APPENDIX I

GLOSSARY

AISI—American Iron and Steel Institute.

ABRASIVE—A hard, tough substance that has many sharp edges.

ALLOWANCE—The difference between maximum size limits of mating parts.

ALLOYING—The procedure of adding elements other than those usually comprising a metal or alloy to change its characteristics and properties.

ALLOYING ELEMENTS—Elements added to nonferrous and ferrous metals and alloys to change their characteristics and properties.

ANNEALING—The softening of metal by heating and slow cooling.

ARBOR—The principal axis member, or spindle, of a machine by which a motion of revolution is transmitted.

ASTM—American Society for Testing Metals.

BABBITT—A lead base alloy used for bearings.

BEND ALLOWANCE—An additional amount of metal used in a bend in metal fabrication.

BENCH MOLDING—The process of making small molds on a bench.

BEVEL—A term for a plane having any angle other than 90° to a given reference plane.

BINARY ALLOY—An alloy of two metals.

BISECT—To divide into two equal parts.

BLOWHOLE—A hole in a casting caused by trapped air or gases.

BOND—Appropriate substance used to hold grains together in grinding wheels.

BORING BAR—A tool used for boring, counter-boring, reboring, facing, grooving, and so forth, where true alignment is of primary importance.

BRINELL—A type of hardness test.

BRITTLENESS—The property of a material that causes it to break or snap suddenly with little or no prior sign of deformation.

BRONZE—A nonferrous alloy composed of copper and tin and sometimes other elements.

CALIBRATION—The procedure required to adjust an instrument or device to produce a standardized output with a given input.

CARBON—An alloying element.

CASTING—A metal object made by pouring melted metal into a mold.

CHAMFER—A bevel surface formed by cutting away the angle of one or two intersecting faces of a piece of material.

CONTOUR—The outline of a figure or body.

DRIFT PIN—A conical-shaped pin gradually tapered from a blunt point to a diameter larger than the hole diameter.

DUCTILITY—The ability to be molded or shaped without breaking.

EXTRACTOR—Tool used in removal of broken taps.

FABRICATE—To shape, assemble, and secure in place component parts to form a complete device.

FALSE CHUCK—Sometimes applied to the facing material used in rechucking a piece of work in the lathe.

FATIGUE—The tendency of a material to break under repeated strain.

FILE FINISH—Finishing a metal surface with a file.

FILLET—A concave internal corner in a metal component.

FINISH ALLOWANCE—An amount of stock left on the surface of a casting to allow for machine finishing.

FINISH MARKS—Marks used to indicate the degree of smoothness of finish to be achieved on surfaces to be machined.

GRAIN—The cutting particles of a grinding wheel.

HARDNESS—The ability of a material to resist penetration.

HONING—Finishing machine operation using stones vice a tool bit or cutting tool.

INVOLUTE—Usually referred to as a cutter used in gearing.

KNOOP—Trade name used in hardness testing.

MANDREL—Tool used to mount work usually done in a lathe or milling machine.

NORMALIZING—Heating iron-base alloys to approximately 100°F above the critical temperature range followed by cooling to below that range in still air at room temperature.

PERPENDICULAR—A straight line that meets another straight line at a 90 degree angle. Also a vertical line extending through the outline of the hull ends and the designer's waterline.

PIG IRON—Cast iron as it comes from the blast furnace in which it was produced from iron ore.

PINHOLE—Small hole under the surface of the casting.

PLAN—A drawing prepared for use in building a ship.

PLASTICITY—The property that enables a material to be excessively and permanently deformed without breaking.

PREHEATING—The application of heat to the base metal before it is welded or cut.

PUNCH, PRICK—A small punch used to transfer the holes from the template to the plate. Also called a **CENTER PUNCH.**

QUENCHING—Rapid cooling of steels at different rates.

REAMING—Enlarging a hole by revolving in it a cylindrical, slightly tapered tool with cutting edges running along its sides.

RECHUCKING—Reversing of a piece of work on a faceplate so that the surface that was against the faceplate may be turned to shape.

REFERENCE PLANE—On a drawing, the normal plane from which all information is referenced.

RPM—Revolutions per minute.

SCALE—The ratio between the measurement used on a drawing and the measurement of the object it represents. A measuring device such as a ruler, having special graduations.

SECTOR—A figure bounded by two radii and the included arc of a circle, ellipse, or other central curve.

SPOT FACING—Turning a circular bearing surface about a hole. It does not affect a pattern.

STANDARD CASING—The half of a split casing that is bolted to the foundation, as opposed to the half, or cover, which can be removed with minimum disturbance to other elements of the equipment.

STRAIGHTEDGE—Relatively long piece of material whose working edge is a true plane.

STRENGTH—The ability of a material to resist strain.

STRESS RELIEVING—Heat treatment to remove stresses or casting strains.

STUD—(1) A light vertical structure member, usually of wood or light structural steel, used as part of a wall and for supporting moderate loads. (2) A bolt threaded on both ends, one end of which is screwed into a hole drilled and tapped in the work, and used where a through bolt cannot be fitted.

SYNTHETIC MATERIAL—A complex chemical compound that is artificially formed by the combining of two or more simpler compounds or elements.

TEMPER—To relieve internal stress by heat treating.

TEMPLATE—A pattern used to reproduce parts.

TOLERANCE—An allowable variation in the dimensions of a machined part.

VICKERS—A scale or test used in metal hardness testing.

VITRIFIED BOND—A man-made bond used in grinding wheels.

WAVINESS—Used as a term in the testing finish machining of parts.

ZINC—An alloy used widely in die casting.

APPENDIX II

TABULAR INFORMATION OF BENEFIT TO A MACHINERY REPAIRMAN

Table AII-1.—Decimal Equivalents of Fractions (inch)

fractions	# 64ths	# 32ds	# 16ths	# 8ths	# 4ths	decimal equiv.	fractions	# 64ths	# 32ds	# 16ths	# 8ths	# 4ths	decimal equiv.
1/64	1	.....	.....	.....	.....	0.015625	33/64	33	.....	.....	.....	.....	0.515625
1/32	2	1	.....	.....	.....	0.03125	17/32	34	17	.....	.....	.....	0.53125
3/64	3	.....	.....	.....	.....	0.046875	35/64	35	.....	.....	.....	.....	0.546875
1/16	4	2	1	.....	.....	0.0625	9/16	36	18	9	.....	.....	0.5625
5/64	5	.....	.....	.....	.....	0.078125	37/64	37	.....	.....	.....	.....	0.578125
3/32	6	3	.....	.....	.....	0.09375	19/32	38	19	.....	.....	.....	0.59375
7/64	7	.....	.....	.....	.....	0.109375	39/64	39	.....	.....	.....	.....	0.609375
1/8	8	4	2	1	.....	0.125	5/8	40	20	10	5	.....	0.625
9/64	9	.....	.....	.....	.....	0.140625	41/64	41	.....	.....	.....	.....	0.640625
5/32	10	5	.....	.....	.....	0.15625	21/32	42	21	.....	.....	.....	0.65625
11/64	11	.....	.....	.....	.....	0.171875	43/64	43	.....	.....	.....	.....	0.671875
3/16	12	6	3	.....	.....	0.1875	11/16	44	22	11	.....	.....	0.6875
13/64	13	.....	.....	.....	.....	0.203125	45/64	45	.....	.....	.....	.....	0.703125
7/32	14	7	.....	.....	.....	0.21875	23/32	46	23	.....	.....	.....	0.71875
15/64	15	.....	.....	.....	.....	0.234375	47/64	47	.....	.....	.....	.....	0.734375
1/4	16	8	4	2	1	0.250	3/4	48	24	12	6	3	0.750
17/64	17	.....	.....	.....	.....	0.265625	49/64	49	.....	.....	.....	.....	0.765625
9/32	18	9	.....	.....	.....	0.28125	25/32	50	25	.....	.....	.....	0.78125
19/64	19	.....	.....	.....	.....	0.296875	51/64	51	.....	.....	.....	.....	0.796875
5/16	20	10	5	.....	.....	0.3125	13/16	52	26	13	.....	.....	0.8125
21/64	21	.....	.....	.....	.....	0.328125	53/64	53	.....	.....	.....	.....	0.828125
11/32	22	11	.....	.....	.....	0.34375	27/32	54	27	.....	.....	.....	0.84375
23/64	23	.....	.....	.....	.....	0.359375	55/64	55	.....	.....	.....	.....	0.859375
3/8	24	12	6	3	.....	0.375	7/8	56	28	14	7	.....	0.875
25/64	25	.....	.....	.....	.....	0.390625	57/64	57	.....	.....	.....	.....	0.890625
13/32	26	13	.....	.....	.....	0.40625	29/32	58	29	.....	.....	.....	0.90625
27/64	27	.....	.....	.....	.....	0.421875	59/64	59	.....	.....	.....	.....	0.921875
7/16	28	14	7	.....	.....	0.4375	15/16	60	30	15	.....	.....	0.9375
29/64	29	.....	.....	.....	.....	0.453125	61/64	61	.....	.....	.....	.....	0.953125
15/32	30	15	.....	.....	.....	0.46875	31/32	62	31	.....	.....	.....	0.96875
31/64	31	.....	.....	.....	.....	0.484375	63/64	63	.....	.....	.....	.....	0.984375
1/2	32	16	8	4	2	0.500	1 Inch	64	32	16	8	4	1.000

Table AII-2.—Decimal Equivalents of Millimeters

mm	inches	mm	inches	mm	inches	mm	inches	mm	inches
0.1	0.00394	3.5	0.13779	6.9	0.27165	10.3	0.40551	13.8	0.54330
0.2	0.00787	3.6	0.14173	7.0	0.27559	10.4	0.40944	13.9	0.54724
0.3	0.01181	3.7	0.14566	7.1	0.27952	10.5	0.41388	14.0	0.55118
0.4	0.01575	3.8	0.14960	7.2	0.28346	10.6	0.41732	14.1	0.55511
0.5	0.01968	3.9	0.15354	7.3	0.28740	10.7	0.42125	14.2	0.55905
0.6	0.02362	4.0	0.15748	7.4	0.29133	10.8	0.42519	14.3	0.56299
0.7	0.02756	4.1	0.16141	7.5	0.29527	10.9	0.42913	14.4	0.56692
0.8	0.03149	4.2	0.16535	7.6	0.29921	11.0	0.43307	14.5	0.57086
0.9	0.03543	4.3	0.16929	7.7	0.30314	11.1	0.43700	14.6	0.57480
1.0	0.03937	4.4	0.17322	7.8	0.30708	11.2	0.44094	14.7	0.57873
1.1	0.04330	4.5	0.17716	7.9	0.31102	11.3	0.44488	14.8	0.58267
1.2	0.04724	4.6	0.18110	8.0	0.31496	11.4	0.44881	14.9	0.58661
1.3	0.05118	4.7	0.18503	8.1	0.31889	11.5	0.45275	15.0	0.59055
1.4	0.05512	4.8	0.18897	8.2	0.32283	11.6	0.45669	15.5	0.61023
1.5	0.05905	4.9	0.19291	8.3	0.32677	11.7	0.46062	16.0	0.62992
1.6	0.06299	5.0	0.19685	8.4	0.33070	11.8	0.46456	16.5	0.64960
1.7	0.06692	5.1	0.20078	8.5	0.33464	11.9	0.46850	17.0	0.66929
1.8	0.07086	5.2	0.20472	8.6	0.33858	12.0	0.47244	17.5	0.68897
1.9	0.07480	5.3	0.20866	8.7	0.34251	12.1	0.47637	18.0	0.70866
2.0	0.07874	5.4	0.21259	8.8	0.34645	12.2	0.48031	18.5	0.72834
2.1	0.08267	5.5	0.21653	8.9	0.35039	12.3	0.48425	19.0	0.74803
2.2	0.08661	5.6	0.22047	9.0	0.35433	12.4	0.48818	19.5	0.76771
2.3	0.09055	5.7	0.22440	9.1	0.35826	12.5	0.49212	20.0	0.78740
2.4	0.09448	5.8	0.22834	9.2	0.36220	12.6	0.49606	20.5	0.80708
2.5	0.09842	5.9	0.23228	9.3	0.36614	12.7	0.49999	21.0	0.82677
2.6	0.10236	6.0	0.23622	9.4	0.37007	12.8	0.50393	21.5	0.84645
2.7	0.10629	6.1	0.24015	9.5	0.37401	12.9	0.50787	22.0	0.86614
2.8	0.11023	6.2	0.24409	9.6	0.37795	13.0	0.51181	22.5	0.88582
2.9	0.11417	6.3	0.24803	9.7	0.38188	13.1	0.51574	23.0	0.90551
3.0	0.11811	6.4	0.25196	9.8	0.38582	13.2	0.51968	23.5	0.92519
3.1	0.12204	6.5	0.25590	9.9	0.38976	13.3	0.52362	24.0	0.94488
3.2	0.12598	6.6	0.25984	10.0	0.39370	13.4	0.52755	24.5	0.96456
						13.5	0.53149	25.0	0.98425
3.3	0.12992	6.7	0.26377	10.1	0.39763	13.6	0.53543	25.5	1.00393
3.4	0.13385	6.8	0.26771	10.2	0.40157	13.7	0.53936	26.0	1.02362

Table AII-3.—Dividing a Circle into Parts

To find the length of the chord for dividing the circumference of a circle into a required number of equal parts, multiply the factor in the table by the diameter.

no. of spaces	chord length	no. of spaces	chord length	no. of spaces	chord length
3	0.866	21	0.149	39	0.0805
4	0.7071	22	0.1423	40	0.0785
5	0.5878	23	0.1362	41	0.0765
6	0.5	24	0.1305	42	0.0747
7	0.4339	25	0.1253	43	0.073
8	0.3827	26	0.1205	44	0.0713
9	0.342	27	0.1161	45	0.0698
10	0.309	28	0.112	46	0.0682
11	0.2818	29	0.1081	47	0.0668
12	0.2584	30	0.1045	48	0.0654
13	0.2393	31	0.1012	49	0.0641
14	0.2224	32	0.098	50	0.0628
15	0.2079	33	0.0951	51	0.0616
16	0.1951	34	0.0932	52	0.0604
17	0.1837	35	0.0896	53	0.0592
18	0.1736	36	0.0872	54	0.0581
19	0.1645	37	0.0848	55	0.0571
20	0.1564	38	0.0826		

Table AII-4.—Formulas for Dimension, Area, and Volume

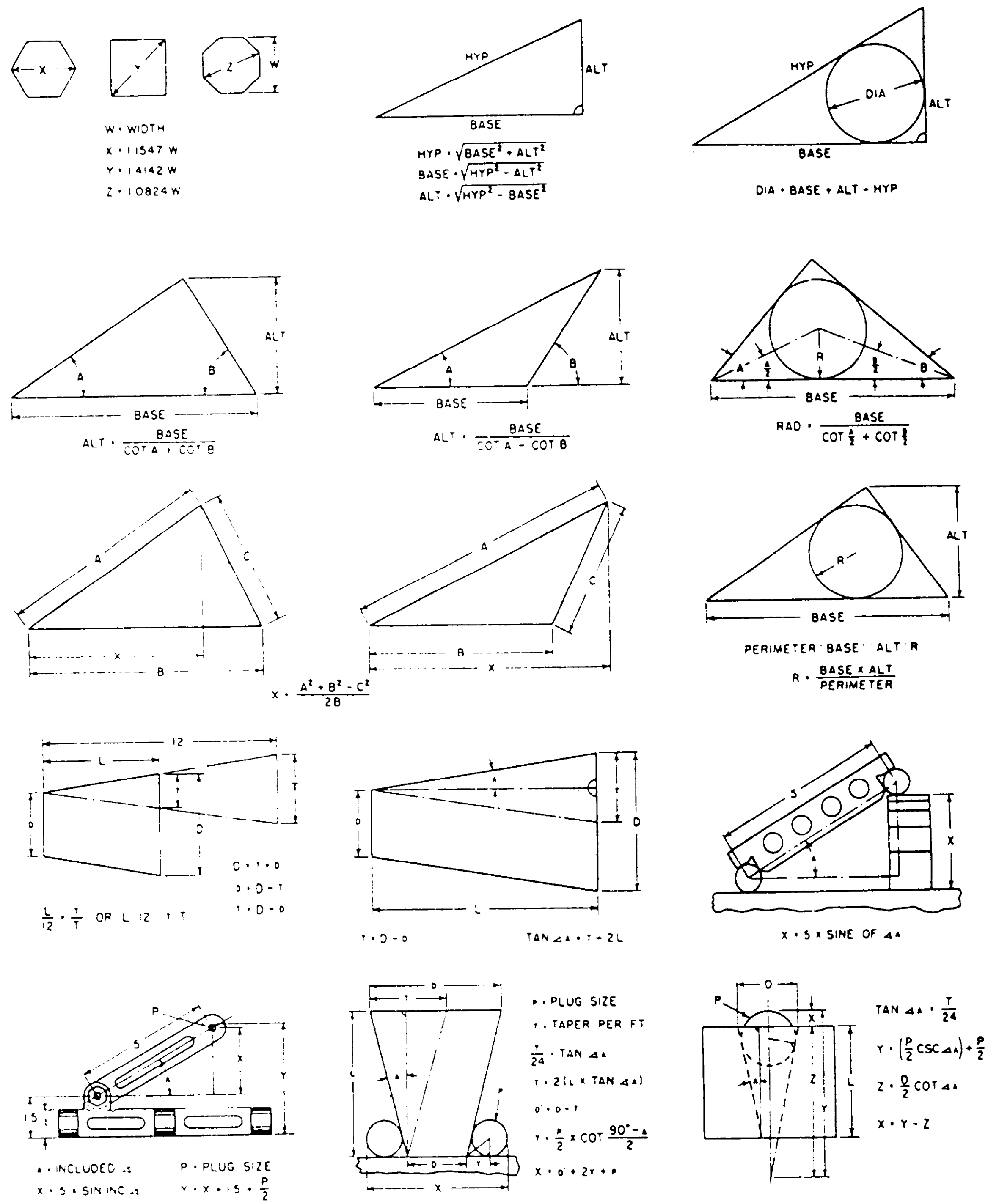


Table AII-4.—Formulas for Dimension, Area, and Volume—Continued

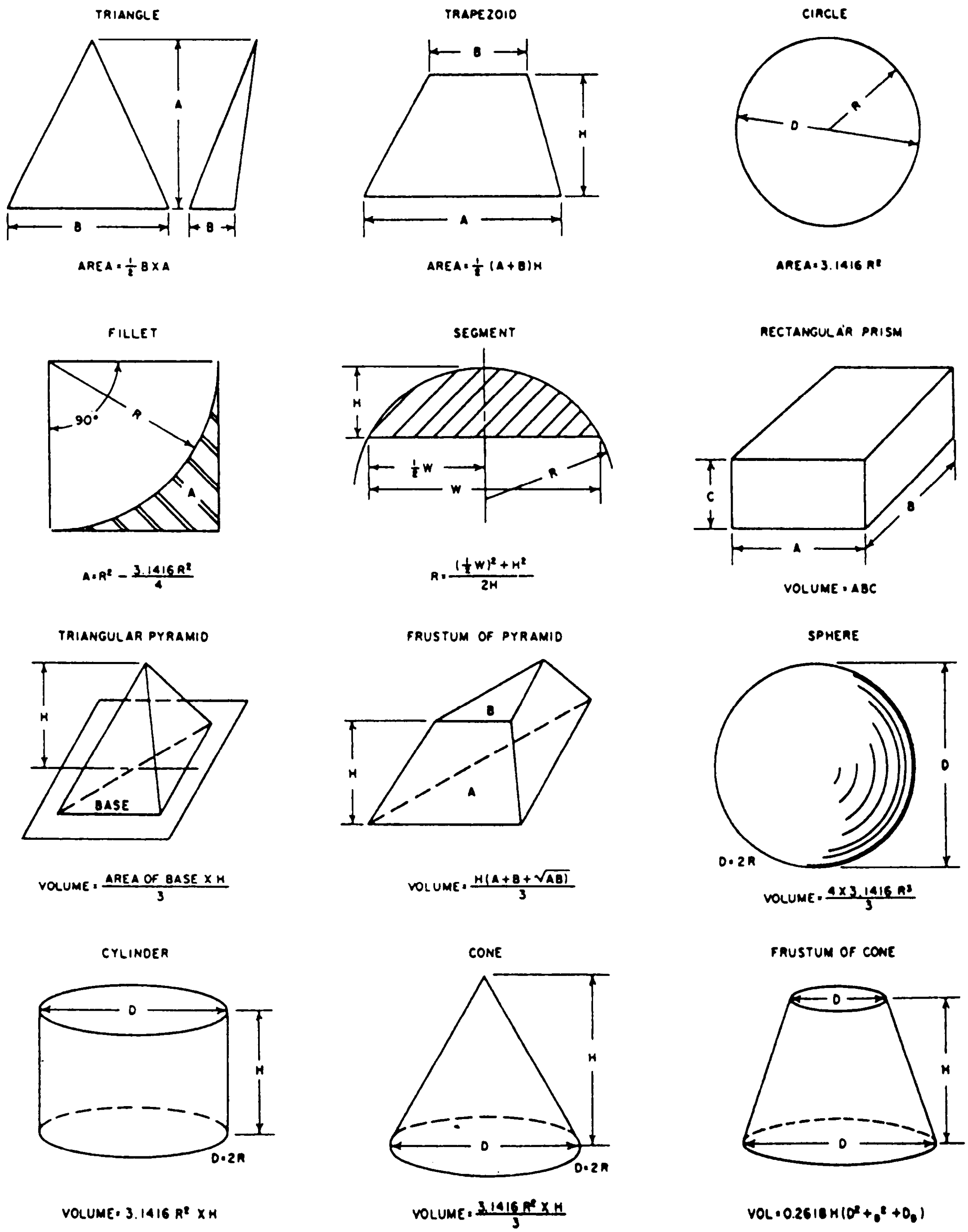


Table AII-5.—Number, Letter and Fractional Identification of Drill Sizes (Letter drills are larger than number drills; they begin where number drills end.)

no. & letter drills	fractional drills	decimal equiv.	no. & letter drills	fractional drills	decimal equiv.	no. & letter drills	fractional drills	decimal equiv.	no. & letter drills	fractional drills	decimal equiv.
80	...	.0135	42	...	.0935		13/64	.2031		13/32	.4062
79	...	.0145		3/32	.0937	6	...	.2040	Z	...	.4130
	1/64	.0156	41	...	.0960	5	...	.2055		27/64	.4219
78	...	.0160	40	...	.0980	4	...	.2090		7/16	.4375
77	...	.0180	39	...	.0995	3	...	.2130		29/64	.4531
76	...	.0200	38	...	.1015		7/32	.2187		15/32	.4687
75	...	.0210	37	...	.1040	2	...	.2210		31/64	.4844
74	...	.0225	36	...	.1065	1	...	.2280		1/2	.5000
73	...	.0240		7/64	.1094	A	...	.2340		33/64	.5156
72	...	.0250	35	...	.1100		15/64	.2344		17/32	.5312
71	...	.0260	34	...	.1110	B	...	.2380		35/64	.5469
70	...	.0280	33	...	.1130	C	...	.2420		9/16	.5625
69	...	.0292	32	...	.1160	D	...	.2460		37/64	.5781
68	...	.0310	31	...	.1200	E	1/4	.2500		19/32	.5937
	1/32	.0312		1/8	.1250	F	...	.2570		39/64	.6094
67	...	.0320	30	...	.1285	G	...	.2610		5/8	.6250
66	...	.0330	29	...	.1360		17/64	.2656		41/64	.6406
65	...	.0350	28	...	.1405	H	...	.2660		21/32	.6562
64	...	.0360		9/64	.1406	I	...	.2720		43/64	.6719
63	...	.0370	27	...	.1440	J	...	.2770		11/16	.6875
62	...	.0380	26	...	.1470	K	...	.2810		45/64	.7031
61	...	.0390	25	...	.1495		9/32	.2812		23/32	.7187
60	...	.0400	24	...	.1520	L	...	.2900		47/64	.7344
59	...	.0410	23	...	.1540	M	...	.2950		3/4	.7500
58	...	.0420		5/32	.1562		19/64	.2969		49/64	.7656
57	...	.0430	22	...	.1570	N	...	.3020		25/32	.7812
56	...	.0465	21	...	.1590		5/16	.3125		51/64	.7969
	3/64	.0469	20	...	.1610	O	...	.3160		13/16	.8125
55	...	.0520	19	...	.1660	P	...	.3230		53/64	.8281
54	...	.0550	18	...	.1695		21/64	.3281		27/32	.8437
53	...	.0595		11/64	.1719	Q	...	.3320		55/64	.8594
	1/16	.0625	17	...	.1720	R	...	.3390		7/8	.8750
52	...	.0635	16	...	.1770		11/32	.3437		57/64	.8906
51	...	.0670	15	...	.1800	S	...	.3480		29/32	.9062
50	...	.0700	14	...	.1820	T	...	.3580		59/64	.9219
49	...	.0730	13	...	.1850		23/64	.3594		15/16	.9375
48	...	.0760		3/16	.1875	U	...	.3680		61/64	.9531
	5/64	.0781	12	...	.1890		3/8	.3750		31/32	.9687
47	...	.0785	11	...	.1910	V	...	.3770		63/64	.9844
46	...	.0810	10	...	.1935	W	...	.3860		1	1.0000
45	...	.0820	9	...	.1960		25/64	.3906			
44	...	.0860	8	...	.1990	X	...	.3970			
43	...	.0890	7	...	.2010	Y	...	.4040			

Table AII-6.—Units of Weight, Volume, and Temperature

AVOIRDUPOIS WEIGHT

16 drams or 437.5 grains = 1 ounce
16 ounces or 7,000 grains = 1 pound
2,000 pounds = 1 net or short ton
2,240 pounds = 1 gross or long ton
2,204.6 pounds = 1 metric ton

BOARD MEASURE

One board foot measure is a piece of wood 12 inches square by 1 inch thick, or 144 cubic inches. A piece of wood 2 by 4, 12 feet long contains 8 feet board measure.

DRY MEASURE

2 pints = 1 quart
8 quarts = 1 peck
4 pecks = 1 bushel
1 standard U.S. bushel = 1.2445 cubic feet
1 British imperial bushel = 1.2837 cubic feet

LIQUID MEASURE

4 gills = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
1 U.S. gallon = 231 cubic inches
1 British imperial gallon = 1.2 U.S. gallons
7.48 U.S. gallons = 1 cubic foot

LONG MEASURE

12 inches = 1 foot
3 feet = 1 yard
1,760 yards = 1 mile
5,280 feet = 1 mile
16.5 feet = 1 rod

PAPER MEASURE

24 sheets = 1 quire
20 quires = 1 ream
2 reams = 1 bundle
5 bundles = 1 bale

SHIPPING MEASURE

1 U.S. shipping ton = 40 cubic feet
1 U.S. shipping ton = 32.143 U.S. bushels
1 U.S. shipping ton = 31.16 imperial bushels
1 British shipping ton = 42 cubic feet
1 British shipping ton = 33.75 U.S. bushels
1 British shipping ton = 32.718 imperial bushels

SQUARE MEASURE

144 square inches = 1 square foot
9 square feet = 1 square yard
30.25 square yards = 1 square rod
160 square rods = 1 acre
640 acres = 1 square mile

TEMPERATURE

Freezing, Fahrenheit scale = 32 degrees
Freezing, celcius scale = 0 degrees
Boiling, Fahrenheit scale = 212 degrees
Boiling, celcius scale = 100 degrees

If any degree on the celcius scale, either above or below zero, be multiplied by 1.8, the result will, in either case, be the number of degrees above or below 32 degrees Fahrenheit.

TROY WEIGHT

24 grains = 1 pennyweight
20 pennyweights = 1 ounce
12 ounces = 1 pound

WEIGHT OF WATER

1 cubic centimeter = 1 gram or 0.035 ounce
1 cubic inch = 0.5787 ounce
1 cubic foot = 62.48 pounds
1 U.S. gallon = 8.355 pounds
1 British imperial gallon = 10 pounds
32 cubic feet = 1 net ton (2,000 pounds)
35.84 cubic feet = 1 long ton (2,240 pounds)
1 net ton =,240 U.S. gallons
1 long ton = 268 U.S. gallons

ENGLISH-METRIC EQUIVALENTS

1 inch = 2.54 centimeters
1 centimeter = 0.3937 inch
1 meter = 39.37 inches
1 kilometer = 0.62 mile
1 quart = 0.946 liter
1 U.S. gallon = 3.785 liters
1 British gallon = 4.543 liters
1 liter = 1.06 quarts
1 pound = 0.454 kilogram
1 kilogram = 2.205 pounds
1 watt = 44.24 foot-pounds per minute
1 horsepower = 33,000 foot-pounds per minute
1 kilowatt = 1.34 horsepower

Table AII-7.—Screw Thread and Tap Drill Sizes (American National)

	threads per inch		dimensions, inches				tap drill 75% full thread			
screw size	NC coarse thread	NF fine thread	major diameter	pitch diameter	single depth of thread	minor diameter	tap drill	decimal equiv.	body drill	decimal equiv.
0		80	0.060	0.0519	0.00812	0.0438	3/64	0.0469	52	0.0635
1	64		0.073	0.0629	0.01015	0.0527	53	0.0595	47	0.0785
1		72	0.073	0.0640	0.00902	0.0550	53	0.0595	47	0.0785
2	56		0.086	0.0744	0.01160	0.0628	50	0.0700	42	0.0935
2		64	0.086	0.0759	0.01015	0.0657	50	0.0700	42	0.0935
3	48		0.099	0.0855	0.01353	0.0719	47	0.0785	37	0.1040
3		56	0.099	0.0874	0.01160	0.0758	45	0.0820	37	0.1040
4	40		0.112	0.0958	0.01624	0.0795	43	0.0890	31	0.1200
4		48	0.112	0.0985	0.01353	0.0849	42	0.0935	31	0.1200
5	40		0.125	0.1088	0.01624	0.0925	38	0.1015	29	0.1360
5		44	0.125	0.1102	0.01476	0.0955	37	0.1040	29	0.1360
6	32		0.138	0.1177	0.02030	0.0974	36	0.1065	27	0.1440
6		40	0.138	0.1218	0.01624	0.1055	33	0.1130	27	0.1440
8	32		0.164	0.1437	0.02030	0.1234	29	0.1360	18	0.1695
8		36	0.164	0.1460	0.01804	0.1279	29	0.1360	18	0.1695
10	24		0.190	0.1629	0.02706	0.1359	25	0.1495	9	0.1960
10		32	0.190	0.1697	0.02030	0.1494	21	0.1590	9	0.1960
12	24		0.216	0.1889	0.02706	0.1619	16	0.1770	2	0.2210
12		28	0.216	0.1928	0.02320	0.1696	14	0.1820	2	0.2210
1/4	20		0.2500	0.2175	0.03248	0.1850	7	0.2010		
1/4		28	0.2500	0.2268	0.02320	0.2036	3	0.2130		
5/16	18		0.3125	0.2764	0.03608	0.2403	F	0.2570		
5/16		24	0.3125	0.2854	0.02706	0.2584	I	0.2720		
3/8	16		0.3750	0.3344	0.04059	0.2938	5/16	0.3125		
3/8		24	0.3750	0.3479	0.02706	0.3209	Q	0.3320		
7/16	14		0.4375	0.3911	0.04639	0.3447	U	0.3680		
7/16		20	0.4375	0.4050	0.03248	0.3725	25/64	0.3906		
1/2	13		0.5000	0.4500	0.04996	0.4001	27/64	0.4219		
1/2		20	0.5000	0.4675	0.03248	0.4350	29/64	0.4531		
9/16	12		0.5625	0.5084	0.05413	0.4542	31/64	0.4844		
9/16		18	0.5625	0.5264	0.03608	0.4903	33/64	0.5156		
5/8	11		0.6250	0.5660	0.05905	0.5069	17/32	0.5313		
5/8		18	0.6250	0.5889	0.03608	0.5528	37/64	0.5781		
3/4	10		0.7500	0.6850	0.06495	0.6201	21/32	0.6562		
3/4		16	0.7500	0.7094	0.04059	0.6688	11/16	0.6875		
7/8	9		0.8750	0.8028	0.07217	0.7307	49/64	0.7656		
7/8		14	0.8750	0.8286	0.04639	0.7822	13/16	0.8125		
1	8		1.0000	0.9188	0.08119	0.8376	7/8	0.8750		
1		14	1.0000	0.9536	0.04639	0.9072	15/16	0.9375		
1 1/8	7		1.1250	1.0322	0.09279	0.9394	63/64	0.9844		
1 1/8		12	1.1250	1.0709	0.05413	1.0167	1 3/64	1.0469		
1 1/4	7		1.2500	1.1572	0.09279	1.0644	1 7/64	1.1094		
1 1/4		12	1.2500	1.1959	0.05413	1.1417	1 11/64	1.1719		
1 3/8	6		1.3750	1.2667	0.10825	1.1585	1 7/32	1.2188		
1 3/8		12	1.3750	1.3209	0.05413	1.2667	1 19/64	1.2969		
1 1/2	6		1.5000	1.3917	0.10825	1.2835	1 11/32	1.3438		
1 1/2		12	1.5000	1.4459	0.05413	1.3917	1 27/64	1.4219		
1 3/4	5		1.7500	1.6201	0.12990	1.4902	1 9/16	1.5625		
2	4 1/2		2.0000	1.8557	0.14434	1.7113	1 25/32	1.7813		

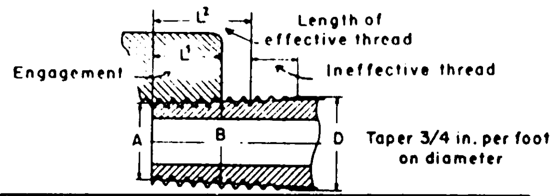
Table AII-8.—American National Pipe Thread

A = Pitch diameter of thread at end of pipe

B = Pitch diameter of thread at gauging notch

D = Outside diameter of pipe

L^1 = Normal engagement by hand between external and internal thread



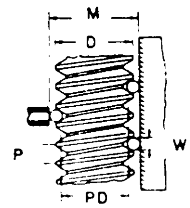
Size Inches	Threads per Inch	Pitch Diameter		Length		Pipe O.D. D Inches	Depth of Thread Inches	Tap Drills for Pipe Threads	
		A Inches	B Inches	L2 Inches	L1 Inches			Minor Diameter Small End of Pipe	Size Drill
1/8	27	.36351	.37476	.2639	.180	.405	.02963	.3339	R
1/4	18	.47739	.48989	.4018	.200	.540	.04444	.4329	7/16
3/8	18	.61201	.62701	.4078	.240	.675	.04444	.5676	37/64
1/2	14	.75843	.77843	.5337	.320	.840	.05714	.7013	23/32
3/4	14	.96768	.98887	.5457	.339	1.050	.05714	.9105	59/64
1	11 1/2	1.21363	1.23863	.6828	.400	1.315	.06957	1.1441	1 5/32
1 1/4	11 1/2	1.55713	1.58338	.7068	.420	1.660	.06957	1.4876	1 1/2
1 1/2	11 1/2	1.79609	1.82234	.7235	.420	1.900	.06957	1.7265	1 47/64
2	11 1/2	2.26902	2.29627	.7565	.436	2.375	.06957	2.1995	2 7/32
2 1/2	8	2.71953	2.76216	1.1375	.682	2.875	.10000	2.6195	2 5/8
3	8	3.34062	3.38850	1.2000	.766	3.500	.10000	3.2406	3 1/4
3 1/2	8	3.83750	3.88881	1.2500	.821	4.000	.10000	3.7375	3 3/4
4	8	4.33438	4.38712	1.3000	.844	4.500	.10000	4.2344	4 1/4

Table AII-9.—3-Wire Method of Measuring American National Standard Threads

M = D — (1.5166 X P) =) 3 X W

$PD — M + \frac{.86603}{\text{No. of thds. per inch}} (3 X W)$

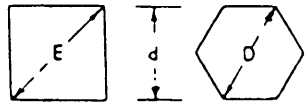
To Check Angle $\frac{M_1 — M_1}{W_1 — W_1}$



M Measurement over best size wire.
M_1 = Measurement over maximum size wire.
M_1 = Measurement over minimum size wire.
D = Ouside Diameter of Thread.
P.D. = Pitch Diameter.
W = Diamerter Best size wire. 0.57735 X pitch
W_1 = Diameter maximum size wire. 0.90 X pitch
W_1 = Diameter minimum size wire. 0.56 X pitch

No. Thds. per inch	Pitch Thds. per inch	Best Wire Size .57735 x Pitch	Maximum Wire Size	Minimum Wire Size
4	.250000	.144337	.225000	.140000
4 ½	.222222	.128300	.200000	.124444
5	.200000	.115470	.180000	.112000
5 ½	.181818	.104969	.163636	.101818
6	.166666	.096224	.149999	.093333
7	.142857	.082478	.128571	.080000
7 ½	.133333	.076979	.120000	.074666
8	.125000	.072168	.112500	.07000
9	.111111	.064149	.100000	.062222
10	.100000	.057735	.090000	.056000
11	.090999	.052486	.081818	.050909
11 ½	.086956	.050204	.078260	.048695
12	.083333	.048112	.075000	.046666
13	.076923	.044411	.069231	.043077
14	.071428	.041239	.064285	.040000
16	.062500	.036084	.056250	.035000
18	.055555	.032074	.050000	.031111
20	.050000	.028867	.045000	.028000
22	.046454	.026242	.040909	.025454
24	.041666	.024055	.037499	.023333
26	.038461	.022205	.034615	.021538
27	.037037	.024383	.033333	.022543
28	.03514	.020620	.032143	.020000
30	.033333	.019244	.030000	.018666
32	.031250	.018042	.028125	.017500
36	.027777	.016037	.024999	.015555
40	.025000	.014433	.022500	.014000
44	.022727	.013121	.020454	.014727
48	.020833	.012027	.018750	.011666
50	.020000	.011547	.018000	.011200
56	.017857	.010309	.016071	.010000

Table AII-10.—Diagonals of Squares and Hexagons



$E = 1.4142\ d$

$D = 1.1547\ d$

d	D	E	d	D	E	d	D	E
1/4	0.2886	0.3535	1 1/4	1.4434	1.7677	2 5/16	2.6702	3.2703
9/32	0.3247	0.3977	1 9/32	1.4794	1.8119	2 3/8	2.7424	3.3587
5/16	0.3608	0.4419	1 5/16	1.5155	1.8561	2 7/16	2.8145	3.4471
11/32	0.3968	0.4861	1 11/32	1.5516	1.9003	2 1/2	2.8867	3.5355
3/8	0.4329	0.5303	1 3/8	1.5877	1.9445	2 9/16	2.9583	3.6239
13/32	0.4690	0.5745	1 13/32	1.6238	1.9887	2 5/8	3.0311	3.7123
7/16	0.5051	0.6187	1 7/16	1.6598	2.0329	2 11/16	3.1032	3.8007
15/32	0.5412	0.6629	1 15/32	1.6959	2.0771	2 3/4	3.1754	3.8891
1/2	0.5773	0.7071	1 1/2	1.7320	2.1213	2 13/16	3.2476	3.9794
17/32	0.6133	0.7513	1 17/32	1.7681	2.1655	2 7/8	3.3197	4.0658
9/16	0.6494	0.7955	1 9/16	1.8042	2.2097	2 15/16	3.3919	4.1542
19/32	0.6855	0.8397	1 19/32	1.8403	2.2539	3	3.4641	4.2426
5/8	0.7216	0.8839	1 5/8	1.8764	2.2981	3 1/16	3.5362	4.3310
21/32	0.7576	0.9281	1 21/32	1.9124	2.3423	3 1/8	3.6084	4.4194
11/16	0.7937	0.9723	1 11/16	1.9485	2.3865	3 3/16	3.6806	4.5078
23/32	0.8298	1.0164	1 23/32	1.9846	2.4306	3 1/4	3.7527	4.5962
3/4	0.8659	1.0606	1 3/4	2.0207	2.4708	3 5/16	3.8249	4.6846
25/32	0.9020	1.1048	1 25/32	2.0568	2.5190	3 3/8	3.8971	4.7729
13/16	0.9380	1.1490	1 13/16	2.0929	2.5632	3 7/16	3.9692	4.8613
27/32	0.9741	1.1932	1 27/32	2.1289	2.6074	3 1/2	4.0414	4.9497
7/8	1.0102	1.2374	1 7/8	2.1650	2.6516	3 9/16	4.1136	5.0381
29/32	1.0463	1.2816	1 29/32	2.2011	2.6958	3 5/8	4.1857	5.1265
15/16	1.0824	1.3258	1 15/16	2.2372	2.7400	3 11/16	4.2579	5.2149
31/32	1.1184	1.3700	1 31/32	2.2733	2.7842	3 3/4	4.3301	5.3033
1	1.1547	1.4142	2	2.3094	2.8284	3 13/16	4.4023	5.3917
1 1/32	1.1907	1.4584	2 1/32	2.3453	2.8726	3 7/8	4.4744	5.4801
1 1/16	1.2268	1.5026	2 1/16	2.3815	2.9168	3 15/16	4.5466	5.5684
1 3/32	1.2629	1.5468	2 3/32	2.4176	2.9610	4	4.6188	5.6568
1 1/8	1.2990	1.5910	2 1/8	2.4537	3.0052	4 1/8	4.7631	5.8336
1 5/32	1.3351	1.6352	2 5/32	2.4898	3.0494	4 1/4	4.9074	6.0104
1 3/16	1.3712	1.6793	2 3/16	2.5259	3.0936	4 3/8	5.0518	6.1872
1 7/32	1.4073	1.7235	2 1/4	2.5981	3.1820	4 1/2	5.1961	6.3639

Table AII-11.—Circles

Circumference of a circle = diameter × 3.1416

Diameter of a circle = circumference × .31831

Area of a circle = the square of the diameter × 0.7854

Surface of a ball (sphere) = the square of the diameter × 3.1416

Side of a square inscribed in a circle = diameter × 0.70711

Diameter of a circle to circumscribe a square = one side × 1.4142

Cubic inches (volume) in a ball = cube of the diameter × 0.5236

When doubled, the diameter of a pipe increases its capacity four times

Radius of a circle × 6.283185 = circumference

Square of the circumference of a circle × 0.07958 = area

1/2 circumference of a circle × 1/2 its diameter = area

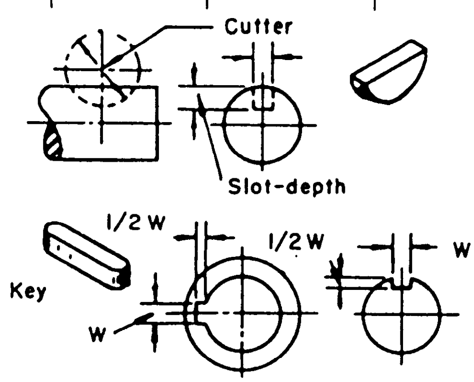
Circumference of a circle × .159155 = radius

Square root of the area of a circle × 0.56419 = radius

Square root of the area of a circle × 1.12838 = diameter

Table AII-12.—Keyway Dimensions

shaft dia	square keyways	Woodruff keyways*			
		key	thickness	cutter dia	slot depth
0.500	1/8 × 1/16	404	0.1250	0.500	0.1405
0.562	1/8 × 1/16	404	0.1250	0.500	0.1405
0.625	5/32 × 5/64	505	0.1562	0.625	0.1669
0.688	3/16 × 3/32	606	0.1875	0.750	0.2193
0.750	3/16 × 3/32	606	0.1875	0.750	0.2193
0.812	3/16 × 3/32	606	0.1875	0.750	0.2193
0.875	7/32 × 7/64	607	0.1875	0.875	0.2763
0.938	1/4 × 1/8	807	0.2500	0.875	0.2500
1.000	1/4 × 1/8	808	0.2500	1.000	0.3130
1.125	5/16 × 5/32	1009	0.3125	1.125	0.3228
1.250	5/16 × 5/32	1010	0.3125	1.250	0.3858
1.375	3/8 × 3/16	1210	0.3750	1.250	0.3595
1.500	3/8 × 3/16	1212	0.3750	1.500	0.4535
1.625	3/8 × 3/16	1212	0.3750	1.500	0.4535
1.750	7/16 × 7/32				
1.875	1/2 × 1/4				
2.000	1/2 × 1/4				
2.250	5/8 × 5/16				
2.500	5/8 × 5/16				
2.750	3/4 × 3/8				
3.000	3/4 × 3/8				
3.250	3/4 × 3/8				
3.500	7/8 × 7/16				
4.000	1 × 1/2				

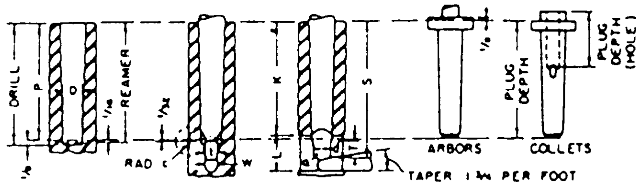


*The depth of a Woodruff keyway is measured from the edge of the slot.

Table AII-13.—Taper Per Foot and Corresponding Angles

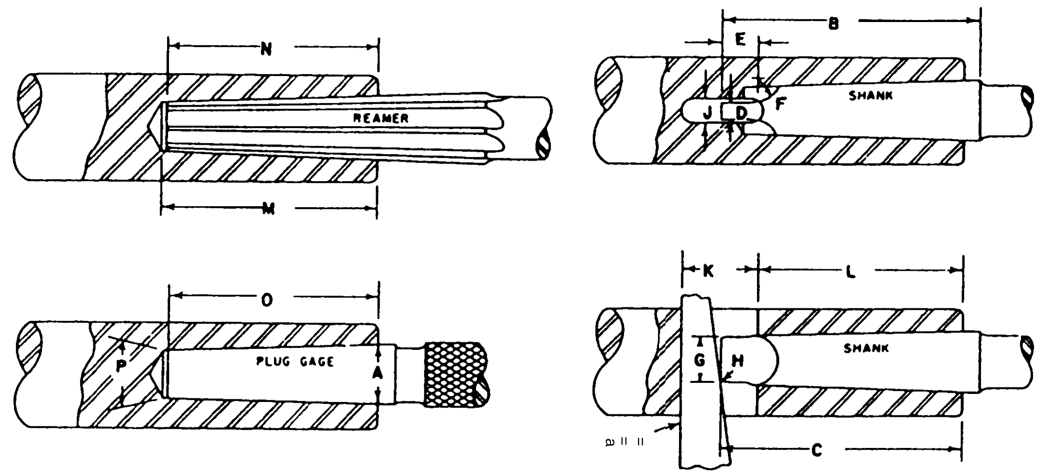
taper per foot	included angle			angle with center line			taper per foot	included angle			angle with center line			taper per foot	included angle			angle with center line		
	deg.	min.	sec.	deg.	min.	sec.		deg.	min.	sec.	deg.	min.	sec.		deg.	min.	sec.	deg.	min.	sec.
1/64	0	4	28	0	2	14	31/32	4	37	20	2	18	40	3 3/4	17	45	40	8	52	50
1/32	0	8	58	0	4	29	1	4	46	18	2	23	9	3 7/8	18	20	34	9	10	17
1/16	0	17	54	0	8	57	1 1/16	5	4	12	2	32	6	4	18	55	28	9	27	44
3/32	0	26	52	0	13	26	1 1/8	5	21	44	2	40	52	4 1/8	19	30	18	9	45	9
1/8	0	35	48	0	17	54	1 3/16	5	39	54	2	49	57	4 1/4	20	5	2	10	2	31
5/32	0	44	44	0	22	22	1 1/4	5	57	48	2	58	54	4 3/8	20	39	44	10	19	52
3/16	0	53	44	0	26	52	1 5/16	6	15	38	3	7	49	4 1/2	21	14	2	10	37	1
7/32	1	2	34	0	31	17	1 3/8	6	33	26	3	16	43	4 5/8	21	48	54	10	54	27
1/4	1	11	36	0	35	48	1 7/16	6	51	20	3	25	40	4 3/4	22	23	22	11	11	41
9/32	1	20	30	0	40	15	1 1/2	7	9	10	3	34	35	4 7/8	22	57	48	11	28	54
5/16	1	29	30	0	44	45	1 9/16	7	26	58	3	43	29	5	23	32	12	11	46	6
11/32	1	38	22	0	49	11	1 5/8	7	44	48	3	52	24	5 1/8	24	6	28	12	3	14
3/8	1	47	24	0	53	42	1 11/16	8	2	38	4	1	19	5 1/4	24	40	42	12	20	21
13/32	1	56	24	0	58	12	1 3/4	8	20	26	4	10	13	5 3/8	25	14	48	12	37	24
7/16	2	5	18	1	2	39	1 13/16	8	38	16	4	19	8	5 1/2	25	48	48	12	54	24
15/32	2	14	16	1	7	8	1 7/8	8	56	2	4	28	1	5 5/8	26	22	52	13	11	26
1/2	2	23	10	1	11	35	1 15/16	9	13	50	4	36	55	5 3/4	26	56	46	13	28	23
17/32	2	32	4	1	16	2	2	9	31	36	4	45	48	5 7/8	27	30	34	13	45	17
9/16	2	41	4	1	20	32	2 1/8	10	7	10	5	3	35	6	28	4	2	14	2	1
19/32	2	50	2	1	25	1	2 1/4	10	42	42	5	21	21	6 1/8	28	37	58	14	18	59
5/8	2	59	2	1	29	31	2 3/8	11	18	10	5	39	5	6 1/4	29	11	34	14	35	47
21/32	3	7	56	1	33	58	2 1/2	11	53	36	5	56	48	6 3/8	29	45	18	14	52	39
11/16	3	16	54	1	38	27	2 5/8	12	29	2	6	14	31	6 1/2	30	18	26	15	9	13
23/32	3	25	50	1	42	55	2 3/4	13	4	24	6	32	12	6 5/8	30	51	48	15	25	54
3/4	3	34	44	1	47	22	2 7/8	13	39	42	6	49	51	6 3/4	31	25	2	15	42	31
25/32	3	43	44	1	51	52	3	14	15	0	7	7	30	6 7/8	31	58	10	15	59	5
13/16	3	52	38	1	56	19	3 1/8	14	50	14	7	25	7	7	32	31	12	16	15	36
27/32	4	1	36	2	0	48	3 1/4	15	25	24	7	42	42	7 1/8	33	4	8	16	32	4
7/8	4	10	32	2	5	16	3 3/8	16	0	34	8	0	17	7 1/4	33	36	40	16	48	20
29/32	4	19	34	2	9	47	3 1/2	16	35	40	8	17	50	7 3/8	34	9	50	17	4	55
15/16	4	28	24	2	14	12	3 5/8	17	10	40	8	35	20							

Table AII-14.—Taper in Inches (Brown and Sharpe)



taper no.	taper per foot	plug dia. at small end, D	plug depth (P) B&S stand.	plug depth (P) for mill mach.	plug depth (P) misc.	keyway from end of spindle, K	shank depth, S	keyway length, L	keyway width, W	arbor tongue length, T	arbor tongue dia., d	arbor tongue thick-ness t	tongue circle radius, c	tongue radius, a	limit for tongue to project through test tool
1	0.50200	0.20000	15/16			15/16	1 3/16	3/8	0.135	3/16	0.170	1/8	3/16	0.030	0.003
2	0.50200	0.25000	1 3/16			1 11/64	1 1/2	1/2	0.166	1/4	0.220	5/32	3/16	0.030	0.003
3	0.50200	0.31250	1 1/2		1 3/4 2	1 15/32 1 23/32 1 31/32	1 7/8 2 1/8 2 3/8	5/8 5/8 5/8	0.197 0.197 0.197	5/16 5/16 5/16	0.282 0.282 0.282	3/16 3/16 3/16	3/16 3/16 3/16	0.040 0.040 0.040	0.003 0.003 0.003
4	0.50240	0.35000	1 11/16	1 1/4		1 13/64 1 41/64	1 21/32 2 3/32	11/16 11/16	0.228 0.228	11/32 11/32	0.320 0.320	7/32 7/32	5/16 5/16	0.050 0.050	0.003 0.003
5	0.50160	0.45000	2 1/8	1 3/4	2	1 11/16 1 15/16 2 1/16	2 3/16 2 7/16 2 9/16	3/4 3/4 3/4	0.260 0.260 0.260	3/8 3/8 3/8	0.420 0.420 0.420	1/4 1/4 1/4	5/16 5/16 5/16	0.060 0.060 0.060	0.003 0.003 0.003
6	0.50329	0.50000	2 3/8			2 15/64	2 7/8	7/8	0.291	7/16	0.460	9/32	5/16	0.060	0.005
7	0.50147	0.60000	2 7/8	3	2 1/2	2 13/32 2 25/32 2 29/32	3 1/32 3 13/32 3 17/32	15/16 15/16 15/16	0.322 0.322 0.322	15/32 15/32 15/32	0.560 0.560 0.560	5/16 5/16 5/16	3/8 3/8 3/8	0.070 0.070 0.070	0.005 0.005 0.005
8	0.50100	0.75000	3 9/16			3 29/64	4 1/8	1	0.353	1/2	0.710	11/32	3/8	0.080	0.005
9	0.50085	0.90010	4 1/4	4		3 7/8 4 1/8	4 5/8 4 7/8	1 1/8 1 1/8	0.385 0.385	9/16 9/16	0.860 0.860	3/8 3/8	7/16 7/16	0.100 0.100	0.005 0.005
10	0.51612	1.04465	5	5 11/16	6 7/32	4 27/32 5 17/32 6 1/16	5 23/32 6 13/32 6 15/16	1 5/16 1 5/16 1 5/16	0.447 0.447 0.447	21/32 21/32 21/32	1.010 1.010 1.010	7/16 7/16 7/16	7/16 7/16 7/16	0.110 0.110 0.110	0.005 0.005 0.005
11	0.50100	1.24995	5 15/16	6 3/4		5 25/32 6 13/32	6 21/32 7 15/32	1 5/16 1 5/16	0.447 0.447	21/32 21/32	1.210 1.210	7/16 7/16	1/2 1/2	0.130 0.130	0.005 0.005
12	0.49973	1.50010	7 1/8	7 1/8	6 1/4	6 15/16	7 13/16	1 1/2	0.510	3/4	1.460	1/2	1/2	0.150	0.005
13	0.50020	1.75005	7 3/4			7 9/16	8 5/16	1 1/2	0.510	3/4	1.710	1/2	5/8	0.170	0.010
14	0.50000	2.00000	8 1/4	8 1/4		8 1/32	9 5/32	1 11/16	0.572	27/32	1.960	9/16	3/4	0.190	0.010
15	0.50000	2.25000	8 3/4			8 17/32	9 21/32	1 11/16	0.572	27/32	2.210	9/16	7/8	0.210	0.010
16	0.50000	2.50000	9 1/4			9	10 1/4	1 7/8	0.635	15/16	2.450	5/8	1	0.230	0.010
17	0.50000	2.75000	9 3/4												
18	0.50000	3.00000	10 1/4												

F P AII-15.— 1 p Standard Tapers (Morse)

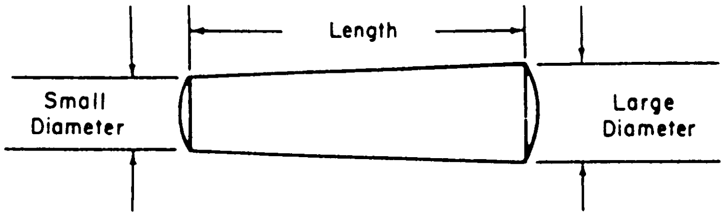


aper no.	diameter: plug at small end, P	diameter: gage line, A	shank: whole length, B	shank: depth, C	drilled hole depth, M	reamed hole depth, N	stan. plug depth, O	tang: thick-ness, D	tang: length, E	tang: radius, F	tang: dia., G	tang: radius, H	tang slot: width, J	tang slot: length, K	end of socket to tang slot, L	taper per inch	taper per foot	drift no.
0	0.252	0.356	2 11/32	2 7/32	2 1/16	2 1/32	2	0.156	1/4	5/32	15/64	3/64	0.166	9/16	1 15/16	0.052000	0.62400	0
1	0.369	0.475	2 9/16	2 7/16	2 3/16	2 5/32	2 1/8	0.203	3/8	3/16	11/32	3/64	0.213	3/4	2 1/16	0.049882	0.59858	1
2	0.572	0.700	3 1/8	2 15/16	2 21/32	2 39/64	2 9/16	0.250	7/16	1/4	17/32	1/16	0.260	7/8	2 1/2	0.049951	0.59941	2
3	0.778	0.938	3 7/8	3 11/16	3 5/16	3 1/4	3 3/16	0.312	9/16	9/32	23/32	5/64	0.322	1 3/16	3 1/16	0.050196	0.60235	3
4	1.020	1.231	4 7/8	4 5/8	4 3/16	4 1/8	4 1/16	0.469	5/8	5/16	31/32	3/32	0.479	1 1/4	3 7/8	0.051938	0.62326	4
5	1.475	1.748	6 1/8	5 7/8	5 5/16	5 1/4	5 3/16	0.625	3/4	3/8	1 13/32	1/8	0.635	1 1/2	4 15/16	0.052626	0.63151	5
6	2.116	2.494	8 9/16	8 1/4	7 13/32	7 21/64	7 1/4	0.750	1 1/8	1/2	2	5/32	0.760	1 3/4	7	0.052137	0.62565	5+
7	2.750	3.270	11 5/8	11 1/4	10 5/32	10 5/64	10	1.125	1 3/8	3/4	2 5/8	3/16	1.135	2 5/8	9 1/2	0.052000	0.62400	

* Dimensions agree essentially with those of the American Standard on Machine Tapers

\+ The No. 5 drift will also eject No. 6 taper shank tools

Table AII-16.—Drill Sizes for Taper Pins



Drill size should be approximately 0.005 smaller than small diameter

Taper = 1/4 In. per foot

Small diameter = large diameter − length X 0.02083

NUMBER	7/0	6/0	5/0	4/0	3/0	2/0	0	1	2	3	4	5	6	7	8	9	10	11	
DIAMETER AT LARGE END	0.0625	0.078	0.094	0.109	0.125	0.141	0.156	0.172	0.193	0.219	0.250	0.289	0.341	0.409	0.492	0.591	0.706	0.857	¼
LENGTH	DIAMETER OF SMALL END OF PIN AND DRILL SIZE																		LENGTH
¼	0.0573	0.0728	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	¼
	54	50																	
⅜	0.0547	0.0702	0.0862	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	⅜
	55	51	45																
½	0.0521	0.0676	0.0836	0.0986	0.1146	0.1306	0.1456	0.1616	......	......	......	......	......	......	......	......	......	......	½
	56	52	46	41	34	30	9/64	5/32											
⅝	0.0495	0.0650	0.0810	0.0960	0.1120	0.1280	0.1430	0.1590	......	......	......	......	......	......	......	......	......	......	⅝
	56	52	5/64	3/32	7/64	1/8	9/64	23											
¾	0.0469	0.0624	0.0784	0.0934	0.1094	0.1254	0.1404	0.1564	0.1774	0.2034	0.2344	......	......	......	......	......	......	......	¾
	56	53	48	43	36	31	29	24	11/64	8	1								
⅞	......	0.0598	0.0758	0.0908	0.1068	0.1228	0.1378	0.1538	0.1748	0.2008	0.2318	......	......	......	......	......	......	......	⅞
	......	54	49	43	37	31	29	25	18	9	1								
1	......	0.0572	0.0732	0.0882	0.1042	0.1202	0.1352	0.1512	0.1722	0.1982	0.2292	0.2682	0.3202	......	......	......	......	......	1
		54	50	44	38	32	30	26	19	10	2	G	O						
1⅛	......	......	......	0.0856	0.1016	0.1176	0.1326	0.1486	0.1696	0.1956	0.2266	0.2656	0.3176	......	......	......	......	......	1⅛
				45	39	33	30	27	19	11	2	G	5/16						
1¼	......	......	......	0.0830	0.0990	0.1150	0.1300	0.1460	0.1670	0.1930	0.2240	0.2630	0.3150	0.3830	......	......	......	......	1¼
				46	41	33	1/8	9/64	20	3/16	7/32	F	N	3/8					
1⅜	......	......	......	......	0.0964	0.1124	0.1274	0.1434	0.1644	0.1904	0.2214	0.2604	0.3124	0.3804	......	......	......	......	1⅜
					3/32	7/64	1/8	9/64	20	3/16	3	F	N	3/8					
1½	......	......	......	......	0.0938	0.1098	0.1248	0.1408	0.1618	0.1878	0.2188	0.2578	0.3098	0.3778	0.4608	......	......	......	1½
					43	36	31	28	5/32	14	3	1/4	N	U	29/64				
1⅝	......	......	......	......	......	0.1045	0.1195	0.1355	0.1565	0.1825	0.2135	0.2525	0.3045	0.3725	0.4555	......	......	......	1⅝
						38	32	30	24	18	4	D	19/64	U	7/16				
2	......	......	......	......	......	0.0993	0.1143	0.1303	0.1513	0.1773	0.2083	0.2473	0.2993	0.3673	0.4503	0.5494	......	......	2
						41	34	1/8	26	11/64	13/64	C	M	23/64	7/16	17/32	......	......	
2¼	......	......	......	......	......	......	......	0.1251	0.1461	0.1721	0.2031	0.2421	0.2941	0.3621	0.4451	0.5442	......	......	2¼
								31	27	18	8	B	L	T	7/16	17/32			
2½	......	......	......	......	......	......	......	0.1199	0.1409	0.1669	0.1979	0.2369	0.2889	0.3569	0.4399	0.5390	0.6540	......	2½
								32	29	20	10	15/64	9/32	S	27/64	17/32	41/64		
2¾	......	......	......	......	......	......	......	......	0.1357	0.1617	0.1927	0.2317	0.2837	0.3517	0.4347	0.5338	0.6488	......	2¾
									30	5/32	3/16	1	J	11/32	27/64	33/64	41/64		

Table AII-16.—Drill Sizes for Taper Pins—Continued

NUMBER	7/0	6/0	5/0	4/0	3/0	2/0	0	1	2	3	4	5	6	7	8	9	10	11	
DIAMETER AT LARGE END	0.0625	0.078	0.094	0.109	0.125	0.141	0.156	0.172	0.193	0.219	0.250	0.289	0.341	0.409	0.492	0.591	0.707	0.857	¼
LENGTH	DIAMETER OF SMALL END OF PIN AND DRILL SIZE																		LENGTH
3	......	......	......	......	......	......	......	......	0.1305 30	0.1565 24	0.1875 14	0.2265 2	0.2785 1	0.3465 R	0.4295 27/64	0.5285 33/64	0.6435 5/8	0.7975 25/32	3
3¼	......	......	......	......	......	......	......	......	......	......	0.1823 16	0.2213 7/32	0.2733 17/64	0.3413 Q	0.4243 Z	0.5233 33/64	0.6383 5/8	0.7923 25/32	3¼
3½	......	......	......	......	......	......	......	......	......	......	0.1771 11/64	0.2161 3	0.2681 G	0.3361 Q	0.4191 13/32	0.5181 1/2	0.6331 5/8	0.7871 25/32	3½
3¾	......	......	......	......	......	......	......	......	......	......	......	......	0.2629 F	0.3309 21/64	0.4139 13/32	0.5129 1/2	0.6279 39/64	0.7819 49/64	3¾
4	......	......	......	......	......	......	......	......	......	......	......	......	0.2577 1/4	0.3257 P	0.4087 Y	0.5077 1/2	0.6227 39/64	0.7767 49/64	4
4¼	......	......	......	......	......	......	......	......	......	......	......	......	......	0.3205 O	0.4035 X	0.5025 31/64	0.6175 39/64	0.7715 49/64	4¼
4½	......	......	......	......	......	......	......	......	......	......	......	......	......	0.3153 5/16	0.3983 25/64	0.4973 31/64	0.6123 19/32	0.7663 3/4	4½
4¾	......	......	......	......	......	......	......	......	......	......	......	......	......	......	0.3931 W	0.4921 31/64	0.6071 19/32	0.7611 3/4	4¾
5	......	......	......	......	......	......	......	......	......	......	......	......	......	......	0.3879 3/8	0.4869 15/32	0.6019 19/32	0.7559 3/4	5
5¼	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	0.4817 15/32	0.5967 37/64	0.7507 47/64	5¼
5½	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	0.4765 15/32	0.5915 37/64	0.7455 47/64	5½
5¾	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	0.4713 29/64	0.5863 37/64	0.7403 47/64	5¾
6	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	0.4660 29/64	0.5810 9/16	0.7350 23/32	6
6¼	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	0.5758 9/16	0.7298 23/32	6¼
6½	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	0.5706 9/16	0.7246 23/32	6½
6¾	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	0.5654 35/64	0.7194 45/64	6¾
7	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	0.5602 35/64	0.7142 45/64	7
7¼	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	0.7090 45/64	7¼
7½	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	0.7038 11/16	7½

APPENDIX III

FORMULAS FOR SPUR GEARING

Having	To Get	Rule	Formula
Diametral pitch	Circular pitch	Divide 3.1416 by the diametral pitch.	$CP = \frac{3.1416}{DP}$
Pitch diameter and number of teeth	Circular pitch	Divide the pitch diameter by the product of 0.3183 and the number of teeth.	$PD = \frac{OD}{0.3183\ NT}$
Outside diameter and number of teeth	Circular pitch	Divide the outside diameter by the product of 0.3183 and the number of teeth plus 2.	$CP = \frac{OD}{0.3183\ NT + 2}$
Number of teeth and circular pitch	Pitch diameter	The product of the number of teeth, the circular pitch, and 0.3183.	$PD = 0.3183\ CP\ NT$
Number of teeth and outside diameter	Pitch diameter	Divide the product of the number of teeth and the outside diameter by the number of teeth plus 2.	$PD = \frac{NT\ OD}{NT + 2}$
Outside diameter and circular pitch	Pitch diameter	Subtract from the outside diameter the product of the circular pitch and 0.6366.	$PD = OD - 0.6366\ CP$
Addendum and number of teeth	Pitch diameter	Multiply the number of teeth by the addendum.	$PD = NT\ ADD$
Number of teeth and circular pitch	Outside diameter	The product of the number of teeth plus 2, the circular pitch, and 0.3183.	$OD = (NT + 2)\ 0.3183\ CP$
Pitch diameter and circular pitch	Outside diameter	Add to the pitch diameter the product of the circular pitch and 0.6366.	$OD = PD + 0.6366\ CP$
Number of teeth and addendum	Outside diameter	Multiply the addendum by the number of teeth plus 2.	$OD = (NT + 2)\ ADD$
Pitch diameter and circular pitch	Number of teeth	Divide the product of the pitch diameter and 3.1416 by the circular pitch.	$NT = \frac{3.1416\ PD}{CP}$
Circular pitch	Chordal thickness	One-half the circular pitch.	$(t_c) = \frac{CP}{2}$

Having	To Get	Rule	Formula
Circular pitch	Addendum	Multiply the circular pitch by 0.3183.	$ADD = 0.3183\ CP$
Circular pitch	Working depth	Multiply the circular pitch by 0.6366.	$WKD = 0.6366\ CP$
Circular pitch	Whole depth	Multiply the circular pitch by 0.6866.	$WD = 0.6866\ CP$
Circular pitch	Clearance	Multiply the circular pitch by 0.05.	$CL = 0.05\ CP$
Circular pitch	Diametral pitch	Divide 3.1416 by the circular pitch.	$DP = \frac{3.1416}{CP}$
Pitch diameter and number of teeth	Diametral pitch	Divide the number of teeth by the pitch diameter.	$DP = \frac{NT}{PD}$
Pitch diameter of gear pinion	Center distance	Add pitch diameter of gear (PD_g) to pitch diameter of pinion (PD_p) and divide by 2.	$C = \frac{PD_g + PD_p}{2}$
Outside diameter and number of teeth	Diametral pitch	Divide the number of teeth plus 2 by the outside diameter.	$DP = \frac{NT + 2}{OD}$
Number of teeth and diametral pitch	Pitch diameter	Divide the number of teeth by the diametral pitch.	$PD = \frac{NT}{DP}$
Outside diameter and diametral pitch	Pitch diameter	Subtract from the outside diameter the quotient of 2 divided by the diametral pitch.	$PD = OD - \frac{2}{DP}$
Number of teeth and diametral pitch	Outside diameter	Divide the number of teeth plus 2 by the diametral pitch.	$OD = \frac{NT + 2}{DP}$
Pitch diameter and diametral pitch	Outside diameter	Add to the pitch diameter the quotient of 2 divided by the diametral pitch.	$OD = PD + \frac{2}{DP}$
Pitch diameter and number of teeth	Outside diameter	Divide the number of teeth plus 2 by the quotient of the number of teeth divided by pitch diameter.	$OD = NT + 2 \div \frac{NT}{PD}$
Pitch diameter and diametral pitch	Number of teeth	Multiply the pitch diameter by the diametral pitch.	$NT = PD\ DP$

Having	To Get	Rule	Formula
Outside diameter and the diametral pitch	Number of teeth	Multiply the outside diameter by the diametral pitch and subtract 2.	$NT = OD\,DP - 2$
Diametral pitch	Chordal thickness	Divide 1.5708 by the diametral pitch.	$t_c = \frac{1.5708}{DP}$
Diametral pitch	Addendum	Divide 1 by the diametral pitch.	$ADD = \frac{1}{DP}$
Diametral pitch	Working depth	Divide 2 by the diametral pitch.	$WKD = \frac{2}{DP}$
Diametral pitch	Whole depth	Divide 2.157 by the diametral pitch.	$WD = \frac{2.157}{DP}$
Diametral pitch	Clearance	Divide 0.157 by the diametral pitch.	$CL = \frac{0.157}{DP}$

APPENDIX IV

DERIVATION OF FORMULAS FOR DIAMETRAL PITCH SYSTEM

1. TOOTH ELEMENTS based on a No. 1 diametral pitch gear (fig. AIV-1)

a. Addendum (ADD)–.000

(1) The distance from the top of the tooth to the pitch line.

b. Circular Pitch (CP)–31416

(1) The length of an arc equal to the circumference of a 1inch circle, covers one tooth and one space on the pitch circle.

(2) Measure the circular pitch on the pitch line. If you could draw a circle inside the tooth using the 1-inch addendum as the diameter, the circumference of the circle would be 3.1416. Using your imagination, break the circle at one point on the circumference, imagining the circumference is a string. Lay the imaginary string on the pitch line at one side of the tooth. Stretch the other end as far as possible on the pitch line; it will stretch to a corresponding point on the next adjacent tooth on the pitch line.

c. Circular Thickness (CT)–1.5708

(1) One-half of the circular pitch, measured at the pitch line.

d. Clearance (CL)–0.15708

(1) One-tenth of the chordal thickness; move decimal one place to the left.

e. Dedendum (DED)–1.15708

(1) The sum of an addendum plus a clearance.

(2) 1.000 - ADD
  0.1570 - CL
  1.1570 - DED

f. Working Depth (WKD)–2.000

(1) The sum of two addendums.

(2) 1.000 - ADD
  +1.000 - ADD
  2.000 - WKD

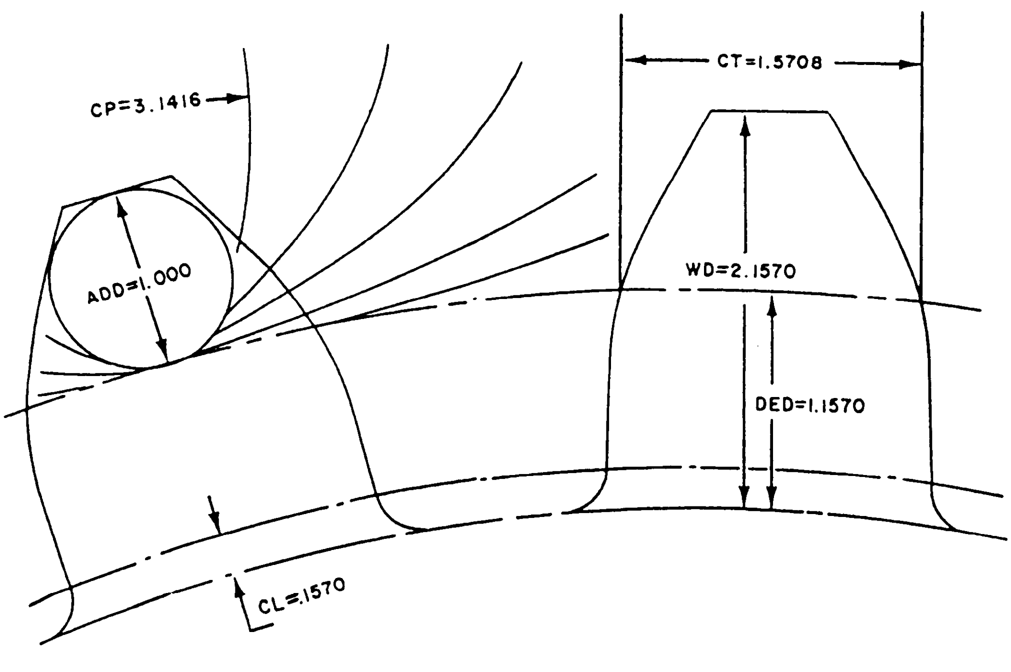


Figure AIV-1.–Tooth elements on a No. 1 diametral pitch gear.

g. Whole Depth (WD)–2.15708

(1) The sum of an addendum and a dedendum.

(2) 1.0000 - ADD
+1.1570 - DED
2.1570 - WD

h. Diametral Pitch (DP)

(1) The ratio of the number of teeth per inch of pitch diameter.

(2) $\frac{NT}{PD} = DP$

i. Chordal Addendum–a_c

(1) The distance from the top of a gear tooth to a chord subtending (extending under) the intersections of the tooth thickness arc and the sides of the tooth.

(2) $a_c = ADD + \frac{(CT)^2}{4(PD)}$

j. Chordal Thickness–t_c

(1) The thickness of the tooth, measured at the pitch circle.

$$t_c = PD \sin \frac{90°}{N}$$

2. GEAR ELEMENTS

a. Number of Teeth (NT)

(1) Connecting link between the tooth elements and gear elements.

(2) Number of teeth in the gear

(3) $\frac{PD}{ADD} = NT$

b. Pitch Diameter (PD)

(1) Diameter of the pitch circle.

(2) For every tooth in the gear there is an addendum on the pitch diameter.

(3) $ADD \times NT = PD$

c. Outside Diameter (OD).

(1) The diameter of the gear.

(2) Since there is an addendum on the pitch diameter for each tooth, the two elements are directly related. Therefore, the outside diameter is simply the pitch diameter plus two addendums, or simulated teeth. The formulas read:

(a) $ADD \times NT = PD$

(b) $ADD \times (NT) + 2) = OD$

(c) $PD + 2ADD = OD$

d. Linear Pitch (LP)

(1) The linear pitch is the same as the circular pitch except that it is the lineal measurement of pitch on a gear rack

(2) CP = LP

(3) Figure AIV-2 illustrates linear pitch.

3. GEAR AND TOOTH ELEMENT RELATIONSHIP

TOOTH	GEAR
a ADD	a. PD
b. DED	b. OD
c. CP	c. a_c
d. CT	d. t_c
e. WD	
f. CL	
g. DP	

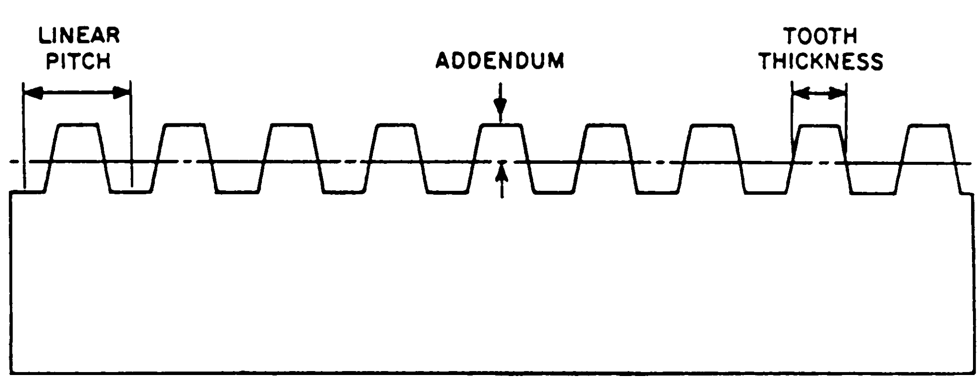


Figure AIV-2.–Linear pitch.

(1) NT is the connecting link between tooth elements and gear elements.

(2) To completely calculate a gear, one tooth and one gear element must be known.

(3) For every tooth in the gear there is a circular pitch on the pitch circle.

(4) For every tooth in the gear there is an addendum on the pitch diameter.

FORMULAS

1. $ADD = \frac{1.000}{DP}$

2. $CP = \frac{3.1416}{DP}$

3. $CT = \frac{1.5708}{DP}$

4. $CL = \frac{0.15708}{DP}$

5. $DED = \frac{1.15708}{DP}$

6. $WKD = \frac{2.000}{DP}$

7. $WD = \frac{2.15708}{DP}$

8. $DP = \frac{NT}{PD}$ or transpose any other formula with DP involved.

9. $NT = \frac{PD}{ADD}$

10. $PD = ADD \times NT$

11. $OD = ADD \times (NT + 2)$

APPENDIX V

REFERENCES USED TO DEVELOP THE TRAMAN

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INDEX

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