ASME B94.33-1996
(Revision of ANSI B94.33-1974)

JIG BUSHINGS

AN AMERICAN NATIONAL STANDARD

The American Society of
Mechanical Engineers

Intentionally left blank

The American Society of Mechanical Engineers

AN AMERICAN NATIONAL STANDARD

JIG BUSHINGS

ASME B94.33-1996

(Revision of ANSI B94.33-1974)

Date of Issuance: February 28, 1997

The 1996 edition of this Standard is being issued with an automatic addenda subscription service. The use of an addenda allows revisions made in response to public review comments or committee actions to be published as necessary. The next edition of this Standard is scheduled for publication in 2002.

This code or standard was developed under procedures accredited as meeting the criteria for American National Standards. The Consensus Committee that approved the code or standard was balanced to assure that individuals from competent and concerned interests have had an opportunity to participate. The proposed code or standard was made available for public review and comment which provides an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

ASME does not "approve," "rate," or "endorse" any item, construction, proprietary device, or activity.

ASME does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this document, and does not undertake to insure anyone utilizing a standard against liability for infringement of any applicable Letters Patent, nor assume any such liability. Users of a code or standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this code or standard.

ASME accepts responsibility for only those interpretations issued in accordance with governing ASME procedures and policies which preclude the issuance of interpretations by individual volunteers.

The American Society of Mechanical Engineers
345 East 47th Street, New York, NY 10017

FOREWORD

(This Foreword is not part of ASME B94.33-1996.)

This Standard for jig bushings was approved and designated as an American Standard by ASA in April, 1935. The use of this Standard by industry necessitated revision in December, 1937.

The Standard was revised and approved by the Sectional Committee in March, 1941. Approval and designation by ASA was given in August, 1941. The Standard was reaffirmed in 1949.

The TC-8 Committee was reactivated in December of 1957 to review and revise the Standard, if necessary. Requests for additional lengths, locking devices, locking dimensions, and a unified marking system by industry users were considered and approved by the committee in December, 1958.

Further additions and deletions were agreed upon by the committee at a meeting in April, 1960. With the exception of counterbores, the draft was approved. Specifications for counterbores were added, and the draft was distributed to committee members November 1, 1960. Committee members approved the draft, and it was submitted to TC-17 for approval. ASA approval was granted on June 22, 1962.

Fractional dimensions were changed to decimal inch, and the document was reviewed for conformance with American National Standard Decimal Inch, ANSI B87.1-1965.

The current revision was approved by the American National Standards Institute on December 27, 1996.

Intentionally left blank

ASME STANDARDS COMMITTEE B94
Cutting Tools, Holders, Drivers, and Bushings

(The following is the roster of the Committee at the time of approval of this Standard.)

OFFICERS

C. W. Preuss, *Chair*
G. L. Fechter, *Secretary*

COMMITTEE PERSONNEL

P. Bourg, Tivoly, Inc.
A. M. Bratkovich, The Association for Manufacturing Technology
E. J. Czopor, E & S Sales, Inc.
D. Fischer, The Wapakoneta Machine Co.
W. E. Gill, Keen Agers, Inc.
D. J. Lionette, Porter Precision Products
M. E. Merchant, Institute of Advanced Manufacturing Science
V. J. Peterson, Kennametal
C. M. Stockinger, U.S. Cutting Tool Institute
J. Wherry, Cemented Carbide Products Association

TECHNICAL COMMITTEE 8 — JIG BUSHINGS

J. Evans, *Chair,* Acme Industrial Co.
D. L. Bethke, United California Corp.
C. C. DeLonghi, C. C. D. Consulting Corp.
K. M. Konet, Economy Bushing Co.
R. Okolischan, Carr Lane Manufacturing Co.
N. O. Shaw, All American P
A. R. Steele, American Drill Bushing Co.
R. Yillik, Yillik Precision Industries

Intentionally left blank

CONTENTS

Intentionally left blank

JIG BUSHINGS

1 SCOPE

This Standard covers the American National Standard practice for sizes, types, tolerances, and identification of jig bushings and locking devices used for securing the bushings in the jig or bushing plate.

2 PURPOSE

The purpose of this Standard is to provide the necessary information for the design, procurement, and installation of jig bushings.

3 GENERAL

3.1 Press Fit Bushings

Press fit bushings to guide the tool are installed 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 also are intended for use where the closeness of the center distance of holes will not permit the installation of liners and renewable bushings. Press fit bushings are made in two types: with heads and without.

3.2 Renewable Bushings

Renewable bushings to guide the tool are for use in liners, which in turn are installed in the jig. They are used where the bushings will wear out or become obsolete before the jig or where several bushings are to be interchangeable in one hole. They are usually made with a knurled head to facilitate removal.

There are "fixed" and "slip" milled notches combined on the head of renewable bushings. There is one type of renewable bushing: slip-fixed renewable.

(a) The fixed side of the renewable bushing is used with the intention of leaving it in place until worn out.

(b) The slip side of the renewable bushing is used with the intention of changing it frequently in a given size of liner. This side is most often 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.

3.3 Liner Bushings

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

3.4 Bushing Specifications

The dimensions and tolerances of jig bushings shall conform to the specifications given in the tables and notes on the following pages.

3.5 Jig Plate Thickness

The standard lengths of the press fit portion of jig bushings as established are based on standardized uniform jig plate thickness.

4 JIG BUSHING DESIGNATION SYSTEM

4.1 Inside Diameter

Specify jig bushing by inside diameter of hole size, in a decimal dimension.

4.2 Bushing Type

Specify bushing type by using letter abbreviation as follows:

(a) SF: Renewable, Slip-Fixed
(b) L: Liner, Plain
(c) HL: Liner, Headed
(d) P: Press Fit, Plain
(e) H: Press Fit, Headed

Carbide bushings should use the letter "C" after the type designation (e.g., a slip-fixed renewable carbide bushing would be designated SFC).

4.3 Body Diameter

Specify body diameter in multiples of $^{1}/_{64}$ in.

4.4 Body Length

Specify the effective or body length in multiples of $^{1}/_{16}$ in.

4.5 Example

For a jig bushing designated 0.5000 and SF-48-16:

(a) inside diameter hole size
  (1) decimal
(b) bushing type
  (1) SF: Renewable, Slip-Fixed
  (2) L: Liner, Plain
  (3) HL: Liner, Headed
  (4) P: Press Fit, Plain
  (5) H: Press Fit, Headed
(c) body diameter = 48 in.
(d) body length = 16 in.

4.6 Formula

A simple formula to remember is that all diameters are in multiples of $^{1}/_{64}$ and all lengths are in multiples of $^{1}/_{16}$.

5 DESIGNATION SYSTEM FOR LOCK SCREWS AND CLAMPS

5.1 Lock Screws

(a) LS-0: lock screw $^{3}/_{32}$ in. locking thickness × 0.438 in. overall length.
(b) LS-1: lock screw $^{1}/_{8}$ in. locking thickness × 0.625 in. overall length.
(c) LS-2: lock screw $^{3}/_{16}$ in. locking thickness × 0.875 in. overall length.
(d) LS-3: lock screw $^{3}/_{16}$ in. locking thickness × 1.000 in. overall length.

5.2 Round Clamps

(a) RC-1: round clamp $^{1}/_{8}$ in. locking thickness × 0.312 in. overall length.
(b) RC-2: round clamp $^{3}/_{16}$ in. locking thickness × 0.438 in. overall length.
(c) RC-3: round clamp $^{3}/_{16}$ in. locking thickness × 0.500 in. overall length.

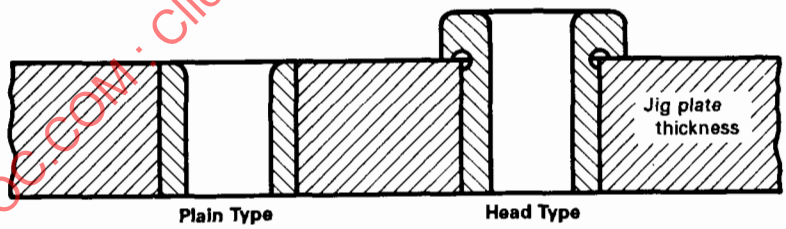

FIG. 1 PRESS FIT BUSHINGS

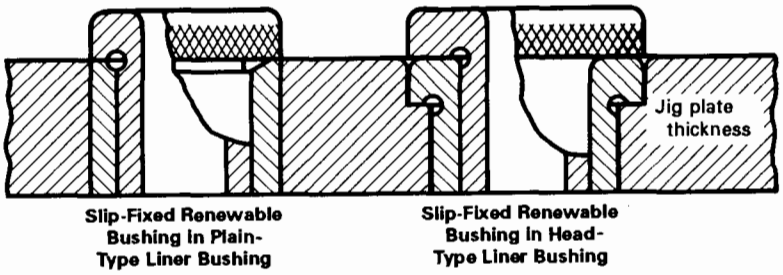

FIG. 2 PLAIN-TYPE AND HEAD-TYPE LINER BUSHINGS

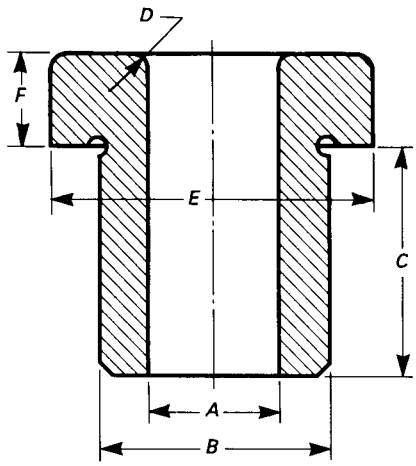

TABLE 1 HEAD-TYPE PRESS FIT BUSHINGS (TYPE H)

Range of Hole Diameters *A*	Body Diameter *B*			Body Length ±1/64 *C*	Radius Min. *D*	Head Diameter ±1/64 *E*	Head Thickness ±1/64 *F*	Number
	Nominal	Finished Max.	Finished Min.					
#80 to 1/16	5/32	0.1578	0.1575	1/4 5/16 3/8 1/2	1/64	1/4	3/32	H-10-4 H-10-5 H-10-6 H-10-8
1/16 to #39	13/64	0.2046	0.2043	1/4 5/16 3/8 1/2	1/64	19/64	3/32	H-13-4 H-13-5 H-13-6 H-13-8
#40 to 9/64	1/4	0.2516	0.2513	1/4 5/16 3/8 1/2 3/4	1/64	23/64	3/32	H-16-4 H-16-5 H-16-6 H-16-8 H-16-12
1/8 to #10	5/16	0.3141	0.3138	1/4 5/16 3/8 1/2 3/4 1	1/32	27/64	1/8	H-20-4 H-20-5 H-20-6 H-20-8 H-20-12 H-20-16
3/16 to "F"	13/32	0.4078	0.4075	1/4 5/16 3/8 1/2 3/4 1 1 3/8	1/32	1/2	5/32	H-26-4 H-26-5 H-26-6 H-26-8 H-26-12 H-26-16 H-26-22
3/16 to "O"	1/2	0.5017	0.5014	3/8 1/2 3/4 1 1 3/8 1 3/4	3/64	39/64	7/32	H-32-6 H-32-8 H-32-12 H-32-16 H-32-22 H-32-28

(continued)

TABLE 1 HEAD-TYPE PRESS FIT BUSHINGS (TYPE H) (CONT'D)

Range of Hole Diameters *A*	Body Diameter *B*			Body Length ±1/64 *C*	Radius Min. *D*	Head Diameter ±1/64 *E*	Head Thickness ±1/64 *F*	Number
	Nominal	Finished Max.	Finished Min.					
5/16 to 7/16	5/8	0.6267	0.6264	3/8 1/2 3/4 1 1 3/8 1 3/4 2 1/8	3/64	51/64	7/32	H-40-6 H-40-8 H-40-12 H-40-16 H-40-22 H-40-28 H-40-34
3/8 to 17/32	3/4	0.7518	0.7515	1/2 3/4 1 1 3/8 1 3/4 2 1/8	1/16	59/64	7/32	H-48-8 H-48-12 H-48-16 H-48-22 H-48-28 H-48-34
1/2 to 5/8	7/8	0.8768	0.8765	1/2 3/4 1 1 3/8 1 3/4 2 1/8	1/16	1 7/64	1/4	H-56-8 H-56-12 H-56-16 H-56-22 H-56-28 H-56-34
5/8 to 3/4	1	1.0018	1.0015	1/2 3/4 1 1 3/8 1 3/4 2 1/8 2 1/2	3/32	1 15/64	5/16	H-64-8 H-64-12 H-64-16 H-64-22 H-64-28 H-64-34 H-64-40
3/4 to 1	1 3/8	1.3772	1.3768	3/4 1 1 3/8 1 3/4 2 1/8 2 1/2	3/32	1 39/64	3/8	H-88-12 H-88-16 H-88-22 H-88-28 H-88-34 H-88-40
1 to 1 3/8	1 3/4	1.7523	1.7519	1 1 3/8 1 3/4 2 1/8 2 1/2 3	3/32	1 63/64	3/8	H-112-16 H-112-22 H-112-28 H-112-34 H-112-40 H-112-48
1 3/8 to 1 3/4	2 1/4	2.2525	2.2521	1 1 3/8 1 3/4 2 1/8 2 1/2 3	3/32	2 31/64	3/8	H-144-16 H-144-22 H-144-28 H-144-34 H-144-40 H-144-48

GENERAL NOTES:
(a) All dimensions are given in inches.
(b) See page 7 for additional information.

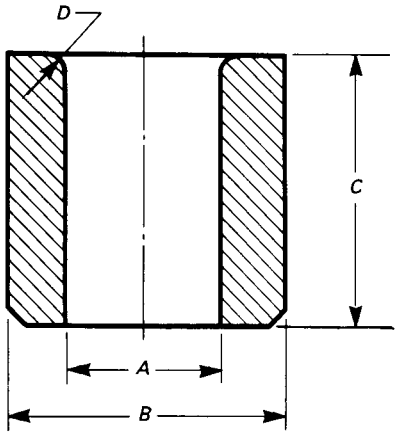

TABLE 2 PLAIN-TYPE PRESS FIT BUSHINGS (TYPE P)

Range of Hole Diameters *A*	Body Diameter *B*			Body Length ±1/64 *C*	Radius Min. *D*	Number
	Nominal	Finished Max.	Finished Min.			
#80 to 1/16	5/32	0.1578	0.1575	1/4	1/64	P-10-4
				5/16		P-10-5
				3/8		P-10-6
				1/2		P-10-8
1/16 to #39	13/64	0.2046	0.2043	1/4	1/64	P-13-4
				5/16		P-13-5
				3/8		P-13-6
				1/2		P-13-8
#40 to 9/64	1/4	0.2516	0.2513	1/4	1/64	P-16-4
				5/16		P-16-5
				3/8		P-16-6
				1/2		P-16-8
				3/4		P-16-12
1/8 to #10	5/16	0.3141	0.3138	1/4	1/32	P-20-4
				5/16		P-20-5
				3/8		P-20-6
				1/2		P-20-8
				3/4		P-20-12
				1		P-20-16
3/16 to "F"	13/32	0.4078	0.4075	1/4	1/32	P-26-4
				5/16		P-26-5
				3/8		P-26-6
				1/2		P-26-8
				3/4		P-26-12
				1		P-26-16
				1 3/8		P-26-22
3/16 to "O"	1/2	0.5017	0.5014	3/8	3/64	P-32-6
				1/2		P-32-8
				3/4		P-32-12
				1		P-32-16
				1 3/8		P-32-22
				1 3/4		P-32-28

(continued)

TABLE 2 PLAIN-TYPE PRESS FIT BUSHINGS (TYPE P) (CONT'D)

Range of Hole Diameters *A*	Body Diameter *B*			Body Length ±1/64 *C*	Radius Min. *D*	Number
	Nominal	Finished				
		Max.	Min.			
5/16 to 7/16	5/8	0.6267	0.6264	3/8	3/64	P-40-6
				1/2		P-40-8
				3/4		P-40-12
				1		P-40-16
				1 3/8		P-40-22
				1 3/4		P-40-28
				2 1/8		P-40-34
3/8 to 17/32	3/4	0.7518	0.7515	1/2	1/16	P-48-8
				3/4		P-48-12
				1		P-48-16
				1 3/8		P-48-22
				1 3/4		P-48-28
				2 1/8		P-48-34
1/2 to 5/8	7/8	0.8768	0.8765	1/2	1/16	P-56-8
				3/4		P-56-12
				1		P-56-16
				1 3/8		P-56-22
				1 3/4		P-56-28
				2 1/8		P-56-34
5/8 to 3/4	1	1.0018	1.0015	1/2	3/32	P-64-8
				3/4		P-64-12
				1		P-64-16
				1 3/8		P-64-22
				1 3/4		P-64-28
				2 1/8		P-64-34
				2 1/2		P-64-40
3/4 to 1	1 3/8	1.3772	1.3768	3/4	3/32	P-88-12
				1		P-88-16
				1 3/8		P-88-22
				1 3/4		P-88-28
				2 1/8		P-88-34
				2 1/2		P-88-40
1 to 1 3/8	1 3/4	1.7523	1.7519	1	3/32	P-112-16
				1 3/8		P-112-22
				1 3/4		P-112-28
				2 1/8		P-112-34
				2 1/2		P-112-40
				3		P-112-48
1 3/8 to 1 3/4	2 1/4	2.2525	2.2521	1	3/32	P-144-16
				1 3/8		P-144-22
				1 3/4		P-144-28
				2 1/8		P-144-34
				2 1/2		P-144-40
				3		P-144-48

GENERAL NOTES:
(a) All dimensions are given in inches.
(b) See page 7 for additional information.

SPECIFICATIONS FOR HEAD-TYPE AND PLAIN-TYPE PRESS FIT BUSHINGS (Tables 1 and 2)

(a) Tolerances on dimensions where not otherwise specified shall be ±1/64 inch.

(b) Hole sizes are in accordance with the American Standard Twist Drill Sizes, ASME B94.11M-1993.

(c) The maximum and minimum values of hole size *A* shall be as follows:

Nominal Size of Hole	Max., in.	Min., in.
Above #80 to 1/4 in. incl.	Nominal +0.0004	Nominal +0.0001
Above 1/4 to 3/4 in. incl.	Nominal +0.0005	Nominal +0.0001
Above 3/4 to 1 1/2 in. incl.	Nominal +0.0006	Nominal +0.0002
Above 1 1/2 in.	Nominal +0.0007	Nominal +0.0003

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

(e) The length *C* is the overall length for the plain type and length underhead for the head type.

(f) The head design and construction shall be in accordance with the manufacturer's option.

(g) Diameter *A* must be concentric to diameter *B* within 0.0005 T.I.R. on finished ground bushings.

(h) Finish on ground diameter *A* shall be a 16 micro finish or better.

(i) Hardness shall be 61–65 Rc.

(j) Material shall be the manufacturer's option.

(k) Bushings in the size range from #80 through 5/16 may be counterbored at the manufacturer's option.

(l) The size of the counterbore shall be the inside diameter of the bushing plus 1/32 inch.

(m) The included angle at the bottom of the counterbore shall be 118 deg. included angle.

(n) The depth of the counterbore shall be in accordance with the chart below to provide adequate drill bearing.

SPECIFICATIONS FOR SLIP-FIXED-TYPE RENEWABLE BUSHINGS (Table 3)

(a) Tolerances on dimensions where not otherwise specified shall be ±1/64 inch.

(b) Hole sizes are in accordance with the American Standard Twist Drill Sizes, ASME B94.11M-1993.

(c) The maximum and minimum values of hole size *A* shall be as follows:

Nominal Size of Hole	Max., in.	Min., in.
Above #80 to 1/4 in. incl.	Nominal +0.0004	Nominal +0.0001
Above 1/4 to 3/4 in. incl.	Nominal +0.0005	Nominal +0.0001
Above 3/4 to 1 1/2 in. incl.	Nominal +0.0006	Nominal +0.0002
Above 1 1/2 in.	Nominal +0.0007	Nominal +0.0003

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

(e) When slip-fixed renewable bushings are used with

MINIMUM DRILL BEARING LENGTH
Bushing Size and Type

Body Length	#80 to 1/16		#52 to #39		#38 to #28		9/64 to 3/16		#12 to 1/4		F to 5/16	
	P	*H*	*P*	*H*	*P*	*H*	*P*	*H*	*P*	*H*	*P*	*H*
1/4	X	1/4	X	X	X	X	X	X	X	X	X	X
5/16	X	1/4	X	X	X	X	X	X	X	X	X	X
3/8	1/4	1/4	X	X	X	X	X	X	X	X	X	X
1/2	1/4	1/4	X	5/16	X	5/16	X	3/8	X	X	X	X
3/4	+	+	+	+	3/8	3/8	X	3/8	X	X	X	X
1	+	+	+	+	+	+	5/8	5/8	5/8	5/8	5/8	5/8
1 3/8	+	+	+	+	+	+	5/8	5/8	5/8	5/8	5/8	5/8
1 3/4	+	+	+	+	+	+	5/8	5/8	5/8	5/8	5/8	5/8

GENERAL NOTES:
(a) "X" indicates no counterbore.
(b) "+" indicates not American National Standard length.
(c) All dimensions are given in inches.

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.

(f) The head design and construction shall be in accordance with the manufacturer's option and is usually knurled.

(g) Diameter *A* must be concentric to Diameter *B* within 0.0005 T.I.R. on finished ground bushings.

(h) Finish on ground diameter *A* shall be a 16 micro finish or better.

(i) Hardness shall be 61–65 Rc.

(j) Material shall be the manufacturer's option.

(k) Bushings in the size range from #80 through $^{5}/_{16}$ may be counterbored at the manufacturer's option.

(l) The size of the counterbore shall be the inside diameter of the bushing plus $^{1}/_{32}$ inch.

(m) The included angle at the bottom of the counterbore shall be 118 deg. included angle.

(n) The depth of the counterbore shall be in accordance with the chart below Table 3 (on page 10) to provide adequate drill bearing.

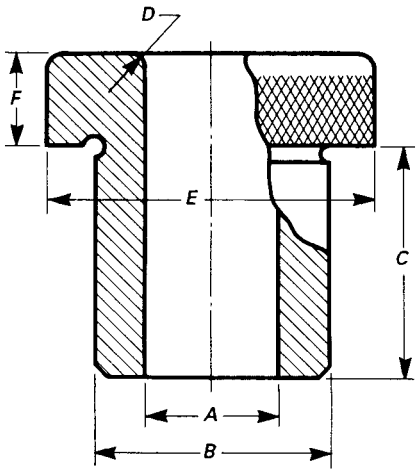

TABLE 3 SLIP-FIXED-TYPE RENEWABLE BUSHINGS (TYPE SF)

Range of Hole Diameters *A*	Body Diameter *B*			Body Length ±1/64 *C*	Radius Min. *D*	Head Diameter ±1/64 *E*	Head Thickness ±1/64 *F*	Number
	Nominal	Max.	Min.					
#80 to 1/16	3/16	0.1875	0.1873	1/4 5/16 3/8 1/2	1/32	5/16	3/16	SF-12-4 SF-12-5 SF-12-6 SF-12-8
1/16 to #10	5/16	0.3125	0.3123	5/16 3/8 1/2 3/4 1	3/64	35/64	1/4	SF-20-5 SF-20-6 SF-20-8 SF-20-12 SF-20-16
5/32 to 11/32	1/2	0.5000	0.4998	5/16 3/8 1/2 3/4 1 1 3/8 1 3/4	3/64	51/64	1/4	SF-32-5 SF-32-6 SF-32-8 SF-32-12 SF-32-16 SF-32-22 SF-32-28
5/16 to 9/16	3/4	0.7500	0.7498	1/2 3/4 1 1 3/8 1 3/4 2 1/8 2 1/2	3/32	1 3/64	1/4	SF-48-8 SF-48-12 SF-48-16 SF-48-22 SF-48-28 SF-48-34 SF-48-40
1/2 to 3/4	1	1.0000	0.9998	1/2 3/4 1 1 3/8 1 3/4 2 1/8 2 1/2	3/32	1 27/64	3/8	SF-64-8 SF-64-12 SF-64-16 SF-64-22 SF-64-28 SF-64-34 SF-64-40

(continued)

TABLE 3 SLIP-FIXED-TYPE RENEWABLE BUSHINGS (TYPE SF) (CONT'D)

Range of Hole Diameters *A*	Body Diameter *B*			Body Length ±1/64 *C*	Radius Min. *D*	Head Diameter ±1/64 *E*	Head Thickness ±1/64 *F*	Number
	Nominal	Max.	Min.					
3/4	1 3/8	1.3750	1.3747	3/4	3/32	1 51/64	3/8	SF-88-12
to				1				SF-88-16
1 1/16				1 3/8				SF-88-22
				1 3/4				SF-88-28
				2 1/8				SF-88-34
				2 1/2				SF-88-40
				3				SF-88-48
1	1 3/4	1.7500	1.7497	1	1/8	2 19/64	3/8	SF-112-16
to				1 3/8				SF-112-22
1 3/8				1 3/4				SF-112-28
				2 1/8				SF-112-34
				2 1/2				SF-112-40
				3				SF-112-48
1 3/8	2 1/4	2.2500	2.2496	1	1/8	2 51/64	3/8	SF-144-16
to				1 3/8				SF-144-22
1 3/4				1 3/4				SF-144-28
				2 1/8				SF-144-34
				2 1/2				SF-144-40
				3				SF-144-48

GENERAL NOTES:
(a) All dimensions are given in inches.
(b) See pages 7 and 8 for additional information.

MINIMUM DRILL BEARING LENGTH
Bushing Size

Body Length	#80 to 1/16	#52 to #39	#38 to #28	9/64 to 3/16	#12 to 1/4	*F* to 5/16
1/4	1/4	+	+	+	+	+
5/16	1/4	3/8	3/8	3/8	3/8	X
3/8	1/4	3/8	3/8	3/8	3/8	X
1/2	1/4	3/8	3/8	3/8	3/8	X
3/4	+	3/8	3/8	3/8	5/8	5/8
1	+	3/8	3/8	5/8	5/8	5/8
1 3/8	+	+	+	5/8	5/8	5/8
1 3/4	+	+	+	5/8	5/8	5/8

GENERAL NOTES:
(a) "X" indicates no counterbore.
(b) "+" indicates not American National Standard length.
(c) All dimensions are given in inches.

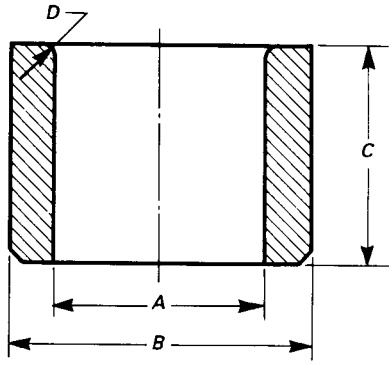

TABLE 4 PLAIN-TYPE LINER BUSHINGS (TYPE L)

Range of Hole Sizes in Renewable Bushings	Inside Diameter *A* [Note (1)]			Body Diameter *B*			Body Length $\pm 1/64$ *C*	Radius Min. *D*	Number
					Finished				
	Nominal	Max.	Min.	Nominal	Max.	Min.			
#80 to 1/16	3/16	0.1879	0.1876	5/16	0.3141	0.3138	1/4	1/32	L-20-4
							5/16		L-20-5
							3/8		L-20-6
							1/2		L-20-8
1/16 to #10	5/16	0.3129	0.3126	1/2	0.5017	0.5014	5/16	3/64	L-32-5
							3/8		L-32-6
							1/2		L-32-8
							3/4		L-32-12
							1		L-32-16
5/32 to 11/32	1/2	0.5005	0.5002	3/4	0.7518	0.7515	5/16	1/16	L-48-5
							3/8		L-48-6
							1/2		L-48-8
							3/4		L-48-12
							1		L-48-16
							1 3/8		L-48-22
							1 3/4		L-48-28
5/16 to 9/16	3/4	0.7506	0.7503	1	1.0018	1.0015	1/2	1/16	L-64-8
							3/4		L-64-12
							1		L-64-16
							1 3/8		L-64-22
							1 3/4		L-64-28
							2 1/8		L-64-34
							2 1/2		L-64-40
1/2 to 3/4	1	1.0007	1.0004	1 3/8	1.3772	1.3768	1/2	3/32	L-88-8
							3/4		L-88-12
							1		L-88-16
							1 3/8		L-88-22
							1 3/4		L-88-28
							2 1/8		L-88-34
							2 1/2		L-88-40

(continued)

TABLE 4 PLAIN-TYPE LINER BUSHINGS (TYPE L) (CONT'D)

Range of Hole Sizes in Renewable Bushings	Inside Diameter *A* [Note (1)]			Body Diameter *B*			Body Length $\pm 1/64$ *C*	Radius Min. *D*	Number
					Finished				
	Nominal	Max.	Min.	Nominal	Max.	Min.			
3/4 to 1 1/16	1 3/8	1.3760	1.3756	1 3/4	1.7523	1.7519	3/4	3/32	L-112-12
							1		L-112-16
							1 3/8		L-112-22
							1 3/4		L-112-28
							2 1/8		L-112-34
							2 1/2		L-112-40
							3		L-112-48
1 to 1 3/8	1 3/4	1.7512	1.7508	2 1/4	2.2525	2.2521	1	3/32	L-144-16
							1 3/8		L-144-22
							1 3/4		L-144-28
							2 1/8		L-144-34
							2 1/2		L-144-40
							3		L-144-48
1 3/8 to 1 3/4	2 1/4	2.2515	2.2510	2 3/4	2.7526	2.7522	1	1/8	L-176-16
							1 3/8		L-176-22
							1 3/4		L-176-28
							2 1/8		L-176-34
							2 1/2		L-176-40
							3		L-176-48

GENERAL NOTES:
(a) Tolerances on dimensions where not otherwise specified shall be $\pm 1/64$ inch.
(b) For detail dimensions of renewable bushings, see Table 3.
(c) All dimensions are given in inches.

NOTE:
(1) Diameter *A* must be concentric to diameter *B* within 0.0005 T.I.R. on finish ground bushings.

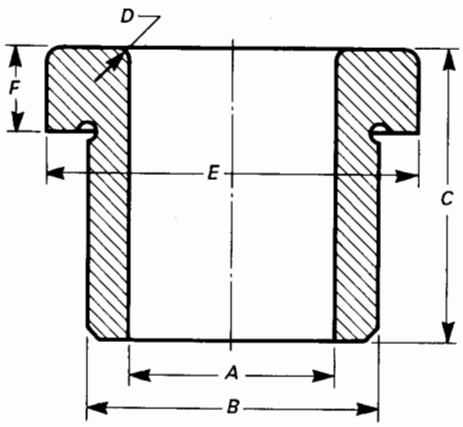

TABLE 5 HEAD-TYPE LINER BUSHINGS (TYPE HL)

Range of Hole Sizes in Renewable Bushings	Inside Diameter *A* [Note (1)]			Body Diameter *B*			Body Length ±1/64 *C*	Radius Min. *D*	Head Diameter ±1/64 *E*	Head Thickness ±1/64 *F*	Number
	Nominal	Max.	Min.	Nominal	Finished Max.	Finished Min.					
1/16 to #10	5/16	0.3129	0.3126	1/2	0.5017	0.5014	5/16	3/64	5/8	3/32	HL-32-5
							3/8				HL-32-6
							1/2				HL-32-8
							3/4				HL-32-12
							1				HL-32-16
5/32 to 11/32	1/2	0.5005	0.5002	3/4	0.7518	0.7515	5/16	1/16	7/8	3/32	HL-48-5
							3/8				HL-48-6
							1/2				HL-48-8
							3/4				HL-48-12
							1				HL-48-16
							1 3/8				HL-48-22
							1 3/4				HL-48-28
5/16 to 9/16	3/4	0.7506	0.7503	1	1.0018	1.0015	1/2	1/16	1 1/8	1/8	HL-64-8
							3/4				HL-64-12
							1				HL-64-16
							1 3/8				HL-64-22
							1 3/4				HL-64-28
							2 1/8				HL-64-34
							2 1/2				HL-64-40
1/2 to 3/4	1	1.0007	1.0004	1 3/8	1.3772	1.3768	1/2	3/32	1 1/2	1/8	HL-88-8
							3/4				HL-88-12
							1				HL-88-16
							1 3/8				HL-88-22
							1 3/4				HL-88-28
							2 1/8				HL-88-34
							2 1/2				HL-88-40
3/4 to 1 1/16	1 3/8	1.3760	1.3756	1 3/4	1.7523	1.7519	3/4	3/32	1 7/8	3/16	HL-112-12
							1				HL-112-16
							1 3/8				HL-112-22
							1 3/4				HL-112-28
							2 1/8				HL-112-34
							2 1/2				HL-112-40
							3				HL-112-48

(continued)

TABLE 5 HEAD-TYPE LINER BUSHINGS (TYPE HL) (CONT'D)

Range of Hole Sizes in Renewable Bushings	Inside Diameter *A* [Note (1)]			Body Diameter *B*			Body Length $\pm 1/64$ *C*	Radius Min. *D*	Head Diameter $\pm 1/64$ *E*	Head Thickness $\pm 1/64$ *F*	Number
	Nominal	Max.	Min.	Nominal	Finished Max.	Finished Min.					
1	1 3/4	1.7512	1.7508	2 1/4	2.2525	2.2521	1	3/32	2 3/8	3/16	HL-144-16
to							1 3/8				HL-144-22
1 3/8							1 3/4				HL-144-28
							2 1/8				HL-144-34
							2 1/2				HL-144-40
							3				HL-144-48
1 3/8	2 1/4	2.2515	2.2510	2 3/4	2.7526	2.7522	1	1/8	2 7/8	3/16	HL-176-16
to							1 3/8				HL-176-22
1 3/4							1 3/4				HL-176-28
							2 1/8				HL-176-34
							2 1/2				HL-176-40
							3				HL-176-48

GENERAL NOTES:
(a) Tolerances on dimensions where not otherwise specified shall be $\pm 1/64$ inch.
(b) For detail dimensions of renewable bushings, see Table 3.
(c) The head design and construction shall be in accordance with manufacturer's standard.
(d) All dimensions are given in inches.

NOTE:
(1) Diameter *A* must be concentric to diameter *B* within 0.0005 T.I.R. on finish ground bushings.

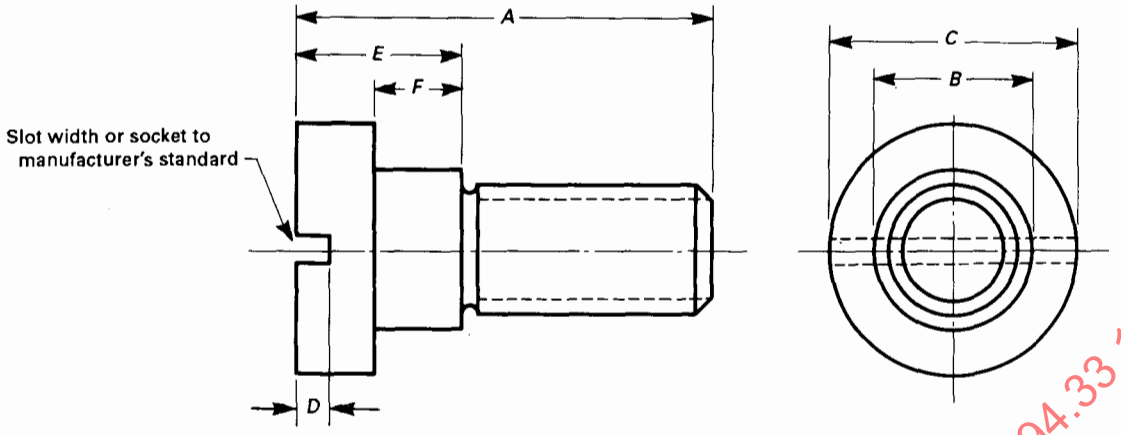

TABLE 6 LOCK SCREW FOR USE WITH SLIP-FIXED RENEWABLE BUSHINGS

Number	*A*	*B*	*C*	*D*	*E*	*F* [Note (1)]	UNC Thread
LS-0	7/16	3/16	5/16	Manufacturer's standard	3/16	0.105 0.100	8–32
LS-1	5/8	3/8	5/8	Manufacturer's standard	1/4	0.138 0.132	5/16–18
LS-2	7/8	3/8	5/8	Manufacturer's standard	3/8	0.200 0.194	5/16–18
LS-3	1	7/16	3/4	Manufacturer's standard	3/8	0.200 0.194	3/8–16

GENERAL NOTES:
(a) Tolerances on dimensions where not otherwise specified shall be ±1/64 inch.
(b) Material and hardness to manufacturer's standard.
(c) All dimensions are given in inches.

NOTE:
(1) Allows clearance to enable rotation of slip side of slip-fixed renewable bushings.