Do hardened steel nozzles clog more than brass?

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Abstract. Not by itself. Hardened steel conducts heat about a fifth as well as brass, so Prusa adds about 5 °C and Slice Engineering 5 to 10 °C to keep the melt hot enough.

Keywords: slicer-settings

Table 1. The number

Nozzle material	Thermal conductivity at 20 °C	Temperature change makers publish	Abrasive filament
Brass (C36000 free-cutting brass as the reference)	67 Btu/(ft·h·°F), about 116 W/(m·K)	None, the baseline	Prusa: wears out “very quickly”; Bambu Lab: do not use
Stainless steel (AISI 304 as the reference)	16 W/(m·K)	Not published	Bambu Lab: do not use, “hardness is insufficient”
Hardened steel (high-speed tool steel; Vanadis 23, AISI M3:2, as the reference)	24 W/(m·K), 28 W/(m·K) at 400 °C	Prusa: about +5 °C; Slice Engineering: +5 to 10 °C	Prusa, E3D and Bambu Lab: the nozzle to use

1 Do hardened steel nozzles clog more than brass?

Not because of the steel. No maker guide we checked names nozzle material as a clog cause. Hardened steel conducts heat about a fifth as well as brass, so brass settings leave the melt cold: Prusa adds about 5 °C, Slice Engineering 5 to 10 °C. The clogs makers do warn about come from fiber-filled filament in small nozzles.

1.1 The number

Conductivity comes from the Copper Development Association (C36000), Uddeholm’s Vanadis 23 data sheet (hardened and tempered) and MakeItFrom (AISI 304). Temperature offsets come from Prusa’s E3D V6 nozzle article and Slice Engineering’s Vanadium nozzle page; the abrasive rules from Prusa, E3D and Bambu Lab’s filament guide.

Treat each row as a class value, not a spec for your nozzle, because makers rarely name the alloy. Micro Swiss machines its hardened nozzles from M2 high-speed steel. Slice Engineering’s Vanadium nozzle is a vanadium-alloyed high-speed steel at 65 HRC (Rockwell C hardness). Bambu Lab nozzles come in hardened steel or stainless steel.

1.2 Why a hardened nozzle can clog at brass settings

Heat reaches the filament through the nozzle wall. With about a fifth of brass’s conductivity, a hardened steel nozzle passes less heat at the same setpoint, so plastic leaves it cooler. Bambu Lab’s clog guide says “printing too cold can cause under-melting and clogs”. Printing too fast for the melt causes partial clogs. Prusa adds that standard materials like ABS (acrylonitrile butadiene styrene) “cannot be printed as fast” through hardened steel. The fix is the offset in the table, or less speed.

The other cause is the filament itself. Bambu Lab warns that with PAHT-CF (high-temperature nylon with carbon fiber), PA-GF (nylon with glass fiber) and similar filaments, “particles tend to accumulate inside the nozzle, causing partial blockages”. Makers send those filaments through hardened steel only, so the clogs show up on that nozzle.

1.3 Which nozzle size clogs with carbon fiber or glass fiber filament?

Table 2. Which nozzle size clogs with carbon fiber or glass fiber filament?

Nozzle diameter	Bambu Lab, CF and GF filament	Prusa, CF or Kevlar filled ABS
0.2 or 0.25 mm	“Do not use a 0.2 mm nozzle. The clogging risk is extremely high.”	Not compatible; particles “can (and will) quickly clog or ruin your nozzle”
0.4 mm	Second choice, 0.15 to 0.3 mm layers, about 100 mm/s maximum; first choice for Bambu PLA-CF and PETG-CF	Compatible with a hardened nozzle
0.6 mm	First choice, “lower clogging risk”	Compatible with a hardened nozzle
0.8 mm	Clog risk falls further as diameter grows	Compatible with a hardened nozzle

Rows come from Bambu Lab’s filament guide and nozzle clog page and Prusa’s Nextruder nozzle article. CF is carbon fiber, GF glass fiber; PLA is polylactic acid and PETG glycol-modified PET.

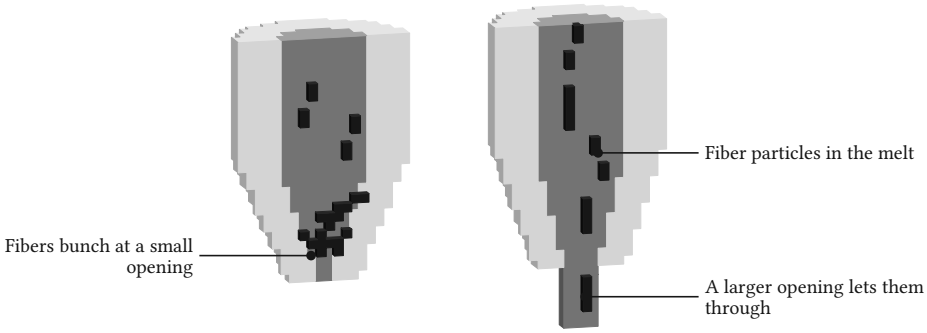


Figure 1. Particles in carbon- and glass-filled filament collect inside the nozzle, and the smaller the opening, the higher the clog risk.

1.4 How to fix a clog after abrasive filament and clear carbon fiber residue

1. **Clean it hot.** Before a fiber-filled print, Bambu Lab heats the nozzle to 280 °C and cleans out residue with an Allen key and a needle. It uses the same method when the nozzle clogs mid-print. The needle sizes are on the needle size page.
2. **Flush when changing to a softer filament.** After PAHT-CF or another high-temperature fiber filament, Bambu Lab sets the nozzle to 250 to 300 °C, unloads, loads the new filament and lets it push the residue out. It then drops to 220 to 240 °C while still extruding, until flow is clean.
3. **Cold pull.** Bambu Lab's X1 method loads PLA at 220 °C, cools the nozzle to 70 °C and pulls. Repeat until the tip comes out free of black specks. Full steps are on the cold pull page.
4. **Check the coating first.** For coated nozzles, Prusa advises against an acupuncture needle or brass brush, which can damage the coating. It also advises against cold pulls on ObXidian nozzles. Use cleaning filament inside instead.
5. **Replace it.** If these steps don't clear it, Bambu Lab's answer is a new nozzle.

1.5 How to check it on your own print

- **Add the offset.** After swapping brass for hardened steel, add 5 °C (Prusa) or 5 to 10 °C (Slice Engineering) and print a test part. If walls still look thin or gappy, slow the print before you raise the temperature again.
- **Stay inside the nozzle's limits.** E3D rates its hardened steel V6 nozzle to 500 °C but not for abrasive filament above 350 °C. Its brass V6 is rated to 300 °C.
- **Match nozzle to filament.** No 0.2 mm nozzle with CF or GF; start at 0.6 mm unless the filament maker says 0.4 mm.
- **Clean before and after fiber filament.** Prusa recommends a cold pull before printing composites. Bambu Lab recommends one at least monthly and whenever you switch filament types.
- **Dry the spool.** Bambu Lab lists nylon, PC (polycarbonate), CF and GF filaments as "especially sensitive" to moisture and prone to clogging when damp.
- **Still clogging at the right temperature and size?** Look at heat creep and the cooling fan next: what heat creep is and why a nozzle keeps clogging.

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