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ANSI B94.33 Jig Bushing Tolerance Chart

A printable working reference for ID and OD tolerances, press-fit and slip-fit specifications, concentricity, and jig bore hole sizing.



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Why This Reference Exists

In precision machining, every micron matters. A drilled hole that drifts by half a thousandth of an inch can put a finished part out of spec — and on a high-volume production line, that single deviation multiplies into scrap, rework, and lost production time.

This is why **ANSI B94.33** exists. The standard governs the sizes, types, tolerances, and identification of jig bushings used in industrial fixtures across the United States and globally.

This guide turns the standard into a practical bench reference. It is designed to be printed, posted at the design desk, or saved on the engineering drive — whichever way your team works.

What you will find inside:

- ID tolerance ranges for drill and reamer bushings
- OD tolerance bands for press-fit and slip-fit installations
- Recommended jig bore hole sizes by nominal OD
- Concentricity, interference, and material guidance
- A practical fit-selection decision flow

What ANSI B94.33 Covers

ANSI B94.33 is the American National Standard that defines the dimensional rules for jig bushings and the locking devices that secure them in fixtures.

Bushing Types Governed

Type	Common Designation	Use Case
P	Press-Fit Headless	Fixed installation, high-volume
H	Press-Fit Head	Fixed installation with shoulder support
L	Liner (headless)	Permanent base for renewable bushings
RL	Liner (head)	Permanent base, head supports renewables
SF	Slip Renewable	Quick-change, frequent operation swap
SFX	Locking Slip Renewable	Slip type with rotation lock
HL/HM	Head-Lock Renewable	Renewable with head locking screw

Each type has its own tolerance band under ANSI B94.33, and choosing the right one is the foundation of fixture reliability.

Inside Diameter (ID) Tolerances

The ID is the bore that guides the cutting tool — drill, reamer, or tap. ANSI B94.33 specifies tighter ID tolerances for drill bushings and slightly looser tolerances for reamer bushings, since reamers require a freer fit to avoid binding.

All ID tolerances are **plus-only** over nominal — the bore is never undersized, so the tool always enters freely.

ID Tolerance — Drill Sizes

Bushing Bore Range	Tolerance Over Nominal	Total Spread
.0135" to .2500"	+0.0001" / +0.0004"	.0003"
Over .2500" to .7500"	+0.0001" / +0.0005"	.0004"
Over .7500" to 1.500"	+0.0002" / +0.0006"	.0004"
Over 1.5000" to 1.8750"	+0.0003" / +0.0007"	.0004"

ID Tolerance — Reamer Sizes

Bushing Bore Range	Tolerance Over Nominal	Total Spread
.0135" to .2500"	+0.0005" / +0.0008"	.0003"
Over .2500" to 1.0000"	+0.0006" / +0.0010"	.0004"
Over 1.0000"	+0.0008" / +0.0012"	.0004"

Engineering note: Specifying a drill-tolerance bushing for a reaming operation is one of the most common bushing-selection errors. The tighter ID will bind the reamer and accelerate ID wear. Always match the bushing tolerance class to the operation.

Concentricity Between ID and OD

ANSI B94.33 also controls how concentric the ID is to the OD. This matters because the OD seats in the jig plate, while the ID guides the tool — the two must share an axis for the tool to enter on location.

ID Size Range	Concentricity (TIR Max)
1/8" to 1/2" (ground)	.0003" TIR
Above 1/2" or below 1/8"	.0005" TIR
Unground bushings	.006" TIR

On counterbored bushings, concentricity applies only across the drill-bearing length.

Outside Diameter (OD) Tolerances

The OD controls how the bushing seats in the jig plate (or in a liner, for renewable types). ANSI B94.33 defines two distinct OD tolerance bands:

Press-fit OD — slightly oversized to create interference with the jig plate hole. Permanent installation.

Slip-fit OD — slightly undersized, designed to insert and remove freely from a liner. Renewable installation.

OD Reference Table — Selected Standard Sizes

Nominal OD	Press-Fit OD	Slip-Fit OD	Recommended Jig Bore
5/32	.1578 – .1575	—	.1570 – .1565
3/16	.1891 – .1888	.1875 – .1873	.1883 – .1880
1/4	.2516 – .2513	.2500 – .2498	.2510 – .2507
5/16	.3141 – .3138	.3125 – .3123	.3135 – .3132
3/8	.3766 – .3763	.3750 – .3748	.3760 – .3757
7/16	.4392 – .4389	.4375 – .4373	.4385 – .4382
1/2	.5017 – .5014	.5000 – .4998	.5010 – .5007
9/16	.5642 – .5639	.5625 – .5623	.5635 – .5632
5/8	.6267 – .6264	.6250 – .6248	.6260 – .6257
3/4	.7518 – .7515	.7500 – .7498	.7510 – .7507
7/8	.8768 – .8765	.8750 – .8748	.8760 – .8757
1	1.0018 – 1.0015	1.0000 – .9998	1.0010 – 1.0007
1-1/8	1.1270 – 1.1267	1.1250 – 1.1247	1.1260 – 1.1257
1-1/4	1.2520 – 1.2517	1.2500 – 1.2497	1.2510 – 1.2507
1-3/8	1.3772 – 1.3768	1.3750 – 1.3747	1.3760 – 1.3757
1-1/2	1.5022 – 1.5018	1.5000 – 1.4997	1.5010 – 1.5007
1-3/4	1.7523 – 1.7519	1.7500 – 1.7497	1.7510 – 1.7507
2-1/4	2.2525 – 2.2521	2.2500 – 2.2469	2.2510 – 2.2507

All dimensions in inches. Applies to standard ANSI B94.33 P, H, L, RL, SF, and SFX bushing types in standard sizes.

Interference Fit Guidance

In a press-fit installation, the diametric interference between the press-fit OD and the prepared jig bore typically falls in the **.0005" – .0008"** range. This is enough to retain the bushing reliably without distorting the jig plate or closing the bushing ID.

Avoid excessive interference. More press-fit is not better. Excess interference distorts the jig plate, closes the bushing ID, and can shear the press fit. Use the minimum interference required to retain the bushing under operational load.

Choosing the Right Tolerance

Use this decision flow when specifying a bushing for a new fixture or a replacement application:

Question	If YES use...	If NO consider...
Will the bushing stay in place for the life of the fixture?	Press-Fit (Type P or H) or Liner + Renewable	Slip Renewable (Type SF / SFX)
Will multiple operations run through the same bushing hole?	Liner + Slip Renewable (L or RL with SF/SFX)	Press-Fit (Type P or H)
Is the operation a reaming, tapping, or finishing operation?	Reamer-tolerance bushing (looser ID class)	Drill-tolerance bushing (tighter ID class)
Will heavy axial load act on the bushing during drilling?	Headed bushing (Type H, RL, HL)	Headless bushing (Type P, L)
Will rotation of the bushing be a risk (slip type)?	Locking slip type (Type SFX)	Standard slip type (Type SF)

Practical Application Tips

Mounting Hole Preparation

Bushings tend to assume the shape of the hole they are pressed into. Always prepare mounting holes with a jig borer or chucking reamer — a twist drill will rarely produce a hole accurately sized and truly round, and the bushing ID will reflect that error.

Chip Clearance

Mount bushings as close to the workpiece as possible while still allowing chip clearance. Cast iron and other short-chip materials need about half a drill diameter; long-chipping materials like cold-rolled steel and aluminum need a full drill diameter or more. Direct workpiece contact is generally not recommended.

Common Mistakes to Avoid

Mistake	Consequence
Using a drill bushing for reaming	ID too tight — reamer binds and wears
Excess press-fit interference	Jig plate distorts, bushing ID closes
Skipping the jig bore reaming step	Out-of-round seat, eccentric bushing
Ignoring tolerance stack-up	Out-of-spec parts at worst-case build
Mismatched fit (slip in unlined hole)	Bushing rotates or walks under load

Key Definitions

Press-Fit Bushing

A wearing bushing installed directly into the jig plate without a liner. Used principally for short production runs where the bushing will not require replacement.

Liner Bushing

A permanent bushing installed in the jig to receive renewable wearing bushings. Sometimes called a master bushing.

Renewable Bushing — Fixed

Installed in a liner with the intention of leaving it in place until worn out.

Renewable Bushing — Slip

Interchangeable in a given size of liner; usually has a knurled head for hand removal. Used when multiple operations require different IDs in the same hole.

TIR (Total Indicator Reading)

A measurement of total runout — the difference between maximum and minimum reading of an indicator over a full rotation. Used to specify concentricity tolerance.

Press-Fit Interference

The diametric difference between the bushing OD and the jig bore hole. ANSI B94.33 standard sizes typically produce .0005" – .0008" interference when installed in a properly reamed hole.

Authoritative Sources

This reference summarises selected provisions of **ANSI/ASME B94.33 — Jig Bushings**, published by the American National Standards Institute in cooperation with the American Society of Mechanical Engineers. The full standard, including all sizes, locking devices, and identification symbols, should be consulted for any design or manufacture in which compliance with B94.33 is contractually or specification-required.

- American National Standards Institute (ANSI) — www.ansi.org
- American Society of Mechanical Engineers (ASME) — www.asme.org
- Society of Manufacturing Engineers (SME) — www.sme.org

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