How to waterproof a 3D printed boat

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Abstract. Print the hull with 4 perimeters (2 in ASA), brush epoxy inside and out, grease the stuffing tube, seal the rudder and hatch, then float-test it overnight.

Keywords: waterproofing, watertight, petg, asa

1 How do you waterproof a 3D printed boat?

Seal it in two layers. Print the hull watertight: Prusa Research's tests needed 4 perimeters in PLA or PETG and 2 in ASA. Brush epoxy over the inside and outside. Then seal what a print cannot: grease the stuffing tube, seal the rudder linkage and tape or gasket the hatch. Float-test it overnight before fitting the electronics.

1.1 Where a printed RC boat leaks, and the fix

Table 1. Where a printed RC boat leaks, and the fix

Leak point	What to do	Source
Hull wall and layer seam	At least 4 perimeters in PLA or PETG, 2 in ASA; 105 to 110 percent flow; 0.15 mm layers	Prusa Research
Pores left in the print	One thin brushed epoxy coat inside and out, threads and mating faces masked first	Prusa Research, MarineLab3D
Propeller shaft stuffing tube	Marine grease on the flex shaft, which is the seal; regrease on a schedule	Pro Boat, Traxxas
Rudder linkage or rudder post	Silicone bellows over the pushrod; a rudder tube bonded into the hull with epoxy	Traxxas, Model Boats forum
Hatch or canopy	Clear marine tape over the joint, or a printed TPU gasket on the rim	Pro Boat, MarineLab3D
Screw and insert holes	Blind bosses that never break through the skin; PTFE paste on any thread that does	MarineLab3D
Water-cooling pickup and outlet	Ports fixed tight to the outside of the hull	Pro Boat
Joints between hull sections	Acetone weld for ASA, adhesive for PETG, clamped, then coated over	Prusa Research, MarineLab3D

Print settings come from Prusa Research's watertight tests. Drivetrain, hatch and cooling steps come from Pro Boat's Recoil 2 owner's manual and Traxxas's marine maintenance guide. Thread, coating and gasket rules come from MarineLab3D, a designer of printed boat fittings.

1.2 Hull waterproofing basics: print it tight, then coat it

In Prusa Research's leak tests, PLA (polylactic acid), PETG (glycol-modified PET) and nylon needed 4 perimeters to hold water. ASA (acrylonitrile styrene acrylate) and ABS (acrylonitrile butadiene styrene) needed 2. The full table is on how many walls make a print watertight.

Prusa found most parts fine at 4 to 6 perimeters, a wall 2 to 3 mm thick. It also recommends 0.15 mm layers, plus 105 to 110 percent flow where you cannot add perimeters.

Let perimeters make up the whole hull skin, with no infill. The Prusa Knowledge Base warns that walls thick enough to need infill leak into the voids between the inner and outer walls.

Then coat it. Prusa's closed PETG box leaked through its seams until an epoxy treatment gave it what Prusa called perfect watertightness. Brush a thin coat over the inside and the outside of the hull; the mix ratio and cure times are on sealing prints with epoxy.

Mask threads, the stuffing tube bore and the hatch rim before coating. MarineLab3D warns that epoxy in a thread ruins the fit.

1.3 How to waterproof the RC boat parts that pass through the hull

Stuffing tube. The prop shaft leaves the hull through a tube that no print setting can seal. Pro Boat's Recoil 2 manual says the marine grease on the flex shaft "also acts as a water seal, keeping water from entering the hull through the stuffing tube."

Pro Boat calls for flex shaft maintenance after every boating session, and drying and lubricating moving parts after every 30 minutes of running. Traxxas says to regrease its flex cable every three runs, or every 15 minutes or so on throttle. Keep grease off the first 20 mm (about 0.8 in) at the motor end. Pro Boat warns that grease there lets the shaft slip in the coupler.

Rudder. Traxxas seals the rudder linkage with a silicone bellows. Replace a bellows that cracks or splits, and rub silicone shock fluid into one that turns chalky.

A rudder post that comes up through the hull bottom runs in a tube instead. In a Model Boats magazine forum thread, a builder whose rudder tubes leaked where they met the hull glued them in with epoxy. Back in the test tank, the boat appeared leak free. Bond the stuffing tube into a printed hull the same way.

Hatch. Pro Boat's manual says to secure the canopy before launch, with clear marine tape over the joint as an option. Its troubleshooting table blames a hatch that is not fully closed when a boat takes on water. A printed hatch rim can carry a TPU (thermoplastic polyurethane) gasket; MarineLab3D recommends 95A TPU for hatches. The thickness and squeeze numbers are on the printed gasket page.

Screw and insert holes. Keep screw holes and heat-set insert bosses blind, so they never break through the hull skin. Where a thread has to cross the hull, MarineLab3D's default sealant for rough printed threads is non-hardening PTFE (polytetrafluoroethylene) paste. It warns that anaerobic thread sealants cure slowly or not at all on plastic without an activator.

Water cooling. A water-cooled motor adds a pickup and an outlet, both holes in the hull. Pro Boat warns that a loose exit port can let excess water into the hull.

Hull sections. A hull printed in sections adds glued joints for water to find. Prusa's gluing guide says ASA can be glued with acetone. PETG is inert to every chemical a hobbyist normally has, so join it with an adhesive such as two-part epoxy. Clamp it while it cures, then brush the epoxy coat over both faces of the joint.

1.4 Why the print alone is not enough

A print closes the wall. It cannot close a joint that moves or opens: the spinning shaft, the swinging rudder, the hatch you lift at every battery change. Bought boats leak at the same joints. Pro Boat calls its Recoil 2 highly water-resistant but "not completely waterproof", and tells owners to drain the hull after use.

1.5 Which filament for a printed boat hull

PLA is the risky choice. The Prusa Knowledge Base says it softens and deforms above 60 °C (140 °F) and degrades under UV light. In a 2014 study in Tempe, Arizona, sunlit dashboards in parked cars averaged 68.9 °C (156 °F). Pro Boat tells owners never to leave a boat in direct sun or a hot car.

Prusa rates PETG for exterior use below 80 °C (176 °F), and Bambu Lab's PETG Basic data sheet claims enhanced resistance to water, UV and temperature. ASA resists UV and heat up to 93 °C (199 °F), but Prusa advises an enclosure to stop it warping. MarineLab3D notes that unfilled epoxy chalks in sunlight, so give a coated hull that lives outdoors a UV-stable paint topcoat.

1.6 How to check it before the electronics go in

1. **Assemble the empty hull.** Leave the electronics out. Grease the shaft, fit the rudder and close the hatch as you would for a run.
2. **Lay a dry paper towel along the hull floor.** MarineLab3D's bench test uses a paper towel overnight, because a slow weep shows as a stain.
3. **Load it to its running waterline** with a waterproof weight in place of the battery, so the joints sit at running depth.
4. **Float it in a bathtub or sink overnight.** Prusa's pass for closed models was a dry interior after a night sunk in a bucket.
5. **Read the towel.** A wet patch under the stuffing tube points at its bond or its grease. A wet line at a section joint means the glue failed. Damp spread across the floor means the wall leaks: add perimeters or recoat.
6. **Run it in calm water first**, as Pro Boat advises for a maiden run. Keep it short, then open the hatch and look.

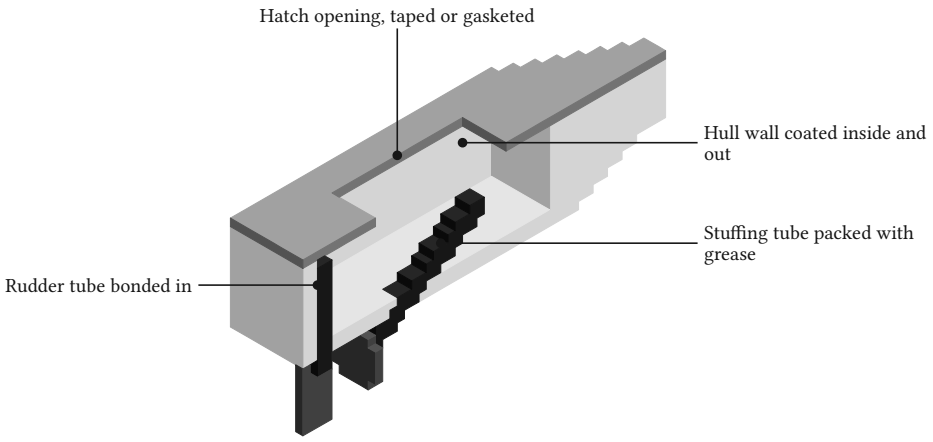


Figure 1. The printed wall is only one of the leak paths; the stuffing tube, the rudder tube and the hatch each need a seal of their own.

7. **Check after every run.** Drain and dry the inside of the hull, as both Pro Boat and Traxxas direct. Look for water around the stuffing tube and for cracked seals, regrease on schedule, and store the boat with its hatch removed. Pro Boat warns that trapped moisture grows mold and mildew.

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