A seacock and its backing block are best fitted dry first, to ensure a tight installation. Note the ground-away gelcoat; a bare surface offers superior epoxy adhesion once the block is permanently installed.

Seacocks

We review the design, selection, and fail-safe installation of these critical—but frequently overlooked—marine fittings.

Text and photographs by Steve D'Antonio

It's a sight no boat owner or builder ever imagines he or she will see, except perhaps in a nightmare: a 1″ (25mm) column of water filling the cabin from a failed through-hull fitting. If that hardware failure were located 3′ (0.9m) below the waterline, it would flood a hull with approximately 34 gallons (129 liters) per minute, or *2,000* gallons (7,570 l) per hour. That's more than most bilge pumps or even the proverbial "scared man with a bucket" can handle. Bilge pump capacities are typically rated as though the pump were at the waterline and operating on 13.8V—an unlikely scenario unless the engine or generator is running.

That alarming flood rate through a failed through-hull/seacock underscores the need for all below-the-waterline, or BTW, fittings to be well engineered, "Marine UL" approved, and properly installed.

The UL label alone, however, is no guarantee that the approved components are correctly installed or appropriate for the specific use. The American Boat & Yacht Council's "Standards and Technical Information Reports for Small Craft," section H27, states, "All piping, tubing, or hose lines penetrating the hull *below the maximum heeled waterline*, under all normal conditions of trim and heel, shall be equipped with a seacock to stop the admission of water in the event of failure of pipes, tubing, or hose…." (Italics are mine.)

There are a few exceptions to this rule: cockpit drains that exit the hull above the resting waterline; and most engine/generator exhaust configurations. Even so, what's worrisome is that builders, repair yards, and do-it-yourself owners frequently ignore the guideline, reasoning that if the through-hull is above the resting waterline, no seacock is required.

Note that "the maximum heeled waterline" on a sailing vessel is the level of the water on the hull when it is inclined such that *the sheer is awash amidships*. According to the ABYC standard, hull penetrations that are wet at this angle of heel require seacocks.

For power vessels, the guideline covers all hull penetrations that would be submerged if the vessel were to heel 7°.

Those ABYC strictures leave little doubt where seacocks are required. But there's more to a good seacock installation than compliance with this recommendation. To be considered secure, reliable, and functional, seacocks must meet several material and installation parameters.

Let's review them in detail.

In addition to lacking a seacock, this waterline-mounted through-hull is far too long to be secure. A misplaced foot, or loose dunnage, could easily cause its failure. The preferred setup would involve less hard-plumbing directly attached to the fitting.

Accessibility

If I could give one piece of advice to anyone preparing for an offshore passage, it would be this: *Know where every seacock is aboard your vessel; make sure each one of them works and can be operated by any crew member; and be able to access all of them without the benefit of tools—with your eyes closed.*

If that sounds alarmist or extreme, consider again the figures in the flooding scenario related earlier. When you're locating a seacock during installation, *always* ask yourself whether the vessel owner/operator will be able to find and access it quickly and easily.

A vessel's owner/operator must be intimately familiar with the location of all skin penetrations; and, as the builder or installer, it's incumbent upon you to share this information, either by demonstration for a single through-hull, or by providing a diagram for multiple installations.

If a boat is flooding, chances are good the failed component may already be underwater, and locating it, or a seacock that will stem the flow, may be an entirely tactile exercise. If the batteries or critical electrical components are submerged, the crew may also be doing this literally in the dark.

A few years ago, a vessel I know of nearly sank during a Caribbean passage because of a long-forgotten, disconnected icebox drain that exited the hull *above the static waterline*. During an extended tack, however, this hole was submerged 2′ (0.6m) underwater, admitting hundreds of gallons of water per hour. The bilge pump eventually failed (most likely clogged by flushed bilge debris), flooding ensued, the batteries submerged, unsecured sole panels floated out of position, and pandemonium reigned below. The crew was unaware of this penetration or its location and was unable to stem the rising tide for several hours, and so the boat was nearly lost.

Equal in importance to knowing seacock locations is being able to easily and quickly get to them without the benefit of tools. Burying a seacock in the bilge, beneath a hatch that's been screwed in place, on top of which are 300 lbs (136 kg) of house batteries; or, locating seacocks under a V-berth shelf in a bilge requiring the owners (a husband and wife in their 60s) to shimmy into place to reach those seacocks, like soldiers crawling under barbed wire, are scenarios—both of which I can attest to—that should be avoided at all costs.

Locate seacocks only in lockers or compartments that are easily opened without a socket wrench, screwdriver, or other tools. In the first case cited above, an access hatch was cut into the battery shelf, making actuation possible. In the latter case, remote rod handles were fabricated to facilitate closing the seacocks.

They may look similar, but brass and bronze are not interchangeable, especially in below-the-waterline applications. Owing to its high zinc content, brass often corrodes, in the process known as dezincification.

Materials

Even the most easily accessible seacock is of little use if it's immobilized by corrosion, or if it breaks when actuated because it's constructed from an inappropriate material. Silicon bronze and leaded red brass make good seacocks.

The latter, sometimes referred to as "85-5-5-5" due to its constituent alloys of 85% copper, 5% zinc, 5% lead, and 5% silicon, should not be confused with ordinary brass, whose zinc content is much higher. High-zinc-content alloys, such as ordinary brass, naval brass, or Tobin bronze, must *never* be used for seacocks or any raw or BTW plumbing. This prohibition includes even the smallest seacock or raw-water strainer drain plugs, which are often inadvertently replaced with brass rather than bronze hardware.

Approved composite materials include glass-reinforced, UV-inhibited nylon such as acetyl and polybutylene terephthalate. Marelon, manufactured by Forespar (Rancho Santa Margarita, California), is an example of an excellent non-metallic, UL-approved material for BTW seacocks. All approved seacocks and through-hull fittings, metallic or composite, should carry the UL approval number 1121 or 618C, for "Marine Through-Hull Fittings and Sea-Valves."

Unsuitable materials include high-zinc-content brasses and stainless steel, the latter being susceptible to crevice corrosion when installed below the waterline. Chrome-plated brass, which has a silver appearance and is often mistaken for stainless steel, suffers from the same failings as ordinary brass and must never be used for seacock, raw-water, or through-hull applications. Plastics such as PVC (regardless of schedule), and other non-reinforced, non-UV-inhibited, non-metallic materials, while fine for domestic plumbing

Left—*This through-hull fitting cracked because of excessive stress from improper installation where the inner and outer hull surfaces were not parallel, and the bulk of the load was placed on only a small portion of the flange.* ***Below left***—*It's critical that brass not be substituted for bronze when replacing drain plugs. Proper bronze replacements can often be obtained from seacock and strainer manufacturers.*
Below middle—*Only a few glass-reinforced plastics, like Marelon, are UL-approved as seacocks.* ***Below right***—*What you don't want to see in your bilge is this sort of mess: a through-hull and in-lineball valve where a seacock should be, plus polyethylene plumbing designed for a potable rather than raw-water system. The profusion of unions only makes matters worse.*

and non–overboard discharge sanitation plumbing, have no place beneath the waterline.

Design

Until a decade or so ago, seacock design had remained unchanged for a generation or more. The traditional cone-valve seacock served, and continues to ably serve, thousands of vessels, although the design suffers from seizure problems if not exercised and lubricated regularly.

If regularly disassembled, cleaned with solvent, lubricated, and lapped or sanded when necessary, then cone-style seacocks are exceptionally long lived. I've seen 50-year-old examples that were operational and relatively leak free. Recently, these traditional seacocks have been supplanted by ball-valve seacocks. Consisting of hard chrome-plated balls, which ride on Teflon seats, such valves have the advantage of being self-lubricating. While not as easily serviced or disassembled as tapered-cone valves, ball-valve seacocks rarely require attention.

To gain Underwriters Laboratories and ABYC approvals, a seacock must have a lever that arcs through 90° of travel to open and close the valve. This makes operation quick and easy, and clearly shows, from a distance, whether the valve is open or closed.

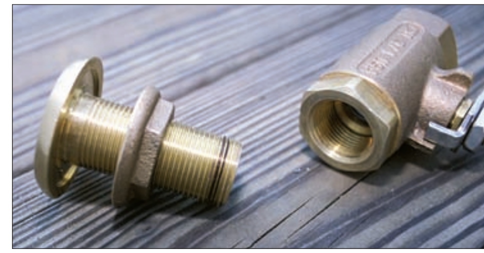
That prerequisite alone (there are additional reasons) disqualifies the familiar domestic plumbing gate valve. Fortunately, few, if any, are available in a size that might be installed aboard small craft, or are designed for application in seawater. Fitted with a round handle that requires several full rotations to ensure that it's fully opened or closed, the gate valve is inconvenient and slow, and is not suited for service in the highly corrosive marine environment. Also, materials in many of these valves are galvanically incompatible and often include zinc-laden-brass valve stems. Operationally, the gates themselves may become inoperable due to fouling by barnacles and other hard marine growth. In short, *gate valves must never be used as seacocks.*

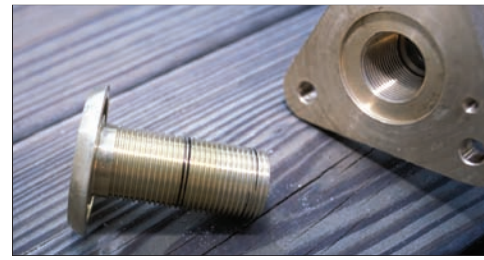
Other desirable seacock attributes include a generous, load-bearing base flange, non-rusting handle and stem (typically bronze or stainless), a bonding fastener threaded into the body of the seacock, and a winterizing drain plug that drains the ball void when it's in the closed position. If allowed to freeze, water trapped within this closed ball will shatter the valve body, though the damage may not be apparent until the vessel is launched or the ice thaws.

Finally, and perhaps most importantly, don't confuse an in-line ball valve with a proper seacock. In-line ball valves lack the load-distributing flange of true seacocks. They may be UL-approved "Valves," but not for use as seacocks, and thus they are not designated as "Sea Valves."

In addition to their lack of flanges, in-line ball valves are machined with tapered, or NPT, threads, while proper seacocks have straight, or NPS, threads. The latter allow full engagement of the like-threaded, through-hull fitting, with as many as eight or 10 threads bearing. The tapered threads of an in-line ball valve will engage as few as two of the straight through-hull threads it is inappropriately married to.

Installing an in-line ball valve in place of a seacock is among the most common errors in through-hull installations I've witnessed during 20 years in the marine industry.





Right—*A poor fit between the tapered threads of an inline ball valve and the straight threads of a through-hull fitting is evidenced by the black line, which marks the full extent of their interface.* ***Bottom right—****A through-hull mated to a seacock, with matching straight threads. The result is greater contact and, therefore, strength.*

Far left—*There's no substitute for a properly installed, flanged seacock to distribute load evenly over a large area. Note the bronze lag screws.* ***Left—****Gate valves, like this one bleeding rust aboard a new boat, have no place in raw-water or below-the-waterline applications.* ***Below—****Not every UL-approved valve is a "UL Listed Sea Valve." It doesn't mean all valves lacking this designation are inferior; rather, those that do carry it can be relied on to meet stringent standards for seacock design and manufacture.*

Installation

Sound seacock and through-hull installation cannot be overemphasized: the watertight integrity of a vessel depends on these components. Properly selected materials *improperly* installed can deceive the installer and operator into a false sense of security.

My preferred installation approach is as follows:

For a new seacock in a solid, uncored hull, select a location and drill a ⅛″ (3mm) pilot hole. After confirming that the location is correct, drill with a holesaw as close to the through-hull fitting's outside diameter as possible for a snug fit. A 1½″ hole for a 1″ through-hull fitting is oversized; a 1⅛″ hole for the same through-hull would be fine.

Replacing an existing seacock with a like unit requires no hole drilling—provided, of course, the existing hole is correctly sized. The old through-hull and seacock, however, must be removed, a task that presents its own challenges. If the through-hull and seacock cannot be easily separated, then grind off the through-hull's external flange with a 36-grit sanding disc. (Heavily masking the area around the through-hull will afford a margin for error.) Once the flange is gone, the seacock can be removed from inside the vessel.

The backing block—an essential component for any seacock installation on a glass or wood hull—should be made from ½″ (19mm) AA marine fir plywood or prefabricated fiberglass sheet; the latter is commonly referred to as GPO3. Because high-density polyethylene is slippery and seals poorly, do *not* employ it as a backing block. Also, solid grown wood, regardless of species, should *never* be used as a seacock backing block, because it tends to fracture under load, especially against irregular surfaces such as the inside of a fiberglass hull.

A well-glassed-in backing plate provides the correct support for a seacock installation. Hard-plumbing fittings that attach directly to seacocks should be limited to a pipe-to-hose, or PTH, adapter; or a 90° fitting and PTH.

The size of the backing block should be proportionate to the size of the seacock base. In general, a round backing block with a minimum 1″ to 1½″ (25mm to 38mm) between the

Far left, top—*Hardware surfaces should be free of all dirt, debris, grease, oil, and wax before sealant is applied. Clean them with denatured alcohol or another suitable solvent.* ***Far left, bottom—****Apply sealant as shown, taking care that none will flow into the valve when the through-hull and seacock are mated.* ***Left—****Be sure to remove antifouling paint where sealant will be applied.* ***Above—****A proprietary through-hull tool makes screwing the through-hull fitting into the seacock easier, and ensures proper torque. Sealant squeeze-out all around signifies that no gaps or water paths exist.*

outside perimeter and the seacock base is appropriate. A seacock with a 4″ (102mm) base would require a 6″ to 7″ (152mm to 177mm) backing block.

With the backing block as a template, thoroughly clean the area beneath and for several inches outward around it, with acetone or denatured alcohol. Remove all traces of oil or grease. Grind or sand this area until *all* paint and gelcoat have been removed. Next, mush the backing block into thickened epoxy with the temporarily installed through-hull fitting to ensure that the hole remains perpendicular to the hull. Wax the fitting with mold release wax to prevent it from sticking in the hole once the epoxy cures.

After the epoxy has kicked, remove the through-hull and, to the prepared area over and around the backing block, apply two or three layers of 1.5-oz (450-g/m^2) fiberglass mat saturated with vinyl ester resin. You can glass over the hole and re-drill it once the resin has cured.

After drilling and re-exposing the through-hull hole, liberally coat the edges of the plywood with epoxy. Once the resin is fully cured, it can be lightly sanded and coated with gelcoat, if cosmetics require it. If the area is to be painted rather than gelcoated, then wait until after the seacock installation has been completed, since bedding material may not adhere well to paint.

The seacock is now ready for its dry fit. Measure the available threads within the seacock body. Have a helper outside the hull hold the fitting through the hole into the boat, where the visible threads can be viewed and measured. For this exercise, remove and save the nut that comes with the through-hull. The visible threads should engage nearly all the available threads in the seacock. If the through-hull has too many threads, it's too long and must be trimmed.

To trim, mark where to cut, then wind on the nut you removed in the step above. Clamp the fitting in a vise by the end that's to be cut off, making as straight a cut as possible with a hacksaw. Unscrew the nut from the remaining portion; it will act as a thread chase, removing burrs and irregularities.

Be sure the through-hull does *not* bottom out in the seacock's threads. Instead, see to it that the through-hull is two or three threads (or approximately ¼″/6mm) shorter than the available threads within the seacock.

Now, with an assistant and the trimmed through-hull fitting, dry-fit the assembly again. If the fit is good, then remove the components, and with acetone or denatured alcohol, proceed to clean the hardware and the backing block and prepared hull surfaces around the hole. (As a general rule, hardware and bedding surfaces should be thoroughly cleaned, degreased, and dewaxed with acetone or denatured alcohol to ensure proper adhesion of the bedding material.)

Starting two or three threads from the un-flanged end of the through-hull, liberally coat the threads with an approved marine *polyurethane* bedding compound. Do the same for the through-hull and seacock flanges.

With the helper and a through-hull holding tool (the latter is available for specific brands of through-hulls, or can be shop-made from flat steel or aluminum stock), assemble the two components, ensuring good sealant squeeze-out around bedding surfaces inside and outside the hull.

Caution: Do not clean excess sealant with alcohol; it will inhibit the cure cycle of many polyurethane-based sealants.

Finally, drill pilot holes, then bed and install 1″ (25mm) bronze lag bolts in the seacock flange. Because the backing block is ¾″ (19mm) thick, and the seacock flange is typically at least ¼″ (6mm) thick, there's no danger of the bolts passing through the hull. As an acceptable alternative, some installers prefer through-fastened carriage bolts, provided they're made of bronze and well bedded. The primary purpose of *lag* bolts is to prevent the seacock from spinning on the through-hull in the event it's struck by an object such as a toolbox, anchor, or battery sliding around in the bilge.

The American Boat & Yacht Council's H27 guideline calls for a seacock installation that will "withstand a 500-pound [226.8-kg] static force applied for 30 seconds to the inboard end of its connecting fitting, at any point in its most vulnerable direction…." The installation described above will meet this standard. Assuming you weigh less than 500 lbs, you should be able to stand on any seacock or below-the-waterline plumbing installation without fear of its failure.

An alternative to the method described above, sometimes favored by professionals faced with space limitations in existing installations, is to exclude the fiberglass mat. It will result in an acceptable and less costly installation—but one that is also less robust. With that alternative, in order to prevent water absorption in the absence of fiberglass mat and resin, the backing block must be fully encapsulated in epoxy resin.

A final note on seacocks and

If your seacock installations are too fragile to survive the "stand on it" test, then you should revisit the design, or the installation method, or both. Remember, ABYC guidelines are tougher still; those call for fittings to withstand 500 lbs (227 kg) of direct force for 30 seconds.

In this completed "aftermarket" seacock installation, the backing block is fully encapsulated in epoxy, and where the block adheres to the hull, all gelcoat has been removed. However, the bonding wire here is incorrect: it is solid, rather than stranded material, and was later replaced with stranded tinned cable.

through-hulls: avoid adding hardware and leverage to installations by making what I call a *seacock tree*. That is, once the seacock is installed, the only additional piece of hardware that should be directly attached to it is a straight or 90° pipe-to-hose adapter, or hose barb. Then, attach a length of the appropriate type of hose, such as SAE J2006 wet exhaust hose, securing it with all-stainless, non-perforated hose clamps.

Do not attach any additional plumbing components, T's, Y's, strainers, or nipples directly to the seacock, because they will only add leverage to the installation, increasing the probability of failure under stress.

A seacock properly designed, made, and installed should provide years of reliable service. Ensure that seacocks you install meet the above recommendations. That way, you and the vessel's owners/operators won't have to give them a second thought. PBB

About the Author: *A former full-service yard manager and longtime technical writer, the author now works with boat builders, owners, and others in the marine industry as "Steve D'Antonio Marine Consulting LLC." His book on marine systems will be published by McGraw-Hill/International Marine this fall.*