Corrosion in the Cooling System

Seawater is a harsh mistress for iron. Where there’s moisture and metal there’s corrosion, but seawater salts—notably sodium chloride—make this no garden-variety corrosion. Metal corrodes 5 times faster in the sea than in freshwater. Corrosion increases in an engine that sits a long while and causes more damage in enclosed areas—typically in engine cooling systems, where the water is. The cooling system is the largest cause of engine failure.

Corrosion in the cooling system comes not only from chemical galvanic action eating away the less noble of dissimilar metals (in seawater = electrolysis, see vol. 8), but from rust and scaly buildup as well. Varying forms of corrosion all end in weak, decayed metal but may take different forms of prevention.

Most marine engines “rust out” rather than wear out. Salts in seawater (or hard freshwater) crystalize & build up scale inside the engine’s water jacket & ports. This type of corrosion both weakens metal & coats it—not only damaging cooling systems from rusted-out leaks, but from rust & scaly buildup restricting water flow to impede heat transfer.

1/8” scale equals 4” steel in heat transfer.

Just as a blood clot in the leg can turn deadly when dislodged & carried to the brain or heart, rust and scaly buildup restricting water flow can turn deadly when dislodged & carried downstream to block heat-exchanger tubing.

Bringing water into the engine is always a tricky business that you just have to stay on top of. The problem is that most of the damage is hidden inside internal water passages. There is no accurate way to measure the damage and predict when the engine will fail. By the time you find leaks, discover heat-exchanger cooling tubes corroded through, or see water in the crankcase—the engine could be toast. Overheating can crack or seize cylinder heads, the block, & manifolds. Basically, could need a new engine.

So stay on top of it (see box at right).

Antifreeze—it’s not just for freezing anymore!

At the recommended distilled-water mix (usually 50-50) a good-quality Antifreeze will:

• prevent gel deposits;
• reduce coolant evaporation;
• lubricate water pump & reduce wear;
• reduce cavitation erosion & liner pitting;
• increase boiling point of coolant (in pressurized systems);
• and, yes—even protect against freezing.

Do not mix types or brands of antifreeze or SCAs.

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your premier provider of marine equipment, parts, and service—since 1954

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Rust & scaly buildup
Corrosion already in the closed kind.

INSIDE
National Fisherman’s 2003 Best Of in the boatbuilding industry, Stewart Everett (at right) Offs Everest Marine builds Coast Savings’ 3rd oyster dredge—Willapa Express—to join Shellfish Express and Coastal Express already working the Washington coast. All powered by JD 6081’s, 4’s in the queue for Penn Cove Shellfish.

IN BOX:

Corrosion in the Cooling System—Rust and Scale

Routine maintenance is key to preventing a very expensive disaster. Based on water source, maintaining cooling systems boils down to 2 universal truths:

Raw-water Circuits—Zincs
Freshwater Circuits—Antifreeze

3 TYPES OF ENGINE COOLING SYSTEMS

Raw water: Cheaper but scary; most corrosive with greatest potential for damage. Not seen much anymore save some pleasure craft or gas engines on lakes. Open circuit, piped seawater directly cools engine and transmission.

Freshwater Heat Exchanger: Actually 2 coolant circuits—one raw, one fresh-inside the boat. Raw (sea)water flows only through the raw-water pump and heat exchanger (open circuit, where scaling occurs) cooling the closed freshwater circuit that absorbs heat from engine and tranny. Note: Heat exchanger cools the coolant from the engine jacket, not to confuse with transmission oil cooler—also exchanging heat but where water cools tranny oil.

Keel Cooler: Closed freshwater circuit transfers heat to raw water outside boat through long coolant tubes mounted on hull beneath waterline (with zincs). Coolant circulates through tranny oil-cooler before cooling the engine & returning to keel. Least potential for corrosion, highest reliability (single centrifugal pump).

QUICK & EASY COOLING-SYSTEM MAINTENANCE
check your cooling, save the engine!

Raw-water circuits: ZNCS. Sacrificial zinc anodes screwed into engine water jackets, heat exchangers, or exhaust jackets. Routinely check & replace pencil zincs before 50% eaten.

Freshwater circuits: ANTIFREEZE. Contains rust and corrosion inhibitors to help keep system clean and undamaged (see box below). Routinely test coolant & add SCAs (Supplemental Cooling Additives) as needed. Test strips expire, antifreeze depletes—renew and replenish for corrosion protection to work.

Hoses, clamps & belts: Visually check cooling system for signs of wear—routinely. Replace pinched, cracked or collapsed hoses, carefully check for corroded clamps, double-crimp any hoses below waterline should one fail.

Raw-water pump: Don’t run dry! Check impeller—if burnt or broken look for rubber bits sucked into heat-exchanger tubes. If no impeller in the pump, it’s in your heat exchanger. Before start-up always check that the seacock’s open (a good practice to shut when leaving the boat) & check sea strainer for clogs.

Heat exchangers: Eventually if corrosion and dirt block the small cupronickel cooling tubes the engine will show a slow but steady rise in temperature. Clean or replace the heat exchanger. Might try back flushing, acid bath, removing for professional cleaning at the shop, or, if removable end caps, poke a wooden dowel or long skinny brush as if cleaning a rifle barrel (careful—soft tubes!). Catch overheating early and, worst case—replacing the heat exchanger, not the engine.

Antifreeze—it’s not just for freezing anymore!

USE CAUTION! Cooling systems can contain scaling liquid under pressure. Dispose of coolant responsibly—antifreeze taken used but deadly toxic to kids & critters.
Established in 1975 as a small family farm, Penn Cove Shellfish C.M. started growing shellfish—selling seed and harvesting mussels on Whidbey Island’s Penn Cove, up at the north end of Washington’s Puget Sound. Steadily building their hobby farm over the years, in 1986, second generation eventually bought it up in 1986, passing ownership of Penn Cove Mussels to brothers Ian, Rawle, and Ian’s wife, Karen.

This is where Everest Marine and boatbuilder Stewart Everest come in: “Since ’86 just about everything they’ve hauled or harvested mussels with I’ve built,” says Stew. “Bluffs, harvest barges, conveyor systems, boxing systems.”

Ian says that partnership was forged when he bought a skiff after Stew’s dad after forging when he happened by the North Sound Marine shop in Burlington, Wash. “We were on the same page,” says Ian. “He was one in a bazillion.”

The late Stewart Everest served as WWII ship captain and NASA engineer who helped power the Apollo that landed on the moon. This really is rocket science—since 1979 Stew’s Everest’s engineered, built, and fabricated cutting-edge boats and equipment: Father and son pioneered the exception handling in wind, she can dredge in 3 ft. of water—what half the other boats need. Fast is where John Deere comes in—& once again, Ian turned to MER.

“We went to John Deere when we started building these new oyster boats for Coast Seafoods,” says Ian. “I looked around the boat shows & power suppliers. I called Bob—I knew him. He worked with North American Marine Jet to come up with the best combination of power and jets—how much power do you need, how much power can you afford.”

“Bob figured out the best match-up,” says Ian. “Same with the best power and tranny that works best with that jet.” Ian bought his first John Deere 6081 in ’05; this is his third. “They supply the most power and most reliably for the best dollar,” he says. “More bang for your buck. All the things they put in a sales brochure, it’s very accurate with John Deere.”

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The EPA is driving traditional competitors into bed together--the latest, BMW and Yanmar. Rather than reinvent the wheel to replace the non-compliant 4JH-2 and 270-hp 6L8, Yanmar searched the world market for a proven diesel that meets newly mandatory Tier-II emission regulations for recreational and light commercial diesels.

They found the 4- and 6-cyl. BMW diesels from Stuttgart, Germany--I suspect after a Yanmar engineer drove the new diesel X-3 SUV and said, "Wow, this would work for us." Lightweight, low-vibration, high-quality, high-hp engines with computerized high-pressure common-rail fuel systems that are state of the art. They run uncommonly quiet and smooth, idling at 650 rpm and developing from 130-200 hp depending on model and computer fuel map.

Our Service Manager Herb Knight and I went to Georgia’s Yanmar Marine Plant for a week’s intensive training class on mechanical & electrical systems for the new BY series diesels.

Skeptical at first, it challenged everything I knew about diesels: no more mechanical governor, throttle, or shifting. Now it’s all computer, & the engine lead determines fuel delivery--if the lead doesn’t move, the computer simply doesn’t deliver it. At full rpm the high-pressure piston pump delivers fuel to the fuel rail at 23,200 psi; computer-controlled injectors are more accurately described as solenoid-controlled diverter valves.

The computer can deliver multiple injections per piston stroke, at variable fuel volume, yielding smoother power delivery to the crankshaft & a more efficient fuel injection, reducing exhaust emissions (particularly NOx--Nitrides of Oxygen, & hydrocarbons--unburned fuel).

High-Pressure Common Rail (HPCR) is growing quite common among manufacturers, the HPCR & computer-controlled injectors proving the most effective systems in meeting ever-higher emission standards.

The Upside: better fuel economy, less noise, low vibration, smokeless operation, cleaner environment, less global warming.

The Downside: always a downside. Some of our favorite tried-&-true, ultra-reliable, simple diesel engines disappeared from the marketplace. We’ll need a computer to diagnose, modify, or repair the fuel system--engine won’t even run without the computer unless maybe to limp home at idle.

Spare-parts lists change. We can program all the above to our personal preferences--it’s no longer father’s diesel engine. Now there’s a laptop in every diesel mechanic’s toolbox. For most of us that means a huge learning curve, challenging & frustrating at the same time. We’re getting calls from customers with P codes (computer trouble code) they never knew they had before.

Time was--you had fuel, air, compression, & timing--any diesel will run. Now, add an ignition-control signal. Time was you could unplug the battery after starting the engine. Those days are over.

We all know that most trouble in a heat’s gas engine is in the ignition system. Now they’re in our diesels too--not technically, it is still compression ignition. But without the computer controlling fuel delivery, it’s not gonna run. All those new fancy features come at a price.

So stay alert when installing: Keep computer, throttle potentiometer, wire-harness connections away from moisture, heat, & vibration. Check electrical connections regularly for corrosion; stock dielectric grease for protection. Invest in a good Fluke multimeter to troubleshoot electrical components. Know your low-voltage relays, timers, diodes, solenoids: how to test, & carry spares. Other than all that--piece of cake.

The fine print:
Not valid with any other offers or online discounts.
One per customer.
Based on standard MER list prices.

Option codes typically are listed on the engine that long list of 4-digit numbers on the engine label. If the label is missing, email or call us with the serial number & we’ll look up the correct codes for you. If you know the part number you’re already there & can skip the codes.

Online discounts can be big--up to 30%--but only if you place the order online. We’ll be happy to answer questions, but regular prices apply when placing the order by phone or in person (use the coupon).

Next project will be online parts for Yanmar, ZF, & Isuzu with some expanded diagrams you can mouse-over to see part names + tips on related parts you may need. We’ll also add technical information for different spcets and eventually sell special tools online as well. Stay tuned & visit often.

You can order John Deere plus Cowil & EM exhaust parts online now! www.merequipment.com info@merequipment.com
Shop till you drop & Save Money--24/7
From the Founder  Ivan Fox Remembers ... THE LOGGER

Ivan worked for San Juan Fishing & Packing Co. in 1948 when they bought the 105-ft. power scow Logger from a SE Alaska logging company. Built in ’44 by Maritime Shipyards in Seattle, San Juan used the Logger on Kodiak Island working for the Uganik Cannery at Port O’Brian in the Northeast Arm of Uganik Bay—tending traps, tendering the fishing fleet, & hauling freight north in the spring of the year, mostly lumber and trap wire to build their 7 salmon traps. When traps became illegal after statehood the company built up their seine fleet which fished all around Kodiak Island & the mainland between Cape Douglas & Kikak Rocks.

In 1960 the trend was to refrigerate fish holds by chilling seawater. Since we had to range further following our fishing fleet we decided to tank the Logger and install refrigeration equipment. We installed 5 tanks on the deck of the Logger under the shelter deck, 3 forward and 2 aft, with a total of 8400 cu. ft. When fully loaded we had enough salmon to can 5000 cases of 48 1-lb. trolls. In late August 1966 we closed the Uganik cannery for the season. A late run of chum salmon showed up in Kukak Bay on the mainland. We had 10 boats that went over for the opening and we sent the Logger over to tender the fleet. The salmon was to be taken to Kodiak to be canned by Ocean Beauty. After 2 days of fishing we had 160,000 lbs. of fish onboard, the fleet had quit fishing, & the Logger departed for Kodiak.

Early that afternoon we received a radio call—the Logger had run aground in Kupreanof Strait about a quarter mile east of the entrance to Onion Bay. The captain had set a course with the autopilot and fell sleep. We immediately loaded some equipment aboard the power scow Viekoda and headed out to the stranded Logger. The bow was up on the rocky beach. When we arrived at the site Chuck Turner, manager for Kadiak Fisheries, was there with the vessel Robert M. to give assistance. The tide was flooding and we hooked up a towline; after a couple hours the tide was high enough to tow the vessel off the beach. The Robert M. took a strain on the line and the Logger came off and immediately started filling with water. I remember Turner standing on the afterdeck with an axe to cut the towline in case the Logger sank. The Logger was rapidly filling with water as we towed it out into deeper water. It was sinking with the weight of the tanks on deck as well as the weight of the salmon onboard. The vessel’s center of gravity changed and it rolled over.

Next issue: Saving the Logger with luck & Yankee ingenuity. (Built 1941, fire destroyed Viekoda Feb. ’07—first power scow in the Alaska fishing fleet.)