Understanding the Waterlift Muffler

Exhaust systems have always been the Achilles' heel of inboard engine installations in sailboats. Traditional copper water-jacketed exhaust systems are heavy, expensive to fabricate, must be designed to fit each engine installation, and are subject to hard-to-detect pinhole leaks that can reduce exhaust cooling efficiency and cause damage to your engine. In addition, most waterjacket systems have no exhaust muffling effect, so that your boat sounds like a tired tractor.

The simple, efficient waterlift exhaust system has all but replaced copper-jacketed systems in both custom and production boats, in much the same way that the diesel engine has replaced the gasoline engine. The modern waterlift system is just about everything the traditional exhaust system is not; lightweight, inexpensive, and flexible in installation.

Unfortunately, tolerances in the design and installation of waterlift systems are small. There are rules that must be followed and precautions that must be taken if a trouble-free exhaust system is to be the result. Failure to follow the rules can be expensive if water backs up into the engine. Whether you are installing a new engine and exhaust system, or just maintaining an existing one, it pays to be familiar with the system and the guidelines for a proper installation.

The waterlift is simply an enclosed pot with inlet and discharge hoses. Engine cooling water is injected into the exhaust line near the manifold, gradually filling the pot. Exhaust pressure builds in the pot as it is filled with cooling water until the pressure in the pot *is* sufficient to blow water and exhaust gases out the discharge port. Since the exhaust gases do not travel straight from the manifold to the outside of the boat, much of the engine exhaust noise is absorbed in the waterlift, resulting in quieter exhaust. The exhaust of boats with waterlift systems is usually easily recognized by the fact that the cooling water does not spurt out the exhaust in a continuous stream unless the engine is running at high speed. Rather, water is discharged in bursts, much like the flow through a diaphragm bilge pump.

Most sailboat engines are installed below the boat's waterline. This means that special precautions must be taken to prevent seawater from siphoning back into the engine, with potentially disastrous results. A typical waterlift installation for an engine mounted below the waterline is shown in the accompanying drawing. Note that the top of the waterlift pot is located below the exhaust manifold outlet. It is important that the waterlift be below the manifold at all angles of heel and all degrees of pitch. If it isn't, cooling water will simply run back into the manifold and into the cylinders through the exhaust valves.

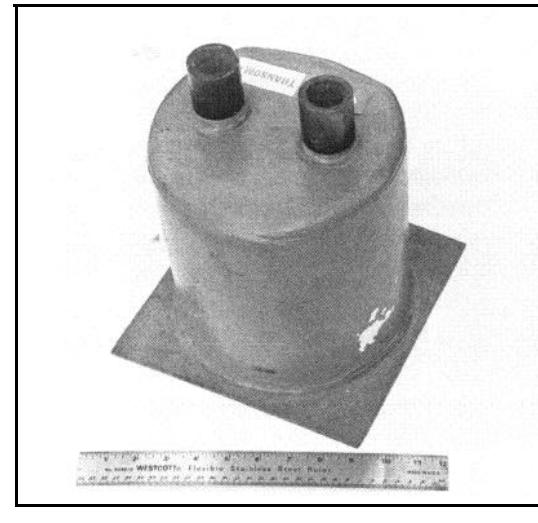
Cooling water is injected into the exhaust line before it reaches the waterlift. The closer this point of injection is to the exhaust manifold, the cooler will be the exhaust line. The uncooled portion of the exhaust line adjacent to the manifold must be metal pipe, as exhaust gases straight off the manifold are quite hot. Exhaust plumbing downstream of the point of water injection can be rubber steam hose.

The cooling water discharge hose between the manifold and the exhaust line must loop well above the waterline, and must be equipped with an anti-siphon valve. Check the operation of the anti-siphon valve frequently. These are notorious for packing up with salt, which renders them totally ineffective. If the anti-siphon valve seizes in the closed position, it has no ability to break the potential siphon in the exhaust or raw water intake line that could fill the waterlift, exhaust line, and engine with water.

A common mistake in mounting the waterlift is to place it to the side of the engine, far from the boat's centerline. In this configuration, the waterlift maybeabove themanifold on one tack at extreme angles of heel. If the waterlift is mounted aft of the engine, this is less likely to be a problem.

The waterlift must be firmly attached to the boat. A muffler half full of water has a certain amount of momentum when it's swinging around under the cockpit, trying to wrench its hoses off and flood your boat. The exhaust line coming out of the waterlift must loop well above the waterline. However, this loop should be no more than about 33 inches above the bottom of the waterlift. To attempt to lift water higher will create excessive back pressure in the exhaust system, reducing engine output.

If the engine is so deep in the boat that a lift of 33" does not allow the exhaust to loop at least a foot above the waterline, the waterlift will have to be mounted above the engine, and the installation becomes more complicated. Rather than injecting cooling water immediately aft of the manifold, there must be a dry stack which rises from the manifold to a



Right: A waterlift is merely a pot to hold engine cooling water, equipped with exhaust inlets and outlets. The outlet pipe goes almost to the bottom of the muffler.

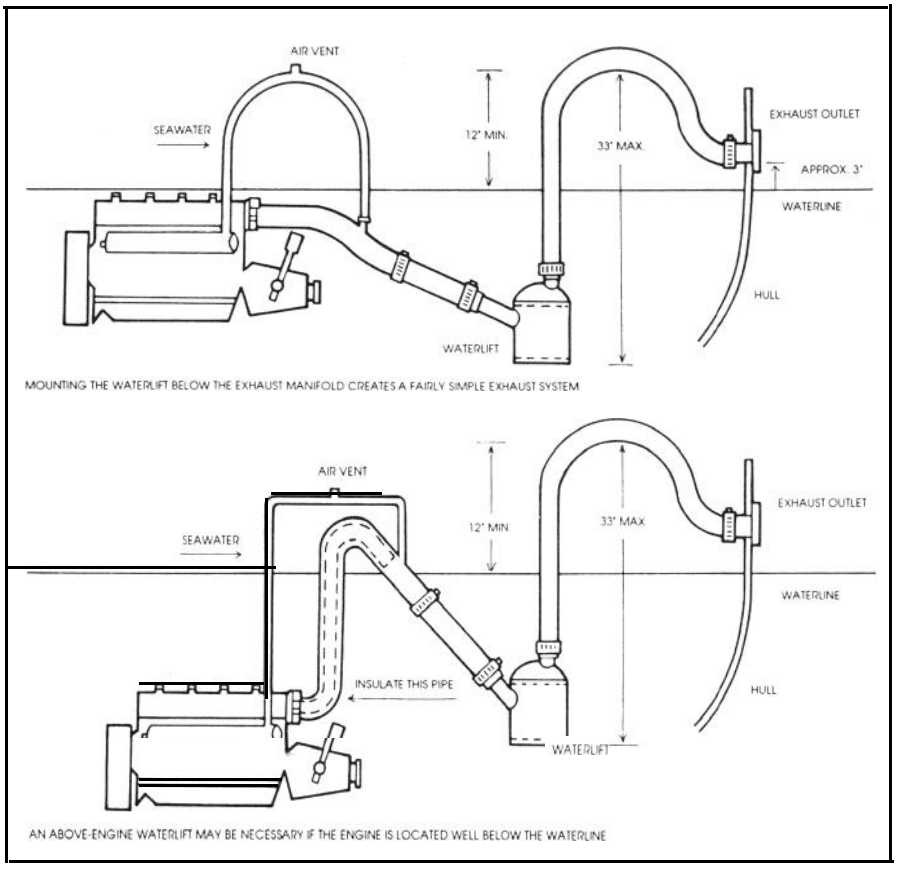
point at least three inches above the waterline at all angles of heel. The top of this stack loops downward toward the waterlift, cooling water being injected on the downhill side of the loop. The rest of the installation is identical to that of the system with the waterlift mounted below the manifold.

This dry riser stack is uncooled, and will get hot enough to require insulation. Asbestos lagging is normally used, which should be enough to give you the willies and convince you to try for the simpler muffler-below-the-engine installation if at all possible.

It is important that the exhaust discharge through the hull be high enough off the water that wave action when the boat is not under power will not create a siphon back into the exhaust system. When the engine is running, there will probably be enough pressure to prevent this, but not at anchor. On more than one boat the engine has filled with water from pitching on the anchor and dipping the exhaust under in heavy weather.

A valve on the exhaust outlet will also remedy the siphoning problem, but it must be accessible, and you must remember to open and close it when you operate and shut down the engine. An engine will usually not start and run if the valve is closed, but it may generate enough exhaust pressure if it does start to blow the exhaust hoses off the waterlift, particularly if they aren't double clamped. If the hose blows off, you will be filling your boat with water and exhaust gases as you motor merrily along.

Engines that are hard to start present special problems with waterlift systems. The raw water pump starts moving water through the engine while the starter is cranking, but no real exhaust pressure is created until the engine actually starts. If you crank your engine several times without getting it started — a common occurrence with a diesel in cold weather -you may fill up the waterlift without having enough pressure to blow it out. Once again, the water will crawl back into the engine via the exhaust valves. Every waterlift muffler should be equipped with an easily accessible drain valve or plug which allows you to empty the waterlift if the engine fails to start. This drain will also be handy when the time comes to winterize the engine, allowing you to drain the muffler. A waterlift can be split by frozen water left in the pot over the winter.



MOUNTING THE WATERLIFT BELOW THE EXHAUST MANIFOLD CREATES A FAIRLY SIMPLE EXHAUST SYSTEM

AN ABOVE-ENGINE WATERLIFT MAY BE NECESSARY IF THE ENGINE IS LOCATED WELL BELOW THE WATERLINE

Waterlifts are made of stainless steel, fiberglass, or even polyethylene plastic. Fiberglass mufflers must be made with fire-retardant resin, as a loss of cooling water in the system from a blocked hose or a broken pump impeller will quickly heat up the exhaust system before the engine shuts down from overheating. The same meltdown risk exists with plastic waterlifts, although they can withstand surprisingly high temperatures.

A cooling water flow detector such as the Aqualarm, manufactured by Aqualarm (544 West 182nd Street, Gardena, CA 90248 (213) 324-5668) can detect a blockage in the raw water system before overheating is a problem. This could prove a valuable asset on a boat equipped with a waterlift system, particularly if the waterlift is of plastic or fiberglass construction.

Waterlift mufflers are a bargain. A plastic waterlift costs less than $50 for a unit suitable for a 25 hp engine. A good fiberglass muffler costs about $100, and a stainless steel muffler about the same. Reinforced rubber exhaust hose costs $5 or $6 per foot. The typical small cruising boat exhaust system, exclusive of the through-hull fitting, shouldn't cost more than $150. A custom copper waterjacketed system, by comparison, would probably cost $300 to $400 or more, provided you can find someone capable of making it.

A waterlift system is a particularly practical system to use when an older boat is being repowered. It would be pure luck if the manifold outlets of the old and new engines lined up properly, but removing the old waterjacket system and replacing it with a waterlift should be relatively easy.

By following these simple guidelines, you can have a trouble-free exhaust system with very little expenditure of time, money, or effort. This is an anomaly in the wonderful world of sailboat ownership, where the usual rule of thumb is that any task will cost twice as much, and take three times as long as the best estimate you can make. ■