Maintenance and Troubleshooting

Dealing With Leaks

This article deals primarily with sailboat leak problems. However, the principles and methods discussed here apply equally well to power boats.

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In printed format, this article is 7 pages long.

There is no point in doing anything on a boat unless you take the time to do it right. -- Anonymous

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It's a fact of life that boats leak. It's also true that as boats age, leaks tend to increase for the simple reason that sailing yachts are under a lot of stress. And in these times when builders emphasize speed and lightweight, the problems with leaks worsen since laminates are not as thick nor are hulls as rigid as they used to be.

Leaks are not only inconvenient and aggravating, but also cause damage to personal gear and the boat itself. The source of leaks are usually hard to find and even harder to stop. The typical case is where the water enters at point A, but shows up at point B, which is six feet away from point A. The owner spends weeks attempting to search out the source so that he can repair it. These are usually instances where inner liners work to distribute the leaks to points far from the source of entry, and are often the subject of many wry jokes.

As an aside here, I want to mention something that I see very frequently that is just a waste of time and makes a mess of things. That is the way some people try to take the easy way out by just smearing some caulking on the outside of an open seam. On boats, to make an effective seal, the caulk has to go between the two parts that are mated, and this is called bedding. Achieving this is not easy, but it is the only way to effectively stop leaks. Moreover, with the way many boats are hurriedly built today, parts are often never bedded properly from the beginning. If that is the case, then you have to go back and do what the builder did not do correctly.

Of course, the granddaddy of all leaks is the leaky hull-to-deck join, which is usually the most difficult of all to repair. I've seen numerous boats where the deck joint leaks so bad that either the boat is uninhabitable, or the boat has become severely damaged as a result of rotting internal plywood structures, wet bedding and the like. Vee berths in both power and sail boats are often a victim of this problem, where you end up with both rotting mattresses and structures. Ouch! This gets expensive.

In many instances, the manner in which the deck is joined is such that effecting an economical repair is near impossible, or that the leakage is so pervasive -- meaning that the deck join is leaking everywhere -- that the deck needs to be removed and reinstalled anew, which also means that it's likely to be more economical to get rid of the boat and buy another one, than it is to attempt to repair it.

For these reasons, when considering the purchase of any used boat, it is of paramount importance to check the boat over for leaking deck joints; this is not a problem that anyone should buy into. Leaking deck joins are most intractable when associated with working hull structures. Not all boats are as rigid as they should be, and if the rigging is causing compression loading, both fore and aft, as well as transversely, then attempting to repair leaking deck joins may be an exercise in futility.

Checking a boat for leaks is fairly easy. Just start opening things up and looking. The usual indicators are, aside from the plainly obvious, are numerous rust stains where canned goods were stored, rusty tools and mattresses wet on the undersides. If not wet, look for stains on the hard berth surface. Check out any place on the interior of the hull sides where you may be able to see water trails or heavy amounts of mildew. Water stains on headliners, discolored cabin soles, damaged paneling, water puddles or water lines under berths or other places that trap water. The number of indicators is nearly endless.

It's a mistake to think that repairing leaks is a relatively minor problem that can be done at low cost. Yes, repairing a leak is usually a simple matter, but the fact is that there is often no access to the area that needs repair, so that to make the repair requires tearing out a part of the interior. Such is often the case with chain plates and other deck hardware.

Chain Plates As any experienced sailor knows, the most common source of leakage is at the shroud chainplates where they pass through the deck. Because of the frequent loading/unloading that occurs at these points, it is very difficult to keep them sealed, and on some boats it is a constant battle. However, if the shroud chain plates are attached to plywood bulkheads, it is critical that the leaks be stopped and the wood protected. Due to poor design, for many boats it is impossible to keep the chain plates sealed completely, but there are things one can do to reduce the leakage and keep the plywood from rotting.

One of the most common mistakes that boat owners make is to caulk these points with the wrong material, most often polysulphides or silicone based caulks. These materials will not do the job because they have poor adhesive qualities. To create a strong, long lasting seal at a chain plate that is subject to working, one needs a strong, resilient adhesive. Such as the dreaded 3M 5200. Boat owners frequently tell me that they hate using the stuff because it's messy, and because once applied, it's very difficult to remove or detach parts bedded with it. But that is precisely why it should be used; 5200 is one of the strongest adhesives available and adheres very well to metals and nearly all other materials other than some vinyls and polypropylenes. Polysulphide "sealers" are not good adhesives and silicone is not an adhesive at all. It's primary means of adhesion is suction. That's why you can glue glass together with it, but nothing else, for only glass will yield a perfect suction surface. If you ever wondered how they can glue aquariums together with silicone, that's the reason why.

> **5200 is like working with tar. It has a way of getting all over everything, no matter how hard you try to be careful. That's one of the reasons it's so good; it sticks to anything and everything. When working with the stuff, you should have plenty of rags and a quart of acetone handy. Once you've used a rag to wipe up excess, get rid of that rag as that rag will transfer 5200 to everything it comes in contact with, including you. It's a real tarbaby. Clean your hands the moment you get some on them, otherwise your fingers will transfer it to whatever you touch. You won't notice this at first, but weeks later dirty finger prints will start showing up all over, and they do not wipe off. Once it's cured, 5200 is no longer soluable with anything.**

If your bedding or caulking material does not adhere to a part, though it may appear to cling closely, what we end up with is a minute crevice between caulk and the mating surface. In turn, this crevice becomes a capillary that is capable

of transporting water in amazing quantities through a crevice so small that it may not even be visible.

Therefore, one of the best ways of sealing up leaky chain plates at the point where they pass through the deck is to thoroughly clean the fiberglass surfaces, preferably with something like a Dremmel tool with grinder bit to get a good bonding surface. Don't waste you time trying to caulk over a dirt laden surface, you efforts to seal will fail. Plus you must be sure that there is no waxy or oily residue. Thus, it's best to sand or grind all surfaces to be bonded.

Often times the width or length of the rectangular hole is too large to be able to fill it in adequately. If that's the case, you can glue in appropriately sized filler strips with 5200 so as to reduce the gap between the chain plate and deck. Once the 5200 has cured, then you can come back and apply the final bead of caulk, and bed down the rectangular flange plate if there is one. Because of the strength and durability of 5200, this method should last for many years assuming that there is not excessive structural movement involved.

If the chainplate is attached to a plywood bulkhead, it's a good idea to treat the area to prevent deterioration. A successful method I have used is to unbolt the plate, grind down the surface to get it good and rough, and then coat the area and bolt holes with epoxy. This will help shed water and greatly reduce the potential for rot if the attempts at sealing the leaks are not successful.

Stanchion Bases and Other Hardware The next most common source of leakage are those pesky lifeline stanchions. These stanchions are subject to an incredible amount of stress, so that over time even the best installations will begin to leak. However, I see far too many boats where the basic design of the base is poor. The foot print of the base is often so small that it has little or no chance of providing a stable attachment. If that's the case, the only option is to change them out, if possible.

Properly repairing leaking stanchions often becomes a nightmare job because the boat builder has provided no access from the underside. If you can reach the under side, the job is fairly easy. First, the bases should be removed entirely. Check to see that the bolt holes are properly sized to the bolts. If the holes are oversized, a rigid attachment cannot be obtained. Correct this by completely filling the holes with epoxy and milled fibers; then redrill the holes (using a drill guide) to their proper size. Lightly sand the outer surface to remove dirt and mold release compound that may still be present. If the base did not have a back up plate, you should add one, space permitting. Aluminum or a blank of scrap laminate will work fine. Use the stanchion base as a pattern to drill the holes. Don't use plywood with nuts and washers as these will crush the plywood and permit loosening.

Again, the material to use for bedding stanchion bases is 5200. Both the stanchion base and the back up plate on the underside should be thoroughly bedded as this will create a double seal. When pushing the bolts down through the holes, and while the head is standing proud about 1/4", make sure that there is bedding under the head. If not, add some.

Deck Drainage I don't know what it is about sail boat designers, but they seem to have a superb knack of overlooking deck drainage. As I make my rounds through marinas and boat yards, it's amazing the number of boats I see with water standing on the decks. When hardware is present, leaks are sure to follow, which are also a serious hazard to cored decks. One way or another, you have to find a way to provide adequate drainage, whether by notching the rail or installing a scupper.

Ports, Windows and Hatches These tend to develop leaks because the structures to which they are attached are not completely rigid and are subject to movement, thus breaking the bedding seals. This is often the case with port holes in the sides of cabin trunks. Jumping on the deck near them results in flexing that breaks the seal. Many boat owners just smear some caulking around the exterior seam. All this will do is create an unsightly mess, but will not stop leaks.

The bedding seals in port holes break loose because a non adhesive bedding compound was used to set them, usually because the ports are plastic. The common reasoning for this runs, "Well, these parts are plastic and if I use 5200 they will never come off without breaking. Therefore, I will use polysulphide or silicone." That is true, but what you've now got is leaks, so it's your choice between leaks and costly interior damage, and parts that come off easily. It's true that if you bed a plastic port with 5200, you may end up destroying the port trying to get it off. On the other hand, if you use 5200 and bed it properly, you shouldn't ever have to deal with leaks again.

If the flexing is excessive, there will be essentially no way to stop the leaks short of reinforcing the flexing area. This is a fairly common problem with side decks adjacent to trunk cabins, and around hatches set in a wide expanse of deck; if the deck flexes at all, the hatch or port won't stay sealed.

Alternative Methods Whenever you suspect that slightly flexing structures are the primary cause of leaks, such as hatches on deck or coach roof, or port holes in a cabin trunk or even hull side, try jumping on the deck or stressing the surface by some method to see how much it flexes. If flexing is only moderate, an alternative method of leak stoppage may be appropriate. Instead of bedding and bolting the part down hard with wet bedding, in which case you squeeze most of the bedding out, leaving only a thin film of bedding that will seal less well, try using this method of creating a gasketed joint, which usually takes two persons to accomplish. For this method, you can use any high qualityflexible caulk rather than 5200.

Cut a number of shims of equal thickness, say 1/8". Apply the bedding thickly and evenly around the mating surface using a putty knife to smooth it out to slightly more than that thickness. Use a new putty knife and wax it so the caulk doesn't stick to it. While you begin to set the hatch or port frame in place, have the other person shim it all around. The objective here is to create a layer of bedding of uniform thickness by using the shims and excess of caulk that will serve as a flexible gasket. The idea is that if there is structural movement, rather than creating a rigid joint that is going to break loose, we create a more flexible join by this method.

Obviously, great care has to be taken that there are no big bubbles or voids between the hatch frame and caulking layer. Set the hatch frame in place, and press down until the shims stop it. A lot of caulk should be squeezing out the sides. Next, run all the screws or bolts in, but do not draw them tight. Leave enough space under the heads that more caulk can be added. Now, allow the bedding to fully cure, at which point you come back , recaulk under the bolt heads, and then draw them tight. What you have done is to create a gasket. If leaks redevelop due to a flexing structure, you can come back and retighten the fasteners.

Note: When retorquing the fasteners, be especially careful with cast aluminum or plastic flange plates; if torqued too much or unevenly, they are likely to crack or break. Extruded aluminum will not break, but you do run the risk of distorting the flange if torqued too much or unevenly.

Windlasses These are another common leakage problem. Because the leakage occurs within the rope locker where leaks usually do not cause interior water damage, the leaks often cause severe damage to the windlass drive motor and housing. Windlasses usually develop leaks because they are highly stressed, breaking the seal around the deck and bolts. If you don't already have leaks, you can usually avoid them by being careful not to place very heavy loads on the windlass. Don't use it to force out stuck anchors.

There is only one solution for curing leaks around the windlass base, and that is to pull it and rebed it. Not a pleasant task, but keep in mind that just smearing some caulk around the base won't help. Very often, I find that the real cause is that the builder failed to provide an adequate foundation for it during construction. In other cases, the builder cored the foundation area with plywood, but the windlass installer failed to thoroughly caulk the bolts with 5200 and water got into the plywood and rotted it. Whatever the cause, you need to evaluate the source of the problem and correct it.

Leaking Packing Glands It is often a great mystery to boat owners why they suffer from chronic packing gland leakage after repeated repackings and tightenings. Some try converting to the "dripless" type of glands and still that doesn't solve the problem.

Chronic packing gland leakage is usually the result of excessively flexible engine mounts on diesel engines. Because small diesels cause a lot more vibration than larger diesels, sail boat builders prefer to use softer mounts which allow for more engine movement. Engine movement, of course, causes shaft misalignment which, in turn, causes packing glands to leak because the shaft is spinning eccentrically and wears the packing out more rapidly on one side. This, in turn, usually results in rapid cutless bearing wear which results in even more shaft movement, at which point even freshly repacked glands won't end the leakage.

Obviously, there is no particularly good solution because you will have to trade off higher vibration levels with stiffer mounts to achieve less leakage. Whatever you do, don't switch to an expensive dripless type of gland because the shaft misalignment caused by flexible engine mounts will damage it and it will be a wasted effort. If the engine mounts are very old, say ten years or more, it's a good idea to replace them. Replace cutless bearings at the point where you can move the shaft in the bearing.

Shaft concentricity can be easily checked without the use of a dial indicator. If the shaft is dirty, clean it off with sandpaper while it is rotating until you get a nice, shiny surface. A shaft that is running out of true as little as 0.010' is plainly visible. At 0.020" out of concentricity is unmistakable and at 800RPM you will notice the wobble. If so, you need look no further as to why you have leakage problems. But why is it wobbling? Is it a bent shaft, or the result of engine movement?

A good way to find out is to directly observe how much engine movement or vibration is occurring. This, too, is usually plainly obvious. Check this at various engine speeds. Usually the largest amount of movement will occur within the lower half of the RPM range, and tend to go away at higher speeds. If the shaft is bent, the eccentricity will become a blur but not go away. The strong vibration will increase. If you put your hand on the stuffing box, or the transmission, you will feel it. If the wobble smoothes out and the vibration tends to lessen, then the shaft is not bent and the mounts are the likely culprit.

If the engine mounts prove to be too flexible, it's a good idea to change them out to a more rigid type.

Thru-hull Fittings With today's modern materials and cored hulls, leaking thru-hull fittings is not a problem in and of itself. But it is a problem that threatens water intrusion into cored structures of all types, including decks.

To eliminate this danger, it is only necessary to adhere to a very simple rule: Never, but NEVER install a through hull fitting or fastener directly into or through a cored structure. Also, never install a through hull on a surface with a pronounced curve. Otherwise, it will no seal properly, or, if you draw it too tight, it will cause a dimple in the hull skin. The proper method of ensuring that water never gets into a core is to never breach the core. When it comes to through hull fittings, especially if you have to add one, this is not as difficult proposition as it may seem, though it's a bit more time consuming than for a non-cored structure where you just drill a hole and pop it in. The entire job takes about 4 hours over two days, not including time to obtain materials.

The first thing is to remove the core from the immediate area where the sea cock or whatever will be installed. This is done from the interior. Let's say, for example, that you are going to install a sea cock that has a 2" diameter foot print. You'll need to remove about a 6" square of inner laminate and core. There are a variety of means to do this, depending on working space available. Usually a die or angle grinder with abrasive cutting disc will work fine in tight spaces. Cut through the inner laminate only and remove the square of inner skin only. Next, cut out the core with a knife in a circular shape. The reason for this is that is necessary to relaminate and completely seal up the exposed areas of the core. It's a lot easier laminating the rounded corners than it is a square one.

Next, using an 80 grit grinding pad on a very small grinder, you smooth out all surfaces in preparation for closing up the exposed edges, keeping in mind that the laminating surfaces must be absolutely clean, and the bottom of the hole must be flat.

There are several ways to finish up here. The method I prefer is to use a high quality marine epoxy paste and 2 or 4 oz. Cloth. Don't use mat because you'll end up with a big mess. Trowel the paste heavily onto the edges of the core, working it into the cells and rounding out the corners at the bottom. Use more rather than less epoxy. It will help to round over the top corner of the expose foam. Then I cut the cloth to the appropriate size -- meaning about a 1" overlap each onto the inner skin and outer skin, and then press these strips into the wet epoxy completely around the circumference of the cut out. Following this, you then trowel the remainder of the epoxy paste onto the outer side of the fabric, making sure that there are no holes or gaps, and then smooth it out. I use latex gloves and smear the epoxy around with my fingers. Note here that you must use fresh two part epoxy for this job, not old stuff that has become thick and stiff.

This method will ensure that there is no chance that water will leak into the core, because you have completely sealed it off. Once it's cured, come back with the grinder and smooth out irregularities. Now you're almost ready to drill your hole for the new sea cock and install it in the usual manner, but there is another important detail to attend to. That is providing a doubler block under the sea cock so as to relieve strain on the outer skin.

What to use for the doubler? Well, the ideal material would be a piece of fiberglass laminate scrounged from a boat yard or trash can. Or any other type of reinforced plastic that is 1/4" to 1/2" thick. The doubler should be about 1" larger than the foot print of the sea cock and be completely flat. It's best to bed this in place with epoxy, let it cure, and then drill the hole through both parts at once to get the best fit. Now you're ready to install the sea cock and never have to worry about it leaking.

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