When you are working to tight tolerances, drilling a hole is rarely as simple as matching the number stamped on the shank of the bit. The final fit depends on two distinct factors: how accurately the manufacturer ground the tool, and the mechanical dynamics of the drilling process itself.

Here is what you can expect regarding tool precision and actual hole size variance.

# 1. Tool Manufacturing Tolerances (The Bit Itself)

For premium, machinist- or instrument-grade drill bits, manufacturing tolerances are incredibly tight. However, general-purpose woodworking bits have slightly wider margins.

- **Brad-Point Bits:** Premium brad-points (often made from High-Speed Steel, or HSS) are usually ground to a tolerance of **$+0.000" / -0.001"$** (or even $ +0.0000" / -0.0005"$). Manufacturers deliberately err on the side of making the bit slightly undersized rather than oversized, ensuring that the initial hole isn't loose right out of the gate. Cheaper, carbon-steel hardware store sets can vary more, sometimes up to $\pm0.003"$.
- **Twist Drills (Spiral/Jobber Bits):** Standard HSS fractional twist drills are typically manufactured to ASME/ANSI standards, which generally stipulate a tolerance of **$+0.0000" / -0.0005"$ to $-0.001"$** depending on the diameter.
- **Conical/Step Drill Bits:** These are general-purpose utility tools meant for sheet metal or plastics. Because of their geometry and how they are sharpened, their tolerances are much looser, often varying by **$\pm0.003"$ to $\pm0.005"$** from the stated step diameter. They are not precision woodworking or machining tools.

# 2. Actual Hole Size vs. Stated Diameter (The Dynamics)

A drill bit almost always cuts a hole **larger** than its actual diameter. In wood, this is complicated by grain direction, elasticity, and fibers compressing and rebounding, but the mechanical rules of runout still dominate.

In a stable setup, you can generally expect the final hole diameter to vary from the bit's stated size by the following margins:

| Drill Bit Type | Expected Hole Variance (Over Stated Size) | Primary Characteristics & Behavior |
|---|---|---|

| | | |
|---|---|---|
| **Premium Brad-Point** | **$+0.001"$ to $+0.003"$** | The center spur prevents walking, and the outer spurs shear the fibers cleanly before the landing engages, resulting in the truest hole in wood. |
| **Standard Twist Drill (HSS)** | **$+0.002"$ to $+0.005"$** | Without a center point, the chisel edge wanders slightly before entering the material, creating an oversized, slightly oval entry. |
| **Conical / Step Bit** | **$+0.005"$ to $+0.015"$** | High friction and aggressive cutting action cause significant vibration and runout. Out-of-round holes are common. |

### Material Elasticity (The Wood Factor)

Wood is an anisotropic, elastic material.

- **Hardwoods** (like maple or ebony) resist compression, meaning the cutters shave the wood cleanly, yielding a hole very close to the bit's true sweep.
- **Softwoods** (like pine or spruce) compress under the pressure of the cutting edge and then bounce back *inward*after the bit is removed. This can occasionally result in a hole that is actually **undersized** relative to the bit.
- **Grain Direction:** The bit will naturally want to deflect along the path of least resistance when hitting hard latewood growth rings, causing the hole to drift or become oval.

### Feed Technique

In woodworking, backing the bit out frequently to clear chips (peck drilling) prevents heat buildup and chip packing. If chips pack tight into the flutes, they rub against the walls of the hole, acting like an abrasive and widening the bore unpredictably.

## Best Practices for Achieving High Precision

If your work demands an exact friction fit (such as for hardware, pins, or specific joinery):

1. **Use a Drill Press:** Handheld drilling introduces human deflection, which guarantees an oversized, tapered hole.

2. **The "Under-Drill and Ream" Method:** Drill the hole using a bit that is $1/64"$ or $0.010"$ undersized. Then, bring it to final size using a precision twist drill, a dedicated reamer, or a shop-made sanding mandrel.

3. **Test on Scrap:** Always drill a test hole in a scrap piece of the *exact same wood species* and measure it with digital calipers or check the fit of your mating part before plunging into your final workpiece.