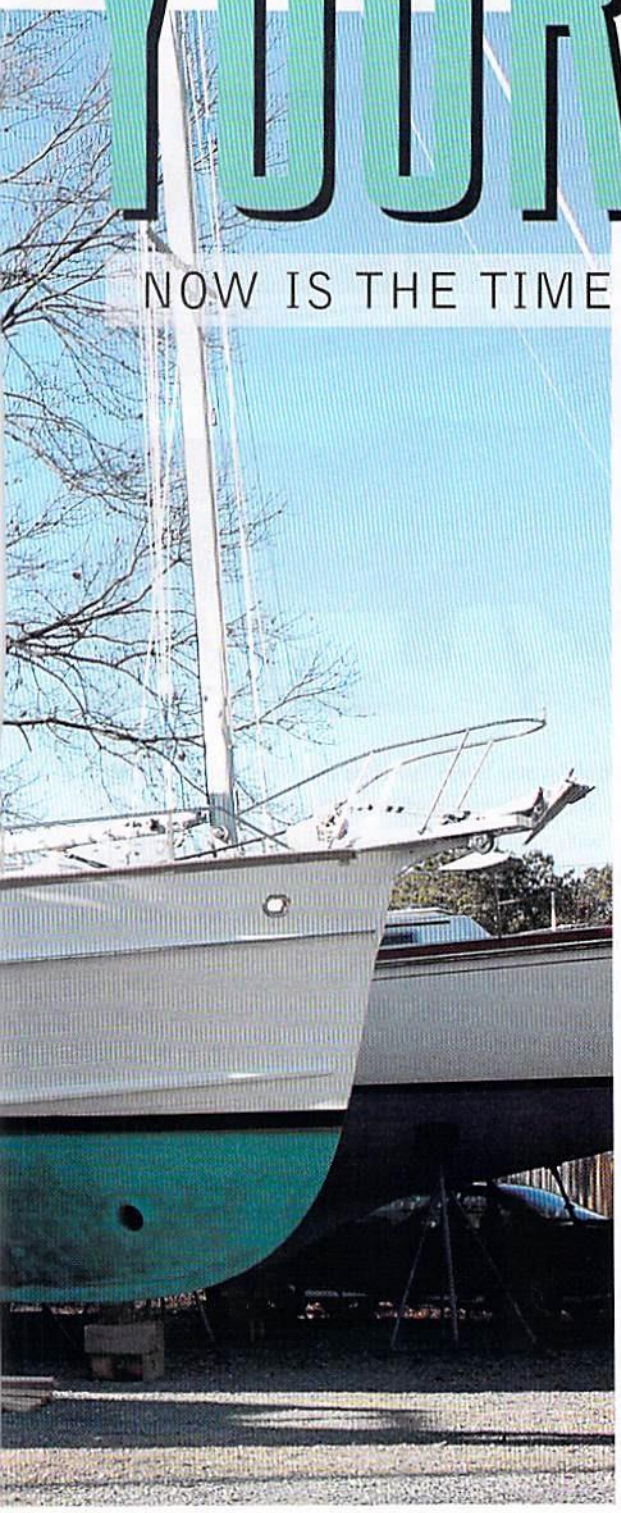
WINTER

YOUR VESSEL

NOW IS THE TIME TO GET YOUR BOAT READY FOR THE NEXT CRUISING SEASON

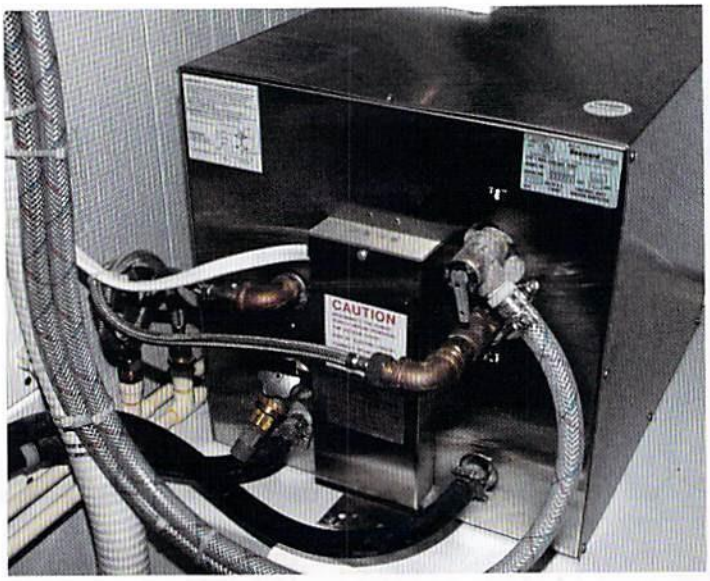
Story And Photography By STEVE D'ANTONIO



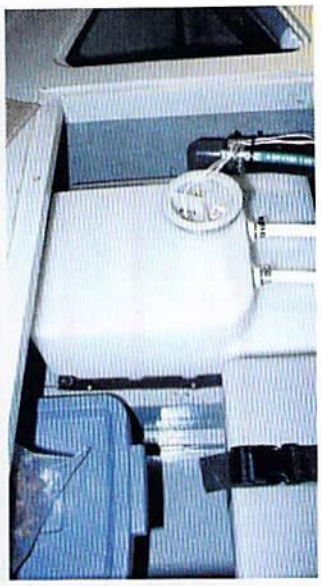
It's something no boat owner wants to think about: the time when all who live in higher latitudes are forced to place their vessels into hibernation for the winter months. Depending on the region in which you store your boat, that period may be as long as eight months or as short as three. Regardless of the duration, for most it seems like an eternity, particularly when that first warm, sunny spring day rolls around.

As many boat owners who have undergone a winterization evolution know, there's more to this procedure than simply running antifreeze through the engine and generator and draining the water tanks. Not only do a variety of systems require careful attention to prevent frost damage, but the winterization exercise also presents an ideal opportunity to conduct routine maintenance on a variety of vessel systems.

Several questions must be posed where winterization and storage are concerned. Among them: Will your vessel be stored afloat or ashore? If it will be stored afloat, will it be used periodically during the off season? In some regions it's possible to use a boat year-round with minimal winterization of systems, while in other locations vessels must be hauled because of ice and extreme temperatures.



Above: Water heaters may present a challenge when it comes to flushing the potable water system with nontoxic antifreeze (also called "nontox"). The water heater should be drained of all water and then bypassed to avoid filling it with nontox. If it becomes filled with nontox and is left that way while stored, it may be difficult to eliminate the taste and odor later.

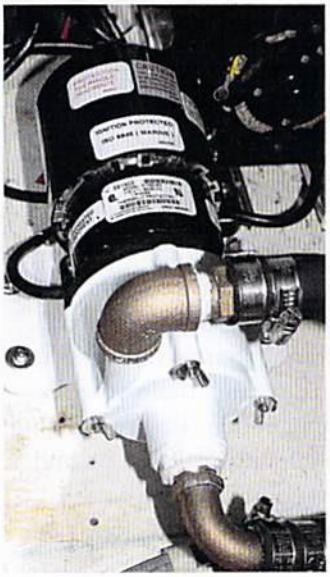


Top left: Potable water filters, such as the whole-boat model shown here, should be drained, the filter element removed, and flushed with nontox. Install a new filter element in the spring once all nontox has been thoroughly flushed out. Top right: Holding tanks should be as empty as possible before beginning the winterization process. Flush them so that effluent or water does not remain in the bottom of the tank or hoses. Above: Many vessels are equipped with a variety of pumps in disparate locations, from shower sump to engine raw water. Be certain that every pump is treated during winterization. Out-of-the-way components, such as this self-priming diaphragm pump, can easily be overlooked.

Interestingly, in my experience, vessels that are located in more moderate climates suffer the most damage from freezing. Because these vessels often remain afloat and rely on partial winterization or shorepower-supplied electric heat, they are more susceptible to damage than boats that are hauled and fully decommissioned and winterized. Relying on electricity to prevent a vessel's systems from freezing, whether the boat is afloat or ashore, is risky at best. Power outages occur (especially during fall storms), circuit breakers trip, and shorepower cables become loose or are inadvertently unplugged.

In short, it's best not to depend on "active" winterization (that is, winterization that utilizes electricity to prevent freezing). Additionally, leaving a vessel afloat for winter storage, especially in harsher climates where intermittent use is not possible or contemplated, carries with it inherent risks: deck drains and bilge pumps may clog or freeze, ice may accumulate on deck or around the hull, and problems are less likely to be noticed because of reduced traffic. Unless you plan to use or check on your vessel regularly in the off season, it's best to haul out for winter storage.

Keep in mind that if the temperature tends to fall rapidly in your area (it's in the 40s one week and in the 20s the next), then it's best to winterize early. Although vessels afloat may stave off freezing for a bit after temperatures have dropped below 32° and it *usually* takes 24 hours of subfreezing weather to place a boat's systems in freeze extremis, there's no worse feeling than lying in bed on a blustery fall night wondering if you waited one weekend too long to winterize. In short, when in doubt about the weather, winterize early. Also remember that systems containing fresh water and those that contain water on or near the deck, such as washdown spigots, tend to freeze first, particularly on vessels that have already been hauled out and blocked.



Above left: Most pumps used for air conditioning are not self-priming and must be "force-fed" nontox to be properly winterized. Gravity-feeding nontox to the pump while it's running is usually all that's required for it to pump fluid to the air conditioning condensers and related plumbing. Above right: If a plug is removed and is lost or damaged after winterization, the replacement must be bronze. Brass should never be used in raw-water applications, as it is susceptible to dezincification. This dezincified brass sea strainer plug was on the verge of failing. If it had failed, it would have caused the vessel to flood.

There are essentially two approaches to winterization. Because they carry no official names within the industry, I'll refer to them as "turnkey" and "assembly required." In the turnkey approach, every system and component that is disassembled or accessed in any way is returned to its original condition upon completion of the vessel's winterization. Importantly, this includes raw-water pumps for propulsion engines and generators. That means any plumbing components (both raw and fresh water), hoses, pipes, and clamps are completely reassembled and remain in a ready-to-launch, ready-to-use condition. The assembly-required method of winterization, on the other hand, leaves many systems in a condition where they must be reassembled before the vessel can be launched and used.

As one might expect, there are advantages and disadvantages to each approach. While they still require commissioning, turnkey winterized vessels are ready to launch and use without delay. They remain in a seaworthy state and thus run little risk of flooding or other damage after being launched. Ideally, their engines require nothing more than opening raw-water seacocks before starting and motoring away from the slip. And, significantly, turnkey winterized vessels are, in most cases, completely winterized by one mechanic.

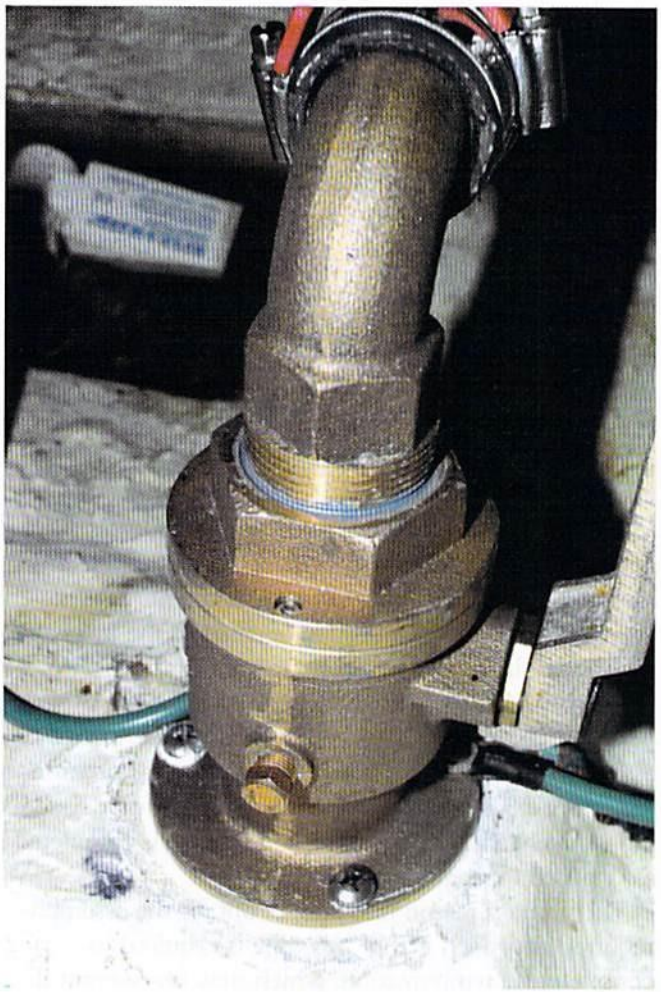
A potential drawback to turnkey winterizations involves the aforementioned raw-water pump and its impeller. Some vessel operators and professionals believe that leaving an impeller installed in its pump housing for long periods of idleness contributes to premature failure. I prefer to change impellers annually, and thus I have not found this to be a problem. There's a good chance the impeller that was in the pump when your engine came from the factory sat stuffed inside the pump body without being turned for a considerable amount of time. (Remember: the impeller was most likely installed at the pump factory, not by the engine manufacturer, so the idle period may be measured in years.)

Conversely, assembly-required winterized vessels demand the services of a mechanic to reassemble any plumbing or propulsion system components that have been left in an incomplete state of affairs. If the mechanic who winterized your vessel no longer works for the yard when spring arrives, or if he or she has a less than perfect memory, it's possible items will be overlooked or assembled incorrectly. There's little doubt that it's easier and more efficient to reassemble a component or system immediately after the winterization process is completed as opposed to waiting several months.

The primary reason many yards opt for the assembly-required approach is that less time is required to complete the winterization, which may be relevant if temperatures fall precipitously and there is a sudden influx of vessels to the yard. Remember, however, that the affected systems will have to be reassembled at some point. Invariably, this occurs during the spring, which only exacerbates the rush that most yards experience during this period. In my opinion, the advantages of turnkey winterization far outweigh its drawbacks.

POTABLE WATER SYSTEMS

Because the potable water system is in the greatest danger of freezing as the thermometer falls, many professionals prefer to begin a vessel's winterization here. The options for winterization of potable water systems include flushing with nontoxic antifreeze (often referred to as "nontox" within the industry) or using a combination of compressed air followed by nontox. To protect yourself and the environment, never use any conventional, permanent antifreeze—the type used inside an engine's closed cooling system—to winterize a vessel. Regardless of its color or claims about nontoxicity, this antifreeze, in addition to being costly, is inappropriate for use in potable water systems and should not be allowed to flow into waterways.



If a seacock is closed while a vessel is afloat, water remains trapped within that seacock. If it is not opened once the vessel is ashore, or drained using a plug, it may freeze and fracture.

Nontox, which is a proprietary, propylene glycol-based, pink antifreeze, is specifically designed to be used in potable water systems. Again, it *must not* be confused or interchanged with permanent nontoxic antifreeze that is designed for use in an engine's closed cooling system. Most varieties of nontox are meant to be used full strength rather than diluted, although some may be diluted. Be certain you understand the properties of the variety you choose and be certain it's capable of protecting your equipment at the temperatures to which you anticipate your vessel to be exposed. Diluting nontox that's not designed to be used at less than full strength may lead to severe freezing damage. As this mixture freezes and turns to ice, it will expand with considerable force, enough to shatter heavy steel, cast iron, bronze, and nonmetallic components. It's normal, however, for full-strength nontox to take on a slushy appearance when exposed to freezing temperatures.

The procedure for using nontox requires that all or as much water as possible, whether fresh or salt, be removed from the system that's being winterized. For a potable water system, storage tanks, water heaters, and plumbing pipes, tubes, and hoses should be emptied by opening drain valves or by removing drain plugs or plumbing fittings attached to the bottom of the tank or system. While using the system's own pump is an option, this places unnecessary wear and tear on this typically costly component. Draining the system via gravity, therefore, is the preferred approach. Unless a water heater is drained manually, via a drain valve or disassembled fitting, it will remain full. (Before draining a water heater, be certain its circuit breaker is off and remains so until it has been recommissioned in the spring.) Water filters, including those used to filter water produced by watermakers, should be opened, the filter element removed, and the housing drained and then reassembled without the filter element installed. All components that are disassembled to facilitate draining should then be reassembled.

If compressed air is available, it can be plumbed in immediately after the water pump and pumped through the potable water system at low pressure (20psi is sufficient) to remove any remaining water. Then, bypass plumbing should be installed at the water heater to prevent it from being filled with nontox. This bypass approach also minimizes the amount of antifreeze required and reduces the odor, taste, and foam that are common after the potable water system is recommissioned. Bypass plumbing typically consists of potable-water-approved hose or whatever type of plumbing is used to connect the water heater to the remainder of the system, such as polyethylene tubing, PVC hose, copper, and so forth. Conscientious builders and boatyards often prepare and supply this bypass plumbing to the owner with the vessel or as part of a winterization kit for future use.

Once the bypass plumbing is in place, the system must be flushed with nontox. As an alternative to nontox, some yards and owners prefer to use inexpensive vodka, as it imparts virtually no taste, odor, or foaming. Whichever liquid is used, as little as possible should be left within the vessel's plumbing. Its mission is to mix with and displace small quantities of remaining potable water. Once it has done this, there's no reason for it to remain in the plumbing.

For the same reason that water heaters are bypassed, the addition of nontox to water storage tanks also should be avoided. As long as potable water tanks are empty, there's no need to flush them with nontox. A small amount of water remaining in a tank will not be harmful,

even if the water freezes, provided it has room to expand. However, if the tank is irregularly shaped (for example, if the top of the tank is narrower than the bottom, which is very unusual), then all of the water must be removed or nontox should be added.

Nontox should be drawn into the system where the plumbing would ordinarily attach to the water tank. A hose dropped directly into a gallon container of antifreeze often works very well. (Several gallons may be needed to complete the process.) Turn on the pump, and nontox will be pumped into the system. Once the system is fully pressurized, all spigots and taps should be opened. Begin by opening the taps that are farthest from the pump, and move successively closer as you proceed. Leave each tap open until a solid stream of antifreeze issues forth. Don't forget showerheads and sumps, freshwater flush toilets, ice makers, and deck washdown spigots. If possible, it's preferable to simply drain and "blow out" ice makers, as the nontoxic antifreeze taste may be noticeable in the first several batches of ice after the system has been commissioned. (If compressed air is unavailable, canned air designed for cleaning computer equipment may be used to blow out the ice maker.) For watermakers, carefully follow the manufacturer's recommendations for winterizing/storing the system.

Once every tap and spigot has been winterized, open all of them again and allow the remaining nontox to be pumped out of the system. Then, reconnect the hose between the system's pump and the water tank. If multiple tanks feed a single pump, be certain the plumbing between each of the tanks and the pump has been flushed with antifreeze. Finally, remove the bypass plumbing at the water heater and, at the circuit breaker panel, attach tags to the breakers for the potable water pump, water heater, and watermaker to indicate that these components have been winterized. A new water filter element may be installed either at this time or when the vessel is commissioned.

RAW-WATER OR SEAWATER PLUMBING

All of the following guidelines for winterizing the remainder of your boat's systems assume that the vessel has been hauled and stored ashore.

Systems that utilize raw or sea water for cooling, washing, or flushing also require winterization. Other than the engine and generator, which will be discussed later, these include the air conditioning and refrigeration systems, deck washdowns, raw-water flush toilets, and hydraulic stabilizers (if not operating on the engine's open cooling circuit and bilge pumps).

Air conditioning and water-cooled refrigeration systems often present the greatest challenge where

Winterizing sanitation systems calls for the removal or displacement of all raw water from plumbing and fixtures. For freshwater flushing systems, such as the vacuum toilet shown here, the freshwater plumbing also must be flushed with nontox.

All parts of the sanitation system through which water or effluent moves must be winterized using nontoxic antifreeze. A portion of the system that is often overlooked is the overboard discharge or macerator pump, such as the one shown here.

winterization is concerned. Most utilize a single raw-water intake seacock, strainer, and pump that distributes water to one or more condensers. Most air conditioning and refrigeration raw-water pumps are not of the self-priming variety; that is, they are designed to operate below the vessel's waterline. Therefore, they will not draw antifreeze out of a container. A simple gravity-feed system may be set up by drilling a hole in a bucket (I prefer to use a 5-gallon plastic pail, often referred to as a spackle bucket) and installing an inexpensive, 1-inch plastic through-hull fitting and inline valve with a 2- or 3-foot length of hose.

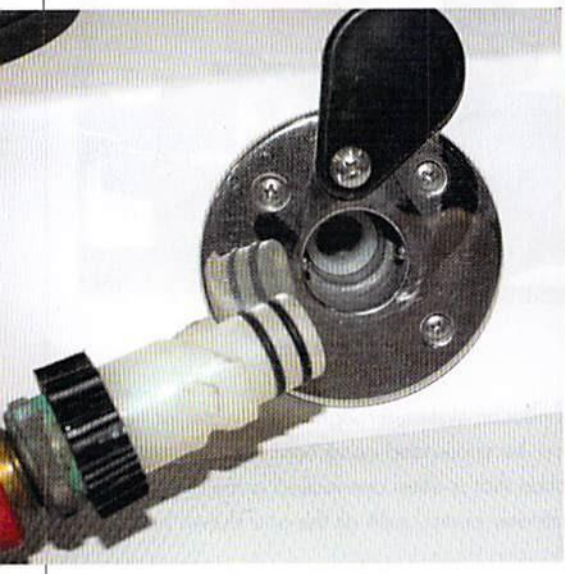
Open, clean out (if necessary), and drain the raw-water strainer for this system, then pour nontox into the

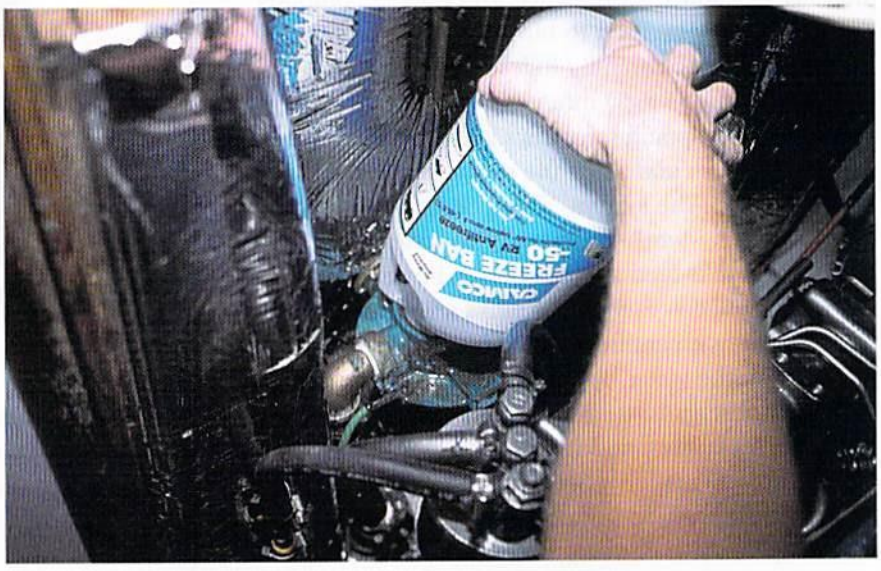
strainer until it runs out the seacock (outside the vessel). Then, disconnect the hose between the strainer and the pump and attach your "flush bucket" hose to this hose. The connection doesn't have to be completely liquid tight; it's OK if some nontox leaks out during the flush process, as long as most of it is drawn into the pump. Holding the bucket above the pump, pour in a couple of gallons of nontox, open the valve on the bucket, and then start the air conditioning system. Using a helper who is standing outside the vessel, allow nontox to be drawn into the system until a clear, red stream is visible *at each and every air conditioning raw-water discharge* (each condenser typically utilizes its own above-the-waterline discharge through-hull fitting). When you're finished, keep your flush bucket handy. You'll use it again for winterizing the engine and generator.

Unlike air conditioning cooling pumps, seawater deck and anchor washdown pumps usually are self-priming, which negates the need for the flush-bucket approach. These pumps often can be winterized by simply pouring nontox into their strainers. Begin by opening, cleaning, and draining the strainer. Then, close the seacock and open the deck washdown spigot (if there's water in the deck hose, be sure to drain it). Now, fill the strainer with nontox, and have a helper turn on the pump while you continue to pour nontox into the strainer. Allow the pump to draw in the antifreeze until it's visible on deck, at which point the pump can be switched off. Then, repeat the procedure that was carried out for the air conditioning strainer: open the seacock and pour nontox into the strainer until it is visible exiting the through-hull under the boat.

If your vessel is equipped with a hydraulic system that uses its own pump, as opposed to the engine's raw cooling water (e.g., for fin stabilizers, thrusters, or windlasses), it too must be winterized. Because it's typically not practical to operate these systems and pumps after the vessel has been hauled, two choices exist. One option is to draw nontox into the system via the strainer before the vessel is hauled. The other option is to drain the raw-water cooling route for the system, blow it out with compressed air, and then "gravity-charge" it with nontox using your flush bucket after the boat has been hauled out. Either way, it's imperative that raw water not remain within the plumbing or heat exchanger of a hydraulic system.

Sanitation systems, whether they utilize fresh or raw water, require winterization. If the toilet uses raw water for flushing, then nontox must be pumped or drawn into the system at the source, which, once again, is the intake seacock and strainer. Follow the same procedure that was used for the air conditioning system and washdown pumps, allowing the antifreeze to be drawn into the system until it exits at the toilet. The flush portion of the toilet requires nothing more than pouring nontox into the bowl and flushing several times. The holding tank should be completely emptied before haulout. For the remainder of this procedure, prepare by donning rubber gloves and eye protection and by having bleach and spray disinfectant on hand. After all of the heads





Left: Don't forget to winterize deck washdown pumps, spigots, and strainers. Located in faraway places, these are often overlooked, with dire consequences. Right: Nontox may be poured directly into the raw-water strainer in order to flush the engine as it's running. Don't let the engine run for more than a few seconds without either water or nontox being drawn into the strainer.

Bilge pumps and their associated plumbing must be flushed with nontox. If water leaks into the bilge during storage and the pump operates, it will need to be re-winterized.

have been winterized, the holding tank's overboard discharge or macerator must also be flushed with nontox. You will need a 5-gallon bucket, preferably one that has a removable lid (don't use your flush bucket; that must remain clean). Place the bucket under the overboard discharge seacock; then, using an assistant, engage the pump either until nontox is visible or until the bucket is nearly full (it may require more than one fill-up before nontox has made its way through the system). The bucket's contents can be dumped, carefully, into a shoreside toilet. Treat the bucket and any spilled effluent with the aforementioned cleaning products.

All bilge pumps, whether of the submersible or remote variety, must be flushed with nontox to prevent frost damage in the pumps themselves and in their plumbing. Typically, this requires nothing more than pouring nontox into the bilge surrounding the pump and either allowing the automatic switch to trigger the pump or engaging it manually. However, if the bilge is especially large or if the pump is not in the lowest section of the bilge, it may be necessary to remove the pump—most submersible bilge pumps can be easily released from their bases without the use of tools—and immerse it in a container of nontox. Your flush bucket may work well for this task. Simply pour a gallon or more of nontox into the bucket and immerse the pump in it. This is also a good time to inspect the pump for debris that may be lodged in the strainer base or around the impeller.

Bilge pumps will remain winterized after nontox has been pumped through their impellers and pumps, but if the vessel leaks water into the bilge from the decks or cabin top, the water that accumulates in the bilges will freeze, as will the pumps if they operate. If this is the case aboard your vessel, you have two choices. First, you may install a garboard plug that will allow the bilge to drain of its own accord, without the need for the bilge pump to operate. Second, you could visit the vessel periodically to add more nontox to the bilges, replacing that which has been pumped out with the accumulated water.

Two final items that are worthy of mention are hydronic heating systems and chiller-style combination heating and air conditioning. Hydronic heaters typically utilize a diesel-fired furnace to heat liquid that is then circulated to radiators throughout the vessel via flexible or metallic plumbing. In most cases, the liquid that is used for conveying heat is an antifreeze solution. The concentration of this antifreeze solution must be tested to ensure that it is sufficient to prevent freezing under the temperature conditions that are anticipated. If it's not, and the system freezes, extensive damage may occur.

Chiller systems work in a similar fashion except that they cool and heat water using an electric hermetic compressor rather than diesel fuel. The liquid they circulate throughout the vessel also should be an antifreeze solution, and its concentration must also be verified. In many cases, particularly where chillers are concerned, the system's antifreeze concentration is insufficient to prevent freezing. (I've encountered systems that were filled with ordinary water, which not only freezes but also promotes corrosion.) Often, this deficiency is not discovered until the vessel is moved to a freezing climate for the first time.

ENGINE AND GENERATOR

Winterization of the engine(s), generator(s), wing engine, and their related systems should be carried out in the sequence described below.

Begin by adding the appropriate quantity of stabilizer to the vessel's fuel tanks. Be certain to use stabilizer rather than a biocide or cetane booster. Stored fuel, particularly during cold winter months, rarely encounters biological growth. Fuel "enhancers" or cetane boosters may be added when the vessel is commissioned. Ideally, stabilizer should be added during the final fill-up in order to ensure that it's circulated and agitated sufficiently inside the tanks. It's best to avoid fully topping off the fuel tanks immediately before storage; leaving the tanks

seven-tenths to nine-tenths full will allow sufficient room for expansion as the fuel warms in the spring. It's easy to identify boats that have not been afforded this expansion room, because their vents begin to dribble fuel as spring approaches and temperatures rise.

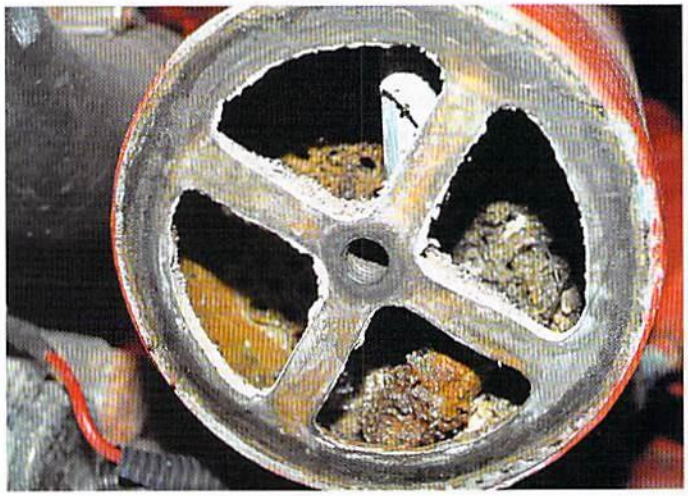
Although changing fuel filters when it's not necessary can reduce efficiency (a slightly dirty filter does a better job of capturing dirt than a squeaky-clean one), changing filters seasonally makes sense. Starting off a new season with clean filters means they are less likely to require replacement midseason. Both primary and secondary filters should be replaced at this time, including those used for generators and wing engines. While the filter elements are out, closely inspect the inside of the filter bodies and bowls for an accumulation of dirt, debris, or water. If they are dirty, this is the time to disassemble and clean them.

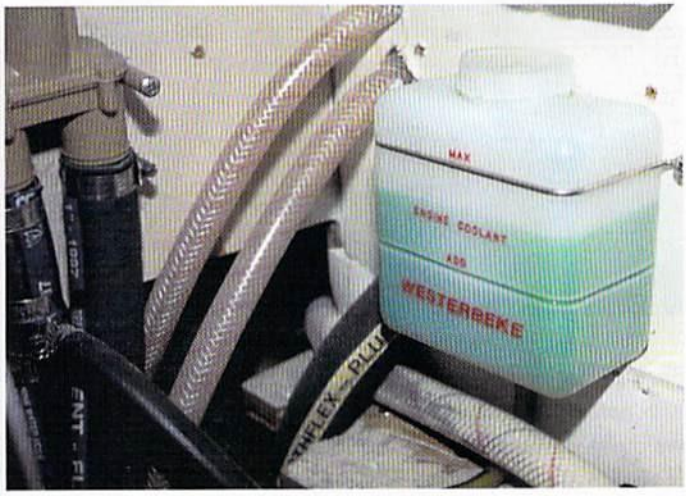
It is critically important that the antifreeze/coolant used in the engine's closed cooling system be of the proper concentration to avoid freeze damage. The most accurate method of checking coolant concentration or strength is by using a refractometer, which is capable of testing both ethylene-based and propylene glycol-based coolant. In lieu of this, a "floating ball"-type tester may be used. Ideally, the mixture should be a 50-50 solution of coolant and distilled water, which affords freeze protection down to minus 40°F, as well as appropriate corrosion protection. Understrength coolant should be fortified with new, undiluted coolant until the required concentration is achieved. If the coolant appears muddy or rusty, or if it's more than two years old, it should be replaced.

Once the filters have been replaced, run each engine and generator on a freshwater flush for at least 15 minutes. This accomplishes two goals. First, it flushes salt and debris out of the engine's raw-water cooling circuit and exhaust system. Second, it ensures that the fuel filters have been properly reassembled and that no air has been introduced into the fuel system. (When diesel engines are idling, fuel moves through the system relatively slowly; thus, trapped air may take several minutes to make its way from the filters to the fuel injection pump and injectors.)

There are two options for operating an engine on a freshwater flush. The first and simplest calls for simply closing the raw-water intake seacock, opening or removing the lid on the raw-water strainer, and inserting a garden hose into the opening. Turn on the garden hose and then start the engine, running it at no more than idle speed. The garden hose flow rate should be adjusted so that it's always supplying slightly *more* water than the engine's raw-water pump is able to draw—that is, the strainer should be overflowing into the bilge. If you choose this method, the engine room bilge pump should not be winterized until after the engine flushing procedure is complete.

The second approach utilizes the flush bucket. Disconnect the hose between the strainer and the engine at the strainer. Insert your flush bucket hose into the engine intake hose. (The interface does not have to be entirely liquid tight. I find that wrapping a wet rag around the two hoses is sufficient to allow proper water flow.) Place the garden hose into the flush bucket and secure it there by tying it to the bucket's handle. Because





Left: Heat exchangers frequently become fouled with marine life or zinc anode debris. Winterization affords the boat owner an ideal opportunity to inspect and service critical components and equipment such as this. Right: While its level should be checked, the coolant in the recovery or overflow tank should not be considered an accurate representation of the concentration and associated freeze protection of the coolant that's in the engine. Always draw engine coolant directly from the expansion tank when testing it.

of the height of the bucket, the hose often wants to fall out of place. Turn on the hose, fill the bucket, and then turn off the hose. Start the engine and observe the level of water in the bucket. As it begins to fall, turn on the garden hose, adjusting its flow to be approximately the same as or slightly more than the engine's flow rate. I find it handy to install a valve, such as those available at hardware and home improvement stores, on the end of the hose so you don't have to leave the boat each time you need to turn the hose on or off. Because of the bucket's volume and the buffer it provides, an overflowing rate of flow is not as necessary as it is when using the previously described strainer method.

The reason for allowing the engine to draw water out of either the strainer or the flush bucket at its own rate is to prevent flooding of the engine's exhaust system and ultimately the cylinders themselves. Additionally, the "open" flow method allows the rate at which water is supplied to and used by the engine to be monitored. A pressurized supply of water should never be attached directly to an engine—whether the engine is running or not.

After the engine has been flushed with fresh water for 15 minutes or longer, move on to changing the crankcase and transmission oil, which will now be warm and easily pumped. If you conduct regular oil analysis, this is an ideal time to take samples from both the crankcase and the transmission.

After completing the oil change, prepare to pump nontox through the engine. Drain as much fresh water from the engine and exhaust system as is possible and practical. Larger exhaust systems and heat exchangers are capable of holding a considerable amount of water, which will only serve to dilute the nontoxic antifreeze as it passes through the system. Additionally, if the water is drained, it's often possible to use less nontox. Most heat exchangers have easily accessible drain plugs, while you may have to search a bit to find drain plugs in exhaust elbows and mufflers. If you can't track these down or if you are unsure about which plugs to remove, don't be overly concerned; it simply means you'll need to use more nontox in order to ensure that the system has been properly freeze-protected.

Be prepared to either dump gallon containers of nontox into the sea strainer or fill your 5-gallon flush bucket with nontox. Using an assistant who is outside the boat (but not standing behind the exhaust outlet), start the engine and allow it to run at idle while pouring nontox into the strainer or flush bucket. Do this until a solid stream of undiluted nontox exits the exhaust. If in doubt, use more nontox; too much can't be run through the system. Once this goal has been achieved, shut down the engine. The cooling system is now winterized, and by running the engine immediately after the oil and transmission fluid have been changed, you've coated all vital, internally lubricated parts with clean oil.

Once the engine has been stopped for a few minutes, check the crankcase fluid level, and add or remove oil as necessary. Some types of transmission fluid can be checked while the engine is at rest; others must be checked while the engine is running and at operating temperature. If yours is the latter type, place a tag at the helm as a reminder to do this when the engine is commissioned in the spring. Finally, give the entire engine a *light* coating of corrosion inhibitor, such as CRC 6-56.

The many systems on your boat deserve proper attention at the end of each season so that they can survive the winter and serve you properly when the time for spring commissioning arrives.

For information on winterizing your tender's outboard, see the Web Extras for this issue at passagemaker.com.

Steve owns and operates Steve D'Antonio Marine Consulting (stevedmarineconsulting.com), providing consulting services to boat buyers, owners, and the marine industry.