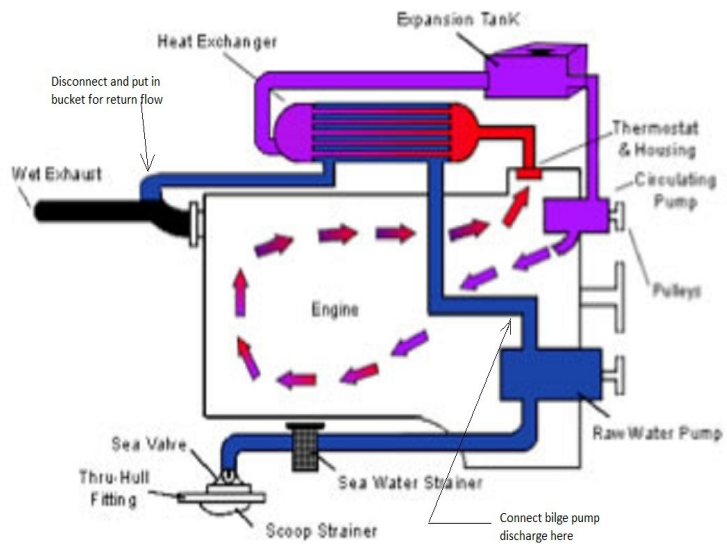


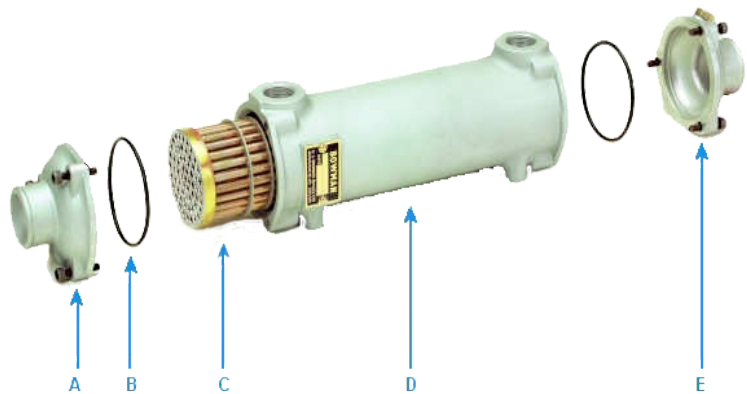
Acid Flushing Your Engine

This article will discuss the use of acid flushing to remove scale from your engine's raw water system. It does not discuss the engine's coolant system and the procedures described here are only applicable to the engine's raw water system. The pic to the right shows a simplified raw water and coolant system on a marine engine. This pic might be applicable to a low hp normally aspirated engine. High hp engines have several more raw water cooled heat exchangers: lube oil, transmission oil, turbo air (after cooler) and sometimes a fuel cooler. But they are all in a continuous path for the raw water flow.



How Scale Forms

Acid flushing is one way to remove water scale that fouls the heat exchanger surfaces. Sea water contains calcium, magnesium and other metallic carbonate compounds that when exposed to the heat of engine systems precipitate out and foul the heat exchange surfaces. This carbonate scale is usually mixed with marine organisms that collect while the engine is running, but die for lack of light and oxygen when shut down for long periods. This fouling can be removed by mechanical rodding and scraping, but to do so generally requires removal and disassembly of the heat exchanger. Rodding also leaves behind a thin layer of scale that accelerates future scaling.



Take a look at the pic of a disassembled heat exchanger. You can usually remove the end caps (A and E) and pull the core (C) from the shell (D) for cleaning. When you reassemble, use new gaskets (B) and lots of waterproof grease to limit corrosion.

But acid flushing is much less labor intensive than removing disassembling all of the engine's heat exchangers for cleaning. It will also remove the scale down to bare metal, slowing down future scaling. But there are some limitations and preparation work that needs to be done before acid flushing your engine.

Preparation for Cleaning

Never acid flush without first completely servicing your after cooler including removing, disassembling, cleaning both water and air sides- acid flushing will do nothing for the air side, reassembling with heavy waterproof grease and pressure testing. The after cooler is prone to corrosion on the sealing surfaces (mostly caused by condensate and salt air on the air side) and if you have a leak, circulating acid can be disastrous. So always clean and pressure test first.

Also acid won't remove the scale in plugged tubes. There is just too much material for the acid to eat through with plugged tubes. You can usually remove the end cap on the first heat exchanger in the raw water loop and check for tube pluggage. Rod out any plugged tubes before acid flushing. You may or may not have to remove the heat exchanger to have enough space to rod the tubes. You can also pull out any impeller pieces that may have become lodged in the heat exchanger with the end cap off. These will always be in the end cap connected to the raw water pump.

There are proprietary acid systems such as Rydlyme and Barnacle Buster that can be used. If you are brave you can use swimming pool, hydrochloric (HCl) or muriatic acid (all the same stuff) and dilute it 30/70. But it is more hazardous than the proprietary stuff, so be very careful. In any case, use goggles and rubber gloves around any acid solutions.

Acid Circulating Procedure

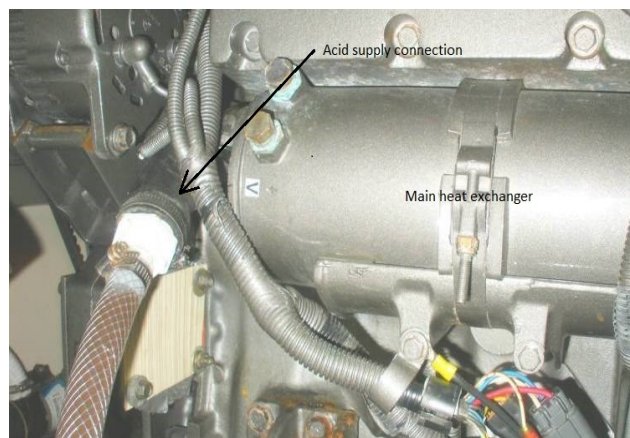
Circulating the acid solution is the best way to remove scale. It continuously brings fresh acid to the scale and flushes away the insolubles that embed in the scale. Filling and soaking can work in a pinch, but is less effective than circulating.

You usually want to circulate the acid solution through the raw water system using a pump of some sort (a small bilge pump works great) dropped in a bucket of acid solution. Do not attempt to circulate through the raw water impeller- you will get very little flow through it that way. Disconnect the discharge hose from the raw water pump and hook up the bilge pump to that hose using pvc adapters- see the pic. Then disconnect the hose to the raw water mixer and drop that into the bucket for a return.

Always remove all zincs first. Unscrew them from the brass plug and reinstall the plug. Also clamp closed any raw water flush hose to the prop shaft log.

Fill the bucket with 50/50 BB or RL solution or 30/70 HCl and start circulating. When I did my system the outside temperature was in the low 40s so I used the engine heat to help. I hooked up a dock water hose to the mixer using duct tape keep the exhaust cool and ran the engine for ten minutes to heat up the cleaning solution. I circulated for about two hours at 120 degrees. Here are some pictures of that operation.

The first pic shows the acid supply connection to the main heat exchanger. The second pic shows the bucket with a bilge pump down inside and the return hose which was disconnected from the mixer. A temporary garden hose is shown hooked up to the mixer to keep the exhaust cool while running the engine.



After acid flushing, dump the acid and replace with fresh water, circulate for a minute and repeat several times to get the bulk of the acid out. If you want to you can back flush to get any sediment out, but I haven't found that to be particularly useful. If you aren't going to take the boat out for a good run any time soon, then it is a good idea to drop in a handful of soda ash, which is available at swimming pool supply stores and called "pH increaser" or similar, and recirculate that solution for 10 minutes, dump and flush with fresh water a few more times. Then reconnect everything and then start up the engine. Let it run for 10-15 minutes to let the raw water pump flush out any residual acid with sea water and then go out for a more extended run within a few days to get any possible acid out.

Some people like to acid flush their heat exchangers yearly. I wouldn't, for two reasons. Unless you are willing to service your after cooler every year as described above, you will never be sure that it doesn't leak. Secondly acid flushing does corrode the metal parts, although minimally and annual flushing is usually unnecessary.

Check your engine temps at wot to determine if you have an overheating problem. I won't give specific temperature recommendations as it depends on the engine, the location of the sensor and if it is reading properly. But if you have been running x degrees at wot and now it has jumped 10 degrees, it is probably time to clean your raw water system.