JIGS AND FIXTURES

Material for Jig Bushings.—Bushings are generally made of a good grade of tool steel to ensure hardening at a fairly low temperature and to lessen the danger of fire cracking. They can also be made from machine steel, which will answer all practical purposes, provided the bushings are properly casehardened to a depth of about $\frac{1}{16}$ inch. Sometimes, bushings for guiding tools may be made of cast iron, but only when the cutting tool is of such a design that no cutting edges come within the bushing itself. For example, bushings used simply to support the smooth surface of a boring-bar or the shank of a reamer might, in some instances, be made of cast iron, but hardened steel bushings should always be used for guiding drills, reamers, taps, etc., when the cutting edges come in direct contact with the guiding surfaces. If the outside diameter of the bushing is very large, as compared with the diameter of the cutting tool, the cost of the bushing can sometimes be reduced by using an outer cast-iron body and inserting a hardened tool steel bushing.

When tool steel bushings are made and hardened, it is recommended that A-2 steel be used. The furnace should be set to 1750°F and the bushing placed in the furnace and held there approximately 20 minutes after the furnace reaches temperature. Remove the bushing and cool in still air. After the part cools to 100–150°F, immediately place in a tempering furnace that has been heated to 300°F. Remove the bushing after one hour and cool in still air. If an atmospherically controlled furnace is unavailable, the part should be wrapped in stainless foil to prevent scaling and oxidation at the 1750°F temperature.

American National Standard Jig Bushings.—Specifications for the following types of jig bushings are given in American National Standard B94.33-1974 (R1986). Head Type Press Fit Wearing Bushings, Type H (Fig. 1 and Tables 1 and 3); Headless Type Press Fit Wearing Bushings, Type P (Fig. 2 and Tables 1 and 3); Slip Type Renewable Wearing Bushings, Type S (Fig. 3 and Tables 4 and 5); Fixed Type Renewable Wearing Bushings, Type F (Fig. 4 and Tables 5 and 6); Headless Type Liner Bushings, Type L (Fig. 5 and Table 7); and Head Type Liner Bushings, Type HL (Fig. 6 and Table 8). Specifications for locking mechanisms are also given in Table 9.

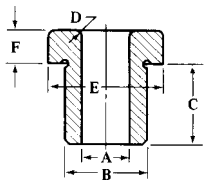


Fig. 1. Head Type Press Fit-Wearing Bushings — Type H

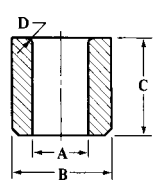


Fig. 2. Headless Type Press Fit Wearing Bushings — Type P

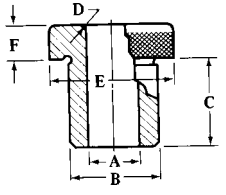


Fig. 3. Slip Type Renewable Wearing Bushings—Type S

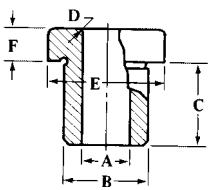


Fig. 4. Fixed Type Renewable Wearing Bushings — Type F

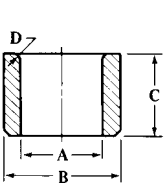


Fig. 5. Headless Type Liner Bushings — Type L

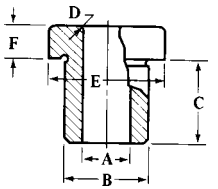


Fig. 6. Head Type Liner Bushings — Type HL

Table 1. American National Standard Head Type Press Fit Wearing Bushings — Type H *ANSI B94.33-1974, R1986*

Range of Hole Sizes *A*	Body Diameter *B*					Body Length *C*	Radius *D*	Head Diam. *E* Max	Head Thickness *F* Max	Number
		Unfinished		Finished						
	Nom	Max	Min	Max	Min					
0.0135 up to and including 0.0625	0.156	0.166	0.161	0.1578	0.1575	0.250 0.312 0.375 0.500	0.016	0.250	0.094	H-10-4 H-10-5 H-10-6 H-10-8
0.0630 to 0.0995	0.203	0.213	0.208	0.2046	0.2043	0.250 0.312 0.375 0.500 0.750	0.016	0.312	0.094	H-13-4 H-13-5 H-13-6 H-13-8 H-13-12
0.1015 to 0.1405	0.250	0.260	0.255	0.2516	0.2513	0.250 0.312 0.375 0.500 0.750	0.016	0.375	0.094	H-16-4 H-16-5 H-16-6 H-16-8 H-16-12
0.1406 to 0.1875	0.312	0.327	0.322	0.3141	0.3138	0.250 0.312 0.375 0.500 0.750 1.000	0.031	0.438	0.125	H-20-4 H-20-5 H-20-6 H-20-8 H-20-12 H-20-16
0.189 to 0.2500	0.406	0.421	0.416	0.4078	0.4075	0.250 0.312 0.375 0.500 0.750 1.000 1.375 1.750	0.031	0.531	0.156	H-26-4 H-26-5 H-26-6 H-26-8 H-26-12 H-26-16 H-26-22 H-26-28
0.2570 to 0.3125	0.500	0.520	0.515	0.5017	0.5014	0.312 0.375 0.500 0.750 1.000 1.375 1.750	0.047	0.625	0.219	H-32-5 H-32-6 H-32-8 H-32-12 H-32-16 H-32-22 H-32-28
0.3160 to 0.4219	0.625	0.645	0.640	0.6267	0.6264	0.312 0.375 0.500 0.750 1.000 1.375 1.750 2.125	0.047	0.812	0.219	H-40-5 H-40-6 H-40-8 H-40-12 H-40-16 H-40-22 H-40-28 H-40-34
0.4375 to 0.5000	0.750	0.770	0.765	0.7518	0.7515	0.500 0.750 1.000 1.375 1.750 2.125	0.062	0.938	0.219	H-48-8 H-48-12 H-48-16 H-48-22 H-29-28 H-48-34
0.5156 to 0.6250	0.875	0.895	0.890	0.8768	0.8765	0.500 0.750 1.000 1.375 1.750 2.125 2.500	0.062	0.125	0.250	H-56-8 H-56-12 H-56-16 H-56-22 H-56-28 H-56-34 H-56-40

Table 1. *(Continued)* **American National Standard Head Type Press Fit Wearing Bushings — Type H** *ANSI B94.33-1974, R1986*

Range of Hole Sizes *A*	Body Diameter *B*					Body Length *C*	Radius *D*	Head Diam. *E* Max	Head Thickness *F* Max	Number
		Unfinished		Finished						
	Nom	Max	Min	Max	Min					
0.6406 to 0.7500	1.000	1.020	1.015	1.0018	1.0015	0.500 0.750 1.000 1.375 1.750 2.125 2.500	0.094	1.250	0.312	H-64-8 H-64-12 H-64-16 H-64-22 H-64-28 H-64-34 H-64-40
0.7656 to 1.0000	1.375	1.395	1.390	1.3772	1.3768	0.750 1.000 1.375 1.750 2.125 2.500	0.094	1.625	0.375	H-88-12 H-88-16 H-88-22 H-88-28 H-88-34 H-88-40
1.0156 to 1.3750	1.750	1.770	1.765	1.7523	1.7519	1.000 1.375 1.750 2.125 2.500 3.000	0.094	2.000	0.375	H-112-16 H-112-22 H-112-28 H-112-34 H-112-40 H-112-48
1.3906 to 1.7500	2.250	2.270	2.265	2.2525	2.2521	1.000 1.375 1.750 2.125 2.500 3.000	0.094	2.500	0.375	H-144-16 H-144-22 H-144-28 H-144-34 H-144-40 H-144-48

All dimensions are in inches.
See also Table 3 for additional specifications.

Table 2. American National Standard Headless Type Press Fit Wearing Bushings — Type P *ANSI B94.33-1974, R1986*

Range of Hole Sizes *A*	Body Diameter *B*					Body Length *C*	Radius *D*	Number
		Unfinished		Finished				
	Nom	Max	Min	Max	Min			
0.0135 up to and including 0.0625	0.156	0.166	0.161	0.1578	0.1575	0.250 0.312 0.375 0.500	0.016	P-10-4 P-10-5 P-10-6 P-10-8
0.0630 to 0.0995	0.203	0.213	0.208	0.2046	0.2043	0.250 0.312 0.375 0.500 0.750	0.016	P-13-4 P-13-5 P-13-6 P-13-8 P-13-12
0.1015 to 0.1405	0.250	0.260	0.255	0.2516	0.2513	0.250 0.312 0.375 0.500 0.750	0.016	P-16-4 P-16-5 P-16-6 P-16-8 P-16-12
0.1406 to 0.1875	0.312	0.327	0.322	0.3141	0.3138	0.250 0.312 0.375 0.500 0.750 1.000	0.031	P-20-4 P-20-5 P-20-6 P-20-8 P-20-12 P-20-16

Table 2. American National Standard Headless Type Press Fit Wearing Bushings — Type P *ANSI B94.33-1974, R1986*

Range of Hole Sizes *A*	Body Diameter *B*					Body Length *C*	Radius *D*	Number
		Unfinished		Finished				
	Nom	Max	Min	Max	Min			
0.1890 to 0.2500	0.406	0.421	0.416	0.4078	0.4075	0.250 0.312 0.375 0.500 0.750 1.000 1.375 1.750	0.031	P-26-4 P-26-5 P-26-6 P-26-8 P-26-12 P-26-16 P-26-22 P-26-28
0.2570 to 0.3125	0.500	0.520	0.515	0.5017	0.5014	0.312 0.375 0.500 0.750 1.000 1.375 1.750	0.047	P-32-5 P-32-6 P-32-8 P-32-12 P-32-16 P-32-22 P-32-28
0.3160 to 0.4219	0.625	0.645	0.640	0.6267	0.6264	0.312 0.375 0.500 0.750 1.000 1.375 1.750 2.125	0.047	P-40-5 P-40-6 P-40-8 P-40-12 P-40-16 P-40-22 P-40-28 P-40-34
0.4375 to 0.5000	0.750	0.770	0.765	0.7518	0.7515	0.500 0.750 1.000 1.375 1.750 2.125	0.062	P-48-8 P-48-12 P-48-16 P-48-22 P-48-28 P-48-34
0.5156 to 0.6250	0.875	0.895	0.890	0.8768	0.8765	0.500 0.750 1.000 1.375 1.750 2.125 2.500	0.062	P-56-8 P-56-12 P-56-16 P-56-22 P-56-28 P-56-34 P-56-40
0.6406 to 0.7500	1.000	1.020	1.015	1.0018	1.0015	0.500 0.750 1.000 1.375 1.750 2.125 2.500	0.062	P-64-8 P-64-12 P-64-16 P-64-22 P-64-28 P-64-34 P-64-40
0.7656 to 1.0000	1.375	1.395	1.390	1.3772	1.3768	0.750 1.000 1.375 1.750 2.125 2.500	0.094	P-88-12 P-88-16 P-88-22 P-88-28 P-88-34 P-88-40
1.0156 to 1.3750	1.750	1.770	1.765	1.7523	1.7519	1.000 1.375 1.750 2.125 2.500 3.000	0.094	P-112-16 P-112-22 P-112-28 P-112-34 P-112-40 P-112-48
1.3906 to 1.7500	2.250	2.270	2.265	2.2525	2.2521	1.000 1.375 1.750 2.125 2.500 3.000	0.094	P-144-16 P-144-22 P-144-28 P-144-34 P-144-40 P-144-48

All dimensions are in inches. See Table 3 for additional specifications.

Table 3. Specifications for Head Type H and Headless Type P Press Fit Wearing Bushings *ANSI B94.33-1974, R1986*

All dimensions given in inches. Tolerance on dimensions where not otherwise specified shall be ±0.010 inch.

Size and type of chamfer on lead end to be manufacturer's option.

The length, *C*, is the overall length for the headless type and length underhead for the head type.

The head design shall be in accordance with the manufacturer's practice.

Diameter *A* must be concentric to diameter *B* within 0.0005 T.I.V. on finish ground bushings.

The body diameter, *B*, for unfinished bushings is larger than the nominal diameter in order to provide grinding stock for fitting to jig plate holes. The grinding allowance is:

0.005 to 0.010 in. for sizes 0.156, 0.203 and 0.250 in.
0.010 to 0.015 in. for sizes 0.312 and 0.406 in.
0.015 to 0.020 in. for sizes 0.500 in. and up.

Hole sizes are in accordance with American National Standard Twist Drill Sizes.

The maximum and minimum values of the hole size, *A*, shall be as follows:

Nominal Size of Hole	Maximum	Minimum
Above 0.0135 to 0.2500 in., incl.	Nominal + 0.0004 in.	Nominal + 0.0001 in.
Above 0.2500 to 0.7500 in., incl.	Nominal + 0.0005 in.	Nominal + 0.0001 in.
Above 0.7500 to 1.5000 in., incl.	Nominal + 0.0006 in.	Nominal + 0.0002 in.
Above 1.5000 in.	Nominal + 0.0007 in.	Nominal + 0.0003 in.

Bushings in the size range from 0.0135 through 0.3125 will be counterbored to provide for lubrication and chip clearance.

Bushings without counterbore are optional and will be furnished upon request.

The size of the counterbore shall be inside diameter of the bushing + 0.031 inch.

The included angle at the bottom of the counterbore shall be 118 deg, ± 2 deg.

The depth of the counterbore shall be in accordance with the table below to provide adequate drill bearing.

	Drill Bushing Hole Size											
	0.0135 to 0.0625		0.0630 to 0.0995		0.1015 to 0.1405		0.1406 to 0.1875		0.1890 to 0.2500		0.2570 to 0.3125	
Body	P	H	P	H	P	H	P	H	P	H	P	H
Length	Minimum Drill Bearing Length—Inch											
0.250	X	0.250	X	X	X	X	X	X	X	X	X	X
0.312	X	0.250	X	X	X	X	X	X	X	X	X	X
0.375	0.250	0.250	X	X	X	X	X	X	X	X	X	X
0.500	0.250	0.250	X	0.312	X	0.312	X	0.375	X	X	X	X
0.750	+	+	0.375	0.375	0.375	0.375	X	0.375	X	X	X	X
1.000	+	+	+	+	+	+	0.625	0.625	0.625	0.625	0.625	0.625
1.375	+	+	+	+	+	+	+	+	0.625	0.625	0.625	0.625
1.750	+	+	+	+	+	+	+	+	0.625	0.625	0.625	0.625

All dimensions are in inches.

X indicates no counterbore.

+ indicates not American National Standard

Table 4. American National Standard Slip Type Renewable Wearing Bushings—Type S *ANSI B94.33-1974, R1986*

Range of Hole Sizes *A*	Body Diameter *B*			Length Under-Head *C*	Radius *D*	Head Diam. *E* Max	Head Thickness *F* Max	Number
	Nom	Max	Min					
0.0135 up to and including 0.0469	0.188	0.1875	0.1873	0.250 0.312 0.375 0.500	0.031	0.312	0.188	S-12-4 S-12-5 S-12-6 S-12-8
0.0492 to 0.1562	0.312	0.3125	0.3123	0.312 0.500 0.750 1.000	0.047	0.562	0.375	S-20-5 S-20-8 S-20-12 S-20-16
0.1570 to 0.3125	0.500	0.5000	0.4998	0.312 0.500 0.750 1.000 1.375 1.750	0.047	0.812	0.438	S-32-5 S-32-8 S-32-12 S-32-16 S-32-22 S-32-28
0.3160 to 0.5000	0.750	0.7500	0.7498	0.500 0.750 1.000 1.375 1.750 2.125	0.094	1.062	0.438	S-48-8 S-48-12 S-48-16 S-48-22 S-48-28 S-48-34

Table 4. *(Continued)* **American National Standard Slip Type Renewable Wearing Bushings—Type S** *ANSI B94.33-1974, R1986*

Range of Hole Sizes *A*	Body Diameter *B* Nom	Max	Min	Length Under-Head *C*	Radius *D*	Head Diam. *E* Max	Head Thickness *F* Max	Number
0.5156 to 0.7500	1.000	1.0000	0.9998	0.500 0.750 1.000 1.375 1.750 2.125 2.500	0.094	1.438	0.438	S-64-8 S-64-12 S-64-16 S-64-22 S-64-28 S-64-34 S-64-40
0.7656 to 1.0000	1.375	1.3750	1.3747	0.750 1.000 1.375 1.750 2.125 2.500	0.094	1.812	0.438	S-88-12 S-88-16 S-88-22 S-88-28 S-88-34 S-88-40
1.0156 to 1.3750	1.750	1.7500	1.7497	1.000 1.375 1.750 2.125 2.500 3.000	0.125	2.312	0.625	S-112-16 S-112-22 S-112-28 S-112-34 S-112-40 S-112-48
1.3906 to 1.7500	2.250	2.2500	2.2496	1.000 1.375 1.750 2.125 2.500 3.000	0.125	2.812	0.625	S-144-16 S-144-22 S-144-28 S-144-34 S-144-40 S-144-48

All dimensions are in inches. See also Table 5 for additional specifications.

Table 5. Specifications for Slip Type S and Fixed Type F Renewable Wearing Bushings *ANSI B94.33-1974, R1986*

Tolerance on dimensions where not otherwise specified shall be plus or minus 0.010 inch.
Hole sizes are in accordance with the American Standard Twist Drill Sizes.
The maximum and minimum values of hole size, *A*, shall be as follows:

Nominal Size of Hole	Maximum	Minimum
Above 0.0135 to 0.2500 in. incl.	Nominal + 0.0004 in.	Nominal + 0.0001 in.
Above 0.2500 to 0.7500 in. incl.	Nominal + 0.0005 in.	Nominal + 0.0001 in.
Above 0.7500 to 1.5000 in. incl.	Nominal + 0.0006 in.	Nominal + 0.0002 in.
Above 1.5000	Nominal + 0.0007 in.	Nominal + 0.0003 in.

The head design shall be in accordance with the manufacturer's practice.
Head of slip type is usually knurled.
When renewable wearing bushings are used with liner bushings of the head type, the length under the head will still be equal to the thickness of the jig plate, because the head of the liner bushing will be countersunk into the jig plate.
Diameter *A* must be concentric to diameter *B* within 0.0005 T.I.R. on finish ground bushings.
Size and type of chamfer on lead end to be manufacturer's option.
Bushings in the size range from 0.0135 through 0.3125 will be counterbored to provide for lubrication and chip clearance.
Bushings without counterbore are optional and will be furnished upon request.
The size of the counterbore shall be inside diameter of the bushings plus 0.031 inch.
The included angle at the bottom of the counterbore shall be 118 deg., plus or minus 2 deg.
The depth of the counterbore shall be in accordance with the table below to provide adequate drill bearing.

Body Length	Drill Bearing Hole Size: 0.0135 to 0.0625 S	F	0.0630 to 0.0995 S	F	0.1015 to 0.1405 S	F	0.1406 to 0.1875 S	F	0.1890 to 0.2500 S	F	0.2500 to 0.3125 S	F
	Minimum Drill Bearing Length											
0.250	0.250	0.250	0.375	0.375	X	X	X	X	X	X	X	X
0.312	0.250	0.250	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	X	X
0.375	0.250	0.250	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	X	X
0.500	0.250	0.250	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	X	X
0.750	0.250	0.250	0.375	0.375	0.375	0.375	0.375	0.375	0.625	0.625	0.625	0.625
1.000	0.312	0.312	0.375	0.375	0.375	0.375	0.625	0.625	0.625	0.625	0.625	0.625
1.375	+	+	+	+	+	+	0.625	0.625	0.625	0.625	0.625	0.625
1.750	+	+	+	+	+	+	0.625	0.625	0.625	0.625	0.625	0.625

All dimensions are in inches.
X indicates no counterbore.
+ indicates not American National Standard length.

Table 6. American National Standard Fixed Type Renewable Wearing Bushings — Type F *ANSI B94.33-1974, R1986*

Range of Hole Sizes *A*	Body Diameter *B*			Length Under Head *C*	Radius *D*	Head Diam. *E* Max	Head Thickness *F* Max	Number
	Nom	Max	Min					
0.0135 up to and including 0.0469	0.188	0.1875	0.1873	0.250	0.031	0.312	0.188	F-12-4
				0.312				F-12-5
				0.375				F-12-6
				0.500				F-12-8
0.0492 to 0.1562	0.312	0.3125	0.3123	0.312	0.047	0.562	0.250	F-20-5
				0.500				F-20-8
				0.750				F-20-12
				1.000				F-20-16
0.1570 to 0.3125	0.500	0.5000	0.4998	0.312	0.047	0.812	0.250	F-32-5
				0.500				F-32-8
				0.750				F-32-12
				1.000				F-32-16
				1.375				F-32-22
				1.750				F-32-28
0.3160 to 0.5000	0.750	0.7500	0.7498	0.500	0.094	1.062	0.250	F-48-8
				0.750				F-48-12
				1.000				F-48-16
				1.375				F-48-22
				1.750				F-48-28
				2.125				F-48-34
0.5156 to 0.7500	1.000	1.0000	0.9998	0.500	0.094	1.438	0.375	F-64-8
				0.750				F-64-12
				1.000				F-64-16
				1.375				F-64-22
				1.750				F-64-28
				2.125				F-64-34
				2.500				F-64-40
0.7656 to 1.0000	1.375	1.3750	1.3747	0.750	0.094	1.812	0.375	F-88-12
				1.000				F-88-16
				1.375				F-88-22
				1.750				F-88-28
				2.125				F-88-34
				2.500				F-88-40
1.0156 to 1.3750	1.750	1.7500	1.7497	1.000	0.125	2.312	0.375	F-112-16
				1.375				F-112-22
				1.750				F-112-28
				2.125				F-112-34
				2.500				F-112-40
				3.000				F-112-48
1.3906 to 1.7500	2.250	2.2500	2.2496	1.000	0.125	2.812	0.375	F-144-16
				1.375				F-144-22
				1.750				F-144-28
				2.125				F-144-34
				2.500				F-144-40
				3.000				F-144-48

All dimensions are in inches. See also Table 5 for additional specifications.

Table 7. American National Standard Headless Type Liner Bushings — Type L *ANSI B94.33-1974, R1986*

Range of Hole Sizes in Renewable Bushings	Inside Diameter *A*			Body Diameter *B*					Over-all Length *C*	Radius *D*	Number
					Unfinished		Finished				
	Nom	Max	Min	Nom	Max	Min	Max	Min			
0.0135 up to and including 0.0469	0.188	0.1879	0.1876	0.312	0.3341	0.3288	0.3141	0.3138	0.250 0.312 0.375 0.500	0.031	L-20-4 L-20-5 L-20-6 L-20-8
0.0492 to 0.1562	0.312	0.3129	0.3126	0.500	0.520	0.515	0.5017	0.5014	0.312 0.500 0.750 1.000	0.047	L-32-5 L-32-8 L-32-12 L-32-16
0.1570 to 0.3125	0.500	0.5005	0.5002	0.750	0.770	0.765	0.7518	0.7515	0.312 0.500 0.750 1.000 1.375 1.750	0.062	L-48-5 L-48-8 L-48-12 L-48-16 L-48-22 L-48-28
0.3160 to 0.5000	0.750	0.7506	0.7503	1.000	1.020	1.015	1.0018	1.0015	0.500 0.750 1.000 1.375 1.750 2.125	0.062	L-64-8 L-64-12 L-64-16 L-64-22 L-64-28 L-64-34
0.5156 to 0.7500	1.000	1.0007	1.0004	1.375	1.395	1.390	1.3772	1.3768	0.500 1.750 1.000 1.375 1.750 2.125 2.500	0.094	L-88-8 L-88-12 L-88-16 L-88-22 L-88-28 L-88-34 L-88-40
0.7656 to 1.0000	1.375	1.3760	1.3756	1.750	1.770	1.765	1.7523	1.7519	0.750 1.000 1.375 1.750 2.125 2.500	0.094	L-112-12 L-112-16 L-112-22 L-112-28 L-112-34 L-112-40
1.0156 to 1.3750	1.750	1.7512	1.7508	2.250	2.270	2.265	2.2525	2.2521	1.000 1.375 1.750 2.125 2.500 3.000	0.094	L-144-16 L-144-22 L-144-28 L-144-34 L-144-40 L-144-48
1.3906 to 1.7500	2.250	2.2515	2.2510	2.750	2.770	2.765	2.7526	2.7522	1.000 1.375 1.750 2.125 2.500 3.000	0.125	L-176-16 L-176-22 L-176-28 L-176-34 L-176-40 L-176-48

All dimensions are in inches.

Tolerances on dimensions where otherwise not specified are ± 0.010 in.

The body diameter, *B*, for unfinished bushings is 0.015 to 0.020 in. larger than the nominal diameter in order to provide grinding stock for fitting to jig plate holes.

Diameter *A* must be concentric to diameter *B* within 0.0005 T.I.R. on finish ground bushings.

Table 8. American National Standard Head Type Liner Bushing — Type HL
ANSI B94.33-1974, R1986

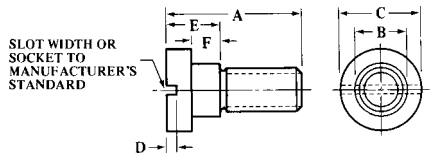
Range of Hole Sizes in Renewable Bushings	Inside Diameter *A*			Body Diameter *B*					Overall Length *C*	Radius *D*	Head Dia. *E*	Head Thickness *F* Max	Number
					Unfinished		Finished						
	Nom	Max	Min	Nom	Max	Min	Max	Min					
0.0135 to 0.1562	0.312	0.3129	0.3126	0.500	0.520	0.515	0.5017	0.5014	0.312	0.047	0.625	0.094	HL-32-5
									0.500				HL-32-8
									0.750				HL-32-12
									1.000				HL-32-16
0.1570 to 0.3125	0.500	0.5005	0.5002	0.750	0.770	0.765	0.7518	0.7515	0.312	0.062	0.875	0.094	HL-48-5
									0.500				HL-48-8
									0.750				HL-48-12
									1.000				HL-48-16
									1.375				HL-48-22
									1.750				HL-48-28
0.3160 to 0.5000	0.750	0.7506	0.7503	1.000	1.020	1.015	1.0018	1.0015	0.500	0.062	1.125	0.125	HL-64-8
									0.750				HL-64-12
									1.000				HL-64-16
									1.375				HL-64-22
									1.750				HL-64-28
									2.125				HL-64-34
0.5156 to 0.7500	1.000	1.0007	1.0004	1.375	1.395	1.390	1.3772	1.3768	0.500	0.094	1.500	0.125	HL-88-8
									0.750				HL-88-12
									1.000				HL-88-16
									1.375				HL-88-22
									1.750				HL-88-28
									2.125				HL-88-34
									2.500				HL-88-40
0.7656 to 1.0000	1.375	1.3760	1.3756	1.750	1.770	1.765	1.7523	1.7519	0.750	0.094	1.875	0.188	HL-112-12
									1.000				HL-112-16
									1.375				HL-112-22
									1.750				HL-112-28
									2.125				HL-112-34
									2.500				HL-112-40
1.0156 to 1.3750	1.750	1.7512	1.7508	2.250	2.27	2.265	2.2525	2.2521	1.000	0.094	2.375	0.188	HL-144-16
									1.375				HL-144-22
									1.750				HL-144-28
									2.125				HL-144-34
									2.500				HL-144-40
									3.000				HL-144-48
1.3906 to 1.7500	2.250	2.2515	2.2510	2.750	2.770	2.765	2.7526	2.7522	1.000	0.125	2.875	0.188	HL-176-16
									1.375				HL-176-22
									1.750				HL-176-28
									2.125				HL-176-34
									2.500				HL-176-40
									3.000				HL-176-48

All dimensions are in inches.

See also footnotes to Table 7.

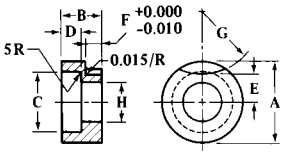
Table 9. American National Standard Locking Mechanisms for Jig Bushings
ANSI B94.33-1974, R1986

Lock Screw for Use with Slip or Fixed Renewable Bushings



No.	*A*	*B*	*C*	*D*	*E*	*F*	UNC Thread
LS-0	0.438	0.188	0.312	Per Manufacturer's Standard	0.188	0.105-0.100	8–32
LS-1	0.625	0.375	0.625		0.250	0.138-0.132	5/16–18
LS-2	0.875	0.375	0.625		0.375	0.200-0.194	5/16–18
LS-3	1.000	0.438	0.750		0.375	0.200-0.194	3/8–16

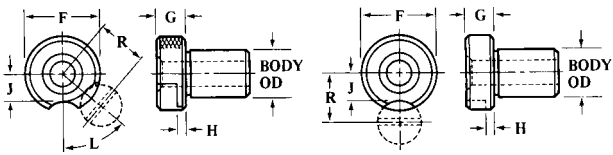
Round Clamp Optional Only for Use with Fixed Renewable Bushing



NOTE: F DIMENSION ALLOWS FOR CLAMPING. MATERIAL AND HARDNESS TO MANUFACTURER'S STANDARD. TO CHANGE TO THE ROUND CLAMP IN OLD FIXTURES, REMOVE THE CONVENTIONAL SCREW AND USE THE SAME TAPPED HOLE TO SECURE THE NEW CLAMP WITH STANDARD SOCKET HEAD SCREW.

Number	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	Use With Socket Head Screw
RC-1	0.625	0.312	0.484	0.150	0.203	0.125	0.531	0.328	5/16–18
RC-2	0.625	0.438	0.484	0.219	0.187	0.188	0.906	0.328	5/16–18
RC-3	0.750	0.500	0.578	0.281	0.219	0.188	1.406	0.391	3/8–16

Locking Mechanism Dimensions of Slip and Fixed Renewable Bushings



Body OD	Max Diam. *F* When Used With Locking Device	*G* Head Thickness		*H* ± 0.005	*J*	*L* Max	*R*	Locking Dim. of Lock Screw (Slip or Fixed)	Locking Dim. of Clamp (Fixed Only)	Max Head Diam. of Mating Liner Used to Clear Locking Device	Clamp or Screw LS or RC
		Slip	Fixed								
0.188	0.312	0.188	0.188	0.094	0.094	55°	0.266	0.105-0.100	…	…	0
0.312	0.562	0.375	0.250	0.125	0.172	65°	0.500	0.138-0.132	0.125-0.115	0.625	1
0.500	0.812	0.438	0.250	0.125	0.297	65°	0.625	0.138-0.132	0.125-0.115	0.875	1
0.750	1.062	0.438	0.250	0.125	0.422	50°	0.750	0.138-0.132	0.125-0.115	1.125	1
1.000	1.438	0.438	0.375	0.188	0.594	35°	0.922	0.200-0.194	0.187-0.177	1.500	2
1.375	1.812	0.438	0.375	0.188	0.781	30°	1.109	0.200-0.194	0.187-0.177	1.875	2
1.750	2.312	0.625	0.375	0.188	1.000	30°	1.391	0.200-0.194	0.187-0.177	2.375	3
2.250	2.812	0.625	0.375	0.188	1.250	25°	1.641	0.200-0.194	0.187-0.177	2.875	3

All dimensions are in inches.

Jig Bushing Definitions.— *Renewable Bushings:* Renewable wearing bushings to guide the tool are for use in liners which in turn are installed in the jig. They are used where the bushing will wear out or become obsolete before the jig or where several bushings are to be interchangeable in one hole. Renewable wearing bushings are divided into two classes, "Fixed" and "Slip." Fixed renewable bushings are installed in the liner with the intention of leaving them in place until worn out. Slip renewable bushings are interchangeable in a given size of liner and, to facilitate removal, they are usually made with a knurled head. They are most frequently used where two or more operations requiring different inside diameters are performed in a single jig, such as where drilling is followed by reaming, tapping, spot facing, counterboring, or some other secondary operation.

Press Fit Bushings: Press fit wearing bushings to guide the tool are for installation directly in the jig without the use of a liner and are employed principally where the bushings are used for short production runs and will not require replacement. They are intended also for short center distances.

Liner Bushings: Liner bushings are provided with and without heads and are permanently installed in a jig to receive the renewable wearing bushings. They are sometimes called master bushings.

Jig Plate Thickness.—The standard length of the press fit portion of jig bushings as established are based on standardized uniform jig plate thicknesses of 5/16, 3/8, 1/2, 3/4, 1, 1 3/8, 1 3/4, 2 1/8, 2 1/2, and 3 inches.

Jig Bushing Designation System.—*Inside Diameter:* The inside diameter of the hole is specified by a decimal dimension.

Type Bushing: The type of bushing is specified by a letter: S for Slip Renewable, F for Fixed Renewable, L for Headless Liner, HL for Head Liner, P for Headless Press Fit, and H for Head Press Fit.

Body Diameter: The body diameter is specified in multiples of 0.0156 inch. For example, a 0.500-inch body diameter = 0.500/0.0156 = 32.

Body Length: The effective or body length is specified in multiples of 0.0625 inch. For example, a 0.500-inch length = 0.500/0.0625 = 8.

Unfinished Bushings: All bushings with grinding stock on the body diameter are designated by the letter U following the number.

Example: A slip renewable bushing having a hole diameter of 0.5000 inch, a body diameter of 0.750 inch, and a body length of 1.000 inch would be designated as .5000-S-48-16.

Definition of Jig and Fixture.—The distinction between a jig and fixture is not easy to define, but, as a general rule, it is as follows: A jig either holds or is held on the work, and, at the same time, contains guides for the various cutting tools, whereas a fixture holds the work while the cutting tools are in operation, but does not contain any special arrangements for guiding the tools. A fixture, therefore, must be securely held or fixed to the machine on which the operation is performed—hence the name. A fixture is sometimes provided with a number of gages and stops, but not with bushings or other devices for guiding and supporting the cutting tools.

Jig Borers.—Jig borers are used for precision hole-location work. For this reason, the coordinate measuring systems on these machines are designed to provide longitudinal and transverse movements that are accurate to 0.0001 in. One widely used method of obtaining this accuracy utilizes ultraprecision lead screws. Another measuring system employs precision end measuring rods and a micrometer head that are placed in a trough which is parallel to the table movement. However, the purpose of all coordinate measuring systems used is the same: to provide a method of aligning the spindle at the precise location where a hole is to be produced. Since the work table of a jig borer moves in two directions, the coordinate system of dimensioning is used, where dimensions are given from two perpen-

dicular reference axes, usually the sides of the workpiece, frequently its upper left-hand corner. See Fig. 1C.

Jig-Boring Practice.—The four basic steps to follow to locate and machine a hole on a jig borer are: 1) align and clamp the workpiece on the jig-borer table; 2) locate the two reference axes of the workpiece with respect to the jig-borer spindle; 3) locate the hole to be machined; and 4) drill and bore the hole to size.

Align and Clamp the Workpiece: The first consideration in placing the workpiece on the jig-borer table should be the relation of the coordinate measuring system of the jig borer to the coordinate dimensions on the drawing. Therefore, the coordinate measuring system is designed so that the readings of the coordinate measurements are direct when the table is moved toward the left and when it is moved toward the column of the jig borer. The result would be the same if the spindle were moved toward the right and away from the column, with the workpiece situated in such a position that one reference axis is located at the left and the other axis at the back, toward the column.

If the holes to be bored are to pass through the bottom of the workpiece, then the workpiece must be placed on precision parallel bars. In order to prevent the force exerted by the clamps from bending the workpiece the parallel bars are placed directly under the clamps, which hold the workpiece on the table. The reference axes of the workpiece must also be aligned with respect to the transverse and longitudinal table movements before it is firmly clamped. This alignment can be done with a dial-test indicator held in the spindle of the jig borer and bearing against the longitudinal reference edge. As the table is traversed in the longitudinal direction, the workpiece is adjusted until the dial-test indicator readings are the same for all positions.

Locate the Two Reference Axes of the Workpiece with Respect to the Spindle: The jig-borer table is now moved to position the workpiece in a precise and known location from where it can be moved again to the location of the holes to be machined. Since all the holes are dimensioned from the two reference axes, the most convenient position to start from is where the axis of the jig-borer spindle and the intersection of the two workpiece reference axes are aligned. This is called the starting position, which is similar to a zero reference position. When so positioned, the longitudinal and transverse measuring systems of the jig borer are set to read zero. Occasionally, the reference axes are located outside the body of the workpiece: a convenient edge or hole on the workpiece is picked up as the starting position, and the dimensions from this point to the reference axes are set on the positioning measuring system.

Locate the Hole: Precise coordinate table movements are used to position the workpiece so that the spindle axis is located exactly where the hole is to be machined. When the measuring system has been set to zero at the starting position, the coordinate readings at the hole location will be the same as the coordinate dimensions of the hole center.

The movements to each hole must be made in one direction for both the transverse and longitudinal directions, to eliminate the effect of any backlash in the lead screw. The usual table movements are toward the left and toward the column.

The most convenient sequence on machines using micrometer dials as position indicators (machines with lead screws) is to machine the hole closest to the starting position first and then the next closest, and so on. On jig borers using end measuring rods, the opposite sequence is followed: The farthest hole is machined first and then the next farthest, and so on, since it is easier to remove end rods and replace them with shorter rods.

Drill and Bore Hole to Size: The sequence of operations used to produce a hole on a jig borer is as follows: 1) a short, stiff drill, such as a center drill, that will not deflect when cutting should be used to spot a hole when the work and the axis of the machine tool spindle are located at the exact position where the hole is wanted; 2) the initial hole is made by a twist drill; and 3) a single-point boring tool that is set to rotate about the axis of the machine tool spindle is then used to generate a cut surface that is concentric to the axis of rotation.

Heat will be generated by the drilling operation, so it is good practice to drill all the holes first, and then allow the workpiece to cool before the holes are bored to size.

Transfer of Tolerances.—All of the dimensions that must be accurately held on precision machines and engine parts are usually given a tolerance. And when such dimensions are changed from the conventional to the coordinate system of dimensioning, the tolerances must also be included. Because of their importance, the transfer of the tolerances must be done with great care, keeping in mind that the sum of the tolerances of any pair of dimensions in the coordinate system must not be larger than the tolerance of the dimension that they replaced in the conventional system. An example is given in Fig. 1.

The first step in the procedure is to change the tolerances given in Fig. 1A to equal, bilateral tolerances given in Fig. 1B. For example, the dimension $2.125^{+.003}_{-.001}$ has a total tolerance of 0.004. The equal, bilateral tolerance would be plus or minus one-half of this value, or ±.002. Then to keep the limiting dimensions the same, the basic dimension must be changed to 2.126, in order to give the required values of 2.128 and 2.124. When changing to equal, bilateral tolerances, if the upper tolerance is decreased (as in this example), the basic dimension must be increased by a like amount. The upper tolerance was decreased by 0.003 – 0.002 = 0.001; therefore, the basic dimension was increased by 0.001 to 2.126. Conversely, if the upper tolerance is increased, the basic dimension is decreased.

The next step is to transfer the revised basic dimension to the coordinate dimensioning system. To transfer the 2.126 dimension, the distance of the applicable holes from the left reference axis must be determined. The first holes to the right are 0.8750 from the reference axis. The second hole is 2.126 to the right of the first holes. Therefore, the second hole is 0.8750 + 2.126 = 3.0010 to the right of the reference axis. This value is then the coordinate dimension for the second hole, while the 0.8750 value is the coordinate dimension of the first two, vertically aligned holes. This procedure is followed for all the holes to find their distances from the two reference axes. These values are given in Fig. 1C.

The final step is to transfer the tolerances. The 2.126 value in Fig. 1B has been replaced by the 0.8750 and 3.0010 values in Fig. 1C. The 2.126 value has an available tolerance of ±0.002. Dividing this amount equally between the two replacement values gives 0.8750 ± 0.001 and 3.0010 ± 0.001. The sum of these tolerances is .002, and as required, does not exceed the tolerance that was replaced. Next transfer the tolerance of the 0.502 dimension. Divide the available tolerance, ±0.002, equally between the two replacement values to yield 3.0010 ±0.001 and 3.5030 ±0.001. The sum of these two tolerances equals the replaced tolerance, as required. However, the 1.125 value of the last hole to the right (coordinate dimension 4.6280 in.) has a tolerance of only ±0.001. Therefore, the sum of the tolerances on the 3.5030 and 4.6280 values cannot be larger than 0.001. Dividing this tolerance equally would give 3.5030 ± .0005 and 4.6280 ±0.0005. This new, smaller tolerance replaces the ± 0.001 tolerance on the 3.5030 value in order to satisfy all tolerance sum requirements. This example shows how the tolerance of a coordinate value is affected by more than one other dimensional requirement.

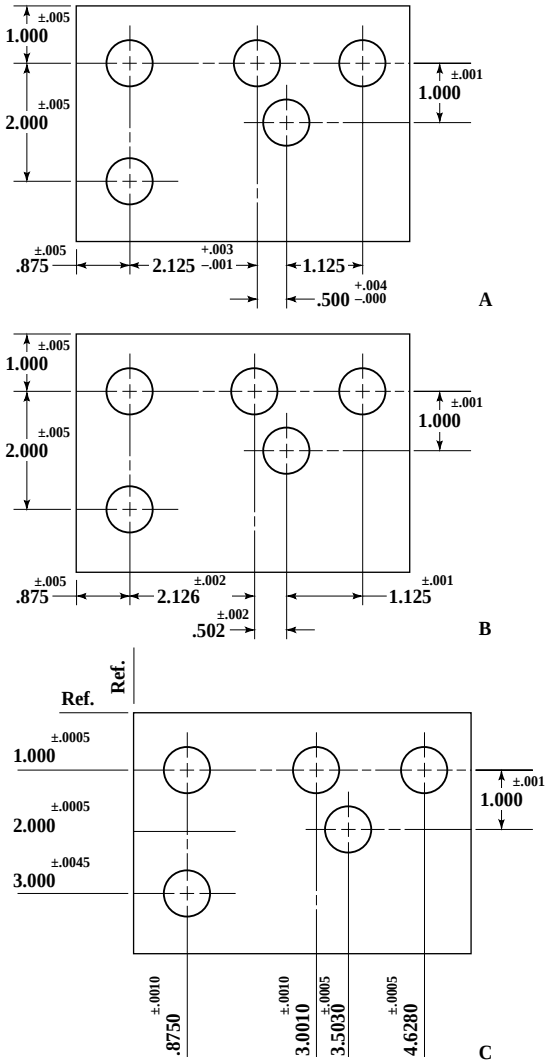


Fig. 1. (A) Conventional Dimensions, Mixed Tolerances; (B) Conventional Dimensions, All Equal, Bilateral Tolerances; and (C) Coordinate Dimensions

The following discussion will summarize the various tolerances listed in Fig. 1C. For the 0.8750 ± 0.0010 dimension, the ± 0.0010 tolerance together with the ± 0.0010 tolerance on the 3.0010 dimension is required to maintain the ± 0.002 tolerance of the 2.126 dimension. The ± .0005 tolerances on the 3.5030 and 4.2680 dimensions are required to maintain the ± 0.001 tolerance of the 1.125 dimension, at the same time as the sum of the ± .0005 tolerance on the 3.5030 dimension and the ± 0.001 tolerance on the 3.0010 dimension does not exceed the ± 0.002 tolerance on the replaced 0.503 dimension. The ± 0.0005 tolerances on the 1.0000 and 2.0000 values maintain the ± 0.001 tolerance on the 1.0000 value given at the right in Fig. 1A. The ± 0.0045 tolerance on the 3.0000 dimension together with the ± 0.0005 tolerance on the 1.0000 value maintains the ± .005 tolerance on the 2.0000 dimension of Fig. 1A. It should be noted that the 2.000 ± .005 dimension in Fig. 1A was replaced by the 1.0000 and 3.0000 dimensions in Fig. 1C. Each of these values could have had a tolerance of ± 0.0025, except that the tolerance on the 1.0000 dimension on the left in Fig. 1A is also bound by the ± 0.001 tolerance on the 1.0000 dimension on the right, thus the ± 0.0005 tolerance value is used. This procedure requires the tolerance on the 3.0000 value to be increased to ± 0.0045.

Lengths of Chords for Spacing Off the Circumferences of Circles

On the following pages are given tables of the lengths of chords for spacing off the circumferences of circles. The object of these tables is to make possible the division of the periphery into a number of equal parts without trials with the dividers. The first table is calculated for circles having a diameter equal to 1. For circles of other diameters, the length of chord given in the table should be multiplied by the diameter of the circle. This first table may be used by toolmakers when setting "buttons" in circular formation. Assume that it is required to divide the periphery of a circle of 20 inches diameter into thirty-two equal parts. From the table the length of the chord is found to be 0.098017 inch, if the diameter of the circle were 1 inch. With a diameter of 20 inches the length of the chord for one division would be 20 × 0.098017 = 1.9603 inches. Another example in metric units: For a 100 millimeter diameter requiring 5 equal divisions, the length of the chord for one division would be 100 × 0.587785 = 58.7785 millimeters.

The two following pages give an additional table for the spacing off of circles, the table, in this case, being worked out for diameters from $\frac{1}{16}$ inch to 14 inches. As an example, assume that it is required to divide a circle having a diameter of 6½ inches into seven equal parts. Find first, in the column headed "6" and in line with 7 divisions, the length of the chord for a 6-inch circle, which is 2.603 inches. Then find the length of the chord for a ½-inch diameter circle, 7 divisions, which is 0.217. The sum of these two values, 2.603 + 0.217 = 2.820 inches, is the length of the chord required for spacing off the circumference of a 6½-inch circle into seven equal divisions.

As another example, assume that it is required to divide a circle having a diameter of $9\frac{23}{32}$ inches into 15 equal divisions. First find the length of the chord for a 9-inch circle, which is 1.871 inch. The length of the chord for a $\frac{23}{32}$-inch circle can easily be estimated from the table by taking the value that is exactly between those given for $\frac{11}{16}$ and $\frac{3}{4}$ inch. The value for $\frac{11}{16}$ inch is 0.143, and for $\frac{3}{4}$ inch, 0.156. For $\frac{23}{32}$, the value would be 0.150. Then, 1.871 + 0.150 = 2.021 inches.

Lengths of Chords for Spacing Off the Circumferences of Circles with a Diameter Equal to 1 (English or metric units)

No. of Spaces	Length of Chord	No. of Spaces	Length of Chord	No. of Spaces	Length of Chord	No. of Spaces	Length of Chord
3	0.866025	22	0.142315	41	0.076549	60	0.052336
4	0.707107	23	0.136167	42	0.074730	61	0.051479
5	0.587785	24	0.130526	43	0.072995	62	0.050649
6	0.500000	25	0.125333	44	0.071339	63	0.049846
7	0.433884	26	0.120537	45	0.069756	64	0.049068
8	0.382683	27	0.116093	46	0.068242	65	0.048313
9	0.342020	28	0.111964	47	0.066793	66	0.047582
10	0.309017	29	0.108119	48	0.065403	67	0.046872
11	0.281733	30	0.104528	49	0.064070	68	0.046183
12	0.258819	31	0.101168	50	0.062791	69	0.045515
13	0.239316	32	0.098017	51	0.061561	70	0.044865
14	0.222521	33	0.095056	52	0.060378	71	0.044233
15	0.207912	34	0.092268	53	0.059241	72	0.043619
16	0.195090	35	0.089639	54	0.058145	73	0.043022
17	0.183750	36	0.087156	55	0.057089	74	0.042441
18	0.173648	37	0.084806	56	0.056070	75	0.041876
19	0.164595	38	0.082579	57	0.055088	76	0.041325
20	0.156434	39	0.080467	58	0.054139	77	0.040789
21	0.149042	40	0.078459	59	0.053222	78	0.040266

For circles of other diameters, multiply length given in table by diameter of circle.

Hole Coordinate Dimension Factors for Jig Boring.—Tables of hole coordinate dimension factors for use in jig boring are given in Tables 1 through 4 starting on page 959. The coordinate axes shown in the figure accompanying each table are used to reference the tool path; the values listed in each table are for the end points of the tool path. In this machine coordinate system, a positive *Y* value indicates that the effective motion of the tool with reference to the work is toward the front of the jig borer (the actual motion of the jig borer table is toward the column). Similarly, a positive *X* value indicates that the effective motion of the tool with respect to the work is toward the right (the actual motion of the jig borer table is toward the left). When entering data into most computer-controlled jig borers, current practice is to use the more familiar Cartesian coordinate axis system in which the positive *Y* direction is "up" (i.e., pointing toward the column of the jig borer). The computer will automatically change the signs of the entered *Y* values to the signs that they would have in the machine coordinate system. Therefore, before applying the coordinate dimension factors given in the tables, it is important to determine the coordinate system to be used. If a Cartesian coordinate system is to be used for the tool path, then the sign of the *Y* values in the tables must be changed, from positive to negative and from negative to positive. For example, when programming for a three-hole type *A* circle using Cartesian coordinates, the *Y* values from Table 3 would be $y1 = +0.50000$, $y2 = -0.25000$, and $y3 = -0.25000$.

Table 10. Table for Spacing Off the Circumferences of Circles

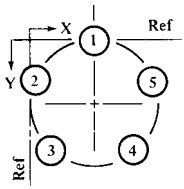
No. of Divisions	Degrees in Arc	Diameter of Circle to be Spaced Off														
		1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16
		Length of Chord														
3	120	0.054	0.108	0.162	0.217	0.271	0.325	0.379	0.433	0.487	0.541	0.595	0.650	0.704	0.758	0.812
4	90	0.044	0.088	0.133	0.177	0.221	0.265	0.309	0.354	0.398	0.442	0.486	0.530	0.575	0.619	0.663
5	72	0.037	0.073	0.110	0.147	0.184	0.220	0.257	0.294	0.331	0.367	0.404	0.441	0.478	0.514	0.551
6	60	0.031	0.063	0.094	0.125	0.156	0.188	0.219	0.250	0.281	0.313	0.344	0.375	0.406	0.438	0.469
7	51 3/7	0.027	0.054	0.081	0.108	0.136	0.163	0.190	0.217	0.244	0.271	0.298	0.325	0.353	0.380	0.407
8	45	0.024	0.048	0.072	0.096	0.120	0.144	0.167	0.191	0.215	0.239	0.263	0.287	0.311	0.335	0.359
9	40	0.021	0.043	0.064	0.086	0.107	0.128	0.150	0.171	0.192	0.214	0.235	0.257	0.278	0.299	0.321
10	36	0.019	0.039	0.058	0.077	0.097	0.116	0.135	0.155	0.174	0.193	0.212	0.232	0.251	0.270	0.290
11	32 8/11	0.018	0.035	0.053	0.070	0.088	0.106	0.123	0.141	0.158	0.176	0.194	0.211	0.229	0.247	0.264
12	30	0.016	0.032	0.049	0.065	0.081	0.097	0.113	0.129	0.146	0.162	0.178	0.194	0.210	0.226	0.243
13	27 9/13	0.015	0.030	0.045	0.060	0.075	0.090	0.105	0.120	0.135	0.150	0.165	0.179	0.194	0.209	0.224
14	25 5/7	0.014	0.028	0.042	0.056	0.069	0.083	0.097	0.111	0.125	0.139	0.153	0.167	0.181	0.195	0.209
15	24	0.013	0.026	0.039	0.052	0.065	0.078	0.091	0.104	0.117	0.130	0.143	0.156	0.169	0.182	0.195
16	22 1/2	0.012	0.024	0.037	0.049	0.061	0.073	0.085	0.098	0.110	0.122	0.134	0.146	0.159	0.171	0.183
17	21 3/17	0.011	0.023	0.034	0.046	0.057	0.069	0.080	0.092	0.103	0.115	0.126	0.138	0.149	0.161	0.172
18	20	0.011	0.022	0.033	0.043	0.054	0.065	0.076	0.087	0.098	0.109	0.119	0.130	0.141	0.152	0.163
19	18 18/19	0.010	0.021	0.031	0.041	0.051	0.062	0.072	0.082	0.093	0.103	0.113	0.123	0.134	0.144	0.154
20	18	0.010	0.020	0.029	0.039	0.049	0.059	0.068	0.078	0.088	0.098	0.108	0.117	0.127	0.137	0.147
21	17 1/7	0.009	0.019	0.028	0.037	0.047	0.056	0.065	0.075	0.084	0.093	0.102	0.112	0.121	0.130	0.140
22	16 4/11	0.009	0.018	0.027	0.036	0.044	0.053	0.062	0.071	0.080	0.089	0.098	0.107	0.116	0.125	0.133
23	15 15/23	0.009	0.017	0.026	0.034	0.043	0.051	0.060	0.068	0.077	0.085	0.094	0.102	0.111	0.119	0.128
24	15	0.008	0.016	0.024	0.033	0.041	0.049	0.057	0.065	0.073	0.082	0.090	0.098	0.106	0.114	0.122
25	14 2/5	0.008	0.016	0.023	0.031	0.039	0.047	0.055	0.063	0.070	0.078	0.086	0.094	0.102	0.110	0.117
26	13 11/13	0.008	0.015	0.023	0.030	0.038	0.045	0.053	0.060	0.068	0.075	0.083	0.090	0.098	0.105	0.113
28	12 6/7	0.007	0.014	0.021	0.028	0.035	0.042	0.049	0.056	0.063	0.070	0.077	0.084	0.091	0.098	0.105
30	12	0.007	0.013	0.020	0.026	0.033	0.039	0.046	0.052	0.059	0.065	0.072	0.078	0.085	0.091	0.098
32	11 1/4	0.006	0.012	0.018	0.025	0.031	0.037	0.043	0.049	0.055	0.061	0.067	0.074	0.080	0.086	0.092

See *Lengths of Chords for Spacing Off the Circumferences of Circles* on page 955 for explanatory matter.

Table for Spacing Off the Circumferences of Circles

No. of Divisions	Degrees in Arc	Diameter of Circle to be Spaced Off													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Length of Chord													
3	120	0.866	1.732	2.598	3.464	4.330	5.196	6.062	6.928	7.794	8.660	9.526	10.392	11.258	12.124
4	90	0.707	1.414	2.121	2.828	3.536	4.243	4.950	5.657	6.364	7.071	7.778	8.485	9.192	9.899
5	72	0.588	1.176	1.763	2.351	2.939	3.527	4.114	4.702	5.290	5.878	6.466	7.053	7.641	8.229
6	60	0.500	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500	5.000	5.500	6.000	6.500	7.000
7	51 5/7	0.434	0.868	1.302	1.736	2.169	2.603	3.037	3.471	3.905	4.339	4.773	5.207	5.640	6.074
8	45	0.383	0.765	1.148	1.531	1.913	2.296	2.679	3.061	3.444	3.827	4.210	4.592	4.975	5.358
9	40	0.342	0.684	1.026	1.368	1.710	2.052	2.394	2.736	3.078	3.420	3.762	4.104	4.446	4.788
10	36	0.309	0.618	0.927	1.236	1.545	1.854	2.163	2.472	2.781	3.090	3.399	3.708	4.017	4.326
11	32 8/11	0.282	0.563	0.845	1.127	1.409	1.690	1.972	2.254	2.536	2.817	3.099	3.381	3.663	3.944
12	30	0.259	0.518	0.776	1.035	1.294	1.553	1.812	2.071	2.329	2.588	2.847	3.106	3.365	3.623
13	27 9/13	0.239	0.479	0.718	0.957	1.197	1.436	1.675	1.915	2.154	2.393	2.632	2.872	3.111	3.350
14	25 5/7	0.223	0.445	0.668	0.890	1.113	1.335	1.558	1.780	2.003	2.225	2.448	2.670	2.893	3.115
15	24	0.208	0.416	0.624	0.832	1.040	1.247	1.455	1.663	1.871	2.079	2.287	2.495	2.703	2.911
16	22 1/2	0.195	0.390	0.585	0.780	0.975	1.171	1.366	1.561	1.756	1.951	2.146	2.341	2.536	2.731
17	21 3/17	0.184	0.367	0.551	0.735	0.919	1.102	1.286	1.470	1.654	1.837	2.021	2.205	2.389	2.572
18	20	0.174	0.347	0.521	0.695	0.868	1.042	1.216	1.389	1.563	1.736	1.910	2.084	2.257	2.431
19	18 18/19	0.165	0.329	0.494	0.658	0.823	0.988	1.152	1.317	1.481	1.646	1.811	1.975	2.140	2.304
20	18	0.156	0.313	0.469	0.626	0.782	0.939	1.095	1.251	1.408	1.564	1.721	1.877	2.034	2.190
21	17 1/7	0.149	0.298	0.447	0.596	0.745	0.894	1.043	1.192	1.341	1.490	1.639	1.789	1.938	2.087
22	16 4/11	0.142	0.285	0.427	0.569	0.712	0.854	0.996	1.139	1.281	1.423	1.565	1.708	1.850	1.992
23	15 15/23	0.136	0.272	0.408	0.545	0.681	0.817	0.953	1.089	1.225	1.362	1.498	1.634	1.770	1.906
24	15	0.131	0.261	0.392	0.522	0.653	0.783	0.914	1.044	1.175	1.305	1.436	1.566	1.697	1.827
25	14 2/5	0.125	0.251	0.376	0.501	0.627	0.752	0.877	1.003	1.128	1.253	1.379	1.504	1.629	1.755
26	13 11/13	0.121	0.241	0.362	0.482	0.603	0.723	0.844	0.964	1.085	1.205	1.326	1.446	1.567	1.688
28	12 6/7	0.112	0.224	0.336	0.448	0.560	0.672	0.784	0.896	1.008	1.120	1.232	1.344	1.456	1.568
30	12	0.105	0.209	0.314	0.418	0.523	0.627	0.732	0.836	0.941	1.045	1.150	1.254	1.359	1.463
32	11 1/4	0.098	0.196	0.294	0.392	0.490	0.588	0.686	0.784	0.882	0.980	1.078	1.176	1.274	1.372

Table 1. Hole Coordinate Dimension Factors for Jig Boring — Type "A" Hole Circles (English or Metric Units)

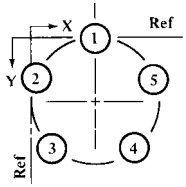


The diagram shows a type "A" circle for a 5-hole circle. Coordinates *x*, *y* are given in the table for hole circles of from 3 to 28 holes. Dimensions are for holes numbered in a counterclockwise direction (as shown). Dimensions given are based upon a hole circle of unit diameter. For a hole circle of, say, 3-inch or 3-centimeter diameter, multiply table values by 3.

3 Holes		4 Holes		5 Holes		6 Holes		7 Holes		8 Holes		9 Holes	
*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000
*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000
*x*2	0.06699	*x*2	0.00000	*x*2	0.02447	*x*2	0.06699	*x*2	0.10908	*x*2	0.14645	*x*2	0.17861
*y*2	0.75000	*y*2	0.50000	*y*2	0.34549	*y*2	0.25000	*y*2	0.18826	*y*2	0.14645	*y*2	0.11698
*x*3	0.93301	*x*3	0.50000	*x*3	0.20611	*x*3	0.06699	*x*3	0.01254	*x*3	0.00000	*x*3	0.00760
*y*3	0.75000	*y*3	1.00000	*y*3	0.90451	*y*3	0.75000	*y*3	0.61126	*y*3	0.50000	*y*3	0.41318
		*x*4	1.00000	*x*4	0.79389	*x*4	0.50000	*x*4	0.28306	*x*4	0.14645	*x*4	0.06699
		*y*4	0.50000	*y*4	0.90451	*y*4	1.00000	*y*4	0.95048	*y*4	0.85355	*y*4	0.75000
				*x*5	0.97553	*x*5	0.93301	*x*5	0.71694	*x*5	0.50000	*x*5	0.32899
				*y*5	0.34549	*y*5	0.75000	*y*5	0.95048	*y*5	1.00000	*y*5	0.96985
						*x*6	0.93301	*x*6	0.98746	*x*6	0.85355	*x*6	0.67101
						*y*6	0.25000	*y*6	0.61126	*y*6	0.85355	*y*6	0.96985
								*x*7	0.89092	*x*7	1.00000	*x*7	0.93301
								*y*7	0.18826	*y*7	0.50000	*y*7	0.75000
										*x*8	0.85355	*x*8	0.99240
										*y*8	0.14645	*y*8	0.41318
												*x*9	0.82139
												*y*9	0.11698

10 Holes		11 Holes		12 Holes		13 Holes		14 Holes		15 Holes		16 Holes	
*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000
*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000
*x*2	0.20611	*x*2	0.22968	*x*2	0.25000	*x*2	0.26764	*x*2	0.28306	*x*2	0.29663	*x*2	0.30866
*y*2	0.09549	*y*2	0.07937	*y*2	0.06699	*y*2	0.05727	*y*2	0.04952	*y*2	0.04323	*y*2	0.03806
*x*3	0.02447	*x*3	0.04518	*x*3	0.06699	*x*3	0.08851	*x*3	0.10908	*x*3	0.12843	*x*3	0.14645
*y*3	0.34549	*y*3	0.29229	*y*3	0.25000	*y*3	0.21597	*y*3	0.18826	*y*3	0.16543	*y*3	0.14645
*x*4	0.02447	*x*4	0.00509	*x*4	0.00000	*x*4	0.00365	*x*4	0.01254	*x*4	0.02447	*x*4	0.03806
*y*4	0.65451	*y*4	0.57116	*y*4	0.50000	*y*4	0.43973	*y*4	0.38874	*y*4	0.34549	*y*4	0.30866
*x*5	0.20611	*x*5	0.12213	*x*5	0.06699	*x*5	0.03249	*x*5	0.01254	*x*5	0.00274	*x*5	0.00000
*y*5	0.90451	*y*5	0.82743	*y*5	0.75000	*y*5	0.67730	*y*5	0.61126	*y*5	0.55226	*y*5	0.50000
*x*6	0.50000	*x*6	0.35913	*x*6	0.25000	*x*6	0.16844	*x*6	0.10908	*x*6	0.06699	*x*6	0.03806
*y*6	1.00000	*y*6	0.97975	*y*6	0.93301	*y*6	0.87426	*y*6	0.81174	*y*6	0.75000	*y*6	0.69134
*x*7	0.79389	*x*7	0.64087	*x*7	0.50000	*x*7	0.38034	*x*7	0.28306	*x*7	0.20611	*x*7	0.14645
*y*7	0.90451	*y*7	0.97975	*y*7	1.00000	*y*7	0.98547	*y*7	0.95048	*y*7	0.90451	*y*7	0.85355
*x*8	0.97553	*x*8	0.87787	*x*8	0.75000	*x*8	0.61966	*x*8	0.50000	*x*8	0.39604	*x*8	0.30866
*y*8	0.65451	*y*8	0.82743	*y*8	0.93301	*y*8	0.98547	*y*8	1.00000	*y*8	0.98907	*y*8	0.96194
*x*9	0.97553	*x*9	0.99491	*x*9	0.93301	*x*9	0.83156	*x*9	0.71694	*x*9	0.60396	*x*9	0.50000
*y*9	0.34549	*y*9	0.57116	*y*9	0.75000	*y*9	0.87426	*y*9	0.95048	*y*9	0.98907	*y*9	1.00000
*x*10	0.79389	*x*10	0.95482	*x*10	1.00000	*x*10	0.96751	*x*10	0.89092	*x*10	0.79389	*x*10	0.69134
*y*10	0.09549	*y*10	0.29229	*y*10	0.50000	*y*10	0.67730	*y*10	0.81174	*y*10	0.90451	*y*10	0.96194
		*x*11	0.77032	*x*11	0.93801	*x*11	0.99635	*x*11	0.98746	*x*11	0.93301	*x*11	0.85355
		*y*11	0.07937	*y*11	0.25000	*y*11	0.43973	*y*11	0.61126	*y*11	0.75000	*y*11	0.85355
				*x*12	0.75000	*x*12	0.91149	*x*12	0.98746	*x*12	0.99726	*x*12	0.96194
				*y*12	0.06699	*y*12	0.21597	*y*12	0.38874	*y*12	0.55226	*y*12	0.69134
						*x*13	0.73236	*x*13	0.89092	*x*13	0.97553	*x*13	1.00000
						*y*13	0.05727	*y*13	0.18826	*y*13	0.34549	*y*13	0.50000
								*x*14	0.71694	*x*14	0.87157	*x*14	0.96194
								*y*14	0.04952	*y*14	0.16543	*y*14	0.30866
										*x*15	0.70337	*x*15	0.85355
										*y*15	0.04323	*y*15	0.14645
												*x*16	0.69134
												*y*16	0.03806

Table 1. *(Continued)* **Hole Coordinate Dimension Factors for Jig Boring — Type "A" Hole Circles** (English or Metric Units)

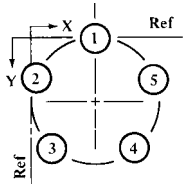


The diagram shows a type "A" circle for a 5-hole circle. Coordinates *x*, *y* are given in the table for hole circles of from 3 to 28 holes. Dimensions are for holes numbered in a counterclockwise direction (as shown). Dimensions given are based upon a hole circle of unit diameter. For a hole circle of, say, 3-inch or 3-centimeter diameter, multiply table values by 3.

17 Holes		18 Holes		19 Holes		20 Holes		21 Holes		22 Holes		23 Holes	
*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000
*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000
*x*2	0.31938	*x*2	0.32899	*x*2	0.33765	*x*2	0.34549	*x*2	0.35262	*x*2	0.35913	*x*2	0.36510
*y*2	0.03376	*y*2	0.03015	*y*2	0.02709	*y*2	0.02447	*y*2	0.02221	*y*2	0.02025	*y*2	0.01854
*x*3	0.16315	*x*3	0.17861	*x*3	0.19289	*x*3	0.20611	*x*3	0.21834	*x*3	0.22968	*x*3	0.24021
*y*3	0.13050	*y*3	0.11698	*y*3	0.10543	*y*3	0.09549	*y*3	0.08688	*y*3	0.07937	*y*3	0.07279
*x*4	0.05242	*x*4	0.06699	*x*4	0.08142	*x*4	0.09549	*x*4	0.10908	*x*4	0.12213	*x*4	0.13458
*y*4	0.27713	*y*4	0.25000	*y*4	0.22653	*y*4	0.20611	*y*4	0.18826	*y*4	0.17257	*y*4	0.15872
*x*5	0.00213	*x*5	0.00760	*x*5	0.01530	*x*5	0.02447	*x*5	0.03456	*x*5	0.04518	*x*5	0.05606
*y*5	0.45387	*y*5	0.41318	*y*5	0.37726	*y*5	0.34549	*y*5	0.31733	*y*5	0.29229	*y*5	0.26997
*x*6	0.01909	*x*6	0.00760	*x*6	0.00171	*x*6	0.00000	*x*6	0.00140	*x*6	0.00509	*x*6	0.01046
*y*6	0.63683	*y*6	0.58682	*y*6	0.54129	*y*6	0.50000	*y*6	0.46263	*y*6	0.42884	*y*6	0.39827
*x*7	0.10099	*x*7	0.06699	*x*7	0.04211	*x*7	0.02447	*x*7	0.01254	*x*7	0.00509	*x*7	0.00117
*y*7	0.80132	*y*7	0.75000	*y*7	0.70085	*y*7	0.65451	*y*7	0.61126	*y*7	0.57116	*y*7	0.53412
*x*8	0.23678	*x*8	0.17861	*x*8	0.13214	*x*8	0.09549	*x*8	0.06699	*x*8	0.04518	*x*8	0.02887
*y*8	0.92511	*y*8	0.88302	*y*8	0.83864	*y*8	0.79389	*y*8	0.75000	*y*8	0.70771	*y*8	0.66744
*x*9	0.40813	*x*9	0.32899	*x*9	0.26203	*x*9	0.20611	*x*9	0.15991	*x*9	0.12213	*x*9	0.09152
*y*9	0.99149	*y*9	0.96985	*y*9	0.93974	*y*9	0.90451	*y*9	0.86653	*y*9	0.82743	*y*9	0.78834
*x*10	0.59187	*x*10	0.50000	*x*10	0.41770	*x*10	0.34549	*x*10	0.28306	*x*10	0.22968	*x*10	0.18446
*y*10	0.99149	*y*10	1.00000	*y*10	0.99318	*y*10	0.97553	*y*10	0.95048	*y*10	0.92063	*y*10	0.88786
*x*11	0.76322	*x*11	0.67101	*x*11	0.58230	*x*11	0.50000	*x*11	0.42548	*x*11	0.35913	*x*11	0.30080
*y*11	0.92511	*y*11	0.96985	*y*11	0.99318	*y*11	1.00000	*y*11	0.99442	*y*11	0.97975	*y*11	0.95861
*x*12	0.89901	*x*12	0.82139	*x*12	0.73797	*x*12	0.65451	*x*12	0.57452	*x*12	0.50000	*x*12	0.43192
*y*12	0.80132	*y*12	0.88302	*y*12	0.93974	*y*12	0.97553	*y*12	0.99442	*y*12	1.00000	*y*12	0.99534
*x*13	0.98091	*x*13	0.93301	*x*13	0.86786	*x*13	0.79389	*x*13	0.71694	*x*13	0.64087	*x*13	0.56808
*y*13	0.63683	*y*13	0.75000	*y*13	0.83864	*y*13	0.90451	*y*13	0.95048	*y*13	0.97975	*y*13	0.99534
*x*14	0.99787	*x*14	0.99240	*x*14	0.95789	*x*14	0.90451	*x*14	0.84009	*x*14	0.77032	*x*14	0.69920
*y*14	0.45387	*y*14	0.58682	*y*14	0.70085	*y*14	0.79389	*y*14	0.86653	*y*14	0.92063	*y*14	0.95861
*x*15	0.94758	*x*15	0.99240	*x*15	0.99829	*x*15	0.97553	*x*15	0.93301	*x*15	0.87787	*x*15	0.81554
*y*15	0.27713	*y*15	0.41318	*y*15	0.54129	*y*15	0.65451	*y*15	0.75000	*y*15	0.82743	*y*15	0.88786
*x*16	0.83685	*x*16	0.93301	*x*16	0.98470	*x*16	1.00000	*x*16	0.98746	*x*16	0.95482	*x*16	0.90848
*y*16	0.13050	*y*16	0.25000	*y*16	0.37726	*y*16	0.50000	*y*16	0.61126	*y*16	0.70771	*y*16	0.78834
*x*17	0.68062	*x*17	0.82139	*x*17	0.91858	*x*17	0.97553	*x*17	0.99860	*x*17	0.99491	*x*17	0.97113
*y*17	0.03376	*y*17	0.11698	*y*17	0.22658	*y*17	0.34549	*y*17	0.46263	*y*17	0.57116	*y*17	0.66744
		*x*18	0.67101	*x*18	0.80711	*x*18	0.90451	*x*18	0.96544	*x*18	0.99491	*x*18	0.99883
		*y*18	0.03015	*y*18	0.10543	*y*18	0.20611	*y*18	0.31733	*y*18	0.42884	*y*18	0.53412
				*x*19	0.66235	*x*19	0.79389	*x*19	0.89092	*x*19	0.95482	*x*19	0.98954
				*y*19	0.02709	*y*19	0.09549	*y*19	0.18826	*y*19	0.29229	*y*19	0.39827
						*x*20	0.65451	*x*20	0.78166	*x*20	0.87787	*x*20	0.94394
						*y*20	0.02447	*y*20	0.08688	*y*20	0.17257	*y*20	0.26997
								*x*21	0.64738	*x*21	0.77032	*x*21	0.86542
								*y*21	0.02221	*y*21	0.07937	*y*21	0.15872
										*x*22	0.64087	*x*22	0.75979
										*y*22	0.02025	*y*22	0.07279
												*x*23	0.63490
												*y*23	0.01854

24Holes		25 Holes		26 Holes		27 Holes		28 Holes	
*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000	*x*1	0.50000
*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000	*y*1	0.00000
*x*2	0.37059	*x*2	0.37566	*x*2	0.38034	*x*2	0.38469	*x*2	0.38874
*y*2	0.01704	*y*2	0.01571	*y*2	0.01453	*y*2	0.01348	*y*2	0.01254
*x*3	0.25000	*x*3	0.25912	*x*3	0.26764	*x*3	0.27560	*x*3	0.28306

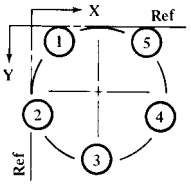
Table 1. *(Continued)* **Hole Coordinate Dimension Factors for Jig Boring — Type "A" Hole Circles** (English or Metric Units)



The diagram shows a type "A" circle for a 5-hole circle. Coordinates *x*, *y* are given in the table for hole circles of from 3 to 28 holes. Dimensions are for holes numbered in a counterclockwise direction (as shown). Dimensions given are based upon a hole circle of unit diameter. For a hole circle of, say, 3-inch or 3-centimeter diameter, multiply table values by 3.

*y*3	0.06699	*y*3	0.06185	*y*3	0.05727	*y*3	0.05318	*y*3	0.04952		
*x*4	0.14645	*x*4	0.15773	*x*4	0.16844	*x*4	0.17861	*x*4	0.18826		
*y*4	0.14645	*y*4	0.13552	*y*4	0.12574	*y*4	0.11698	*y*4	0.10908		
*x*5	0.06699	*x*5	0.07784	*x*5	0.08851	*x*5	0.09894	*x*5	0.10908		
*y*5	0.25000	*y*5	0.23209	*y*5	0.21597	*y*5	0.20142	*y*5	0.18826		
*x*6	0.01704	*x*6	0.02447	*x*6	0.03249	*x*6	0.04089	*x*6	0.04952		
*y*6	0.37059	*y*6	0.34549	*y*6	0.32270	*y*6	0.30196	*y*6	0.28306		
*x*7	0.00000	*x*7	0.00099	*x*7	0.00365	*x*7	0.00760	*x*7	0.01254		
*y*7	0.50000	*y*7	0.46860	*y*7	0.43973	*y*7	0.41318	*y*7	0.38874		
*x*8	0.01704	*x*8	0.00886	*x*8	0.00365	*x*8	0.00085	*x*8	0.00000		
*y*8	0.62941	*y*8	0.59369	*y*8	0.56027	*y*8	0.52907	*y*8	0.50000		
*x*9	0.06699	*x*9	0.04759	*x*9	0.03249	*x*9	0.02101	*x*9	0.01254		
*y*9	0.75000	*y*9	0.71289	*y*9	0.67730	*y*9	0.64340	*y*9	0.61126		
*x*10	0.14645	*x*10	0.11474	*x*10	0.08851	*x*10	0.06699	*x*10	0.04952		
*y*10	0.85355	*y*10	0.81871	*y*10	0.78403	*y*10	0.75000	*y*10	0.71694		
*x*11	0.25000	*x*11	0.20611	*x*11	0.16844	*x*11	0.13631	*x*11	0.10908		
*y*11	0.93301	*y*11	0.90451	*y*11	0.87426	*y*11	0.84312	*y*11	0.81174		
*x*12	0.37059	*x*12	0.31594	*x*12	0.26764	*x*12	0.22525	*x*12	0.18826		
*y*12	0.98296	*y*12	0.96489	*y*12	0.94273	*y*12	0.91774	*y*12	0.89092		
*x*13	0.50000	*x*13	0.43733	*x*13	0.38034	*x*13	0.32899	*x*13	0.28306		
*y*13	1.00000	*y*13	0.99606	*y*13	0.98547	*y*13	0.96985	*y*13	0.95048		
*x*14	0.62941	*x*14	0.56267	*x*14	0.50000	*x*14	0.44195	*x*14	0.38874		
*y*14	0.98296	*y*14	0.99606	*y*14	1.00000	*y*14	0.99662	*y*14	0.98746		
*x*15	0.75000	*x*15	0.68406	*x*15	0.61966	*x*15	0.55805	*x*15	0.50000		
*y*15	0.93301	*y*15	0.96489	*y*15	0.98547	*y*15	0.99662	*y*15	1.00000		
*x*16	0.85355	*x*16	0.79389	*x*16	0.73236	*x*16	0.67101	*x*16	0.61126		
*y*16	0.85355	*y*16	0.90451	*y*16	0.94273	*y*16	0.96985	*y*16	0.98746		
*x*17	0.93301	*x*17	0.88526	*x*17	0.83156	*x*17	0.77475	*x*17	0.71694		
*y*17	0.75000	*y*17	0.81871	*y*17	0.87426	*y*17	0.91774	*y*17	0.95048		
*x*18	0.98296	*x*18	0.95241	*x*18	0.91149	*x*18	0.86369	*x*18	0.81174		
*y*18	0.62941	*y*18	0.71289	*y*18	0.78403	*y*18	0.84312	*y*18	0.89092		
*x*19	1.00000	*x*19	0.99114	*x*19	0.96751	*x*19	0.93301	*x*19	0.89092		
*y*19	0.50000	*y*19	0.59369	*y*19	0.67730	*y*19	0.75000	*y*19	0.81174		
*x*20	0.98296	*x*20	0.99901	*x*20	0.99635	*x*20	0.97899	*x*20	0.95048		
*y*20	0.37059	*y*20	0.46860	*y*20	0.56027	*y*20	0.64340	*y*20	0.71694		
*x*21	0.93301	*x*21	0.97553	*x*21	0.99635	*x*21	0.99915	*x*21	0.98746		
*y*21	0.25000	*y*21	0.34549	*y*21	0.43973	*y*21	0.52907	*y*21	0.61126		
*x*22	0.85355	*x*22	0.92216	*x*22	0.96751	*x*22	0.99240	*x*22	1.00000		
*y*22	0.14645	*y*22	0.23209	*y*22	0.32270	*y*22	0.41318	*y*22	0.50000		
*x*23	0.75000	*x*23	0.84227	*x*23	0.91149	*x*23	0.95911	*x*23	0.98746		
*y*23	0.6699	*y*23	0.13552	*y*23	0.21597	*y*23	0.30196	*y*23	0.38874		
*x*24	0.62941	*x*24	0.74088	*x*24	0.83156	*x*24	0.90106	*x*24	0.95048		
*y*24	0.01704	*y*24	0.06185	*y*24	0.12574	*y*24	0.20142	*y*24	0.28306		
		*x*25	0.62434	*x*25	0.73236	*x*25	0.82139	*x*25	0.89092		
		*y*25	0.01571	*y*25	0.05727	*y*25	0.11698	*y*25	0.18826		
				*x*26	0.61966	*x*26	0.72440	*x*26	0.81174		
				*y*26	0.01453	*y*26	0.05318	*y*26	0.10908		
						*x*27	0.61531	*x*27	0.71694		
						*y*27	0.01348	*y*27	0.04952		
								*x*28	0.61126		
								*y*28	0.01254		

Table 2. Hole Coordinate Dimension Factors for Jig Boring — Type "B" Hole Circles (English or Metric Units)

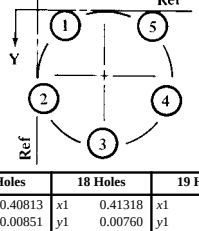


The diagram shows a type "B" circle for a 5-hole circle. Coordinates *x*, *y* are given in the table for hole circles of from 3 to 28 holes. Dimensions are for holes numbered in a counterclockwise direction (as shown). Dimensions given are based upon a hole circle of unit diameter. For a hole circle of, say, 3-inch or 3-centimeter diameter, multiply table values by 3.

3 Holes		4 Holes		5 Holes		6 Holes		7 Holes		8 Holes		9 Holes	
*x*1	0.06699	*x*1	0.14645	*x*1	0.20611	*x*1	0.25000	*x*1	0.28306	*x*1	0.30866	*x*1	0.32899
*y*1	0.25000	*y*1	0.14645	*y*1	0.09549	*y*1	0.06699	*y*1	0.04952	*y*1	0.03806	*y*1	0.03015
*x*2	0.50000	*x*2	0.14645	*x*2	0.02447	*x*2	0.00000	*x*2	0.01254	*x*2	0.03806	*x*2	0.06699
*y*2	1.00000	*y*2	0.85355	*y*2	0.65451	*y*2	0.50000	*y*2	0.38874	*y*2	0.30866	*y*2	0.25000
*x*3	0.93301	*x*3	0.85355	*x*3	0.50000	*x*3	0.25000	*x*3	0.10908	*x*3	0.03806	*x*3	0.00760
*y*3	0.25000	*y*3	0.85355	*y*3	1.00000	*y*3	0.93301	*y*3	0.81174	*y*3	0.69134	*y*3	0.58682
		*x*4	0.85355	*x*4	0.97553	*x*4	0.75000	*x*4	0.50000	*x*4	0.30866	*x*4	0.17861
		*y*4	0.14645	*y*4	0.65451	*y*4	0.93301	*y*4	1.00000	*y*4	0.96194	*y*4	0.88302
				*x*5	0.79389	*x*5	1.00000	*x*5	0.89092	*x*5	0.69134	*x*5	0.50000
				*y*5	0.09549	*y*5	0.50000	*y*5	0.81174	*y*5	0.96194	*y*5	1.00000
						*x*6	0.75000	*x*6	0.98746	*x*6	0.96194	*x*6	0.82139
						*y*6	0.06699	*y*6	0.38874	*y*6	0.69134	*y*6	0.88302
								*x*7	0.71694	*x*7	0.96194	*x*7	0.99240
								*y*7	0.04952	*y*7	0.30866	*y*7	0.58682
										*x*8	0.69134	*x*8	0.93301
										*y*8	0.03806	*y*8	0.25000
												*x*9	0.67101
												*y*9	0.03015

10 Holes		11 Holes		12 Holes		13 Holes		14 Holes		15 Holes		16 Holes	
*x*1	0.34549	*x*1	0.35913	*x*1	0.37059	*x*1	0.38034	*x*1	0.38874	*x*1	0.39604	*x*1	0.40245
*y*1	0.02447	*y*1	0.02025	*y*1	0.01704	*y*1	0.01453	*y*1	0.01254	*y*1	0.01093	*y*1	0.00961
*x*2	0.09549	*x*2	0.12213	*x*2	0.14645	*x*2	0.16844	*x*2	0.18826	*x*2	0.20611	*x*2	0.22221
*y*2	0.20611	*y*2	0.17257	*y*2	0.14645	*y*2	0.12574	*y*2	0.10908	*y*2	0.09549	*y*2	0.08427
*x*3	0.00000	*x*3	0.00509	*x*3	0.01704	*x*3	0.03249	*x*3	0.04952	*x*3	0.06699	*x*3	0.08427
*y*3	0.50000	*y*3	0.42884	*y*3	0.37059	*y*3	0.32270	*y*3	0.28306	*y*3	0.25000	*y*3	0.22221
*x*4	0.09549	*x*4	0.04518	*x*4	0.01704	*x*4	0.00365	*x*4	0.00000	*x*4	0.00274	*x*4	0.00961
*y*4	0.79389	*y*4	0.70771	*y*4	0.62941	*y*4	0.56027	*y*4	0.50000	*y*4	0.44774	*y*4	0.40245
*x*5	0.34549	*x*5	0.22968	*x*5	0.14645	*x*5	0.08851	*x*5	0.04952	*x*5	0.02447	*x*5	0.00961
*y*5	0.97553	*y*5	0.92063	*y*5	0.85355	*y*5	0.78403	*y*5	0.71694	*y*5	0.65451	*y*5	0.59755
*x*6	0.65451	*x*6	0.50000	*x*6	0.37059	*x*6	0.26764	*x*6	0.18826	*x*6	0.12843	*x*6	0.08427
*y*6	0.97553	*y*6	1.00000	*y*6	0.98296	*y*6	0.94273	*y*6	0.89092	*y*6	0.83457	*y*6	0.77779
*x*7	0.90451	*x*7	0.77032	*x*7	0.62941	*x*7	0.50000	*x*7	0.38874	*x*7	0.29663	*x*7	0.22221
*y*7	0.79389	*y*7	0.92063	*y*7	0.98296	*y*7	1.00000	*y*7	0.98746	*y*7	0.95677	*y*7	0.91573
*x*8	1.00000	*x*8	0.95482	*x*8	0.85355	*x*8	0.73236	*x*8	0.61126	*x*8	0.50000	*x*8	0.40245
*y*8	0.50000	*y*8	0.70771	*y*8	0.85355	*y*8	0.94273	*y*8	0.98746	*y*8	1.00000	*y*8	0.99039
*x*9	0.90451	*x*9	0.99491	*x*9	0.98296	*x*9	0.91149	*x*9	0.81174	*x*9	0.70337	*x*9	0.59755
*y*9	0.20611	*y*9	0.42884	*y*9	0.62941	*y*9	0.78403	*y*9	0.89092	*y*9	0.95677	*y*9	0.99039
*x*10	0.65451	*x*10	0.87787	*x*10	0.98296	*x*10	0.99635	*x*10	0.95048	*x*10	0.87157	*x*10	0.77779
*y*10	0.02447	*y*10	0.17257	*y*10	0.37059	*y*10	0.56027	*y*10	0.71694	*y*10	0.83457	*y*10	0.91573
		*x*11	0.64087	*x*11	0.85355	*x*11	0.96751	*x*11	1.00000	*x*11	0.97553	*x*11	0.91573
		*y*11	0.02025	*y*11	0.14645	*y*11	0.32270	*y*11	0.50000	*y*11	0.65451	*y*11	0.77779
				*x*12	0.62941	*x*12	0.83156	*x*12	0.95048	*x*12	0.99726	*x*12	0.99039
				*y*12	0.01704	*y*12	0.12574	*y*12	0.28306	*y*12	0.44774	*y*12	0.59755
						*x*13	0.61966	*x*13	0.81174	*x*13	0.93301	*x*13	0.99039
						*y*13	0.01453	*y*13	0.10908	*y*13	0.25000	*y*13	0.40245
								*x*14	0.61126	*x*14	0.79389	*x*14	0.91573
								*y*14	0.01254	*y*14	0.09549	*y*14	0.22221
										*x*15	0.60396	*x*15	0.77779
										*y*15	0.01093	*y*15	0.08427
												*x*16	0.59755
												*y*16	0.00961

Table 2. *(Continued)* **Hole Coordinate Dimension Factors for Jig Boring — Type "B" Hole Circles** (English or Metric Units)

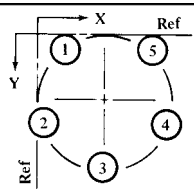


The diagram shows a type "B" circle for a 5-hole circle. Coordinates *x*, *y* are given in the table for hole circles of from 3 to 28 holes. Dimensions are for holes numbered in a counterclockwise direction (as shown). Dimensions given are based upon a hole circle of unit diameter. For a hole circle of, say, 3-inch or 3-centimeter diameter, multiply table values by 3.

17 Holes		18 Holes		19 Holes		20 Holes		21 Holes		22 Holes		23 Holes	
*x*1	0.40813	*x*1	0.41318	*x*1	0.41770	*x*1	0.42178	*x*1	0.42548	*x*1	0.42884	*x*1	0.43192
*y*1	0.00851	*y*1	0.00760	*y*1	0.00682	*y*1	0.00616	*y*1	0.00558	*y*1	0.00509	*y*1	0.00466
*x*2	0.23678	*x*2	0.25000	*x*2	0.26203	*x*2	0.27300	*x*2	0.28306	*x*2	0.29229	*x*2	0.30080
*y*2	0.07489	*y*2	0.06699	*y*2	0.06026	*y*2	0.05450	*y*2	0.04952	*y*2	0.04518	*y*2	0.04139
*x*3	0.10099	*x*3	0.11698	*x*3	0.13214	*x*3	0.14645	*x*3	0.15991	*x*3	0.17257	*x*3	0.18446
*y*3	0.19868	*y*3	0.17861	*y*3	0.16136	*y*3	0.14645	*y*3	0.13347	*y*3	0.12213	*y*3	0.11214
*x*4	0.01909	*x*4	0.03015	*x*4	0.04211	*x*4	0.05450	*x*4	0.06699	*x*4	0.07937	*x*4	0.09152
*y*4	0.36317	*y*4	0.32899	*y*4	0.29915	*y*4	0.27300	*y*4	0.25000	*y*4	0.22968	*y*4	0.21166
*x*5	0.00213	*x*5	0.00000	*x*5	0.00171	*x*5	0.00616	*x*5	0.01254	*x*5	0.02025	*x*5	0.02887
*y*5	0.54613	*y*5	0.50000	*y*5	0.45871	*y*5	0.42178	*y*5	0.38874	*y*5	0.35913	*y*5	0.33256
*x*6	0.05242	*x*6	0.03015	*x*6	0.01530	*x*6	0.00616	*x*6	0.00140	*x*6	0.00000	*x*6	0.00117
*y*6	0.72287	*y*6	0.67101	*y*6	0.62274	*y*6	0.57822	*y*6	0.53737	*y*6	0.50000	*y*6	0.46588
*x*7	0.16315	*x*7	0.11698	*x*7	0.08142	*x*7	0.05450	*x*7	0.03456	*x*7	0.02025	*x*7	0.01046
*y*7	0.86950	*y*7	0.82139	*y*7	0.77347	*y*7	0.72700	*y*7	0.68267	*y*7	0.64087	*y*7	0.60173
*x*8	0.31938	*x*8	0.25000	*x*8	0.19289	*x*8	0.14645	*x*8	0.10908	*x*8	0.07937	*x*8	0.05606
*y*8	0.96624	*y*8	0.93301	*y*8	0.89457	*y*8	0.85355	*y*8	0.81174	*y*8	0.77032	*y*8	0.73003
*x*9	0.50000	*x*9	0.41318	*x*9	0.33765	*x*9	0.27300	*x*9	0.21834	*x*9	0.17257	*x*9	0.13458
*y*9	1.00000	*y*9	0.99240	*y*9	0.97291	*y*9	0.94550	*y*9	0.91312	*y*9	0.87787	*y*9	0.84128
*x*10	0.68062	*x*10	0.58682	*x*10	0.50000	*x*10	0.42178	*x*10	0.35262	*x*10	0.29229	*x*10	0.24021
*y*10	0.96624	*y*10	0.99240	*y*10	1.00000	*y*10	0.99384	*y*10	0.97779	*y*10	0.95482	*y*10	0.92721
*x*11	0.83685	*x*11	0.75000	*x*11	0.66235	*x*11	0.57822	*x*11	0.50000	*x*11	0.42884	*x*11	0.36510
*y*11	0.86950	*y*11	0.93301	*y*11	0.97291	*y*11	0.99384	*y*11	1.00000	*y*11	0.99491	*y*11	0.98146
*x*12	0.94758	*x*12	0.88302	*x*12	0.80711	*x*12	0.72700	*x*12	0.64738	*x*12	0.57116	*x*12	0.50000
*y*12	0.72287	*y*12	0.82139	*y*12	0.89457	*y*12	0.94550	*y*12	0.97779	*y*12	0.99491	*y*12	1.00000
*x*13	0.99787	*x*13	0.96985	*x*13	0.91858	*x*13	0.85355	*x*13	0.78166	*x*13	0.70771	*x*13	0.63490
*y*13	0.54613	*y*13	0.67101	*y*13	0.77347	*y*13	0.85355	*y*13	0.91312	*y*13	0.95482	*y*13	0.98146
*x*14	0.98091	*x*14	1.00000	*x*14	0.98470	*x*14	0.94550	*x*14	0.89092	*x*14	0.82743	*x*14	0.75979
*y*14	0.36317	*y*14	0.50000	*y*14	0.62274	*y*14	0.72700	*y*14	0.81174	*y*14	0.87787	*y*14	0.92721
*x*15	0.89901	*x*15	0.96985	*x*15	0.99829	*x*15	0.99384	*x*15	0.96544	*x*15	0.92063	*x*15	0.86542
*y*15	0.19868	*y*15	0.32899	*y*15	0.45871	*y*15	0.57822	*y*15	0.68267	*y*15	0.77032	*y*15	0.84128
*x*16	0.76322	*x*16	0.88302	*x*16	0.95789	*x*16	0.99384	*x*16	0.99860	*x*16	0.97975	*x*16	0.94394
*y*16	0.07489	*y*16	0.17861	*y*16	0.29915	*y*16	0.42178	*y*16	0.53737	*y*16	0.64087	*y*16	0.73003
*x*17	0.59187	*x*17	0.75000	*x*17	0.86786	*x*17	0.94550	*x*17	0.98746	*x*17	1.00000	*x*17	0.98954
*y*17	0.00851	*y*17	0.06699	*y*17	0.16136	*y*17	0.27300	*y*17	0.38874	*y*17	0.50000	*y*17	0.60173
		*x*18	0.58682	*x*18	0.73797	*x*18	0.85355	*x*18	0.93301	*x*18	0.97975	*x*18	0.99883
		*y*18	0.00760	*y*18	0.06026	*y*18	0.14645	*y*18	0.25000	*y*18	0.35913	*y*18	0.46588
				*x*19	0.58230	*x*19	0.72700	*x*19	0.84009	*x*19	0.92063	*x*19	0.97113
				*y*19	0.00682	*y*19	0.05450	*y*19	0.13347	*y*19	0.22968	*y*19	0.33256
						*x*20	0.57822	*x*20	0.71694	*x*20	0.82743	*x*20	0.90848
						*y*20	0.00616	*y*20	0.04952	*y*20	0.12213	*y*20	0.21166
								*x*21	0.57452	*x*21	0.70771	*x*21	0.81554
								*y*21	0.00558	*y*21	0.04518	*y*21	0.11214
										*x*22	0.57116	*x*22	0.69920
										*y*22	0.00509	*y*22	0.04139
												*x*23	0.56808
												*y*23	0.00466

24 Holes		25 Holes		26 Holes		27 Holes		28 Holes	
*x*1	0.43474	*x*1	0.43733	*x*1	0.43973	*x*1	0.44195	*x*1	0.44402
*y*1	0.00428	*y*1	0.00394	*y*1	0.00365	*y*1	0.00338	*y*1	0.00314
*x*2	0.30866	*x*2	0.31594	*x*2	0.32270	*x*2	0.32899	*x*2	0.33486
*y*2	0.03806	*y*2	0.03511	*y*2	0.03249	*y*2	0.03015	*y*2	0.02806
*x*3	0.19562	*x*3	0.20611	*x*3	0.21597	*x*3	0.22525	*x*3	0.23398

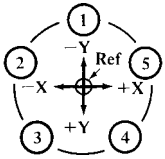
Table 2. *(Continued)* **Hole Coordinate Dimension Factors for Jig Boring — Type "B" Hole Circles** (English or Metric Units)



The diagram shows a type "B" circle for a 5-hole circle. Coordinates *x*, *y* are given in the table for hole circles of from 3 to 28 holes. Dimensions are for holes numbered in a counterclockwise direction (as shown). Dimensions given are based upon a hole circle of unit diameter. For a hole circle of, say, 3-inch or 3-centimeter diameter, multiply table values by 3.

*y*3	0.10332	*y*3	0.09549	*y*3	0.08851	*y*3	0.08226	*y*3	0.07664
*x*4	0.10332	*x*4	0.11474	*x*4	0.12574	*x*4	0.13631	*x*4	0.14645
*y*4	0.19562	*y*4	0.18129	*y*4	0.16844	*y*4	0.15688	*y*4	0.14645
*x*5	0.03806	*x*5	0.04759	*x*5	0.05727	*x*5	0.06699	*x*5	0.07664
*y*5	0.30866	*y*5	0.28711	*y*5	0.26764	*y*5	0.25000	*y*5	0.23398
*x*6	0.00428	*x*6	0.00886	*x*6	0.01453	*x*6	0.02101	*x*6	0.02806
*y*6	0.43474	*y*6	0.40631	*y*6	0.38034	*y*6	0.35660	*y*6	0.33486
*x*7	0.00428	*x*7	0.00099	*x*7	0.00000	*x*7	0.00085	*x*7	0.00314
*y*7	0.56526	*y*7	0.53140	*y*7	0.50000	*y*7	0.47093	*y*7	0.44402
*x*8	0.03806	*x*8	0.02447	*x*8	0.01453	*x*8	0.00760	*x*8	0.00314
*y*8	0.69134	*y*8	0.65451	*y*8	0.61966	*y*8	0.58682	*y*8	0.55598
*x*9	0.10332	*x*9	0.07784	*x*9	0.05727	*x*9	0.04089	*x*9	0.02806
*y*9	0.80438	*y*9	0.76791	*y*9	0.73236	*y*9	0.69804	*y*9	0.66514
*x*10	0.19562	*x*10	0.15773	*x*10	0.12574	*x*10	0.09894	*x*10	0.07664
*y*10	0.89668	*y*10	0.86448	*y*10	0.83156	*y*10	0.79858	*y*10	0.76602
*x*11	0.30866	*x*11	0.25912	*x*11	0.21597	*x*11	0.17861	*x*11	0.14645
*y*11	0.96194	*y*11	0.93815	*y*11	0.91149	*y*11	0.88302	*y*11	0.85355
*x*12	0.43474	*x*12	0.37566	*x*12	0.32270	*x*12	0.27560	*x*12	0.23398
*y*12	0.99572	*y*12	0.98429	*y*12	0.96751	*y*12	0.94682	*y*12	0.92336
*x*13	0.56526	*x*13	0.50000	*x*13	0.43973	*x*13	0.38469	*x*13	0.33486
*y*13	0.99572	*y*13	1.00000	*y*13	0.99635	*y*13	0.98652	*y*13	0.97194
*x*14	0.69134	*x*14	0.62434	*x*14	0.56027	*x*14	0.50000	*x*14	0.44402
*y*14	0.96194	*y*14	0.98429	*y*14	0.99635	*y*14	1.00000	*y*14	0.99686
*x*15	0.80438	*x*15	0.74088	*x*15	0.67730	*x*15	0.61531	*x*15	0.55598
*y*15	0.89668	*y*15	0.93815	*y*15	0.96751	*y*15	0.98652	*y*15	0.99686
*x*16	0.89668	*x*16	0.84227	*x*16	0.78403	*x*16	0.72440	*x*16	0.66514
*y*16	0.80438	*y*16	0.86448	*y*16	0.91149	*y*16	0.94682	*y*16	0.97194
*x*17	0.96194	*x*17	0.92216	*x*17	0.87426	*x*17	0.82139	*x*17	0.76602
*y*17	0.69134	*y*17	0.76791	*y*17	0.83156	*y*17	0.88302	*y*17	0.92336
*x*18	0.99572	*x*18	0.97553	*x*18	0.94273	*x*18	0.90106	*x*18	0.85355
*y*18	0.56526	*y*18	0.65451	*y*18	0.73236	*y*18	0.79858	*y*18	0.85355
*x*19	0.99572	*x*19	0.99901	*x*19	0.98547	*x*19	0.95911	*x*19	0.92336
*y*19	0.43474	*y*19	0.53140	*y*19	0.61966	*y*19	0.69804	*y*19	0.76602
*x*20	0.96194	*x*20	0.99114	*x*20	1.00000	*x*20	0.99240	*x*20	0.97194
*y*20	0.30866	*y*20	0.40631	*y*20	0.50000	*y*20	0.58682	*y*20	0.66514
*x*21	0.89668	*x*21	0.95241	*x*21	0.98547	*x*21	0.99915	*x*21	0.99686
*y*21	0.19562	*y*21	0.28711	*y*21	0.38034	*y*21	0.47093	*y*21	0.55598
*x*22	0.80438	*x*22	0.88526	*x*22	0.94273	*x*22	0.97899	*x*22	0.99686
*y*22	0.10332	*y*22	0.18129	*y*22	0.26764	*y*22	0.35660	*y*22	0.44402
*x*23	0.69134	*x*23	0.79389	*x*23	0.87426	*x*23	0.93301	*x*23	0.97194
*y*23	0.03806	*y*23	0.09549	*y*23	0.16844	*y*23	0.25000	*y*23	0.33486
*x*24	0.56526	*x*24	0.68406	*x*24	0.78403	*x*24	0.86369	*x*24	0.92336
*y*24	0.00428	*y*24	0.03511	*y*24	0.08851	*y*24	0.15688	*y*24	0.23398
		*x*25	0.56267	*x*25	0.67730	*x*25	0.77475	*x*25	0.85355
		*y*25	0.00394	*y*25	0.03249	*y*25	0.08226	*y*25	0.14645
				*x*26	0.56027	*x*26	0.67101	*x*26	0.76602
				*y*26	0.00365	*y*26	0.03015	*y*26	0.07664
						*x*27	0.55805	*x*27	0.66514
						*y*27	0.00338	*y*27	0.02806
								*x*28	0.55598
								*y*28	0.00314

Table 3. Hole Coordinate Dimension Factors for Jig Boring — Type "A" Hole Circles, Central Coordinates (English or Metric Units)

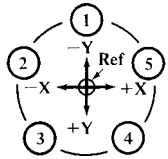


The diagram shows a type "A" circle for a 5-hole circle. Coordinates *x*, *y* are given in the table for hole circles of from 3 to 28 holes. Dimensions are for holes numbered in a counterclockwise direction (as shown). Dimensions given are based upon a hole circle of unit diameter. For a hole circle of, say, 3-inch or 3-centimeter diameter, multiply table values by 3.

3 Holes		4 Holes		5 Holes		6 Holes		7 Holes		8 Holes		9 Holes	
*x*1	0.00000	*x*1	0.00000	*x*1	0.00000	*x*1	0.00000	*x*1	0.00000	*x*1	0.00000	*x*1	0.00000
*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000
*x*2	−0.43301	*x*2	−0.50000	*x*2	−0.47553	*x*2	−0.43301	*x*2	−0.39092	*x*2	−0.35355	*x*2	−0.32139
*y*2	+0.25000	*y*2	0.00000	*y*2	−0.15451	*y*2	−0.25000	*y*2	−0.31174	*y*2	−0.35355	*y*2	−0.38302
*x*3	+0.43301	*x*3	0.00000	*x*3	−0.29389	*x*3	−0.43301	*x*3	−0.48746	*x*3	−0.50000	*x*3	−0.49240
*y*3	+0.25000	*y*3	+0.50000	*y*3	+0.40451	*y*3	+0.25000	*y*3	+0.11126	*y*3	0.00000	*y*3	−0.08682
		*x*4	+0.50000	*x*4	+0.29389	*x*4	0.00000	*x*4	−0.21694	*x*4	−0.35355	*x*4	−0.43301
		*y*4	0.00000	*y*4	+0.40451	*y*4	+0.50000	*y*4	+0.45048	*y*4	+0.35355	*y*4	+0.25000
				*x*5	+0.47553	*x*5	+0.43301	*x*5	+0.21694	*x*5	0.00000	*x*5	−0.17101
				*y*5	−0.15451	*y*5	+0.25000	*y*5	+0.45048	*y*5	+0.50000	*y*5	+0.46985
						*x*6	+0.43301	*x*6	+0.48746	*x*6	+0.35355	*x*6	+0.17101
						*y*6	−0.25000	*y*6	+0.11126	*y*6	+0.35355	*y*6	+0.46985
								*x*7	+0.39092	*x*7	+0.50000	*x*7	+0.43301
								*y*7	−0.31174	*y*7	0.00000	*y*7	+0.25000
										*x*8	+0.35355	*x*8	+0.49240
										*y*8	−0.35355	*x*8	−0.08682
												*x*9	+0.32139
												*y*9	−0.38302

10 Holes		11 Holes		12 Holes		13 Holes		14 Holes		15 Holes		16 Holes	
*x*1	0.00000	*x*1	0.00000	*x*1	0.00000	*x*1	0.00000	*x*1	0.00000	*x*1	0.00000	*x*1	0.00000
*y*1	−0.50000	*y*1	−0.5000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000
*x*2	−0.29389	*x*2	−0.27032	*x*2	−0.25000	*x*2	−0.23236	*x*2	−0.21694	*x*2	−0.20337	*x*2	−0.19134
*y*2	−0.40451	*y*2	−0.42063	*y*2	−0.43301	*y*2	−0.44273	*y*2	−0.45048	*y*2	−0.45677	*y*2	−0.46194
*x*3	−0.47553	*x*3	−0.45482	*x*3	−0.43301	*x*3	−0.41149	*x*3	−0.39092	*x*3	−0.37157	*x*3	−0.35355
*y*3	−0.15451	*y*3	−0.20771	*y*3	−0.25000	*y*3	−2.28403	*y*3	−0.31174	*y*3	−0.33457	*y*3	−0.35355
*x*4	−0.47553	*x*4	−0.49491	*x*4	−0.50000	*x*4	−0.49635	*x*4	−0.48746	*x*4	−0.47553	*x*4	−0.46194
*y*4	+0.15451	*y*4	+0.07116	*y*4	0.00000	*y*4	−0.06027	*y*4	−0.11126	*y*4	−0.15451	*y*4	−0.19134
*x*5	−0.29389	*x*5	−0.37787	*x*5	−0.43301	*x*5	−0.46751	*x*5	−0.48746	*x*5	−0.49726	*x*5	−0.50000
*y*5	+0.40451	*y*5	+0.32743	*y*5	+0.25000	*y*5	+0.17730	*y*5	+0.11126	*y*5	+0.05226	*y*5	0.00000
*x*6	0.00000	*x*6	−0.14087	*x*6	−0.25000	*x*6	− 0.33156	*x*6	−0.39092	*x*6	−0.43301	*x*6	−0.46194
*y*6	+0.50000	*y*6	+0.47975	*y*6	+0.43301	*y*6	+0.37426	*y*6	+0.31174	*y*6	+0.25000	*y*6	+0.19134
*x*7	+0.29389	*x*7	+0.14087	*x*7	0.00000	*x*7	−0.11966	*x*7	−0.21694	*x*7	−0.29389	*x*7	−0.35355
*y*7	+0.40451	*y*7	+0.47975	*y*7	+0.50000	*y*7	+0.48547	*y*7	+0.45048	*y*7	+0.40451	*y*7	+0.35355
*x*8	+0.47553	*x*8	+0.37787	*x*8	+0.25000	*x*8	+0.11966	*x*8	0.00000	*x*8	−0.10396	*x*8	−0.19134
*y*8	+0.15451	*y*8	+0.32743	*y*8	+0.43301	*y*8	+0.48547	*y*8	+0.50000	*y*8	+0.48907	*y*8	+0.46194
*x*9	+0.47553	*x*9	+0.49491	*x*9	+0.43301	*x*9	+0.33156	*x*9	+0.21694	*x*9	+0.10396	*x*9	0.00000
*y*9	−0.15451	*y*9	+0.07116	*y*9	+0.25000	*y*9	+0.37426	*y*9	+0.45048	*y*9	+0.48907	*y*9	+0.50000
*x*10	+0.29389	*x*10	+0.45482	*x*10	+0.50000	*x*10	+0.46751	*x*10	+0.39092	*x*10	+0.29389	*x*10	+0.19134
*y*10	−0.40451	*y*10	−0.20771	*y*10	0.00000	*y*10	+0.17730	*y*10	+0.31174	*y*10	+0.40451	*y*10	+0.46194
		*x*11	+0.27032	*x*11	+0.43301	*x*11	+0.49635	*x*11	+0.48746	*x*11	+0.43301	*x*11	+0.35355
		*y*11	−0.42063	*y*11	−0.25000	*y*11	−0.06027	*y*11	+0.11126	*y*11	+0.25000	*y*11	+0.35355
				*x*12	+0.25000	*x*12	+0.41149	*x*12	+0.48746	*x*12	+0.49726	*x*12	+0.46194
				*y*12	−0.43301	*y*12	−0.28403	*y*12	−0.11126	*y*12	+0.05226	*y*12	+0.19134
						*x*13	+0.23236	*x*13	+0.39092	*x*13	+0.47553	*x*13	+0.50000
						*y*13	−0.44273	*y*13	−0.31174	*y*13	−0.15451	*y*13	0.00000
								*x*14	+0.21694	*x*14	+0.37157	*x*14	+0.46194
								*y*14	−0.45048	*y*14	−0.33457	*y*14	−0.19134
										*x*15	+0.20337	*x*15	+0.35355
										*y*15	−0.45677	*y*15	−0.35355
												*x*16	+0.19134
												*y*16	−0.46194

Table 3. *(Continued)* **Hole Coordinate Dimension Factors for Jig Boring — Type "A" Hole Circles, Central Coordinates** (English or Metric Units)

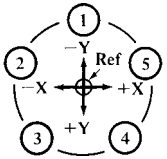


The diagram shows a type "A" circle for a 5-hole circle. Coordinates *x*, *y* are given in the table for hole circles of from 3 to 28 holes. Dimensions are for holes numbered in a counterclockwise direction (as shown). Dimensions given are based upon a hole circle of unit diameter. For a hole circle of, say, 3-inch or 3-centimeter diameter, multiply table values by 3.

17 Holes		18 Holes		19 Holes		20 Holes		21 Holes		22 Holes		23 Holes	
*x*1	0.00000	*x*1	0.00000	*x*1	0.00000	*x*1	0.000000	*x*1	0.00000	*x*1	0.00000	*x*1	0.00000
*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000
*x*2	−0.18062	*x*2	−0.17101	*x*2	−0.16235	*x*2	−0.15451	*x*2	−0.14738	*x*2	−0.14087	*x*2	−0.13490
*y*2	−0.46624	*y*2	−0.46985	*y*2	−0.47291	*y*2	−0.47553	*y*2	−0.47779	*y*2	−0.47975	*y*2	−0.48146
*x*3	−0.33685	*x*3	+0.32139	*x*3	−0.30711	*x*3	−0.29389	*x*3	−0.28166	*x*3	−0.27032	*x*3	−0.25979
*y*3	−0.36950	*y*3	−0.38302	*y*3	−0.39457	*y*3	−0.40451	*y*3	−0.41312	*y*3	−0.42063	*y*3	−0.42721
*x*4	−0.44758	*x*4	−0.43301	*x*4	−0.41858	*x*4	−0.40451	*x*4	−0.39092	*x*4	−0.37787	*x*4	−0.36542
*y*4	−0.22287	*y*4	−0.25000	*y*4	−0.27347	*y*4	−0.29389	*y*4	−0.31174	*y*4	−0.32743	*y*4	−0.34128
*x*5	−0.49787	*x*5	−0.49240	*x*5	−0.48470	*x*5	−0.47553	*x*5	−.046544	*x*5	−0.45482	*x*5	−0.44394
*y*5	−0.04613	*y*5	−0.08682	*y*5	−0.12274	*y*5	−0.15451	*y*5	−0.18267	*y*5	−0.20771	*y*5	−0.23003
*x*6	−0.48091	*x*6	−0.49420	*x*6	−0.49829	*x*6	−0.50000	*x*6	−0.49860	*x*6	−0.49491	*x*6	−0.48954
*y*6	+0.13683	*y*6	+0.08682	*y*6	+0.04129	*y*6	0.00000	*y*6	−0.03737	*y*6	−0.07116	*y*6	−0.10173
*x*7	−0.39901	*x*7	−0.43301	*x*7	−0.45789	*x*7	−0.47553	*x*7	−0.48746	*x*7	−0.49491	*x*7	−0.49883
*y*7	+0.30132	*y*7	+0.25000	*y*7	+0.20085	*y*7	+0.15451	*y*7	+0.11126	*y*7	+0.07116	*y*7	+0.03412
*x*8	−0.26322	*x*8	−0.32139	*x*8	−0.36786	*x*8	−0.40451	*x*8	−0.43301	*x*8	−0.45482	*x*8	−0.47113
*y*8	+0.42511	*y*8	+0.38302	*y*8	+0.33864	*y*8	+0.29389	*y*8	+0.25000	*y*8	+0.20771	*y*8	+0.16744
*x*9	−0.09187	*x*9	−0.17101	*x*9	−0.23797	*x*9	−0.29389	*x*9	−0.34009	*x*9	−0.37787	*x*9	−0.40848
*y*9	+0.49149	*y*9	+0.46985	*y*9	+0.43974	*y*9	+0.40451	*y*9	+0.36653	*y*9	+0.32743	*y*9	+0.28834
*x*10	+0.09187	*x*10	0.00000	*x*10	−0.08230	*x*10	−0.15451	*x*10	−0.21694	*x*10	−0.27032	*x*10	−0.31554
*y*10	+0.49149	*y*10	+0.50000	*y*10	+0.49318	*y*10	+0.47553	*y*10	+0.45048	*y*10	+0.42063	*y*10	+0.38786
*x*11	+0.26322	*x*11	+0.17101	*x*11	+0.08230	*x*11	0.00000	*x*11	−0.07452	*x*11	−0.14087	*x*11	−0.19920
*y*11	+0.42511	*y*11	+0.46985	*y*11	+0.49318	*y*11	+0.50000	*y*11	+0.49442	*y*11	+0.47975	*y*11	+0.45861
*x*12	+0.39901	*x*12	+0.32139	*x*12	+0.23797	*x*12	+0.15451	*x*12	+0.07452	*x*12	0.00000	*x*12	−0.06808
*y*12	+0.30132	*y*12	+0.38302	*y*12	+0.43974	*y*12	+0.47553	*y*12	+0.49442	*y*12	+0.50000	*y*12	+0.49534
*x*13	+0.48091	*x*13	+0.43301	*x*13	+0.36786	*x*13	+0.29389	*x*13	+0.21694	*x*13	+0.14087	*x*13	+0.06808
*y*13	+0.13683	*y*13	+0.25000	*y*13	+0.33864	*y*13	+0.40451	*y*13	+0.45048	*y*13	+0.47975	*y*13	+0.49534
*x*14	+0.49787	*x*14	+0.49240	*x*14	+0.45789	*x*14	+0.40451	*x*14	+0.34009	*x*14	+0.27032	*x*14	+0.19920
*y*14	−0.04613	*y*14	+0.08682	*y*14	+0.20085	*y*14	+0.29389	*y*14	+0.36653	*y*14	+0.42063	*y*14	+0.45861
*x*15	+0.44758	*x*15	+0.49240	*x*15	+0.49829	*x*15	+0.47553	*x*15	+0.43301	*x*15	+0.37787	*x*15	+0.31554
*y*15	−0.22287	*y*15	−0.08682	*y*15	+0.04129	*y*15	+0.15451	*y*15	+0.25000	*y*15	+0.32743	*y*15	+0.38786
*x*16	+0.33685	*x*16	+0.43301	*x*16	+0.48470	*x*16	+0.50000	*x*16	+0.48746	*x*16	+0.45482	*x*16	+0.40848
*y*16	−0.36950	*y*16	−0.25000	*y*16	−0.12274	*y*16	0.00000	*y*16	+0.11126	*y*16	+0.20771	*y*16	+0.28834
*x*17	+0.18062	*x*17	+0.32139	*x*17	+0.41858	*x*17	+0.47553	*x*17	+0.49860	*x*17	+0.49491	*x*17	+0.47113
*y*17	−0.46624	*y*17	−0.38302	*y*17	−0.27347	*y*17	−0.15451	*y*17	−0.03737	*y*17	+0.07116	*y*17	+0.16744
		*x*18	+0.17101	*x*18	+0.30711	*x*18	+0.40451	*x*18	+0.46544	*x*18	+0.49491	*x*18	+0.49883
		*y*18	−0.46985	*y*18	−0.39457	*y*18	−0.29389	*y*18	−0.18267	*y*18	−0.07116	*y*18	+0.03412
				*x*19	+ 0.16235	*x*19	+0.29389	*x*19	+0.39092	*x*19	+0.45482	*x*19	+0.48954
				*y*19	−0.47291	*y*19	−0.40451	*y*19	−0.31174	*y*19	−0.20771	*y*19	−0.10173
						*x*20	+0.15451	*x*20	+0.28166	*x*20	+0.37787	*x*20	+0.44394
						*y*20	−0.47553	*y*20	−0.41312	*y*20	−0.32743	*y*20	−0.23003
								*x*21	+0.14738	*x*21	+0.27032	*x*21	+0.36542
								*y*21	−0.47779	*y*21	−0.42063	*y*21	−0.34128
										*x*22	+0.14087	*x*22	+0.25979
										*y*22	−0.47975	*y*22	−0.42721
												*x*23	+0.13490
												*y*23	−0.48146

24 Holes		25 Holes		26 Holes		27 Holes		28 Holes	
*x*1	0.00000	*x*1	0.00000	*x*1	0.00000	*x*1	0.00000	*x*1	0.00000
*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000	*y*1	−0.50000
*x*2	−0.12941	*x*2	−0.12434	*x*2	−0.11966	*x*2	−0.11531	*x*2	−0.11126
*y*2	−0.48296	*y*2	−0.48429	*y*2	−0.48547	*y*2	−0.48652	*y*2	−0.48746
*x*3	−0.25000	*x*3	−0.24088	*x*3	−0.23236	*x*3	−0.22440	*x*3	−0.21694

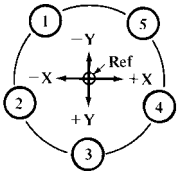
Table 3. *(Continued)* **Hole Coordinate Dimension Factors for Jig Boring — Type "A" Hole Circles, Central Coordinates** (English or Metric Units)



The diagram shows a type "A" circle for a 5-hole circle. Coordinates *x*, *y* are given in the table for hole circles of from 3 to 28 holes. Dimensions are for holes numbered in a counterclockwise direction (as shown). Dimensions given are based upon a hole circle of unit diameter. For a hole circle of, say, 3-inch or 3-centimeter diameter, multiply table values by 3.

*y*3	− 0.43301	*y*3	−0.43815	*y*3	−0.44273	*y*3	−0.44682	*y*3	−0.45048		
*x*4	−0.35355	*x*4	−0.34227	*x*4	−0.33156	*x*4	−0.32139	*x*4	−0.31174		
*y*4	−0.35355	*y*4	−0.36448	*y*4	−0.37426	*y*4	−0.38302	*y*4	−0.39092		
*x*5	−0.43301	*x*5	−0.42216	*x*5	−0.41149	*x*5	−0.40106	*x*5	−0.39092		
*y*5	−0.25000	*y*5	−0.26791	*y*5	−0.28403	*y*5	−0.29858	*y*5	−0.31174		
*x*6	−0.48296	*x*6	−0.47553	*x*6	−0.46751	*x*6	−0.45911	*x*6	−0.45048		
*y*6	−0.12941	*y*6	−0.15451	*y*6	−0.17730	*y*6	−0.19804	*y*6	−0.21694		
*x*7	−0.50000	*x*7	−0.49901	*x*7	−0.49635	*x*7	−0.49240	*x*7	−0.48746		
*y*7	0.00000	*y*7	−0.03140	*y*7	−0.06027	*y*7	−0.08682	*y*7	−0.11126		
*x*8	−0.48296	*x*8	−0.49114	*x*8	−0.49635	*x*8	−0.49915	*x*8	−0.50000		
*y*8	+0.12941	*y*8	+0.09369	*y*8	+0.06027	*y*8	+0.02907	*y*8	0.00000		
*x*9	−0.43301	*x*9	−0.45241	*x*9	−0.46751	*x*9	−0.47899	*x*9	−0.48746		
*y*9	+0.25000	*y*9	+0.21289	*y*9	+0.17730	*y*9	+0.14340	*y*9	+0.11126		
*x*10	−0.35355	*x*10	−0.38526	*x*10	−0.41149	*x*10	−0.43301	*x*10	−0.45048		
*y*10	+0.35355	*y*10	+0.31871	*y*10	+0.28403	*y*10	+0.25000	*y*10	+0.21694		
*x*11	−0.25000	*x*11	−0.29389	*x*11	−0.33156	*x*11	−0.36369	*x*11	−0.39092		
*y*11	+0.43301	*y*11	+0.40451	*y*11	+0.37426	*y*11	+0.34312	*y*11	+0.31174		
*x*12	−0.12941	*x*12	−0.18406	*x*12	−0.23236	*x*12	−0.27475	*x*12	−0.31174		
*y*12	+0.48296	*y*12	+0.46489	*y*12	+0.44273	*y*12	+0.41774	*y*12	+0.39092		
*x*13	0.00000	*x*13	−0.06267	*x*13	−0.11966	*x*13	−0.17101	*x*13	−0.21694		
*y*13	+0.50000	*y*13	+0.49606	*y*13	+0.48547	*y*13	+0.46985	*y*13	+0.45048		
*x*14	+0.12941	*x*14	+0.06267	*x*14	0.00000	*x*14	−0.05805	*x*14	−0.11126		
*y*14	+0.48296	*y*14	+0.49606	*y*14	+0.50000	*y*14	+0.49662	*y*14	+0.48746		
*x*15	+0.25000	*x*15	+0.18406	*x*15	+0.11966	*x*15	+0.05805	*x*15	0.00000		
*y*15	+0.43301	*y*15	+0.46489	*y*15	+0.48547	*y*15	+0.49662	*y*15	+0.50000		
*x*16	+0.35355	*x*16	+0.29389	*x*16	+0.23236	*x*16	+0.17101	*x*16	+0.11126		
*y*16	+0.35355	*y*16	+0.40451	*y*16	+0.44273	*y*16	+0.46985	*y*16	+0.48746		
*x*17	+0.43301	*x*17	+ 0.38526	*x*17	+0.33156	*x*17	+0.27475	*x*17	+0.21694		
*y*17	+0.25000	*y*17	+0.31871	*y*17	+0.37426	*y*17	+0.41774	*y*17	+0.45048		
*x*18	+0.48296	*x*18	+0.45241	*x*18	+0.41149	*x*18	+0.36369	*x*18	+0.31174		
*y*18	+0.12941	*y*18	+0.21289	*y*18	+0.28403	*y*18	+0.34312	*y*18	+0.39092		
*x*19	+0.50000	*x*19	+0.49114	*x*19	+0.46751	*x*19	+0.43301	*x*19	+0.39092		
*y*19	0.00000	*y*19	+0.09369	*y*19	+0.17730	*y*19	+0.25000	*y*19	+0.31174		
*x*20	+0.48296	*x*20	+0.49901	*x*20	+0.49635	*x*20	+0.47899	*x*20	+0.45048		
*y*20	−0.12941	*y*20	−0.03140	*y*20	+0.06027	*y*20	+0.14340	*y*20	+0.21694		
*x*21	+0.43301	*x*21	+0.47553	*x*21	+0.49635	*x*21	+0.49915	*x*21	+0.48746		
*y*21	−0.25000	*y*21	−0.15451	*y*21	−0.06027	*y*21	+0.02907	*y*21	+0.11126		
*x*22	+0.35355	*x*22	+0.42216	*x*22	+0.46751	*x*22	+0.49240	*x*22	+0.50000		
*y*22	−0.35355	*y*22	−0.26791	*y*22	−0.17730	*y*22	−0.08682	*y*22	0.00000		
*x*23	+0.25000	*x*23	+0.34227	*x*23	+0.41149	*x*23	+0.45911	*x*23	+0.48746		
*y*23	−0.43301	*y*23	−0.36448	*y*23	−0.28403	*y*23	−0.19804	*y*23	−0.11126		
*x*24	+0.12941	*x*24	+0.24088	*x*24	+0.33156	*x*24	+0.40106	*x*24	+0.45048		
*y*24	−0.48296	*y*24	−0.43815	*y*24	−0.37426	*y*24	−0.29858	*y*24	−0.21694		
		*x*25	+0.12434	*x*25	+0.23236	*x*25	+0.32139	*x*25	+0.39092		
		*y*25	−0.48429	*y*25	−0.44273	*y*25	−0.38302	*y*25	−0.31174		
				*x*26	+0.11966	*x*26	+0.22440	*x*26	+0.31174		
				*y*26	−0.48547	*y*26	−0.44682	*y*26	−0.39092		
						*x*27	+0.11531	*x*27	+0.21694		
						*y*27	−0.48652	*y*27	−0.45048		
								*x*28	+0.11126		
								*y*28	−0.48746		

Table 4. Hole Coordinate Dimension Factors for Jig Boring —Type "B" Hole Circles Central Coordinates (English or Metric units)

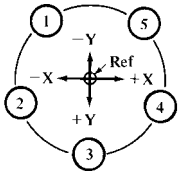


The diagram shows a type "B" circle for a 5-hole circle. Coordinates *x*, *y* are given in the table for hole circles of from 3 to 28 holes. Dimensions are for holes numbered in a counterclockwise direction (as shown). Dimensions given are based upon a hole circle of unit diameter. For a hole circle of, say, 3-inch or 3-centimeter diameter, multiply table values by 3.

3 Holes		4 Holes		5 Holes		6 Holes		7 Holes		8 Holes		9 Holes	
*x*1	−0.43301	*x*1	−0.35355	*x*1	−0.29389	*x*1	−0.25000	*x*1	−0.21694	*x*1	−0.19134	*x*1	−0.17101
*y*1	−0.25000	*y*1	−0.35355	*y*1	−0.40451	*y*1	−0.43301	*y*1	−0.45048	*y*1	−0.46194	*y*1	−0.46985
*x*2	0.00000	*x*2	−0.35355	*x*2	−0.47553	*x*2	−0.50000	*x*2	−0.48746	*x*2	−0.46194	*x*2	−0.43301
*y*2	+0.50000	*y*2	+0.35355	*y*2	+0.15451	*y*2	0.00000	*y*2	−0.11126	*y*2	−0.19134	*y*2	−0.25000
*x*3	+0.43301	*x*3	+0.35355	*x*3	0.00000	*x*3	−0.25000	*x*3	−0.39092	*x*3	−0.46194	*x*3	−0.49240
*y*3	−0.25000	*y*3	+0.35355	*y*3	+0.50000	*y*3	+0.43301	*y*3	+0.31174	*y*3	+0.19134	*y*3	+0.08682
		*x*4	+0.35355	*x*4	+0.47553	*x*4	+0.25000	*x*4	0.00000	*x*4	−0.19134	*x*4	−0.32139
		*y*4	−0.35355	*y*4	+0.15451	*y*4	+0.43301	*y*4	+0.50000	*y*4	+0.46194	*y*4	+0.38302
				*x*5	+0.29389	*x*5	+0.50000	*x*5	+0.39092	*x*5	+0.19134	*x*5	0.00000
				*y*5	−0.40451	*y*5	0.00000	*y*5	+0.31174	*y*5	+0.46194	*y*5	+0.50000
						*x*6	+0.25000	*x*6	+0.48746	*x*6	+0.46194	*x*6	+0.32139
						*y*6	−0.43301	*y*6	−0.11126	*y*6	+0.19134	*y*6	+0.38302
								*x*7	+0.21694	*x*7	+0.46194	*x*7	+0.49240
								*y*7	−0.45048	*y*7	−0.19134	*y*7	+0.08682
										*x*8	+0.19134	*x*8	+0.43301
										*y*8	−0.46194	*y*8	−0.25000
												*x*9	+0.17101
												*y*9	−0.46985

10 Holes		11 Holes		12 Holes		13 Holes		14 Holes		15 Holes		16 Holes	
*x*1	−0.15451	*x*1	−0.14087	*x*1	−0.12941	*x*1	−0.11966	*x*1	−0.11126	*x*1	−0.10396	*x*1	−0.09755
*y*1	−0.47553	*y*1	−0.47975	*y*1	−0.48296	*y*1	−0.48547	*y*1	−0.48746	*y*1	−0.48907	*y*1	−0.49039
*x*2	−0.40451	*x*2	−0.37787	*x*2	−0.35355	*x*2	−0.33156	*x*2	−0.31174	*x*2	−0.29389	*x*2	−0.27779
*y*2	−0.29389	*y*2	−0.32743	*y*2	−0.35355	*y*2	−0.37426	*y*2	−0.39092	*y*2	−0.40451	*y*2	−0.41573
*x*3	−0.50000	*x*3	−0.49491	*x*3	−0.48296	*x*3	−0.46751	*x*3	−0.45048	*x*3	−0.43301	*x*3	−0.41573
*y*3	0.00000	*y*3	−0.07116	*y*3	−0.12941	*y*3	−0.17730	*y*3	−0.21694	*y*3	−0.25000	*y*3	−0.27779
*x*4	−0.40451	*x*4	−0.45482	*x*4	−0.48296	*x*4	−0.49635	*x*4	−0.50000	*x*4	−0.49726	*x*4	−0.49039
*y*4	+0.29389	*y*4	+0.20771	*y*4	+0.12941	*y*4	+0.06027	*y*4	0.00000	*y*4	−0.05226	*y*4	−0.09755
*x*5	−0.15451	*x*5	−0.27032	*x*5	−0.35355	*x*5	−0.41149	*x*5	−0.45048	*x*5	−0.47553	*x*5	−0.49039
*y*5	+0.47553	*y*5	+0.42063	*y*5	+0.35355	*y*5	+0.28403	*y*5	+0.21694	*y*5	+0.15451	*y*5	+0.09755
*x*6	+0.15451	*x*6	0.00000	*x*6	−0.12941	*x*6	−0.23236	*x*6	−0.31174	*x*6	−0.37157	*x*6	−0.41573
*y*6	+0.47553	*y*6	+0.50000	*y*6	+0.48296	*y*6	+0.44273	*y*6	+0.39092	*y*6	+0.33457	*y*6	+0.27779
*x*7	+0.40451	*x*7	+0.27032	*x*7	+0.12941	*x*7	0.00000	*x*7	−0.11126	*x*7	−0.20337	*x*7	−0.27779
*y*7	+0.29389	*y*7	+0.42063	*y*7	+0.48296	*y*7	+0.50000	*y*7	+0.48746	*y*7	+0.45677	*y*7	+0.41573
*x*8	+0.50000	*x*8	+0.45482	*x*8	+0.35355	*x*8	+0.23236	*x*8	+0.11126	*x*8	0.00000	*x*8	−0.09755
*y*8	0.00000	*y*8	+0.20771	*y*8	+0.35355	*y*8	+0.44273	*y*8	+0.48746	*y*8	+0.50000	*y*8	+0.49039
*x*9	+0.40451	*x*9	+0.49491	*x*9	+0.48296	*x*9	+0.41149	*x*9	+0.31174	*x*9	+0.20337	*x*9	+0.09755
*y*9	−0.29389	*y*9	−0.07116	*y*9	+0.12941	*y*9	+0.28403	*y*9	+0.39092	*y*9	+0.45677	*y*9	+0.49039
*x*10	+0.15451	*x*10	+0.37787	*x*10	+0.48296	*x*10	+0.49635	*x*10	+0.45048	*x*10	+0.37157	*x*10	+0.27779
*y*10	−0.47553	*y*10	−0.32743	*y*10	−0.12941	*y*10	+0.06027	*y*10	+0.21694	*y*10	+0.33457	*y*10	+0.41573
		*x*11	+0.14087	*x*11	+0.35355	*x*11	+0.46751	*x*11	+0.50000	*x*11	+0.47553	*x*11	+0.41573
		*y*11	−0.47975	*y*11	−0.35355	*y*11	−0.17730	*y*11	0.00000	*y*11	+0.15451	*y*11	+0.27779
				*x*12	+0.12941	*x*12	+0.33156	*x*12	+0.45048	*x*12	+0.49726	*x*12	+0.49039
				*y*12	−0.48296	*y*12	−0.37426	*y*12	−0.21694	*y*12	−0.05226	*y*12	+0.09755
						*x*13	+0.11966	*x*13	+0.31174	*x*13	+0.43301	*x*13	+0.49039
						*y*13	−0.48547	*y*13	−0.39092	*y*13	−0.25000	*y*13	−0.09755
								*x*14	+0.11126	*x*14	+0.29389	*x*14	+0.41573
								*y*14	− 0.48746	*y*14	−0.40451	*y*14	−0.27779
										*x*15	+0.10396	*x*15	+0.27779
										*y*15	−0.48907	*y*15	−0.41573
												*x*16	+0.09755
												*y*16	−0.49039

Table 4. *(Continued)* **Hole Coordinate Dimension Factors for Jig Boring —Type "B" Hole Circles Central Coordinates** (English or Metric units)

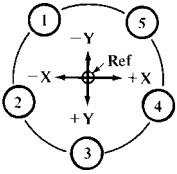


The diagram shows a type "B" circle for a 5-hole circle. Coordinates *x*, *y* are given in the table for hole circles of from 3 to 28 holes. Dimensions are for holes numbered in a counterclockwise direction (as shown). Dimensions given are based upon a hole circle of unit diameter. For a hole circle of, say, 3-inch or 3-centimeter diameter, multiply table values by 3.

17 Holes	18 Holes	19 Holes	20 Holes	21 Holes	22 Holes	23 Holes
x1 −0.09187	x1 −0.08682	x1 −0.08230	x1 −0.07822	x1 −0.07452	x1 −0.07116	x1 −0.06808
y1 − 0.49149	y1 −0.49240	y1 −0.49318	y1 −0.49384	y1 −0.49442	y1 −0.49491	y1 −0.49534
x2 −0.26322	x2 −0.25000	x2 −0.23797	x2 −0.22700	x2 −0.21694	x2 −0.20771	x2 −0.19920
y2 −0.42511	y2 −0.43301	y2 −0.43974	y2 −0.44550	y2 −0.45048	y2 −0.45482	y2 −0.45861
x3 − 0.39901	x3 −0.38302	x3 −0.36786	x3 −0.35355	x3 −0.34009	x3 −0.32743	x3 −0.31554
y3 −0.30132	y3 −0.32139	y3 −0.33864	y3 −0.35355	y3 −0.36653	y3 −0.37787	y3 −0.38786
x4 −0.48091	x4 −0.46985	x4 −0.45789	x4 −0.44550	x4 −0.43301	x4 −0.42063	x4 −0.40848
y4 −0.13683	y4 −0.17101	y4 −0.20085	y4 −0.22700	y4 −0.25000	y4 −0.27032	y4 −0.28834
x5 −0.49787	x5 −0.50000	x5 −0.49829	x5 −0.49384	x5 −0.48746	x5 −0.47975	x5 −0.47113
y5 +0.04613	y5 0.00000	y5 −0.04129	y5 −0.07822	y5 −0.11126	y5 −0.14087	y5 −0.16744
x6 −0.44758	x6 −0.46985	x6 −0.48470	x6 −0.49384	x6 −0.49860	x6 −0.50000	x6 −0.49883
y6 +0.22287	y6 +0.17101	y6 +0.12274	y6 +0.07822	y6 +0.03737	y6 0.00000	y6 −0.03412
x7 −0.33685	x7 −0.38302	x7 −0.41858	x7 −0.44550	x7 −0.46544	x7 −0.47975	x7 −0.48954
y7 +0.36950	y7 +0.32139	y7 +0.27347	y7 +0.22700	y7 +0.18267	y7 +0.14087	y7 +0.10173
x8 −0.18062	x8 −0.25000	x8 −0.30711	x8 −0.35355	x8 −0.39092	x8 −0.42063	x8 −0.44394
y8 +0.46624	y8 +0.43301	y8 +0.39457	y8 +0.35355	y8 +0.31174	y8 +0.27032	y8 +0.23003
x9 0.00000	x9 −0.08682	x9 −0.16235	x9 −0.22700	x9 −0.28166	x9 −0.32743	x9 −0.36542
y9 +0.50000	y9 +0.49240	y9 +0.47291	y9 +0.44550	y9 +0.41312	y9 +0.37787	y9 +0.34128
x10 +0.18062	x10 +0.08682	x10 0.00000	x10 −0.07822	x10 −0.14738	x10 −0.20771	x10 −0.25979
y10 +0.46624	y10 +0.49240	y10 +0.50000	y10 +0.49384	y10 +0.47779	y10 +0.45482	y10 +0.42721
x11 +0.33685	x11 +0.25000	x11 +0.16235	x11 +0.07822	x11 0.00000	x11 −0.07116	x11 −0.13490
y11 +0.36950	y11 +0.43301	y11 +0.47291	y11 +0.49384	y11 +0.50000	y11 +0.49491	y11 +0.48146
x12 +0.44758	x12 +0.38302	x12 +0.30711	x12 +0.22700	x12 +0.14738	x12 + 0.07116	x12 0.00000
y12 +0.22287	y12 +0.32139	y12 +0.39457	y12 +0.44550	y12 +0.47779	y12 +0.49491	y12 +0.50000
x13 +0.49787	x13 +0.46985	x13 +0.41858	x13 +0.35355	x13 +0.28166	x13 +0.20771	x13 +0.13490
y13 +0.04613	y13 +0.17101	y13 +0.27347	y13 +0.35355	y13 +0.41312	y13 +0.45482	y13 +0.48146
x14 +0.48091	x14 +0.50000	x14 +0.48470	x14 +0.44550	x14 +0.39092	x14 +0.32743	x14 +0.25979
y14 −0.13683	y14 0.00000	y14 +0.12274	y14 +0.22700	y14 +0.31174	y14 +0.37787	y14 +0.42721
x15 +0.39901	x15 +0.46985	x15 +0.49829	x15 +0.49384	x15 +0.46544	x15 +0.42063	x15 +0.36542
y15 −0.30132	y15 −0.17101	y15 −0.04129	y15 +0.07822	y15 +0.18267	y15 +0.27032	y15 +0.34128
x16 +0.26322	x16 +0.38302	x16 +0.45789	x16 +0.49384	x16 +0.49860	x16 +0.47975	x16 +0.44394
y16 −0.42511	y16 −0.32139	y16 −0.20085	y16 −0.07822	y16 +0.03737	y16 +0.14087	y16 +0.23003
x17 +0.09187	x17 +0.25000	x17 +0.36786	x17 +0.44550	x17 +0.48746	x17 +0.50000	x17 +0.48954
y17 − 0.49149	y17 −0.43301	y17 −0.33864	y17 −0.22700	y17 −0.11126	y17 0.00000	y17 +0.10173
	x18 +0.08682	x18 +0.23797	x18 +0.35355	x18 +0.43301	x18 +0.47975	x18 +0.49883
	y18 −0.49240	y18 −0.43974	y18 −0.35355	y18 −0.25000	y18 −0.14087	y18 −0.03412
		x19 +0.08230	x19 +0.22700	x19 +0.34009	x19 +0.42063	x19 +0.47113
		y19 −0.49318	y19 −0.44550	y19 −0.36653	y19 −0.27032	y19 −0.16744
			x20 +0.07822	x20 +0.21694	x20 +0.32743	x20 +0.40848
			y20 −0.49384	y20 −0.45048	y20 −0.37787	y20 −0.28834
				x21 +0.07452	x21 +0.20771	x21 +0.31554
				y21 −0.49442	y21 −0.45482	y21 −0.38786
					x22 +0.07116	x22 +0.19920
					y22 −0.49491	y22 −0.45861
						x23 +0.06808
						y23 −0.49534

24 Holes	25 Holes	26 Holes	27 Holes	28 Holes
x1 −0.06526	x1 −0.06267	x1 −0.06027	x1 −0.05805	x1 −0.05598
y1 −0.49572	y1 −0.49606	y1 −0.49635	y1 −0.49662	y1 −0.49686
x2 −0.19134	x2 −0.18406	x2 −0.17730	x2 −0.17101	x2 −0.16514
y2 −0.46194	y2 −0.46489	y2 −0.46751	y2 −0.46985	y2 −0.47194
x3 −0.30438	x3 −0.29389	x3 −0.28403	x3 −0.27475	x3 −0.26602

Table 4. *(Continued)* **Hole Coordinate Dimension Factors for Jig Boring —Type "B" Hole Circles Central Coordinates** (English or Metric units)

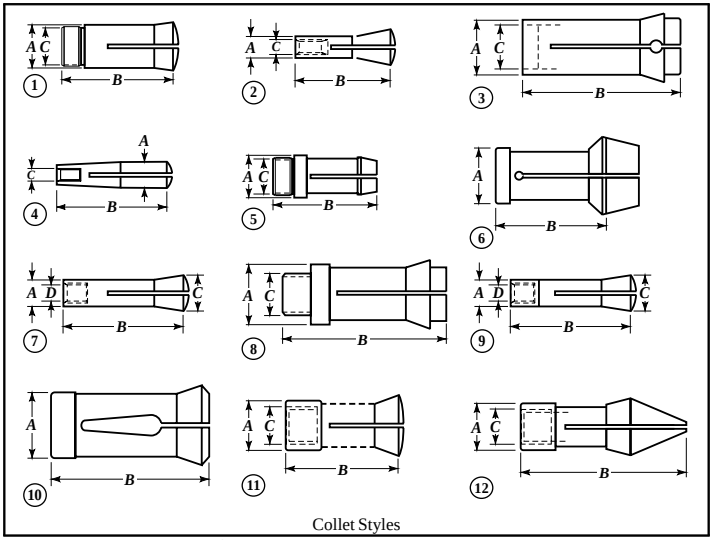


The diagram shows a type "B" circle for a 5-hole circle. Coordinates *x*, *y* are given in the table for hole circles of from 3 to 28 holes. Dimensions are for holes numbered in a counterclockwise direction (as shown). Dimensions given are based upon a hole circle of unit diameter. For a hole circle of, say, 3-inch or 3-centimeter diameter, multiply table values by 3.

*y*3	−0.39668	*y*3	−0.40451	*y*3	−0.41149	*y*3	−0.41774	*y*3	−0.42336		
*x*4	−0.39668	*x*4	−0.38526	*x*4	−0.37426	*x*4	−0.36369	*x*4	−0.35355		
*y*4	−0.30438	*y*4	−0.31871	*y*4	−0.33156	*y*4	−0.34312	*y*4	−0.35355		
*x*5	−0.46194	*x*5	−0.45241	*x*5	−0.44273	*x*5	−0.43301	*x*5	−0.42336		
*y*5	−0.19134	*y*5	−0.21289	*y*5	−0.23236	*y*5	− 0.25000	*y*5	−0.26602		
*x*6	−0.49572	*x*6	−0.49114	*x*6	−0.48547	*x*6	−0.47899	*x*6	−0.47194		
*y*6	−0.06526	*y*6	−0.09369	*y*6	−0.11966	*y*6	−0.14340	*y*6	−0.16514		
*x*7	−0.49572	*x*7	−0.49901	*x*7	−0.50000	*x*7	−0.49915	*x*7	−0.49686		
*y*7	+0.06526	*y*7	+0.03140	*y*7	0.00000	*y*7	− 0.02907	*y*7	−0.05598		
*x*8	−0.46194	*x*8	−0.47553	*x*8	−0.48547	*x*8	−0.49240	*x*8	−0.49686		
*y*8	+0.19134	*y*8	+0.15451	*y*8	+0.11966	*y*8	+0.08682	*y*8	+0.05598		
*x*9	−0.39668	*x*9	−0.42216	*x*9	−0.44273	*x*9	−0.45911	*x*9	−0.47194		
*y*9	+0.30438	*y*9	+0.26791	*y*9	+0.23236	*y*9	+0.19804	*y*9	+0.16514		
*x*10	−0.30438	*x*10	−0.34227	*x*10	−0.37426	*x*10	−0.40106	*x*10	−0.42336		
*y*10	+0.39668	*y*10	+ 0.36448	*y*10	+0.33156	*y*10	+0.29858	*y*10	+0.26602		
*x*11	−0.19134	*x*11	−0.24088	*x*11	−0.28403	*x*11	−0.32139	*x*11	−0.35355		
*y*11	+0.46194	*y*11	+0.43815	*y*11	+0.41149	*y*11	+0.38302	*y*11	+0.35355		
*x*12	−0.06526	*x*12	−0.12434	*x*12	−0.17730	*x*12	−0.22440	*x*12	−0.26602		
*y*12	+0.49572	*y*12	+0.48429	*y*12	+0.46751	*y*12	+0.44682	*y*12	+0.42336		
*x*13	+0.06526	*x*13	0.00000	*x*13	−0.06027	*x*13	−0.11531	*x*13	−0.16514		
*y*13	+0.49572	*y*13	+0.50000	*y*13	+0.49635	*y*13	+0.48652	*y*13	+0.47194		
*x*14	+0.19134	*x*14	+0.12434	*x*14	+0.06027	*x*14	0.00000	*x*14	−0.05598		
*y*14	+0.46194	*y*14	+0.48429	*y*14	+0.49635	*y*14	+0.50000	*y*14	+0.49686		
*x*15	+0.30438	*x*15	+0.24088	*x*15	+0.17730	*x*15	+0.11531	*x*15	+0.05598		
*y*15	+0.39668	*y*15	+0.43815	*y*15	+0.46751	*y*15	+0.48652	*y*15	+0.49686		
*x*16	+0.39668	*x*16	+0.34227	*x*16	+0.28403	*x*16	+0.22440	*x*16	+0.16514		
*y*16	+0.30438	*y*16	+0.36448	*y*16	+0.41149	*y*16	+0.44682	*y*16	+0.47194		
*x*17	+0.46194	*x*17	+0.42216	*x*17	+0.37426	*x*17	+0.32139	*x*17	+0.26602		
*y*17	+0.19134	*y*17	+0.26791	*y*17	+0.33156	*y*17	+0.38302	*y*17	+0.42336		
*x*18	+0.49572	*x*18	+0.47553	*x*18	+0.44273	*x*18	+0.40106	*x*18	+0.35355		
*y*18	+0.06526	*y*18	+0.15451	*y*18	+0.23236	*y*18	+ 0.29858	*y*18	+0.35355		
*x*19	+0.49572	*x*19	+0.49901	*x*19	+0.48547	*x*19	+0.45911	*x*19	+0.42336		
*y*19	−0.06526	*y*19	+0.03140	*y*19	+0.11966	*y*19	+0.19804	*y*19	+0.26602		
*x*20	+0.46194	*x*20	+0.49114	*x*20	+0.50000	*x*20	+0.49240	*x*20	+0.47194		
*y*20	−0.19134	*y*20	−0.09369	*y*20	0.00000	*y*20	+0.08682	*y*20	+0.16514		
*x*21	+0.39668	*x*21	+0.45241	*x*21	+ 0.48547	*x*21	+0.49915	*x*21	+0.49686		
*y*21	−0.30438	*y*21	−0.21289	*y*21	−0.11966	*y*21	−0.02907	*y*21	+0.05598		
*x*22	+0.30438	*x*22	+0.38526	*x*22	+0.44273	*x*22	+0.47899	*x*22	+0.49686		
*y*22	−0.39668	*y*22	−0.31871	*y*22	−0.23236	*y*22	− 0.14340	*y*22	−0.05598		
*x*23	+0.19134	*x*23	+0.29389	*x*23	+0.37426	*x*23	+0.43301	*x*23	+0.47194		
*y*23	−0.46194	*y*23	−0.40451	*y*23	−0.33156	*y*23	−0.25000	*y*23	−0.16514		
*x*24	+0.06526	*x*24	+0.18406	*x*24	+0.28403	*x*24	+0.36369	*x*24	+0.42336		
*y*24	−0.49572	*y*24	−0.46489	*y*24	−0.41149	*y*24	−0.34312	*y*24	−0.26602		
		*x*25	+0.06267	*x*25	+0.17730	*x*25	+0.27475	*x*25	+0.35355		
		*y*25	−0.49606	*y*25	−0.46751	*y*25	−0.41774	*y*25	−0.35355		
				*x*26	+0.06027	*x*26	+0.17101	*x*26	+0.26602		
				*y*26	−0.49635	*y*26	−0.46985	*y*26	−0.42336		
						*x*27	+0.05805	*x*27	+0.16514		
						*y*27	−0.49662	*y*27	−0.47194		
								*x*28	+0.05598		
								*y*28	−0.49686		

Collets

Collets for Lathes, Mills, Grinders, and Fixtures



Collet Styles

Collets for Lathes, Mills, Grinders, and Fixtures

		Dimensions			Max. Capacity (inches)		
Collet	Style	Bearing Diam., A	Length, B	Thread, C	Round	Hex	Square
1A	1	0.650	2.563	0.640 × 26 RH	0.500	0.438	0.344
1AM	1	1.125	3.906	1.118 × 24 RH	1.000	0.875	0.719
1B	2	0.437	1.750	0.312 × 30 RH	0.313	0.219	0.188
1C	1	0.335	1.438	0.322 × 40 RH	0.250	0.219	0.172
1J	1	1.250	3.000	1.238 × 20 RH	1.063	0.875	0.750
1K	3	1.250	2.813	None	1.000	0.875	0.719
2A	1	0.860	3.313	0.850 × 20 RH	0.688	0.594	0.469
2AB	2	0.750	2.563	0.500 × 20 RH	0.625	0.484	0.391
2AM	1	0.629	3.188	0.622 × 24 RH	0.500	0.438	0.344
2B	2	0.590	2.031	0.437 × 26 RH	0.500	0.438	0.344
2C	1	0.450	1.812	0.442 × 30 RH	0.344	0.594	0.234
2H	1	0.826	4.250	0.799 × 20 RH	0.625	0.531	1.000
2J	1	1.625	3.250	1.611 × 18 RH	1.375	1.188	0.438
2L	1	0.950	3.000	0.938 × 20 RH	0.750	0.656	1.000
2M	4	2 Morse	2.875	0.375 × 16 RH	0.500	0.438	0.344
2NS	1	0.324	1.562	0.318 × 40 RH	0.250	0.203	0.172
2OS	1	0.299	1.250	0.263 × 40 RH	0.188	0.156	0.125
2S	1	0.750	3.234	0.745 × 18 RH	0.563	0.484	0.391
2VB	2	0.595	2.438	0.437 × 26 RH	0.500	0.438	0.344
3AM	1	0.750	3.188	0.742 × 24 RH	0.625	0.531	0.438
3AT	1	0.687	2.313	0.637 × 26 RH	0.500	0.438	0.344

Collets for Lathes, Mills, Grinders, and Fixtures *(Continued)*

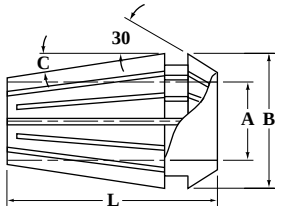
Collet	Style	Dimensions			Max. Capacity (inches)		
		Bearing Diam., A	Length, B	Thread, C	Round	Hex	Square
3B	2	0.875	3.438	0.625 × 16 RH	0.750	0.641	0.531
3C	1	0.650	2.688	0.640 × 26 RH	0.500	0.438	0.344
3H	1	1.125	4.438	1.050 × 20 RH	0.875	0.750	0.625
3J	1	2.000	3.750	1.988 × 20 RH	1.750	1.500	1.250
3NS	1	0.687	2.875	0.647 × 20 RH	0.500	0.438	0.344
3OS	1	0.589	2.094	0.518 × 26 RH	0.375	0.313	0.266
3PN	1	0.650	2.063	0.645 × 24 RH	0.500	0.438	0.344
3PO	1	0.599	2.063	0.500 × 24 RH	0.375	0.313	0.266
3S	1	1.000	4.594	0.995 × 20 RH	0.750	0.656	0.531
3SC	1	0.350	1.578	0.293 × 36 RH	0.188	0.156	0.125
3SS	1	0.589	2.125	0.515 × 26 RH	0.375	0.313	0.266
4C	1	0.950	3.000	0.938 × 20 RH	0.750	0.656	0.531
4NS	1	0.826	3.500	0.800 × 20 RH	0.625	0.531	0.438
4OS	1	0.750	2.781	0.660 × 20 RH	0.500	0.438	0.344
4PN	1	1.000	2.906	0.995 × 16 RH	0.750	0.656	0.531
4S	1	0.998	3.250	0.982 × 20 RH	0.750	0.656	0.531
5C	1	1.250	3.281	1.238 × 20 RH[a]	1.063	0.906	0.750
5M	5	1.438	3.438	1.238 × 20 RH	0.875	0.750	0.625
5NS	1	1.062	4.219	1.050 × 20 RH	0.875	0.750	0.625
5OS	1	3.500	3.406	0.937 × 18 RH	0.750	0.641	0.516
5P	1	0.812	3.687	0.807 × 24 RH	0.625	0.531	0.438
5PN	1	1.312	3.406	1.307 × 16 RH	1.000	0.875	0.719
5SC	1	0.600	2.438	0.500 × 26 RH	0.375	0.328	0.266
5ST	1	1.250	3.281	1.238 × 20 RH	1.063	0.906	0.750
5V	1	0.850	3.875	0.775 × 18 RH	0.563	0.484	0.391
6H	1	1.375	4.750	1.300 × 10 RH	1.125	0.969	0.797
6K	1	0.842	3.000	0.762 × 26 RH	0.625	0.531	0.438
6L	1	1.250	4.438	1.178 × 20 RH	1.000	0.875	0.719
6NS	1	1.312	5.906	1.234 × 14 RH	1.000	0.859	0.703
6R	1	1.375	4.938	1.300 × 20 RH	1.125	0.969	0.781
7B	4	7 B&S	3.125	0.375 × 16 RH	0.500	0.406	0.344
7 B&S	4	7 B&S	2.875	0.375 × 16 RH	0.500	0.406	0.344
7P	1	1.125	4.750	1.120 × 20 RH	0.875	0.750	0.625
7R	6	1.062	3.500	None	0.875	0.750	0.625
8H	1	1.500	4.750	1.425 × 20 RH	1.250	1.063	0.875
8ST	1	2.375	5.906	2.354 × 12 RH	2.125	1.844	1.500
8WN	1	1.250	3.875	1.245 × 16 RH	1.000	0.875	0.719
9B	4	9 B&S	4.125	0.500 × 13 RH	0.750	0.641	0.531
10L	1	1.562	5.500	1.490 × 18 RH	1.250	1.063	0.875
10P	1	1.500	4.750	1.495 × 20 RH	1.250	1.063	0.875
16C	1	1.889	4.516	1.875 × 1.75 mm RH[b]	1.625	1.406	1.141
20W	1	0.787	2.719	0.775 × 6–1 cm	0.563	0.484	0.391
22J	1	2.562	4.000	2.550 × 18 RH	2.250	1.938	1.563
32S	1	0.703	2.563	0.690 × 24 RH	0.500	0.438	0.344
35J	1	3.875	5.000	3.861 × 18 RH	3.500	3.000	2.438
42S	1	1.250	3.688	1.236 × 20 RH	1.000	0.875	0.719
50V	8	1.250	4.000	1.125 × 24 RH	0.938	0.813	0.656
52SC	1	0.800	3.688	0.795 × 20 RH	0.625	0.531	0.438
115	1	1.344	3.500	1.307 × 20 LH	1.125	0.969	0.797

Collets for Lathes, Mills, Grinders, and Fixtures *(Continued)*

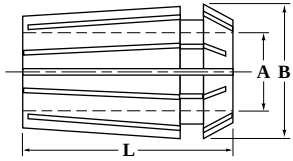
Collet	Style	Dimensions			Max. Capacity (inches)		
		Bearing Diam., A	Length, B	Thread, C	Round	Hex	Square
215	1	2.030	4.750	1.990 × 18 LH	1.750	1.500	1.219
315	1	3.687	5.500	3.622 × 16 LH	3.250	2.813	2.250
B3	7	0.650	3.031	0.437 × 20 RH	0.500	0.438	0.344
D5	7	0.780	3.031	0.500 × 20 RH	0.625	0.531	0.438
GTM	7	0.625	2.437	0.437 × 20 RH	0.500	0.438	0.344
J&L	9	0.999	4.375	None	0.750	0.641	0.516
JC	8	1.360	4.000	None	1.188	1.000	0.813
LB	10	0.687	2.000	None	0.500	0.438	0.344
RO	11	1.250	2.938	0.875 × 16 RH	1.125	0.969	0.781
RO	12	1.250	4.437	0.875 × 16 RH	0.800	0.688	0.563
RO	12	1.250	4.437	0.875 × 16 RH	1.125	0.969	0.781
RO	11	1.250	2.938	0.875 × 16 RH	0.800	0.688	0.563
R8	7	0.950	4.000	0.437 × 20 RH	0.750	0.641	0.531

[a] Internal stop thread is 1.041 × 24 RH.
[b] Internal stop thread is 1.687 × 20 RH.
Dimensions in inches unless otherwise noted. Courtesy of Hardinge Brothers, Inc.

DIN 6388, Type B, and DIN 6499, ER Type Collets



ER Type



Type B

Collet Standard	Type	Dimensions			
		B (mm)	*L* (mm)	*A* (mm)	*C*
Type B, DIN 6388	16	25.50	40	4.5–16	…
	20	29.80	45	5.5–20	…
	25	35.05	52	5.5–25	…
	32	43.70	60	9.5–32	…
ER Type, DIN 6499	ERA8	8.50	13.5	0.5–5	8°
	ERA11	11.50	18	0.5–7	8°
	ERA16	17	27	0.5–10	8°
	ERA20	21	31	0.5–13	8°
	ERA25	26	35	0.5–16	8°
	ERA32	33	40	2–20	8°
	ERA40	41	46	3–26	8°
		41	39	26–30	8°
	ERA50	52	60	5–34	8°