TASK SHEET

Installing Hardware in Cored Composites

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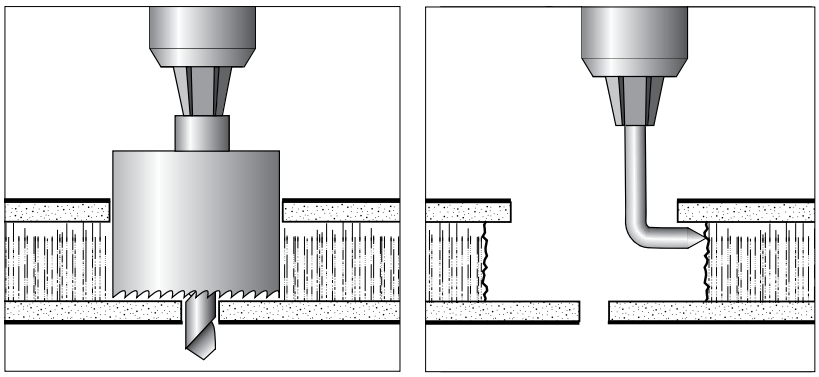
INTRODUCTION:

This guide is designed to assist you in the installation or replacement of fasteners, through-hulls, and hardware in cored-composite structures such as hulls, decks, and cabins. Commonly installed parts and components include cleats, ports, windows, hatches, stanchions, antennas, through-hull fittings, and transducers, to name a few. Whatever you're installing, for any penetration drilled or cut into a cored-composite structure, you should follow the basic procedures below.

First, let's recall that the purpose of core is to add lightweight rigidity to the thin and flexible (inner and outer) fiberglass skins. When built correctly and subsequently treated well by the boat's owner and service yard, cored marine composites are immensely strong, comparatively light, reliable, and stiffer than solid skins of equal weight. Set boat owners straight about the pros and cons of cored construction by summing up its complex virtues—lightweight, stiff, strong—and its two primary weaknesses—water intrusion and point loading/compression.

If water enters the core, it can lead to deterioration, delamination, freeze damage, and an undeniable decrease in vessel value. There's nothing a seller wants to hear less than the wail of a surveyor's moisture meter. Wet core will wreak havoc with the weight and the structural integrity of the hull or deck, the boat owner's confidence and budget, as well as the reputation of the boatbuilder and the service yard or aftermarket equipment installer.

The cause of most water intrusion is improper hardware installation. If a cored composite is point-loaded by clamping action from a through-bolted fastener or plumbing component such as a seacock and through-hull, the core can easily be compressed or crushed, which has two side effects: it weakens the structure in the immediate area, often where strength is needed most; and if it's on a horizontal surface such as a deck or cabintop, it creates a depression where water can pool. Standing water at a deck penetration is a recipe for disaster; that includes a simple screw or bolt, where sealant alone is relied upon to exclude water's entry into the core.



Left—*With a holesaw, first remove the outer skin and core (but not the inner laminate) around the planned hardware installation.* ***Right—****Next, take out more core between the skins using a router, or an Allen wrench or bent nail chucked in a drill (shown here).*

For many new builds, hardware installations are taken into account during lamination, so all their penetrations are in strategically located sections of high-density non-water-absorbing core or core closeouts to thick single-skin solid laminate. When those protocols are followed, it is difficult if not impossible for water to enter a cored structure, but any cored marine composite that relies solely on polyurethane, polysulfide, or another type sealant as the barrier between water and a porous core has a poor long-term outlook; water is almost sure to intrude.

Even well-built boats are vulnerable to faulty aftermarket, boat yard, or dealer hardware installations. For those, the core must be locally removed and backfilled with a thickened epoxy mixture (often referred to as reefing and backfilling), forming an impenetrable barrier to moisture, one that won't decay over time like caulk and is structurally resistant to crushing from fastener-induced compression. That's the procedure I'll address in this guide.

REQUIRED TOOLS:

- common hand tools
- drill and bits
- holesaw or reciprocating saw
- eye protection
- rubber gloves
- shop vacuum

PARTS:

- hardware/part to be installed
- fasteners
- backing blocks where necessary (GPO-3, G10, aluminum, or stainless steel)

MATERIALS:

- polyurethane, polysulfide, or silicone sealant
- Marine epoxy and high-density silica-based filler (or an equivalent pre-thickened nonsagging structural epoxy)
- denatured alcohol
- mineral spirits
- clean, rinsed cotton rags
- plastic sheet for vessel protection
- masking tape

NOTE: This is not a substitute for following all applicable manufacturer and ABYC guidelines, as well as recognized marine industry best practices.

PROCEDURE:

1. Thoroughly clean the hardware installation area with detergent and water, dry it, and then clean with a solvent such as denatured alcohol. If you are reinstalling existing hardware, remove it and inspect any visible core for signs of deterioration or moisture. For new installations, use the hardware as a template, and mark the location of penetrations, checking the opposite side of the planned penetration for proper clearance. If it's in a deck or a cabin side or top, spread a drop cloth or other protection inside to catch dust and epoxy.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2. Drill a pilot hole through the full cored laminate for the fastener or hardware penetration. These holes should not be any larger than the pilot bit for the holesaw you will use. (For smaller fasteners, you may require only a larger drill instead of a holesaw.)

3. Then, with a holesaw or larger drill bit, drill only the outer skin and core roughly two to three times the diameter of the hardware or fastener to be installed. For example, for a ¼″-diameter (6mm) fastener installation, the outer skin and core should be drilled to ½″ to ¾″ (13mm to 19mm). For larger flanged hardware such as through-hull fittings, ideally the hole should not exceed the outside diameter of the portion of the fitting that will pass through the hull. For more highly loaded underwater hardware—struts and shaftlogs—a larger area may need to be decored, closed out, and reinforced as thick single-skin laminate.

4. If you are cutting rather than drilling, for a port or window frame for instance, the procedure is similar, although inner and outer skins should be cut evenly.

5. Remove the core surrounding the hole about ½″ to ¾″ outward from the perimeter. You can do this with a die grinder, Dremel tool, router bit, or an Allen wrench or bent nail chucked into a drill (I prefer the router bit). When removal is complete, vacuum out the loose material. If the installation includes a central hole and then fasteners for a trim ring, the fasteners supporting the trim pieces should land within the reefing or removal of core. If they don't, each of those holes must be treated to the same process individually.

6. Apply two layers of masking tape to the pilot hole on the inside skin to keep epoxy from dripping through. Apply more tape around the outside of the hole to protect from epoxy spills.


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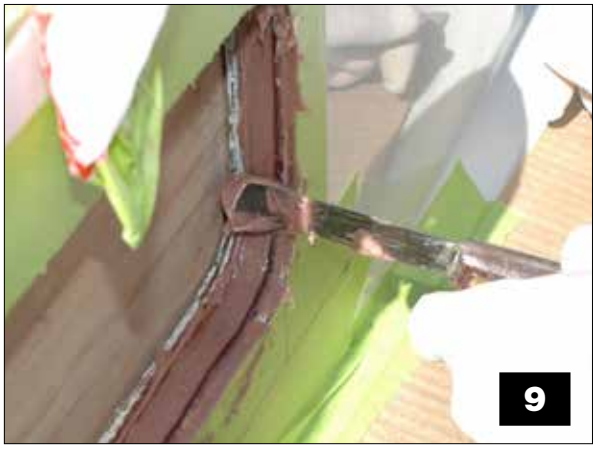
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7. Mix a marine epoxy with an appropriate high-density thickening agent to the consistency of mayonnaise (I use WEST System epoxy with 404 or 406 filler). Or mix a pre-thickened nonsagging epoxy and hardener (like System 3 GelMagic).

8. To get the epoxy into the hole, pour it, push it with a mixing stick, or for deeper holes, inject it from a syringe from the bottom up, and then skim it flush with the surface.

9. For installations on vertical surfaces you may need more thickener to keep the epoxy from running out of the upper edges. Remove the tape before the epoxy cures.

10. When the epoxy has cured, wipe it with a damp rag to remove amines (do not use solvent, as amine is water soluble). Place the hardware on the surface and mark the perimeter and hole locations. A perimeter of masking tape around the hardware footprint will simplify caulk cleanup.

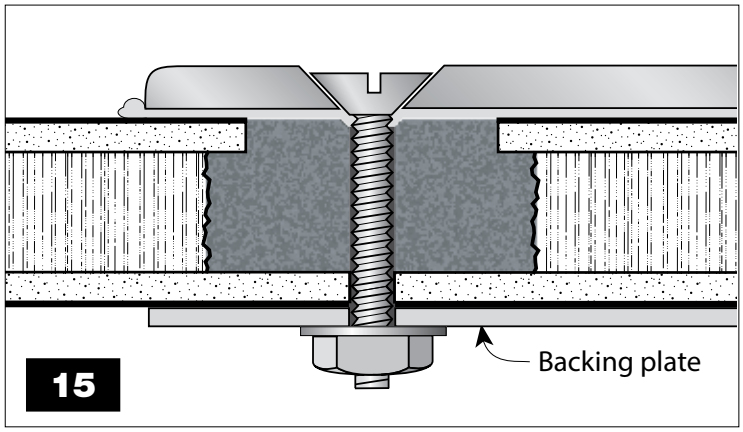
11. Drill the holes for the fasteners. These should be a snug but not tight fit; the fastener should move easily through the hole. The edges of each hole should be chamfered so it will retain sealant in an O-ring-like profile. This can be done with a file or countersink bit. Then dry-fit the hardware to ensure that all holes are aligned.

12. Thoroughly clean the hardware base and fasteners to remove all traces of oil and wax. This is critical. Use clean cotton rags that have been rinsed in clean, fresh water and allowed to fully dry; doing so removes traces of detergents, laundry scents, surfactants, and other possible contaminants. Wet the rag with mineral spirits or denatured alcohol for the cleaning process. The rag will almost certainly begin to turn black as it removes contaminants from metallic surfaces. Use another rag if the first one gets soiled. Remember to clean the shanks and underside of bolt heads, and anywhere sealant will be applied.

13. With 120- or 220-grit sandpaper, thoroughly sand the deck or any other area, including the hardware surface where the sealant will be applied. This will create a “tooth,” or rough surface, to which the sealant can more effectively adhere. After sanding, wipe down the surfaces again with a clean rag and solvent. Once these surfaces are clean, avoid touching them with your hands.

14. Apply sealant to the underside of the hardware, the fastener shanks, and the underside of fastener heads. Use enough to ensure that no voids remain and that sealant will squeeze out around the full perimeter of the hardware base, thus preventing water from migrating under it.

15. Assisted by a helper, install nuts on the backside of the installation (the cabin overhead, for instance). Use a backing plate or block if necessary. It can be made from stainless steel, aluminum, GPO-3, or G10. Under no circumstance should the inside fasteners or backing plate/block be bedded, as doing so will only trap water in the fastener bores when it leaks past the outside bedding. The trapped water can lead to fastener corrosion, as well as test the integrity of the closeout epoxy donut.



16. Fully torque the fasteners now. There are two reasons for this. One: waiting for sealant to cure to create a "gasket" is risky because it takes time, and if it is forgotten, the hardware will go into service with loose fasteners. Two: conventional polyurethane, polysulfide, or silicone sealant is not designed to serve as a field-made gasket. If the hardware is heavily torqued later, in the case of a chainplate, stanchion, cleat, etc., it is likely that cured sealant will split and be forced out from under the hardware flange.

About the Author: *For many years a full-service yard manager, Steve now works with boat builders and owners and others in the industry as Steve D'Antonio Marine Consulting. He is an ABYC-certified Master Technician and sits on that organization's Engine and Powertrain, Electrical, and Hull Piping Project Technical Committees. He is also technical editor of* Professional BoatBuilder.