	.0889	.1070	40	29
6	36	.1380	.1019	.1200	34	25
7	30	.1510	.1077	.1294	31	21
7	36	.1510	.1149	.1330	1/4"	21
8	30	.1640	.1207	.1423	30	16
8	40	.1640	.1315	.1478	28	16
9	24	.1770	.1229	.1499	29	13
9	30	.1770	.1337	.1553	27	13
9	32	.1770	.1364	.1567	26	13
10	28	.1900	.1436	.1668	23	13/64"
10	30	.1900	.1467	.1684	22	13/64"
12	32	.2160	.1754	.1957	13	7/32"
14	20	.2420	.1770	.2095	10	17/64"
14	24	.2420	.1879	.2149	7	17/64"

† Refer to tables of "DIAMETERS OF NUMBERED DRILLS" and "DIAMETERS OF LETTERED DRILLS" for sizes.

\* Clearance drill makes hole with standard clearance for diameter of nominal size.

## STRAIGHT PIPE THREADS

AMERICAN STANDARD FORM

Nominal Pipe Size	Threads per Inch	Major Diameter Inches	Minor Diameter Inches	Pitch Diameter Inches	Tap Drill for Full Thread
1/8"	27	.4044	.3451	.3748	11/32"
1/4"	18	.5343	.4455	.4899	7/16"
3/8"	18	.6714	.5826	.6270	37/64"
1/2"	14	.8356	.7213	.7784	23/32"
3/4"	14	1.0460	.9318	.9889	59/64"
1"	11 1/2	1.3082	1.1690	1.2386	1 5/32"
1 1/4"	11 1/2	1.6530	1.5138	1.5834	1 1/2"
1 1/2"	11 1/2	1.8919	1.7527	1.8223	1 47/64"
2"	11 1/2	2.3658	2.2267	2.2963	2 7/32"
2 1/2"	8	2.8622	2.6622	2.7622	2 5/8"
3"	8	3.4885	3.2885	3.3885	3 1/4"
3 1/2"	8	3.9888	3.7888	3.8888	3 3/4"
4"	8	4.4871	4.2871	4.3871	4 1/4"

## DIAMETERS OF NUMBERED DRILLS

Drill No.	Diameter Inches	Drill No.	Diameter Inches	Drill No.	Diameter Inches
80	.0135	53	.0595	26	.1470
79	.0145	52	.0635	25	.1495
78	.0160	51	.0670	24	.1520
77	.0180	50	.0700	23	.1540
76	.0200	49	.0730	22	.1570
75	.0210	48	.0760	21	.1590
74	.0225	47	.0785	20	.1610
73	.0240	46	.0810	19	.1660
72	.0250	45	.0820	18	.1695
71	.0260	44	.0860	17	.1730
70	.0280	43	.0890	16	.1770
69	.0292	42	.0935	15	.1800
68	.0310	41	.0960	14	.1820
67	.0320	40	.0980	13	.1850
66	.0330	39	.0995	12	.1890
65	.0350	38	.1015	11	.1910
64	.0360	37	.1040	10	.1935
63	.0370	36	.1065	9	.1960
62	.0380	35	.1100	8	.1990
61	.0390	34	.1110	7	.2010
60	.0400	33	.1130	6	.2040
59	.0410	32	.1160	5	.2055
58	.0420	31	.1200	4	.2090
57	.0430	30	.1285	3	.2130
56	.0465	29	.1360	2	.2210
55	.0520	28	.1405	1	.2280
54	.0550	27	.1440		

## DIAMETERS OF LETTERED DRILLS

Drill Letter	Diameter Inches	Drill Letter	Diameter Inches	Drill Letter	Diameter Inches
A	.2340	I	.2720	Q	.3320
B	.2380	J	.2770	R	.3390
C	.2420	K	.2810	S	.3480
D	.2460	L	.2900	T	.3580
E	.2500	M	.2950	U	.3680
F	.2570	N	.3020	V	.3770
G	.2610	O	.3160	W	.3860
H	.2660	P	.3230	X	.3970
				Y	.4040
				Z	.4130

# CIRCUMFERENCES AND AREAS OF CIRCLES FROM $\frac{1}{64}$ TO $19\frac{7}{8}$ , IN INCHES

Diameter	Circumference	Area	Diameter	Circumference	Area	Diameter	Circumference	Area
$\frac{1}{64}$	.0491	.0002	6	18.8496	28.2744	13	40.8408	132.733
$\frac{1}{32}$	.0982	.0008	$6\frac{1}{8}$	19.2423	29.4648	$13\frac{1}{8}$	41.2335	135.297
$\frac{1}{16}$	.1964	.0031	$6\frac{1}{4}$	19.6350	30.6797	$13\frac{1}{4}$	41.6262	137.887
$\frac{1}{8}$	.3927	.0123	$6\frac{3}{8}$	20.0277	31.9191	$13\frac{3}{8}$	42.0189	140.501
$\frac{3}{16}$	.5890	.0276	$6\frac{1}{2}$	20.4204	33.1831	$13\frac{1}{2}$	42.4116	143.139
$\frac{1}{4}$	.7854	.0491	$6\frac{5}{8}$	20.8131	34.4717	$13\frac{5}{8}$	42.8043	145.802
$\frac{5}{16}$	.9817	.0767	$6\frac{3}{4}$	21.2058	35.7848	$13\frac{3}{4}$	43.1970	148.490
$\frac{3}{8}$	1.1781	.1105	$6\frac{7}{8}$	21.5985	37.1224	$13\frac{7}{8}$	43.5897	151.202
$\frac{7}{16}$	1.3745	.1503	7	21.9912	38.4846	14	43.9824	153.938
$\frac{1}{2}$	1.5708	.1964	$7\frac{1}{8}$	22.3839	39.8713	$14\frac{1}{8}$	44.3751	156.700
$\frac{9}{16}$	1.7672	.2485	$7\frac{1}{4}$	22.7766	41.2826	$14\frac{1}{4}$	44.7678	159.485
$\frac{5}{8}$	1.9635	.3068	$7\frac{3}{8}$	23.1693	42.7184	$14\frac{3}{8}$	45.1605	162.296
$\frac{11}{16}$	2.1598	.3712	$7\frac{1}{2}$	23.5620	44.1787	$14\frac{1}{2}$	45.5532	165.130
$\frac{3}{4}$	2.3562	.4418	$7\frac{5}{8}$	23.9547	45.6636	$14\frac{5}{8}$	45.9459	167.990
$\frac{13}{16}$	2.5525	.5185	$7\frac{3}{4}$	24.3474	47.1731	$14\frac{3}{4}$	46.3386	170.874
$\frac{7}{8}$	2.7489	.6013	$7\frac{7}{8}$	24.7401	48.7071	$14\frac{7}{8}$	46.7313	173.782
$1\frac{1}{16}$	2.9452	.6903	8	25.1328	50.2656	15	47.1240	176.715
1	3.1416	.7854	$8\frac{1}{8}$	25.5255	51.8487	$15\frac{1}{8}$	47.5167	179.673
$1\frac{1}{8}$	3.5343	.9940	$8\frac{1}{4}$	25.9182	53.4563	$15\frac{1}{4}$	47.9094	182.655
$1\frac{1}{4}$	3.9270	1.2272	$8\frac{3}{8}$	26.3109	55.0884	$15\frac{3}{8}$	48.3021	185.661
$1\frac{3}{8}$	4.3197	1.4849	$8\frac{1}{2}$	26.7036	56.7451	$15\frac{1}{2}$	48.6948	188.692
$1\frac{1}{2}$	4.7124	1.7671	$8\frac{5}{8}$	27.0963	58.4264	$15\frac{5}{8}$	49.0875	191.748
$1\frac{5}{8}$	5.1051	2.0739	$8\frac{3}{4}$	27.4890	60.1322	$15\frac{3}{4}$	49.4802	194.828
$1\frac{3}{4}$	5.4978	2.4053	$8\frac{7}{8}$	27.8817	61.8625	$15\frac{7}{8}$	49.8729	197.933
$1\frac{7}{8}$	5.8905	2.7612	9	28.2744	63.6174	16	50.2656	201.062
2	6.2832	3.1416	$9\frac{1}{8}$	28.6671	65.3968	$16\frac{1}{8}$	50.6583	204.216
$2\frac{1}{8}$	6.6759	3.5466	$9\frac{1}{4}$	29.0598	67.2008	$16\frac{1}{4}$	51.0510	207.395
$2\frac{1}{4}$	7.0686	3.9761	$9\frac{3}{8}$	29.4525	69.0293	$16\frac{3}{8}$	51.4437	210.598
$2\frac{3}{8}$	7.4613	4.4301	$9\frac{1}{2}$	29.8452	70.8823	$16\frac{1}{2}$	51.8364	213.825
$2\frac{1}{2}$	7.8540	4.9087	$9\frac{5}{8}$	30.2379	72.7599	$16\frac{5}{8}$	52.2291	217.077
$2\frac{5}{8}$	8.2467	5.4119	$9\frac{3}{4}$	30.6306	74.6621	$16\frac{3}{4}$	52.6218	220.354
$2\frac{3}{4}$	8.6394	5.9396	$9\frac{7}{8}$	31.0233	76.589	$16\frac{7}{8}$	53.0145	223.655
$2\frac{7}{8}$	9.0321	6.4918	10	31.4160	78.540	17	53.4072	226.981
3	9.4248	7.0686	$10\frac{1}{8}$	31.8087	80.516	$17\frac{1}{8}$	53.7999	230.331
$3\frac{1}{8}$	9.8175	7.6699	$10\frac{1}{4}$	32.2014	82.516	$17\frac{1}{4}$	54.1926	233.706
$3\frac{1}{4}$	10.2102	8.2958	$10\frac{3}{8}$	32.5941	84.541	$17\frac{3}{8}$	54.5853	237.105
$3\frac{3}{8}$	10.6029	8.9462	$10\frac{1}{2}$	32.9868	86.590	$17\frac{1}{2}$	54.9780	240.529
$3\frac{1}{2}$	10.9956	9.6211	$10\frac{5}{8}$	33.3795	88.664	$17\frac{5}{8}$	55.3707	243.977
$3\frac{5}{8}$	11.3883	10.3206	$10\frac{3}{4}$	33.7722	90.763	$17\frac{3}{4}$	55.7634	247.450
$3\frac{3}{4}$	11.7810	11.0447	$10\frac{7}{8}$	34.1649	92.886	$17\frac{7}{8}$	56.1561	250.948
$3\frac{7}{8}$	12.1737	11.7933	11	34.5576	95.033	18	56.5488	254.470
4	12.5664	12.5664	$11\frac{1}{8}$	34.9503	97.205	$18\frac{1}{8}$	56.9415	258.016
$4\frac{1}{8}$	12.9591	13.3641	$11\frac{1}{4}$	35.3430	99.402	$18\frac{1}{4}$	57.3342	261.587
$4\frac{1}{4}$	13.3518	14.1863	$11\frac{3}{8}$	35.7357	101.623	$18\frac{3}{8}$	57.7269	265.183
$4\frac{3}{8}$	13.7445	15.0330	$11\frac{1}{2}$	36.1283	103.869	$18\frac{1}{2}$	58.1196	268.803
$4\frac{1}{2}$	14.1372	15.9043	$11\frac{5}{8}$	36.5211	106.139	$18\frac{5}{8}$	58.5123	272.448
$4\frac{5}{8}$	14.5299	16.8002	$11\frac{3}{4}$	36.9138	108.434	$18\frac{3}{4}$	58.9050	276.117
$4\frac{3}{4}$	14.9226	17.7206	$11\frac{7}{8}$	37.3065	110.754	$18\frac{7}{8}$	59.2977	279.811
$4\frac{7}{8}$	15.3153	18.6655	12	37.6992	113.098	19	59.6904	283.529
5	15.7080	19.6350	$12\frac{1}{8}$	38.0919	115.466	$19\frac{1}{8}$	60.0831	287.272
$5\frac{1}{8}$	16.1007	20.6290	$12\frac{1}{4}$	38.4846	117.859	$19\frac{1}{4}$	60.4758	291.040
$5\frac{1}{4}$	16.4934	21.6476	$12\frac{3}{8}$	38.8773	120.277	$19\frac{3}{8}$	60.8685	294.832
$5\frac{3}{8}$	16.8864	22.6907	$12\frac{1}{2}$	39.2700	122.719	$19\frac{1}{2}$	61.2612	298.648
$5\frac{1}{2}$	17.2788	23.7583	$12\frac{5}{8}$	39.6627	125.185	$19\frac{5}{8}$	61.6539	302.489
$5\frac{5}{8}$	17.6715	24.8505	$12\frac{3}{4}$	40.0554	127.677	$19\frac{3}{4}$	62.0466	306.355
$5\frac{3}{4}$	18.0642	25.9673	$12\frac{7}{8}$	40.4481	130.192	$19\frac{7}{8}$	62.4393	310.245
$5\frac{7}{8}$	18.4569	27.1086						

# CIRCUMFERENCES AND AREAS OF CIRCLES FROM 20 TO 40%, IN INCHES

Diameter	Circumference	Area	Diameter	Circumference	Area	Diameter	Circumference	Area
20	62.8320	314.160	27	84.8232	572.557	34	106.814	907.922
20 <sup>1</sup> / <sub>8</sub>	63.2247	318.099	27 <sup>1</sup> / <sub>8</sub>	85.2159	577.870	34 <sup>1</sup> / <sub>8</sub>	107.207	914.611
20 <sup>1</sup> / <sub>4</sub>	63.6174	322.063	27 <sup>1</sup> / <sub>4</sub>	85.6086	583.209	34 <sup>1</sup> / <sub>4</sub>	107.600	921.323
20 <sup>3</sup> / <sub>8</sub>	64.0101	326.051	27 <sup>3</sup> / <sub>8</sub>	86.0013	588.571	34 <sup>3</sup> / <sub>8</sub>	107.992	928.061
20 <sup>1</sup> / <sub>2</sub>	64.4028	330.064	27 <sup>1</sup> / <sub>2</sub>	86.3940	593.959	34 <sup>1</sup> / <sub>2</sub>	108.385	934.822
20 <sup>5</sup> / <sub>8</sub>	64.7955	334.102	27 <sup>5</sup> / <sub>8</sub>	86.7867	599.371	34 <sup>5</sup> / <sub>8</sub>	108.778	941.609
20 <sup>3</sup> / <sub>4</sub>	65.1882	338.164	27 <sup>3</sup> / <sub>4</sub>	87.1794	604.807	34 <sup>3</sup> / <sub>4</sub>	109.171	948.420
20 <sup>7</sup> / <sub>8</sub>	65.5809	342.250	27 <sup>7</sup> / <sub>8</sub>	87.5721	610.268	34 <sup>7</sup> / <sub>8</sub>	109.563	955.255
21	65.9736	346.361	28	87.9648	615.754	35	109.956	962.115
21 <sup>1</sup> / <sub>8</sub>	66.3663	350.497	28 <sup>1</sup> / <sub>8</sub>	88.3575	621.264	35 <sup>1</sup> / <sub>8</sub>	110.349	969.000
21 <sup>1</sup> / <sub>4</sub>	66.7590	354.657	28 <sup>1</sup> / <sub>4</sub>	88.7502	626.798	35 <sup>1</sup> / <sub>4</sub>	110.741	975.909
21 <sup>3</sup> / <sub>8</sub>	67.1517	358.842	28 <sup>3</sup> / <sub>8</sub>	89.1429	632.357	35 <sup>3</sup> / <sub>8</sub>	111.134	982.842
21 <sup>1</sup> / <sub>2</sub>	67.5444	363.051	28 <sup>1</sup> / <sub>2</sub>	89.5356	637.941	35 <sup>1</sup> / <sub>2</sub>	111.527	989.800
21 <sup>5</sup> / <sub>8</sub>	67.9371	367.285	28 <sup>5</sup> / <sub>8</sub>	89.9283	643.549	35 <sup>5</sup> / <sub>8</sub>	111.919	996.783
21 <sup>3</sup> / <sub>4</sub>	68.3298	371.543	28 <sup>3</sup> / <sub>4</sub>	90.3210	649.182	35 <sup>3</sup> / <sub>4</sub>	112.312	1,003.790
21 <sup>7</sup> / <sub>8</sub>	68.7225	375.826	28 <sup>7</sup> / <sub>8</sub>	90.7137	654.840	35 <sup>7</sup> / <sub>8</sub>	112.705	1,010.822
22	69.1152	380.134	29	91.1064	660.521	36	113.098	1,017.878
22 <sup>1</sup> / <sub>8</sub>	69.5079	384.466	29 <sup>1</sup> / <sub>8</sub>	91.4991	666.228	36 <sup>1</sup> / <sub>8</sub>	113.490	1,024.960
22 <sup>1</sup> / <sub>4</sub>	69.9006	388.822	29 <sup>1</sup> / <sub>4</sub>	91.8918	671.959	36 <sup>1</sup> / <sub>4</sub>	113.883	1,032.065
22 <sup>3</sup> / <sub>8</sub>	70.2933	393.203	29 <sup>3</sup> / <sub>8</sub>	92.2845	677.714	36 <sup>3</sup> / <sub>8</sub>	114.276	1,039.195
22 <sup>1</sup> / <sub>2</sub>	70.6860	397.609	29 <sup>1</sup> / <sub>2</sub>	92.6772	683.494	36 <sup>1</sup> / <sub>2</sub>	114.668	1,046.349
22 <sup>5</sup> / <sub>8</sub>	71.0787	402.038	29 <sup>5</sup> / <sub>8</sub>	93.0699	689.299	36 <sup>5</sup> / <sub>8</sub>	115.061	1,053.528
22 <sup>3</sup> / <sub>4</sub>	71.4714	406.494	29 <sup>3</sup> / <sub>4</sub>	93.4626	695.128	36 <sup>3</sup> / <sub>4</sub>	115.454	1,060.732
22 <sup>7</sup> / <sub>8</sub>	71.8641	410.973	29 <sup>7</sup> / <sub>8</sub>	93.8553	700.982	36 <sup>7</sup> / <sub>8</sub>	115.846	1,067.960
23	72.2568	415.477	30	94.2480	706.860	37	116.239	1,075.213
23 <sup>1</sup> / <sub>8</sub>	72.6495	420.004	30 <sup>1</sup> / <sub>8</sub>	94.6407	712.763	37 <sup>1</sup> / <sub>8</sub>	116.632	1,082.490
23 <sup>1</sup> / <sub>4</sub>	73.0422	424.558	30 <sup>1</sup> / <sub>4</sub>	95.0334	718.690	37 <sup>1</sup> / <sub>4</sub>	117.025	1,089.792
23 <sup>3</sup> / <sub>8</sub>	73.4349	429.135	30 <sup>3</sup> / <sub>8</sub>	95.4261	724.642	37 <sup>3</sup> / <sub>8</sub>	117.417	1,097.118
23 <sup>1</sup> / <sub>2</sub>	73.8276	433.737	30 <sup>1</sup> / <sub>2</sub>	95.8188	730.618	37 <sup>1</sup> / <sub>2</sub>	117.810	1,104.469
23 <sup>5</sup> / <sub>8</sub>	74.2203	438.364	30 <sup>5</sup> / <sub>8</sub>	96.2115	736.619	37 <sup>5</sup> / <sub>8</sub>	118.202	1,111.844
23 <sup>3</sup> / <sub>4</sub>	74.6130	443.015	30 <sup>3</sup> / <sub>4</sub>	96.6042	742.645	37 <sup>3</sup> / <sub>4</sub>	118.595	1,119.244
23 <sup>7</sup> / <sub>8</sub>	75.0057	447.690	30 <sup>7</sup> / <sub>8</sub>	96.9969	748.695	37 <sup>7</sup> / <sub>8</sub>	118.988	1,126.669
24	75.3984	452.390	31	97.3896	754.769	38	119.381	1,134.118
24 <sup>1</sup> / <sub>8</sub>	75.7911	457.115	31 <sup>1</sup> / <sub>8</sub>	97.7823	760.869	38 <sup>1</sup> / <sub>8</sub>	119.773	1,141.591
24 <sup>1</sup> / <sub>4</sub>	76.1838	461.864	31 <sup>1</sup> / <sub>4</sub>	98.1750	766.992	38 <sup>1</sup> / <sub>4</sub>	120.166	1,149.089
24 <sup>3</sup> / <sub>8</sub>	76.5765	466.638	31 <sup>3</sup> / <sub>8</sub>	98.5677	773.140	38 <sup>3</sup> / <sub>8</sub>	120.559	1,156.612
24 <sup>1</sup> / <sub>2</sub>	76.9692	471.436	31 <sup>1</sup> / <sub>2</sub>	98.9604	779.313	38 <sup>1</sup> / <sub>2</sub>	120.952	1,164.159
24 <sup>5</sup> / <sub>8</sub>	77.3619	476.259	31 <sup>5</sup> / <sub>8</sub>	99.3531	785.510	38 <sup>5</sup> / <sub>8</sub>	121.344	1,171.731
24 <sup>3</sup> / <sub>4</sub>	77.7546	481.107	31 <sup>3</sup> / <sub>4</sub>	99.7458	791.732	38 <sup>3</sup> / <sub>4</sub>	121.737	1,179.327
24 <sup>7</sup> / <sub>8</sub>	78.1473	485.979	31 <sup>7</sup> / <sub>8</sub>	100.138	797.979	38 <sup>7</sup> / <sub>8</sub>	122.130	1,186.948
25	78.5400	490.875	32	100.531	804.250	39	122.522	1,194.593
25 <sup>1</sup> / <sub>8</sub>	78.9327	495.796	32 <sup>1</sup> / <sub>8</sub>	100.924	810.545	39 <sup>1</sup> / <sub>8</sub>	122.915	1,202.263
25 <sup>1</sup> / <sub>4</sub>	79.3254	500.742	32 <sup>1</sup> / <sub>4</sub>	101.316	816.865	39 <sup>1</sup> / <sub>4</sub>	123.308	1,209.958
25 <sup>3</sup> / <sub>8</sub>	79.7181	505.712	32 <sup>3</sup> / <sub>8</sub>	101.709	823.210	39 <sup>3</sup> / <sub>8</sub>	123.700	1,217.677
25 <sup>1</sup> / <sub>2</sub>	80.1108	510.706	32 <sup>1</sup> / <sub>2</sub>	102.102	829.579	39 <sup>1</sup> / <sub>2</sub>	124.093	1,225.420
25 <sup>5</sup> / <sub>8</sub>	80.5035	515.726	32 <sup>5</sup> / <sub>8</sub>	102.494	835.972	39 <sup>5</sup> / <sub>8</sub>	124.486	1,233.188
25 <sup>3</sup> / <sub>4</sub>	80.8962	520.769	32 <sup>3</sup> / <sub>4</sub>	102.887	842.391	39 <sup>3</sup> / <sub>4</sub>	124.879	1,240.981
25 <sup>7</sup> / <sub>8</sub>	81.2889	525.838	32 <sup>7</sup> / <sub>8</sub>	103.280	848.833	39 <sup>7</sup> / <sub>8</sub>	125.271	1,248.798
26	81.6816	530.930	33	103.673	855.301	40	125.664	1,256.640
26 <sup>1</sup> / <sub>8</sub>	82.0743	536.048	33 <sup>1</sup> / <sub>8</sub>	104.065	861.792	40 <sup>1</sup> / <sub>8</sub>	126.056	1,264.506
26 <sup>1</sup> / <sub>4</sub>	82.4670	541.190	33 <sup>1</sup> / <sub>4</sub>	104.458	868.309	40 <sup>1</sup> / <sub>4</sub>	126.449	1,272.397
26 <sup>3</sup> / <sub>8</sub>	82.8597	546.356	33 <sup>3</sup> / <sub>8</sub>	104.851	874.850	40 <sup>3</sup> / <sub>8</sub>	126.842	1,280.312
26 <sup>1</sup> / <sub>2</sub>	83.2524	551.547	33 <sup>1</sup> / <sub>2</sub>	105.244	881.415	40 <sup>1</sup> / <sub>2</sub>	127.235	1,288.252
26 <sup>5</sup> / <sub>8</sub>	83.6451	556.763	33 <sup>5</sup> / <sub>8</sub>	105.636	888.005	40 <sup>5</sup> / <sub>8</sub>	127.627	1,296.217
26 <sup>3</sup> / <sub>4</sub>	84.0378	562.003	33 <sup>3</sup> / <sub>4</sub>	106.029	894.620	40 <sup>3</sup> / <sub>4</sub>	128.020	1,304.206
26 <sup>7</sup> / <sub>8</sub>	84.4305	567.267	33 <sup>7</sup> / <sub>8</sub>	106.422	901.259	40 <sup>7</sup> / <sub>8</sub>	128.413	1,312.219